

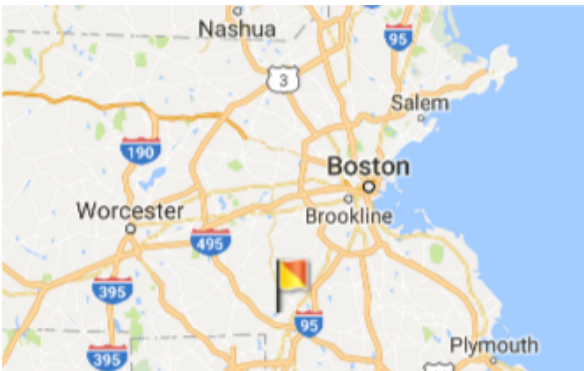
# Climate Change Adaptation Plan

Bristol Lot

April 11, 2017

Prepared by Paul Gregory

Prepared using the Adaptation Workbook - [AdaptationWorkbook.org](http://AdaptationWorkbook.org)



Property details

**Acres:** 42

**Ownership:** State

A forest management proposal that endeavors to demonstrate a two-age silvicultural system, shelterwood with reserves, and to sustain regeneration of oak species through the use of prescribed fire.

Climate Adaptation Plan	<b>Bristol Lot</b>
Project Details	<p>42 acres</p> <p>State ownership</p> <p>A forest management proposal that endeavors to demonstrate a two-age silvicultural system, shelterwood with reserves, and to sustain regeneration of oak species through the use of prescribed fire.</p>
Management area(s)	<p><b>Central hardwood-pine</b></p> <p><b>Wildlife Habitat</b></p> <p><b>Aesthetics</b></p>
Regional Climate Change Impacts & Property-Level Considerations	<p>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.</p> <p><b>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.</b>  Property considerations: Warmer winters and a longer growing season will increase evaporation and water use by forests. Greater water use will likely reduce summertime soil moisture and increase the occurrence and length of droughts. Drought will decrease forest productivity and increase the susceptibility of trees to insects and disease, with ripple effects on fall foliage, wood supply, and other economic resources.</p> <p><b>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.</b>  Property considerations: May increase the compaction of harvesting equipment due to lack of frozen soils.</p> <p><b>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.</b>  Property considerations: Reduced growing season precipitation may increase stress due to current drought.</p> <p><b>Forest vegetation in New England and northern New York may face increased risk of moisture deficit and drought during the growing season.</b>  Property considerations: Increased evapotranspiration and decreased soil moisture are likely to exacerbate summertime drying and contribute to drought-induced plant stress and decreases in productivity and survival.</p> <p><b>Low-diversity systems are at greater risk from climate change.</b>  Property considerations: May effect project due to current state of low diversity of forest structure. Creating a more diverse forest structure will make the forest more resilient to disturbance.</p> <p><b>Systems that are more tolerant of disturbance have less risk of declining on the landscape</b>  Property considerations: Oak is a disturbance dependent species, and should continue across the landscape.</p> <p><b>Habitat will become more suitable in New England and northern New York for some southern species.</b>  Property considerations: Oaks will generally do better, with the habitat for some oak species increasing as much as three times. Being mainly a southern community, the central hardwoods may be expected to extend its range further into MA as the climate warms.</p>

## 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	<p>Central hardwood-pine</p> <p>These forests are found in dry to mesic conditions across a variety of sites in southern New England. Dominant species may include several oak species, especially red, white, black, or scarlet oak, and other hardwood species.</p>
Management Goal	Increase tree regeneration.
Management Objective(s)	Increase seedlings of a variety of tree species to more than 400 per acre. If conditions allow, concentrate on oak seedlings. (Increase oak seedling and oak stumps sprouts to more than 400 per acre.) <i>(5 years)</i>
Management Goal	Increase the structural diversity of the stand
Management Objective(s)	<p>Increase the diversity of diameter and height distributions. <i>(15 years)</i></p> <p>Increase the stems/acre of understory vegetation by 20% <i>(10 years)</i></p>
Management Goal	Sustain the regeneration of oak species through the use of prescribed fire.
Management Objective(s)	Conduct a prescribed fire if oak seedlings are being overtopped by other hardwood species. <i>(5 years)</i>
Potential identified impacts for Central hardwood-pine	<p><b>Central hardwood-pine forests are widely distributed across a variety of sites, increasing adaptive capacity.</b>  Property considerations: Oak and hickory should be fine with respect to adaptability in this project area. The project area is on the northern edge of the current central hardwoods range.</p> <p><b>Changes in herbivore populations may also have substantial effects on forest growth and composition.</b>  Property considerations: Recent deer browse survey of the larger state forest indicated that the area was moderately impacted by deer, with some areas showing little to no impact.</p> <p><b>High levels of diversity may increase the ability of forests to adapt to climate change.</b>  Property considerations: The project area contains a variety of oak species and hickory. These species traits include drought tolerance and stump sprouting. These traits may increase the number of ways in which the ecosystem can adjust to changing conditions while maintaining important ecosystem functions.</p> <p><b>Insect pests and forest diseases could become more problematic in central hardwood-pine forests under a warmer climate.</b>  Property considerations: A portion of the project area was impacted this last spring by Gypsy moth. It is highly likely it will continue this spring as well. Recent drought conditions have limited the effectiveness of a soil borne fungus, <i>Entomophaga maimaiga</i>, which has helped keep populations in check since the last large out-breaks of the 1980's.</p> <p><b>Invasive species such as buckthorn, honeysuckle, and garlic mustard are expected to become more problematic under climate change.</b>  Property considerations: Glossy buckthorn is present in the project area, albeit at a low level.</p>

	<p><b>Many of the dominant tree species in central hardwood-pine forests are projected to have similar or increased habitat, including black, chestnut, scarlet, and white oak and pignut and shagbark hickory.</b> Property considerations: Positive effect as these dominant trees species reside in the project area.</p> <p><b>Previous human influences, including fragmentation and fire suppression, may have reduced the adaptive capacity of some central hardwood-pine forests.</b> Property considerations: As oak needs disturbance to perpetuate itself, the lack of disturbance over the past 100 years has resulted in little to no oak regeneration on the project area.</p> <p><b>Some tree species in central hardwood-pine forests are projected to have reduced habitat in the future under scenarios of greater warming and change.</b> Property considerations: The northern red oak is mainly on the north facing slope, which may help to reduce stress brought on by hotter and drier conditions.</p>
Potential impact of climate change on health and function of system	Mixed/Neutral
Adaptive Capacity of system to climate change impacts or disturbances	Low-Moderate
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	Increase tree regeneration.
Management Objective	Increase seedlings of a variety of tree species to more than 400 per acre. If conditions allow, concentrate on oak seedlings. (Increase oak seedling and oak stumps sprouts to more than 400 per acre.) <i>(5 years)</i>
Challenges	Impacts from gypsy moth and winter moth and drought may make it difficult to sustain canopy oak trees to provide a seed source for oak regeneration.
Opportunities	Promote less common species. (Climate change will provide less competition from more northern tree species whom are at their southern limit.)
Feasibility of meeting objectives after evaluation of climate impacts on system	<p>Medium</p> <p>Comments: A disturbance through a timber harvest will enable stump sprouts to increase in number. The impact of drought and insect pests on the canopy trees may be severe that doing nothing results in the trees dying on the stump and will not produce stump sprouts.</p>

## Other Considerations

Comments: Perhaps think about not being confined to trying to increase oak regeneration if the stand is being impacted by insects pests. Be open to ideas of what is possible such as moving the stand to a more open woodland with more shrubs and grasses and just a scattering of trees. Could provide more habitat for birds and animals, such as the brown thrasher.

## 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	<b>Alter the timing of forest operations to reduce potential impacts on soils and residual trees.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	Protects soil structure. Is already a consideration in our management guidelines.
Drawbacks and barriers of this tactic	There may not be many days in the winter frozen enough to meet this tactic.
Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Perform a silvicultural operation to remove crowded, damaged, or stressed trees in order to reduce competition for light, nutrients, and water.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce competition for moisture, nutrients, and light
Benefits of this tactic	Gives residual trees more nutrients and light to increase its viability to withstand drought stress and damage for pests and disease.
Drawbacks and barriers of this tactic	N/A

Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Use prescribed fire to maintain oak regeneration and sustain a mixed oak ecosystem.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Restore or maintain fire in fire-adapted ecosystems
Benefits of this tactic	Reduces competing vegetation. Expands our Rx burn program to another property and demonstrates how prescribed fire can be a useful tool in ecosystem management.
Drawbacks and barriers of this tactic	May not be supported by the public who are not used to seeing fire used in a beneficial way.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Create a mix of species, age classes, and stand structures to reduce the availability of host species for pests and pathogens.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Benefits of this tactic	A more diverse forest is more resilient to impacts from climate change.
Drawbacks and barriers of this tactic	insect pests may infest the project are to such an extent that timber harvest is not financially possible or will become a salvage operation.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to</i>

... practicability of tactic?	<i>ultimately achieve desired intent.</i>
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Require the cleaning of equipment prior to forest operations in order to prevent the spread of invasive plants during site preparation, harvesting, or other activities.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	greatly reduces spread of invasive species
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant blight-resistant American chestnut as it is more resistant to gypsy moth.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Reestablishes American chestnut back into the Central Hardwood forest. Increases chances for natural regeneration to take hold.
Drawbacks and barriers of this tactic	Will need a funding source for the chestnut as well as approval from several directors.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>

... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Planting disease-resistant chestnut in order to reestablish a form of this species on the landscape.</b>
<b>Strategy</b>	<b>Maintain and enhance genetic diversity</b>
Approach	Favor existing genotypes that are better adapted to future conditions
Benefits of this tactic	Increases diversity of species. Increases hard mast species. Could be a good public campaign.
Drawbacks and barriers of this tactic	Will need a funding source for the chestnut as well as approval from several directors.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Favor establishing oak (a drought- and heat-tolerant species) on south-facing slopes with shallow soils, or other sites that are expected to become warmer and drier.</b>
<b>Strategy</b>	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Many oak species are expected to fare better under future climate change
Drawbacks and barriers of this tactic	Insect pests may initially impact oak to such extent other species (pine) may move into the project area and make it difficult to reestablish oak once the insect outbreaks subside.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium



Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Prevent and remove undesired species, including invasive nonnative or aggressive native species, in order to reduce competition for moisture, nutrients, and light through the use of prescribed fire.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Guide changes in species composition at early stages of stand development
Benefits of this tactic	Prescribed fire will help lower the competition of oak, enabling it to have an advantage.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Create suitable physical conditions for natural regeneration through site preparation by encouraging scarification.</b>
Strategy	<b>Realign ecosystems after disturbance</b>
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Increases the possibility for an increase in regeneration following the anticipated insect pest disturbance.
Drawbacks and barriers of this tactic	Insect pests infestation may be severe enough to make a timber harvest not economically viable.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for	<i>The decision to recommend a tactic may be based on the likelihood of success, potential</i>

implementation	<i>tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Perform a shelterwood with reserves to increase structural and species diversity while maintaining aspects of the mature forest.</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Promote diverse age classes
Benefits of this tactic	Maintaining a mix of ages, species, sizes, or canopy positions will help buffer vulnerability to stressors of any species or single age class, as well as increase structural diversity within the stand.
Drawbacks and barriers of this tactic	Aesthetics may be a concern if oak mortality is severe. The public may think the insect pest impact was from the timber harvest if the oaks continue to face mortality after the timber harvest.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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)	tree regeneration
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	an increase of at least 25% in tree regeneration
Implementing monitoring efforts	Using stand exam plots remeasure tree regeneration 5 years after timber harvest

(frequency, time of year, etc)	
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	oak regeneration
Monitoring Variable 2	
Threshold or Criteria for Evaluation of adaptation tactic	over 400 stems per acre of oak following a prescribed burn
Implementing monitoring efforts (frequency, time of year, etc)	Using stand exam plots remeasure tree regeneration 2 years after Rx burn

## 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 structural diversity of the stand
Management Objective	Increase the diversity of diameter and height distributions. <i>(15 years)</i>
Challenges	Drought, invasive plants, and insect pests may affect the project area.
Opportunities	Insect pests may to some degree increase the structural diversity if the outbreaks are small and scattered.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Creating gaps through a timber harvest will provide the opportunity for diameter and height distributions to increase. The vegetation may not respond if drought, invasive plants, and insect pests are severe.
Other Considerations	Comments: The project area may be affected by drought, invasive plants, and insect pests to such an extent a timber harvest would not be financially viable.

## 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	<b>Alter the timing of forest operations to reduce potential impacts on soils and residual trees.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	Protects soil structure. Is already a consideration in our management guidelines.
Drawbacks and barriers of this tactic	There may not be many days in the winter frozen enough to meet this tactic.
Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Perform a silvicultural operation to remove crowded, damaged, or stressed trees in order to reduce competition for light, nutrients, and water.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce competition for moisture, nutrients, and light
Benefits of this tactic	Gives residual trees more nutrients and light to increase its viability to withstand drought stress and damage for pests and disease.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

Adaptation Tactic	<b>Create a mix of species, age classes, and stand structures to reduce the availability of host species for pests and pathogens.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Benefits of this tactic	A more diverse forest is more resilient to impacts from climate change.
Drawbacks and barriers of this tactic	insect pests may infest the project are to such an extent that timber harvest is not financially possible or will become a salvage operation.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Plant blight-resistant American chestnut as it is more resistant to gypsy moth.</b>
Strategy	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Reestablishes American chestnut back into the Central Hardwood forest. Increases chances for natural regeneration to take hold.
Drawbacks and barriers of this tactic	Will need a funding source for the chestnut as well as approval from several directors.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Perform a shelterwood with reserves to increase structural and species diversity while maintaining aspects of the mature forest.</b>

Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Promote diverse age classes
Benefits of this tactic	Maintaining a mix of ages, species, sizes, or canopy positions will help buffer vulnerability to stressors of any species or single age class, as well as increase structural diversity within the stand.
Drawbacks and barriers of this tactic	Aesthetics may be a concern if oak mortality is severe. The public may think the insect pest impact was from the timber harvest if the oaks continue to face mortality after the timber harvest.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Retain habitat elements of the mature forest (e.g. mast production, vertical structural diversity, large diameter trees).</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Retain biological legacies
Benefits of this tactic	Retains habitat elements of the mature forest, more aesthetically pleasing, shows thought went into management decisions.
Drawbacks and barriers of this tactic	If the impact from insect pests is severe, may have to remove the large trees that were to be retained especially near roads.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Planting disease-resistant chestnut in order to reestablish a form of this species on the landscape.</b>
Strategy	<b>Maintain and enhance genetic diversity</b>

Approach	Favor existing genotypes that are better adapted to future conditions
Benefits of this tactic	Increases diversity of species. Increases hard mast species. Could be a good public campaign.
Drawbacks and barriers of this tactic	Will need a funding source for the chestnut as well as approval from several directors.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Create suitable physical conditions for natural regeneration through site preparation by encouraging scarification.</b>
<b>Strategy</b>	<b>Realign ecosystems after disturbance</b>
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Increases the possibility for an increase in regeneration following the anticipated insect pest disturbance.
Drawbacks and barriers of this tactic	Insect pests infestation may be severe enough to make a timber harvest not economically viable.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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)	tree regeneration
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	an increase of at least 25% in tree regeneration
Implementing monitoring efforts (frequency, time of year, etc)	Using stand exam plots remeasure tree regeneration 5 years after timber harvest
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	saplings
Monitoring Variable 2	
Threshold or Criteria for Evaluation of adaptation tactic	25% increase in the number of stems/acre of understory tree species
Implementing monitoring efforts (frequency, time of year, etc)	Using stand exam plots remeasure tree saplings 10 years after the timber 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 structural diversity of the stand
Management Objective	Increase the stems/acre of understory vegetation by 20% ( <i>10 years</i> )
Challenges	Insect pests and invasive species may decrease the understory tree diversity.
Opportunities	Insect pests may defoliate the canopy trees of the stand to such a degree to substantially increase the amount of sunlight hitting the forest floor giving the understory more available



Feasibility of meeting objectives after evaluation of climate impacts on system	<p>sunlight. May provide for more soft mast available for wildlife.</p> <p>High</p> <p>Comments: Any advanced regeneration and seeds in the soil in the short term should increase in number through the actions of the timber harvest. In the long term they may be adversely affected by insects pests, drought, or invasive plants.</p>
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## 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	<b>Alter the timing of forest operations to reduce potential impacts on soils and residual trees.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce impacts to soils and nutrient cycling
Benefits of this tactic	Protects soil structure. Is already a consideration in our management guidelines.
Drawbacks and barriers of this tactic	There may not be many days in the winter frozen enough to meet this tactic.
Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes

Adaptation Tactic	<b>Perform a silvicultural operation to remove crowded, damaged, or stressed trees in order to reduce competition for light, nutrients, and water.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Reduce competition for moisture, nutrients, and light
Benefits of this tactic	Gives residual trees more nutrients and light to increase its viability to withstand drought stress and damage for pests and disease.

Drawbacks and barriers of this tactic	N/A
Timeframe to implement	next year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Create a mix of species, age classes, and stand structures to reduce the availability of host species for pests and pathogens.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Maintain or improve the ability of forests to resist pests and pathogens
Benefits of this tactic	A more diverse forest is more resilient to impacts from climate change.
Drawbacks and barriers of this tactic	insect pests may infest the project are to such an extent that timber harvest is not financially possible or will become a salvage operation.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Require the cleaning of equipment prior to forest operations in order to prevent the spread of invasive plants during site preparation, harvesting, or other activities.</b>
Strategy	<b>Reduce the impact of biological stressors</b>
Approach	Prevent the introduction and establishment of invasive plant species and remove existing invasive species
Benefits of this tactic	greatly reduces spread of invasive species
Drawbacks and barriers	N/A

of this tactic	
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Plant blight-resistant American chestnut as it is more resistant to gypsy moth.</b>
<b>Strategy</b>	<b>Reduce the risk and long-term impacts of severe disturbances</b>
Approach	Promptly revegetate sites after disturbance
Benefits of this tactic	Reestablishes American chestnut back into the Central Hardwood forest. Increases chances for natural regeneration to take hold.
Drawbacks and barriers of this tactic	Will need a funding source for the chestnut as well as approval from several directors.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Perform a shelterwood with reserves to increase structural and species diversity while maintaining aspects of the mature forest.</b>
<b>Strategy</b>	<b>Maintain and enhance species and structural diversity</b>
Approach	Promote diverse age classes
Benefits of this tactic	Maintaining a mix of ages, species, sizes, or canopy positions will help buffer vulnerability to stressors of any species or single age class, as well as increase structural diversity within the stand.
Drawbacks and barriers of this tactic	Aesthetics may be a concern if oak mortality is severe. The public may think the insect pest impact was from the timber harvest if the oaks continue to face mortality after the timber harvest.

Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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)	saplings
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	25% increase in the number of stems/acre of understory tree species
Implementing monitoring efforts (frequency, time of year, etc)	Using stand exam plots remeasure tree saplings 10 years after the timber 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	Sustain the regeneration of oak species through the use of prescribed fire.
Management Objective	Conduct a prescribed fire if oak seedlings are being overtopped by other hardwood species. (5 years)
Challenges	Climate change may make it difficult to conduct a Rx burn due to drought conditions. 1000 hour fuels may become available which can intensify the burn and have smoke related issues.

Opportunities	A milder winter may allow early season or late season Rx burns to occur.
Feasibility of meeting objectives after evaluation of climate impacts on system	High Comments: Typically, there are windows of opportunities to conduct a burn throughout the year.
Other Considerations	Comments: This would be the first Rx burn in this state forest. The public may be wary, but gives us the opportunity to provide an example of using fire in a beneficial way.

## 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	<b>Use prescribed fire to maintain oak regeneration and sustain a mixed oak ecosystem.</b>
Strategy	<b>Sustain fundamental ecological functions</b>
Approach	Restore or maintain fire in fire-adapted ecosystems
Benefits of this tactic	Reduces competing vegetation. Expands our Rx burn program to another property and demonstrates how prescribed fire can be a useful tool in ecosystem management.
Drawbacks and barriers of this tactic	May not be supported by the public who are not used to seeing fire used in a beneficial way.
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Prevent and remove undesired species, including invasive nonnative or aggressive native species, in order to reduce competition for moisture, nutrients, and light through the use of prescribed fire.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Guide changes in species composition at early stages of stand development

Benefits of this tactic	Prescribed fire will help lower the competition of oak, enabling it to have an advantage.
Drawbacks and barriers of this tactic	N/A
Timeframe to implement	within 5 years
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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)	tree regeneration
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	an increase of at least 25% in tree regeneration
Implementing monitoring efforts (frequency, time of year, etc)	Using stand exam plots remeasure tree regeneration 5 years after timber harvest
Monitoring variables used to evaluate if tactic is achieving desired management objective(s)	oak regeneration
Monitoring Variable 2	
Threshold or Criteria for	over 400 stems per acre of oak following a prescribed burn

Evaluation of adaptation tactic

Implementing monitoring efforts (frequency, time of year, etc)

Using stand exam plots remeasure tree regeneration 2 years after Rx burn

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## 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	<p><b>Wildlife Habitat</b></p> <p>Provide mast for wildlife. Favor mast trees, e.g. hickory, for retention.</p>
Management Goal	Retain hard mast species in the overstory. Promote hard mast in the understory.
Management Objective(s)	retain a subset of hickory and oak trees in the overstory. Promote hazelnut in the understory.
Potential identified impacts for Wildlife Habitat	<p><b>Forest vegetation in New England and northern New York may face increased risk of moisture deficit and drought during the growing season.</b></p> <p>Seed production may be increased by drought, but often drops during the two to three years following a drought. Acorn production was negatively correlated with high levels of drought.</p> <p>Temperate forest trees and stands under severe drought: a review of ecophysiological responses, adaptation processes and long-term consequences (<a href="http://www.afs-journal.org/articles/forest/abs/2006/06/f6063/f6063.html">http://www.afs-journal.org/articles/forest/abs/2006/06/f6063/f6063.html</a>)</p> <p>Prediction of acorn crops in three species of North American oaks: Quercus alba, Q rubra and Q velutina (<a href="http://www.afs-journal.org/articles/forest/abs/1993/07/AFS_0003-4312_1993_50_Suppl1_ART0012/AFS_0003-4312_1993_50_Suppl1_ART0012.html">http://www.afs-journal.org/articles/forest/abs/1993/07/AFS_0003-4312_1993_50_Suppl1_ART0012/AFS_0003-4312_1993_50_Suppl1_ART0012.html</a>)</p> <p><b>Climate may affect wildlife through changes in the quality and distribution of habitat, the availability of food, the abundance of parasites and diseases, and the incidence of stress from heat and drought.</b></p> <p>Direct effects, such as late spring storms, may kill migrating birds. Indirect effects include changes in habitat quality from alterations in food supplies or shifts in vegetation composition and structure. Climate change affects mammals through direct thermal stress, shifts in habitat and food availability, increases in parasites and diseases, and responses to extreme weather events.</p> <p>Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada (<a href="https://www.treearch.fs.fed.us/pubs/41165">https://www.treearch.fs.fed.us/pubs/41165</a>)</p>
Potential impact of climate change on health and function of system	Mixed/Neutral
Adaptive Capacity of system to climate change impacts or disturbances	Low-Moderate
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	Retain hard mast species in the overstory. Promote hard mast in the understory.
Management Objective	retain a subset of hickory and oak trees in the overstory. Promote hazelnut in the understory.
Challenges	Impacts from insect pests (gypsy moth and winter moth) may make it difficult to sustain oak canopy trees as a source for mast for wildlife.
Opportunities	Plant blight-resistant American chestnuts, which is more resistant to gypsy moths.
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: Might be medium in the short term as insect pests are currently affecting the project area. The feasibility could go up or down depending on the long term impact of these insect pests.
Other Considerations	Comments: May need to pursue a financial source (grant) for the chestnuts. Will current administration allow for these chestnut hybrids to be planted on state property?

## 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	<b>Perform a shelterwood with reserves to increase structural and species diversity while maintaining aspects of the mature forest.</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Promote diverse age classes
Benefits of this tactic	Maintaining a mix of ages, species, sizes, or canopy positions will help buffer vulnerability to stressors of any species or single age class, as well as increase structural diversity within the stand.
Drawbacks and barriers of this tactic	Aesthetics may be a concern if oak mortality is severe. The public may think the insect pest impact was from the timber harvest if the oaks continue to face mortality after the timber harvest.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>

... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Retain habitat elements of the mature forest (e.g. mast production, vertical structural diversity, large diameter trees).</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Retain biological legacies
Benefits of this tactic	Retains habitat elements of the mature forest, more aesthetically pleasing, shows thought went into management decisions.
Drawbacks and barriers of this tactic	If the impact from insect pests is severe, may have to remove the large trees that were to be retained especially near roads.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Favor establishing oak (a drought- and heat-tolerant species) on south-facing slopes with shallow soils, or other sites that are expected to become warmer and drier.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Many oak species are expected to fare better under future climate change
Drawbacks and barriers of this tactic	Insect pests may initially impact oak to such extent other species (pine) may move into the project area and make it difficult to reestablish oak once the insect outbreaks subside.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium

Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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)	oak and hickory trees
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Presence of large diameter oak and hickory trees
Implementing monitoring efforts (frequency, time of year, etc)	Visual observation following timber harvest

## 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	Aesthetics Promote large-diameter trees, forest structure, forest health, and quality scenery.
Management Goal	Protect the aesthetic value of the stand
Management Objective(s)	Reserve a set of trees of good timber quality to promote large-diameter trees, forest structure, forest health, and quality scenery.
Potential identified impacts for Aesthetics	<b>Certain insect pests and pathogens will increase in occurrence or become more damaging in New England and northern New York.</b> Reducing competition for resources can enhance the persistence of desired species and increase the ability of ecosystems to cope with the direct effects (drought stress, temperature increases) and indirect effects (increased damage from pests and disease) of climate change. Will these steps be enough to overcome the direct and indirect effects of climate change to keep the reserve trees healthy.
Potential impact of climate change on health and function of system	Mixed/Neutral
Adaptive Capacity of system to climate change impacts or disturbances	Low-Moderate
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	Protect the aesthetic value of the stand
Management Objective	Reserve a set of trees of good timber quality to promote large-diameter trees, forest structure, forest health, and quality scenery.
Challenges	The project area may be affected by drought, invasive plants, and insect pests to such a degree that the aesthetic value of the stand is diminished.  May be able to showcase less common species.

Opportunities	
Feasibility of meeting objectives after evaluation of climate impacts on system	Medium Comments: A timber harvest would reduce stress and competition, and increase nutrients and light for the trees that remain, giving the possibility for these reserve trees to provide aesthetic value.
Other Considerations	Comments: Aesthetics is highly personal and subjective.

## 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	<b>Perform a shelterwood with reserves to increase structural and species diversity while maintaining aspects of the mature forest.</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Promote diverse age classes
Benefits of this tactic	Maintaining a mix of ages, species, sizes, or canopy positions will help buffer vulnerability to stressors of any species or single age class, as well as increase structural diversity within the stand.
Drawbacks and barriers of this tactic	Aesthetics may be a concern if oak mortality is severe. The public may think the insect pest impact was from the timber harvest if the oaks continue to face mortality after the timber harvest.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
Adaptation Tactic	<b>Retain habitat elements of the mature forest (e.g. mast production, vertical structural diversity, large diameter trees).</b>
Strategy	<b>Maintain and enhance species and structural diversity</b>
Approach	Retain biological legacies

Benefits of this tactic	Retains habitat elements of the mature forest, more aesthetically pleasing, shows thought went into management decisions.
Drawbacks and barriers of this tactic	If the impact from insect pests is severe, may have to remove the large trees that were to be retained especially near roads.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	High
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... recommend tactic?	Yes
<b>Adaptation Tactic</b>	<b>Favor establishing oak (a drought- and heat-tolerant species) on south-facing slopes with shallow soils, or other sites that are expected to become warmer and drier.</b>
Strategy	<b>Facilitate community adjustments through species transitions.</b>
Approach	Favor or restore native species that are expected to be adapted to future conditions
Benefits of this tactic	Many oak species are expected to fare better under future climate change
Drawbacks and barriers of this tactic	Insect pests may initially impact oak to such extent other species (pine) may move into the project area and make it difficult to reestablish oak once the insect outbreaks subside.
Timeframe to implement	within 1 year
Practicability	<i>An adaptation tactic is practicable if it is both effective &amp; feasible to implement and to ultimately achieve desired intent.</i>
... practicability of tactic?	Medium
Recommendation for implementation	<i>The decision to recommend a tactic may be based on the likelihood of success, potential tradeoffs, cost, and other factors.</i>
... 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	oak and hickory trees
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management objective(s)	
Monitoring Variable 1	
Threshold or Criteria for Evaluation of adaptation tactic	Presence of large diameter oak and hickory trees
Implementing monitoring efforts (frequency, time of year, etc)	Visual observation following timber harvest

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