Climate Change Adaptation Plan

Tannery Road Timber Sale

March 2, 2017

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Prepared using the Adaptation Workbook - AdaptationWorkbook.org

Property details

Acres: 101

Size: N/A

Ownership: State

This timber sale will employ both even aged, and uneven aged techniques to accomplish a number of goals and objectives for both the sale area, and as part of the goals identified in the 2012 Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines. The silvicultural systems currently planned are a 3-3 row thinning in 3 Norway spruce plantations located within the sale area, a shelterwood for a small white pine plantation, group selection openings within the northern hardwoods, and improvement thinnings between groups. The mixed northern hardwoods currently occupy 82 +/- acres of the sale area, while a series of small Norway spruce plantations comprise another 19 +/- acres.

Climate Adaptation Plan	**Tannery Road Timber Sale**
Project Details	101 acres **Size:** N/A State ownership This timber sale will employ both even aged, and uneven aged techniques to accomplish a number of goals and objectives for both the sale area, and as part of the goals identified in the 2012 Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines. The silvicultural systems currently planned are a 3-3 row thinning in 3 Norway spruce plantations located within the sale area, a shelterwood for a small white pine plantation, group selection openings within the northern hardwoods, and improvement thinnings between groups. The mixed northern hardwoods currently occupy 82 +/- acres of the sale area, while a series of small Norway spruce plantations comprise another 19 +/- acres.
Management area(s)	**Northern hardwood** **Norway Spruce**
Regional Climate Change Impacts & Property-Level Considerations	The following climate change impacts are regional expectations drawn from published resources. Under each regional climate change impact statement, property-level considerations describe how the general trend might be meaningful at the scale of the property. **Temperatures in New England are projected to increase 3.5 to 8.5 °F by the end of the century, with the greatest warming expected to occur during winter.** Property considerations: Warming trends may cause a shift in forest tree species composition. Boreal forest habitats would be the most vulnerable forests to this shift potentially causing them to move north, and/or only inhabit the highest elevations. My current project area has species that would be considered constituents of boreal forests; i.e.: red spruce and balsam fir, which may suffer a substantial reduction in occurrence over time. **The growing season in New England and northern New York is generally expected to increase by 20 days or more by the end of the century, due to fewer days with a minimum temperatures below 32°F.** Property considerations: This could cause dramatic shifts within the species compositions of what may be considered an otherwise moderate impact. For instance the northern hardwoods cover type consists of a number of individual species, however, the number of species may decrease due to the lower number of days below freezing. An example of this is sugar maple (which is a preferred species in the project area), which needs approximately 2,000 hours of freezing temperatures in order initiate bud break. The loss of the lengthened cold period could have deleterious effects on those species requiring extended freezing temperatures. Over time this could also impact the ability to work within the project area. Currently there are a number of wet areas and erodible soils that would be most suited to harvesting during frozen conditions. With fewer freezing days, the area may not freeze enough to stabilize soils or appropriate harvesting times may be relegated to a few weeks rather than months. **The winter season will be shorter and milder across New England and northern New York, with less precipitation falling as snow and reduced snow cover and depth.** Property considerations: With less snow cover, and lower amounts of winter precipitation, events with subzero temperatures may be much more damaging to trees and tree roots. In the project area there are a number of areas where the soils are somewhat shallow and stony making trees and vegetation growing on these sites even more susceptible. Additionally, this may make it more difficult to work areas that require frozen ground conditions. **Precipitation patterns will be altered, with projected increases in annual precipitation and potential for reduced growing season precipitation in New England and northern New York.**

Property considerations: Over time this may cause shifts in overall species composition. However, the amount of vegetative diversity on this site should minimize the overall impacts that this particular issue would cause.

Intense precipitation events will continue to become more frequent in New England and northern New York.

Property considerations: Observing BMP's and residual stand densities will be critical in order to prevent site degradation due to extreme weather events. On the project site, those impacts of major concern under this scenario include erosion and wind throw. Erosion can be mitigated by strict adherence to BMP's and operating when the site is most resilient to disturbance. Wind throw is typically minimized by removing no more than 30% of the stand's basal area, and selecting for threes that are know to be wind resistant such as oak and sugar maple.

Warmer temperatures and altered precipitation in New England and northern New York will interact to change soil moisture patterns throughout the year, with the potential for both wetter and drier conditions depending on the location and season.

Property considerations: The reduction in the number of days below freezing may be advantageous because if the soils are not frozen but rather very dry, harvesting requiring frozen ground may be able to shift to dry summer operations. Due to the topography and geology of the area the issue of overly dry conditions on this site is remote. If the area were to become wetter, then the amount of area included in the project would certainly be decreased over time moving the harvested areas to only the most stable of soils.

Many invasive plants will increase in extent or abundance in New England and northern New York.

Property considerations: This would reduce the amount of biodiversity and available growing space for native vegetation. Additionally, harvesting work in the area would have the potential to either introduce exotic vegetation to the site or transport exotic vegetation off site.

Many northern and boreal tree species will face increasing stress across much of New England and northern New York.

Property considerations: This would cause a shift in species within the project area. There are tree species within the project area that would be considered boreal, to include balsam fir and red spruce, that are already under represented and may disappear altogether.

Forest composition will change across the landscape in New England and northern New York.

Property considerations: The current species composition being managed for today may not be the species composition managed for in the future. Some softwood components will always be appropriate for the foreseeable future, such as white pine and hemlock, while others such as spruce and fir may not. This also applies to some of the hardwood components such as the reduction in the occurrence sugar maple and white birch, with more of a shift towards red oak and hickory.

Shifts in forest composition in New England and northern New York will take at least several decades to occur in the absence of major disturbance.

Property considerations: The current management trajectory will be maintained, while monitoring for shifts in species composition. Massachusetts has a statewide Continuous Forest Inventory, and the information gathered from that inventory will continue to be incorporated into management decisions.

Conditions affecting tree regeneration and recruitment will change in New England and northern New York.

Property considerations: Recruitment of desirable hardwoods may decrease, while the recruitment of less desirable species may increase. For instance, sugar maple decline is more a factor of sugar maple not regenerating as opposed to a die-off. Striped maple and pin cherry can dominate a site choking out other species. This trend may become exaggerated.

Forest productivity in New England and northern New York will increase during the next several decades in the absence of significant stressors.

Property considerations: The time between stand entries may decrease. Entries are a function of both the ability of the site to recover from the disturbances due to harvesting, as well as for the trees to grow. Generally, the limiting factor is growth. With a more productive site that limiting factor may become site disturbance.

Low-diversity systems are at greater risk from climate change.

Property considerations: A goal of the project is to increase diversity and complexity within the natural systems in order to mitigate climate change impacts.

Systems that are limited to particular environments will have less opportunity to migrate in response to climate change.

Property considerations: This project area contains a certified vernal pool and a number of wetlands. These systems are not easily replaced or mimicked and will be protected during operations. If species cannot migrate, then protecting current habitats becomes a vital role of the public land manager.

Certain insect pests and pathogens will increase in occurrence or become more damaging in New England and northern New York.

Property considerations: Depending on the pathogen it could be devastating to a non factor. certain pathogens target specific species, while others are generalists. If there are increases in pathogens that target specific species, and the species doesn't occur on-site then there is no issue. However, if the species does occur on-site; or the specific pathogen is a generalist, then serious considerations need to be made. Currently the list of potential damaging agents for this area is rather high, but the level of activity is low.

Systems that are more tolerant of disturbance have less risk of declining on the landscape

Property considerations: By promoting desirable species that are also tolerant of disturbance, it may be possible to move the forested natural communities towards a condition that is more tolerant of disturbance.

Habitat will become more suitable in New England and northern New York for some southern species.

Property considerations: This would be completely dependent on the species. Those species such as oaks, hickories, etc. may serve to enhance the natural communities without major disruption to the systems; whereas a species such as sweetgum could become a nuisance. It is also entirely possible that due to elevation southern species would not be an issue.

Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

Plan for specific Management area	Northern hardwood Northern hardwood forests are widely distributed over a variety of sites with dry-mesic to wet-mesic conditions and nutrient-poor to rich soils. This forest type is generally found at low to moderate elevations. Species that are commonly dominant include sugar maple, yellow birch, American beech, eastern hemlock, and red spruce.
Management Goal Management Objective(s)	Successful Implementation of Silvicultural Prescription Residual relative basal areas at 66% within the hardwood stand with between 83 ft2 and 55 ft2 BA/ac. *(Immediately)* Residual basal area within selected groups in the hardwood stand between 20 ft2 and 0 ft2 per acre. *(Immediately)* No cutting or harvesting within filter strips *(Immediately)* No cutting or harvesting within 75' of identified cultural resources other than stone walls. *(Immediately)* No loss of undesignated wood. *(Immediately)* Ensure harvesting contractor compliance with all BMP's. *(Immediately)* Frequently monitor operations to minimize and/or mitigate damage to the site. *(Immediately)* Ensure full understanding of contractual requirements by the harvesting contractor. *(Immediately)* Residual CWD of no less than 256 ft3 per acre. *(Immediately)*
Management Goal Management Objective(s)	Improve the distribution of early successional habitat and younger age classes Distribute group selection openings in the hardwood stand, where appropriate, throughout the stand. *(Immediately)*
Management Goal Management Objective(s)	Adequate Stocking in Single Tree and Group Selection Areas Have 500+ stems per acre of healthy native hardwood or softwood regeneration within gaps and thinned rows, with the exception of those species which can dominate a site; i.e.: striped maple, pin cherry, etc.; within 5 years of the harvest. *(5 Years)* Reduced beech regeneration competition with native tree regeneration and ground cover. *(5 Years)*
Management Goal Management Objective(s)	Increase biological diversity and introduce more complexity into existing stands Install gaps within the existing hardwood stand in order to create early successional habitat and begin a new age class of trees. *(5 years)*

Management Goal Management Objective(s)	Improve recreational experiences primarily associated with hunting and wildlife viewing When marking in the hardwood stand, maximize the number of gaps to be installed based on site conditions and current and/or anticipated vegetation. *(Immediately)*
Management Goal Management Objective(s)	Increase the distribution and density of sugar maple to combat sugar maple decline. Sugar Maple will be favored for retention over other tree species. Regenerating areas of sugar maple will have competing overstory trees removed provided that the removal(s) does not violate the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). *(Immediately)*
Management Goal Management Objective(s)	Remove beech infected with Beech Bark Disease Complex (BBD) Beech that show clear signs of BBD will be biased for removal, while adhering to the guidelines established in the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). Particularly those guidelines relating to legacy trees and opening sizes. *(Immediately)*
Management Goal Management Objective(s)	Improve wildlife habitat, specifically browse and cover When establishing gaps ensure that they are large enough to have full sunlight on the forest floor. Gaps in the hardwood stand will not exceed 1/3 acre in size, and will be located a minimum of 100’ apart. Beech brush or exotic vegetation that is disturbance driven will be mitigated through treatments that will most likely occur prior to harvest. *(Immediately)*
Potential identified impacts for Northern hardwood	**Several dominant tree species are at risk of decling by the end of the century, including red spruce and balsam fir.** Property considerations: Within my project area these species are favored for retention. The elevation of the project area may be such that climate change impacts are mitigated. Additionally, these trees may disappear in other parts of the landscape so areas such as where my project is located may be able to serve as a reserve. **Some tree species may be more likley to persist or increase through the end of the century , such as red maple.** Property considerations: Red maple is already a major component of the northern hardwoods mix that exists on-site. An increase in red maple may lead to red maple dominated cover types, and away from a northern hardwood mix. **Northern hardwood forests are widely distributed across a variety of sites, increasing adaptive capacity.** Property considerations: Landscape management and the interaction of projects across a landscape may become more important than an individual project. Also, it may become important to coordinate projects across political or organizational boundaries. **High levels of diversity may increase the ability of forests to adapt to climate change.** Property considerations: This has been considered during the prescription development, and increases in diversity and complexity became a goal of the project. **Insect pests and forest diseases could become more problematic in northern hardwood forests under a warmer climate.** Property considerations: Diseases or pest outbreaks caused by natives may become more severe if they are bolstered as a result of changing conditions or foreign pest infestations may become more common. With a project goal of increasing complexity and diversity any single pest or disease causing agent should have a lesser impact. **Invasive species such as buckthorn, honeysuckle, and garlic mustard are expected to become more problematic under climate change.**

	Property considerations: Treatments of exotics prior to harvest, and/or treatments post-harvest may be required in order to keep exotics from gaining a significant foothold and/or spreading. **Changes in herbivore populations may also have substantial effects on forest growth and composition in northern hardwood forests.** Property considerations: The amount of moose is most likely to decrease while deer populations are expected to increase. In this project area the populations of both animals overlap, so an increase in one of the species should balance with the decrease of the other and not have major impacts on the forest composition.
Potential impact of climate change on health and function of system	Mixed/Neutral
Adaptive Capacity of system to climate change impacts or disturbances	Moderate-High
Vulnerability determination	Moderate

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual relative basal areas at 66% within the hardwood stand with between 83 ft2 and 55 ft2 BA/ac. *(Immediately)*
Challenges	The residual stand may have the target densities and numbers immediately post harvest, but changes in weather and climate may, i.e.: storms, drought, etc. may reduce stem density quicker than growth can make up the basal area.
Opportunities	Lengthened growing seasons and/or increased annual growth may allow for more rapid return intervals and provide opportunities for more intensive management.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Very feasible in the short term, and most likely within the next return interval. Will require monitoring and potential adjustments in the future.
Other Considerations	Comments: None

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic	Residual Stem Density

is achieving desired management objective(s)	
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Residual relative basal area at 66% post harvest within the hardwood stand and 43% within the Norway spruce plantations
Implementing monitoring efforts (frequency, time of year, etc)	During harvest operations, and 5 years post-harvest

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual basal area within selected groups in the hardwood stand between 20 ft2 and 0 ft2 per acre. *(Immediately)*
Challenges	Since these are low residual basal area targets climate change should have minimal negative impacts on reaching this target. May also create conditions that are more conducive to invasion by exotic species.
Opportunities	Instances of damaging storms, and large impact areas may provide opportunities to expand those gaps even further allowing more significant areas of early successional growth.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Currently part of an approved prescription, and is based on current accepted forestry practices.
Other Considerations	Comments: Use of herbicides on public lands. Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers	None related to climate change.

of this tactic	
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Adequate Regeneration within Group Selection Openings
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	500+ stems per acre of desirable tree species. No invasion by exotic vegetation.
Implementing monitoring efforts (frequency, time of year, etc)	Measured 5 years post-harvest.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	No cutting or harvesting within filter strips *(Immediately)*
Challenges	Over time with the frequency, timing, and duration of peak flows being an unknown the width of current filter strips or riparian protection may extend much further out from the banks than

	what is currently established. In many areas if current filter strip widths were widened, the overlapping of multiple buffers may cause larger acreages to be inappropriate for many types of silvicultural treatments.
Opportunities	With potentially lower flows, and lower stream levels during the late summer and earlier in the fall, stream crossings and harvesting around wetlands will have much lower impacts, especially when coupled with remediation techniques.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Already part of current practices.
Other Considerations	Comments: None related to climate change.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium

Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	No cutting or harvesting within 75' of identified cultural resources other than stone walls. *(Immediately)*
Challenges	More extreme weather events, changes in freeze thaw cycles, and milder winters may cause exposed cultural resources to degrade quicker. The ability to identify cultural resources may be diminished.
Opportunities	Access to difficult sites for protection measures may be improved, or have a longer period of time for access.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Sites are already difficult to identify at times.
Other Considerations	Comments: Policy and Administrative

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	No loss of undesignated wood. *(Immediately)*
Challenges	The ways in which wood is designated may need to be expanded, especially in light of the potential for large scale salvage events.
Opportunities	Begin discussions and planning for those potential outcomes, and recognize that they may occur.
Feasibility of meeting objectives after	High Comments: Clear prescriptions, frequent site visits, and loss mitigation measures such as cleat butt marks will always be necessary.

evaluation of climate impacts on system	
Other Considerations	Comments: Administrative

Responding to climate change impacts

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Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Ensure harvesting contractor compliance with all BMP's. *(Immediately)*
Challenges	Depending on how quickly climate changes, and the extent of those changes, may impact the effectiveness of BMP's. Simple compliance may not go far enough.
Opportunities	Begin to include standards that exceed BMP's during the contract process.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: These are currently options within the contract development process
Other Considerations	Comments: None.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers	Cost of treatment and potentially extends the length of operations.

of this tactic	
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Ensure compliance with BMP's
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	All standards identified in the Massachusetts Forestry Best Management Practices are followed.
Implementing monitoring efforts (frequency, time of year, etc)	During the marking and harvesting phases of the operations. Prior to the removal of harvesting equipment of the site ensure all requirements are fulfilled. Continue to monitor the site post harvest each year for 5 years to ensure that the BMP compliance is enough to mitigate site damage.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Frequently monitor operations to minimize and/or mitigate damage to the site. *(Immediately)*
Challenges	Depending on the frequency, duration, and magnitude of other events associated with climate change the ability to monitor operations may also be impacted.

Opportunities	Make arguments for more and better planning, increasing personnel, and improving interagency communication.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Frequent monitoring is currently a very high priority for both the program and the agency.
Other Considerations	Comments: None.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*

... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Ensure full understanding of contractual requirements by the harvesting contractor. *(Immediately)*
Challenges	Project goal not related to climate change
Opportunities	Project goal not related to climate change
Feasibility of meeting objectives after evaluation of climate impacts on system	Comments: N/A
Other Considerations	Comments: N/A

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual CWD of no less than 256 ft3 per acre. *(Immediately)*
Challenges	Longer growing seasons and milder temperatures may increase the decomposition rate of coarse woody debris. Standards established now may not be relevant to requirements in the future.
Opportunities	Fewer stumps, logs, and large diameter branches will help facilitate ground work.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: May want to include the artificial creation of brush piles, logs, and tip-up mounds.
Other Considerations	Comments: This is not a well understood facet of forest management and the science is continually evolving.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Establish a target of at least 256 square feet per acre of CWD that is over 3" in diameter and over 3' long. Bias sugar maple and hickory as leave trees. Leave behind snags and live trees with cavities and/or nests.**
Strategy	**Maintain or create refugia**
Approach	Prioritize and maintain sensitive or at-risk species or communities
Benefits of this tactic	CWD and snag requirements are business as usual. The retention of sugar maple and hickory are justified for timber value, wildlife value, current occurrence, and future potential occurrence.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	Accomplished during marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Improve the distribution of early successional habitat and younger age classes
Management Objective	Distribute group selection openings in the hardwood stand, where appropriate, throughout the stand. *(Immediately)*
Challenges	Properly locating the openings is critical in order to ensure that the regenerating area serves as a "life boat" for potential losers such as balsam fir, while facilitating potential winners such as hickory and oak.
	Increase the density and distribution of potential climate change winners, and attempt to

Opportunities	close the colonization gap preemptively.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Extremely difficult to gauge if every opening is going to have the desired results. Monitoring and evaluation will be critical.
Other Considerations	Comments: Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	

	Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Adequate Stocking in Single Tree and Group Selection Areas
Management Objective	Have 500+ stems per acre of healthy native hardwood or softwood regeneration within gaps and thinned rows, with the exception of those species which can dominate a site; i.e.: striped maple, pin cherry, etc.; within 5 years of the harvest. *(5 Years)*
Challenges	Germination rates and species mixes can be problematic to predict. A vast majority of the forestlands that are managed in this district are composed of species on the tipping point of being either a winner or loser.

Opportunities	Narrow the species that are considered desirable as those that are considered to be the most resilient to climate change, and use the presence of those species in regeneration as the success criteria.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: The ability to have 500+ stems per acre of desirable species in the northeastern forest is typically easy to attain, under current conditions. In the long-term this may change.
Other Considerations	Comments: Administrative. Funding.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*

... recommend tactic?	Yes
Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	**Norway spruce plantations will have rows thinned east-west b/c typically the most damaging winds com from the north. Ensure that the site has regenerated with target species.**
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Northern hardwood forest types usually regenerate naturally very readily. Limiting openings to 1/3 acre in the Norway spruce plantations will result in windbreaks within the longer rows.
Drawbacks and barriers of this tactic	Should an area not have adequate regeneration of desirable species, costs of artificial regeneration.
Timeframe to implement	during the harvest and within 5 years post harvest.

Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Adequate Regeneration within Group Selection Openings
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	500+ stems per acre of desirable tree species. No invasion by exotic vegetation.
Implementing monitoring efforts (frequency, time of year, etc)	Measured 5 years post-harvest.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Adequate Stocking in Single Tree and Group Selection Areas
Management Objective	Reduced beech regeneration competition with native tree regeneration and ground cover. *(5 Years)*
Challenges	There are no additional challenges in regard to climate change.
Opportunities	Drier summers and milder windows may mean more opportunities for treatment may occur. Additionally, even under the low emission scenarios it appears that beech may also begin to move further north, and the instances of site domination may decrease.

Feasibility of meeting objectives after evaluation of climate impacts on system	Low Comments: Uneven aged management tends to favor those species that are mid-tolerant and tolerant of shade. In an ideal scenario the entire project area would be treated for BBD infested beech.
Other Considerations	Comments: Funding. Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	

	Norway spruce plantations will have rows thinned east-west b/c typically the most damaging winds com from the north. Ensure that the site has regenerated with target species.
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Northern hardwood forest types usually regenerate naturally very readily. Limiting openings to 1/3 acre in the Norway spruce plantations will result in windbreaks within the longer rows.
Drawbacks and barriers of this tactic	Should an area not have adequate regeneration of desirable species, costs of artificial regeneration.
Timeframe to implement	during the harvest and within 5 years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Treatment of American beech that is infested with BBD
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	95% kill within 1 month of treatment for those group selection openings designated for treatment.
Implementing monitoring efforts	Within 1 month of treatment, and prior to beginning harvesting operations. Visit the site again in 5 years during regeneration surveys to gauge the effectiveness of the treatments.

(frequency, time of year, etc)	

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Increase biological diversity and introduce more complexity into existing stands
Management Objective	Install gaps within the existing hardwood stand in order to create early successional habitat and begin a new age class of trees. *(5 years)*
Challenges	Climate change scenarios, in the long term, seem to project a reduction in the numbers of tree species.
Opportunities	In many areas of the south, vegetative biological diversity is in the ground cover rather than the overstory. This also creates very diverse habitats and diversity in the plant an animal species that occupy them. This may create the same opportunity for a more diverse ground cover species mix in the forests of the northeast.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: The rate of change is very slow, and in all of the scenarios that I have had the opportunity to study none of the species disappear altogether.
Other Considerations	Comments: None.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species

Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
	Yes

... recommend tactic?	

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Adequate Regeneration within Group Selection Openings
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	500+ stems per acre of desirable tree species. No invasion by exotic vegetation.
Implementing monitoring efforts (frequency, time of year, etc)	Measured 5 years post-harvest.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Improve recreational experiences primarily associated with hunting and wildlife viewing
Management Objective	When marking in the hardwood stand, maximize the number of gaps to be installed based on site conditions and current and/or anticipated vegetation. *(Immediately)*
Challenges	Anticipated vegetation is somewhat of a moving target and will depend on the severity of the conditions realized.
Opportunities	Enhance and expand desirable species that are projected to be winners under all of the scenarios.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: There are a number of factors, even without climate change, that influence the success of a management action.
Other Considerations	Comments: Competing interests from forest users.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species

Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Increase the distribution and density of sugar maple to combat sugar maple decline.
Management Objective	Sugar Maple will be favored for retention over other tree species. Regenerating areas of sugar maple will have competing overstory trees removed provided that the removal(s) does not violate the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). *(Immediately)*
Challenges	Sugar maple is not a loser, but is going to suffer negative impacts due to climate change.
Opportunities	Enhance the health and vigor of the sugar maple on-site because future recruitment may become an issue.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: ugar maple is expected to be impacted negatively and begin to move it's range north. However, the elevation of the site, and the nature of the soils and topography may be a mitigating factor and remain as favorable sugar maple habitat.
Other Considerations	Comments: Due to the values of sugar maple as a wildlife tree, as a source of quality lumber, and as a source for syrup and sugar products, research and money for sugar maple conservation may become more available.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Establish a target of at least 256 square feet per acre of CWD that is over 3" in diameter and over 3' long. Bias sugar maple and hickory as leave trees. Leave behind snags and live trees with cavities and/or nests.**
Strategy	**Maintain or create refugia**
Approach	Prioritize and maintain sensitive or at-risk species or communities
Benefits of this tactic	CWD and snag requirements are business as usual. The retention of sugar maple and hickory are justified for timber value, wildlife value, current occurrence, and future potential occurrence.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	Accomplished during marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Remove beech infected with Beech Bark Disease Complex (BBD)
Management Objective	Beech that show clear signs of BBD will be biased for removal, while adhering to the guidelines established in the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). Particularly those guidelines relating to legacy trees and opening sizes. *(Immediately)*
Challenges	No additional challenges in respect to climate change.
	As before, beech may begin to shift north taking the disease with it. Extended periods of

Opportunities	milder weather and drier conditions may make mechanical and chemical treatments for the disease easier, and with more opportunity to conduct the treatments.
Feasibility of meeting objectives after evaluation of climate impacts on system	Low Comments: Very large extent of the disease.
Other Considerations	Comments: Aesthetics. Funding. Use of herbicides on public lands.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.* Yes

... recommend tactic?	
Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Treatment of American beech that is infested with BBD
Monitoring Variable 1	

Threshold or Criteria for Evaluation of adaptation tactic	95% kill within 1 month of treatment for those group selection openings designated for treatment.
Implementing monitoring efforts (frequency, time of year, etc)	Within 1 month of treatment, and prior to beginning harvesting operations. Visit the site again in 5 years during regeneration surveys to gauge the effectiveness of the treatments.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Improve wildlife habitat, specifically browse and cover
Management Objective	When establishing gaps ensure that they are large enough to have full sunlight on the forest floor. Gaps in the hardwood stand will not exceed 1/3 acre in size, and will be located a minimum of 100’ apart. Beech brush or exotic vegetation that is disturbance driven will be mitigated through treatments that will most likely occur prior to harvest. *(Immediately)*
Challenges	No impact die to climate change
Opportunities	No impact due to climate change
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: This is a statement of practice and policy.
Other Considerations	Comments: None.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology

Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
	The decision to recommend a tactic may be based on the likelihood of success, potential

Recommendation for implementation	*tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired	Treatment of American beech that is infested with BBD

management objective(s)	
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	95% kill within 1 month of treatment for those group selection openings designated for treatment.
Implementing monitoring efforts (frequency, time of year, etc)	Within 1 month of treatment, and prior to beginning harvesting operations. Visit the site again in 5 years during regeneration surveys to gauge the effectiveness of the treatments.

Climate Adaptation Plan for Individual Management areas

The following plan details the management goals and objectives for a particular component of the project. Included below is a detailed review of potential climate impacts and site level considerations, along with an evaluation of objectives, potential adaptation responses (tactics) and monitoring variables to assess success over time.

Plan for specific Management area	Norway Spruce Plantations established by the Civilian Conservation Corps in the 1930's. These plantations typically occupy sites that were deforested prior to planting, and can occur at any elevation.
Management Goal Management Objective(s)	Successful Implementation of Silvicultural Prescription Residual basal area of Norway spruce within thinned rows of 0 ft2 BA/ac. *(Immediately)* Residual relative densities within the Norway spruce at 43% with between 155 ft2 and 105 ft2 BA/ac. *(Immediately)* No loss of undesignated wood. *(Immediately)* Ensure harvesting contractor compliance with all BMP's *(Immediately)* Frequently monitor operations to minimize and/or mitigate damage to the site. *(Immediately)* Ensure full understanding of contractual requirements by the harvesting contractor. *(Immediately)* Residual CWD of no less than 256 ft3 per acre. *(Immediately)*
Management Goal Management Objective(s)	Commence the process of removing the off-site Norway spruce plantations. Approximately ½ of the volume within the existing Norway spruce plantation will be removed through third row thinning.
Management Goal Management Objective(s)	Increase biological diversity and introduce more complexity into existing stands Row thin within the existing Norway spruce plantations to promote native species recruitment and diversity.
Management Goal Management Objective(s)	Improve recreational experiences primarily associated with hunting and wildlife viewing Completely remove all Norway spruce in areas that are 3 rows wide while alternately leave 3 rows uncut.
Management Goal Management Objective(s)	Increase the distribution and density of sugar maple to combat sugar maple decline. Sugar Maple will be favored for retention over other tree species. Regenerating areas of sugar maple will have competing overstory trees removed provided that the removal(s) does not violate the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012).
Management Goal	Remove beech infected with Beech Bark Disease Complex (BBD)

Management Objective(s)	Beech that show clear signs of BBD will be biased for removal, while adhering to the guidelines established in the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). Particularly those guidelines relating to legacy trees and opening sizes.
Management Goal Management Objective(s)	Improve wildlife habitat, specifically browse and cover Thinned rows in the Norway spruce plantations will not exceed 1/3 acre in size, and will be located a minimum of 100' apart. Beech brush or exotic vegetation that is disturbance driven will be mitigated through treatments that will most likely occur prior to harvest.
Potential identified impacts for Norway Spruce	**Incresing temperatures and fewer days below 32 degrees F may impact on Norway spruce plantations** Norway spruce plantations within the project area will continue to decline, with a potential for an increase in disease and pathogens. Norway spruce are considered resistant to most of the diseases currently within most of the North American forest systems, however, under conditions of constant stress this may change. **Changing weather patterns with an increase in the number of storms may be a result of climate change** Norway spruce plantations within the project area are already prone to wind throw and root disease. An increase in the number of storms or extreme weather events will increase the incidence of wind throw.
Potential impact of climate change on health and function of system Adaptive Capacity of system to climate change impacts or disturbances Vulnerability determination	Disruptive Low-Moderate High

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual basal area of Norway spruce within thinned rows of 0 ft2 BA/ac. *(Immediately)*
Challenges	No impact due to climate change
Opportunities	No impact due to climate change

Feasibility of meeting objectives after evaluation of climate impacts on system	High

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**

Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual relative densities within the Norway spruce at 43% with between 155 ft2 and 105 ft2 BA/ac. *(Immediately)*
Challenges	Changing weather patterns, especially in relation to winds and storms, can have severe impacts on Norway spruce. Blowdown is already common, and the instances and probability of this occurring is increased under climate change. Also recently thinned plantations seem to be the most susceptible.
Opportunities	Norway spruce is consider an exotic, and is typically off-site. Large scale blowdowns would accelerate the conversion process.
Feasibility of meeting objectives after	Medium Comments: Long term climate changes will not have any impact on this project at the moment, but could have major impacts in the future. We may have to make a second entry into the plantations before the rest of the stand is scheduled for treatment due to increased

evaluation of climate impacts on system	rates of decline, or even a salvage operation.
Other Considerations	Comments: Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Residual Stem Density
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Residual relative basal area at 66% post harvest within the hardwood stand and 43% within the Norway spruce plantations
Implementing monitoring efforts (frequency, time of year, etc)	During harvest operations, and 5 years post-harvest

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	No loss of undesignated wood. *(Immediately)*
Challenges	Same as hardwood
Opportunities	Same as hardwood
Feasibility of meeting objectives after evaluation of climate impacts on system	High

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Ensure harvesting contractor compliance with all BMP's *(Immediately)*
Challenges	Same as hardwood

Opportunities	Same as hardwood
Feasibility of meeting objectives after evaluation of climate impacts on system	High

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Frequently monitor operations to minimize and/or mitigate damage to the site. *(Immediately)*
Challenges	Same as hardwood
Opportunities	Same as hardwood
Feasibility of meeting objectives after evaluation of climate impacts on system	High

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
	Anywhere from pre-harvest to within two years post harvest.

Timeframe to implement	
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Ensure full understanding of contractual requirements by the harvesting contractor. *(Immediately)*
Challenges	No challenges related to climate change
Opportunities	No opportunities related to climate change
Feasibility of meeting objectives after evaluation of climate impacts on system	High

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Successful Implementation of Silvicultural Prescription
Management Objective	Residual CWD of no less than 256 ft3 per acre. *(Immediately)*
Challenges	Plantations that are already prone to windthrow may experience more of it, and as a result work within the plantations may be more difficult because of the amount of material on the ground.
Opportunities	Meeting the 256 cubic feet per acre threshold should be relatively easy
Feasibility of meeting	High

objectives after evaluation of climate impacts on system	Comments: Under the current prescriptions the Norway spruce plantations should be removed after the next cutting cycle.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Establish a target of at least 256 square feet per acre of CWD that is over 3" in diameter and over 3' long. Bias sugar maple and hickory as leave trees. Leave behind snags and live trees with cavities and/or nests.**
Strategy	**Maintain or create refugia**
Approach	Prioritize and maintain sensitive or at-risk species or communities
Benefits of this tactic	CWD and snag requirements are business as usual. The retention of sugar maple and hickory are justified for timber value, wildlife value, current occurrence, and future potential occurrence.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	Accomplished during marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Commence the process of removing the off-site Norway spruce plantations.
Management Objective	Approximately ½ of the volume within the existing Norway spruce plantation will be removed through third row thinning.

Challenges	With the potential for more storms and erratic weather patterns volume retention in Norway spruce plantations may be difficult due to blowdown.
Opportunities	The plantation removal may resolve itself, and move operations to salvage.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Under current management this is feasible, but depending on the rate of climate change the plantations may end up needing to be salvaged rather than harvested.
Other Considerations	Comments: Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Norway spruce plantations will have rows thinned east-west b/c typically the most damaging winds com from the north. Ensure that the site has regenerated with target species.**
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Northern hardwood forest types usually regenerate naturally very readily. Limiting openings to 1/3 acre in the Norway spruce plantations will result in windbreaks within the longer rows.
Drawbacks and barriers of this tactic	Should an area not have adequate regeneration of desirable species, costs of artificial regeneration.
Timeframe to implement	during the harvest and within 5 years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Increase biological diversity and introduce more complexity into existing stands
Management Objective	Row thin within the existing Norway spruce plantations to promote native species recruitment and diversity.
Challenges	In the event of increased windthrow and or disease, the cleared rows may end up filling in again with downed timber.
Opportunities	With longer growing seasons and milder winters, the biological processes required to reduce soil acidity and encourage a broader spectrum of potential recruitment vegetation may be enhanced.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Numerous varialbes exist. The areas may also be colonized by invasive vegetation.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
	N/A

Timeframe to implement	
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Adequate Regeneration within Group Selection Openings
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	500+ stems per acre of desirable tree species. No invasion by exotic vegetation.
Implementing monitoring efforts (frequency, time of year, etc)	Measured 5 years post-harvest.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Improve recreational experiences primarily associated with hunting and wildlife viewing
Management Objective	Completely remove all Norway spruce in areas that are 3 rows wide while alternately leave 3 rows uncut.
Challenges	If trees blow down, or fall due to disease or pathogens the areas will fill back in, negating the opportunites for wildlife viewing and making hunting difficult.
Opportunities	Trees and vegetation are not the only biota that may move north, there are a number of songbirds and migratory birds that may shift ranges providing viewing opportunities not previously available without leaving the state.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: The techniques employed are currently the most expeditious methods available to remove off site plantations.
Other Considerations	Comments: Aesthetics.

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
Timeframe to implement	N/A
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	**Norway spruce plantations will have rows thinned east-west b/c typically the most damaging winds com from the north. Ensure that the site has regenerated with target species.**
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Alter forest structure to reduce severity or extent of wind and ice damage
Strategy	**Reduce the risk and long-term impacts of severe disturbances**
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Northern hardwood forest types usually regenerate naturally very readily. Limiting openings to 1/3 acre in the Norway spruce plantations will result in windbreaks within the longer rows.

Drawbacks and barriers of this tactic	Should an area not have adequate regeneration of desirable species, costs of artificial regeneration.
Timeframe to implement	during the harvest and within 5 years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Residual Stem Density
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Residual relative basal area at 66% post harvest within the hardwood stand and 43% within the Norway spruce plantations
Implementing monitoring efforts (frequency, time of year, etc)	During harvest operations, and 5 years post-harvest

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Increase the distribution and density of sugar maple to combat sugar maple decline.
Management Objective	Sugar Maple will be favored for retention over other tree species. Regenerating areas of sugar maple will have competing overstory trees removed provided that the removal(s) does not violate the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012).

Challenges	Same as hardwood
Opportunities	Same as hardwood
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Establish a target of at least 256 square feet per acre of CWD that is over 3" in diameter and over 3' long. Bias sugar maple and hickory as leave trees. Leave behind snags and live trees with cavities and/or nests.**
Strategy	**Maintain or create refugia**
Approach	Prioritize and maintain sensitive or at-risk species or communities
Benefits of this tactic	CWD and snag requirements are business as usual. The retention of sugar maple and hickory are justified for timber value, wildlife value, current occurrence, and future potential occurrence.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	Accomplished during marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Remove beech infected with Beech Bark Disease Complex (BBD)
Management Objective	Beech that show clear signs of BBD will be biased for removal, while adhering to the guidelines established in the Landscape Designations for DCR Parks & Forests: Selection Criteria and Management Guidelines (2012). Particularly those guidelines relating to legacy trees and opening sizes.
Challenges	Same as hardwood
Opportunities	Same as hardwood
Feasibility of meeting objectives after evaluation of climate impacts on system	Low

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	**Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).**
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.

Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Adaptation Tactic	**Group selection and gap selections are designed to move stands towards uneven aged conditions. Thinning operations are done with a variable density and designed to promote the healthiest and most vigorous trees. Large legacy trees are left within the stands.**
Strategy	**Maintain and enhance species and structural diversity**
Approach	Promote diverse age classes
Strategy	**Maintain and enhance species and structural diversity**
Approach	Maintain and restore diversity of native species
Strategy	**Maintain and enhance species and structural diversity**
Approach	Retain biological legacies
Benefits of this tactic	The agency encourages uneven aged management and has existing guidelines for legacy trees. Prescribed densities are designed to be within a range in order to encourage variability.
Drawbacks and barriers of this tactic	None related to climate change.
Timeframe to implement	During marking
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

Monitoring adaptation actions

Monitoring is critical for understanding if management actions are effective or if management should be altered in the future to account for new information. The following monitoring variables were described for this particular management objective and adaptation tactics.

Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	Treatment of American beech that is infested with BBD
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	95% kill within 1 month of treatment for those group selection openings designated for treatment.
Implementing monitoring efforts (frequency, time of year, etc)	Within 1 month of treatment, and prior to beginning harvesting operations. Visit the site again in 5 years during regeneration surveys to gauge the effectiveness of the treatments.

Evaluation of climate change impacts on goals and objectives

Climate change might make management objectives for this property harder or easier to achieve, presenting challenges and opportunities. This section also includes a simple rating and description for the feasibility of meeting management objectives under current management. This is a critical step to evaluate whether management objectives are robust, or whether any might need to be changed.

Management Goal	Improve wildlife habitat, specifically browse and cover
Management Objective	Thinned rows in the Norway spruce plantations will not exceed 1/3 acre in size, and will be located a minimum of 100’ apart. Beech brush or exotic vegetation that is disturbance driven will be mitigated through treatments that will most likely occur prior to harvest.
Challenges	No challenges due to climate change
Opportunities	No opportunities due to climate change
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: This is a policy objecitve

Responding to climate change impacts

The following adaptation actions (tactics) were identified to help prepare for climate change impacts. Each adaptation tactic is linked to one or more Adaptation Strategies and Approaches, providing connections to climate change adaptation and forest management and conservation. Refer to the Adaptation Workbook for a complete list of Adaptation Strategies and Approaches.

Note - Tactics that are recommended can be implemented or explored further. However, some adaptation tactics might not be recommended for implementation on this property, which may be due to a combination of barriers and drawbacks or external factors.

Adaptation Tactic	

	Strict adherence to forestry practices BMP's, conduct operations in only frozen or very dry conditions, treat invasive exotics as well as nuisance natives (American beech with BBD).
Strategy	**Sustain fundamental ecological functions**
Approach	Maintain or restore hydrology
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce competition for moisture, nutrients, and light
Strategy	**Sustain fundamental ecological functions**
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	BMP's are part of business-as-usual, timing operations are also part of business-as-usual. The implementation of exotic and nuisance native treatments is being encouraged.
Drawbacks and barriers of this tactic	Cost of treatment and potentially extends the length of operations.
Timeframe to implement	Anywhere from pre-harvest to within two years post harvest.
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	Medium
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes
Adaptation Tactic	**Installing canopy gaps and/ or rows wide enough to encourage recruitment by a range of species. Targeting the removal of host species, specifically ash b/c of emerald ash borer. Requiring that harvesting equipment be cleaned prior to arriving on-site.**
Strategy	**Reduce the impact of biological stressors**
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Strategy	**Reduce the impact of biological stressors**
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	These are business as usual practices.
Drawbacks and barriers of this tactic	The size of the gaps.
	N/A

Timeframe to implement	
Practicability	*An adaptation tactic is practicable if it is both effective & feasible to implement and to ultimately achieve desired intent.*
... practicability of tactic?	High
Recommendation for implementation	*The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.*
... recommend tactic?	Yes

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