

Appendix E

Adaptive Management and Monitoring

This appendix described how adaptive management will be used in the North Shore Restoration Project and what monitoring will occur with the project. Adaptive management can be used where one of three primary treatments has been prescribed: 1) underplanting, 2) mechanical site preparation, or 3) clearcut with reserves. Appendix A lists what primary treatment is prescribed for each unit that is included in the decision. Units with underplanting, mechanical site preparation or clearcut with reserves listed as the primary treatment will be considered for adaptive management and implementation of those treatments will follow the process described below.

The adaptive management will occur in two phases. Phase I will occur before stand treatments take place; Phase II will occur after management actions have been implemented within a stand. This will allow us to conduct primary treatments appropriate to the initial site conditions (Phase I), prescribe additional reforestation activities (Phase II), and achieve desired conditions over a larger portion of the project area than will otherwise be the case. Adaptation will take the form of an iterative process that will use monitoring data to inform and adjust implementation of the decision, rather than simply eliminating areas from treatment when conditions at the time of implementation do not match conditions at the time of the decision.

Phase I: Proposed Primary Treatment

Phase I adaptive management addresses changes in stand condition that occur between decision and implementation. The selected primary treatments are based on forest plot data gathered in 2009 and 2010 (or earlier) and supplemented with site visits in 2012 (and are displayed in Appendix A). However many of the stands are in a rapid state of decline; some stands may regenerate to a diverse species mix but others may not regenerate at all. Since this project is likely to be implemented over a time frame of 5-15 years, it is likely there will be changes to stand conditions by the time implementation occurred. Actions will be modified in response to such changes. In Phase I, monitoring and adaptation will address the question, *Is the primary treatment prescription appropriate for the site given its condition at the time of implementation?*

Observable stand conditions (thresholds, or "trigger points",) will be used to determine if the primary treatment is appropriate given the stand conditions at time of implementation, or whether a different treatment is needed. In Phase I, the indicators shown in Table D-1 will be monitored relative to their trigger points.

Table E-1: Phase 1 Adaptive Management Indicators and Triggers

Indicator	Trigger point
Basal area ¹ of overstory	Basal area is less than 50-60 square feet
Composition of regenerating tree species	Existing diversity, measured in percentages of species present, is inadequate to meet stand objectives
Stocking level of regenerating tree species	Stocking level, measured by stems per acre of species, is inadequate to meet stand objectives

¹ Basal area is the cross-sectional area of all stems in a stand measured at breast height, expressed per acre.

Monitoring data will be collected during initial stand assessment and implementation of the project to track trigger points in this phase. After monitoring the stand conditions, if the proposed primary treatment is deemed inappropriate, the prescription will be adapted. Figures E-1 through E-3 illustrate the adaptive management process that will be used to determine changes in management actions in response to changed stand conditions. Each figure illustrates a decision tree for one of the three primary treatments (clearcut with reserves, mechanical site preparation, underplanting). In many cases primary treatments will be followed by secondary reforestation activities, for example, timber harvest followed by site preparation and planting. Adaptive management will be used in an iterative cycle to ensure both primary and secondary treatments are appropriate to the site.

Example of unit with adequate overstory. Underplanting could be used to increase species diversity.



Example of unit with inadequate overstory. Mechanical site preparation and planting will be needed.



Figure E-1: Phase I Adaptive Management Process for Units in Appendix A with Clearcut with Reserves as the Primary Treatment.

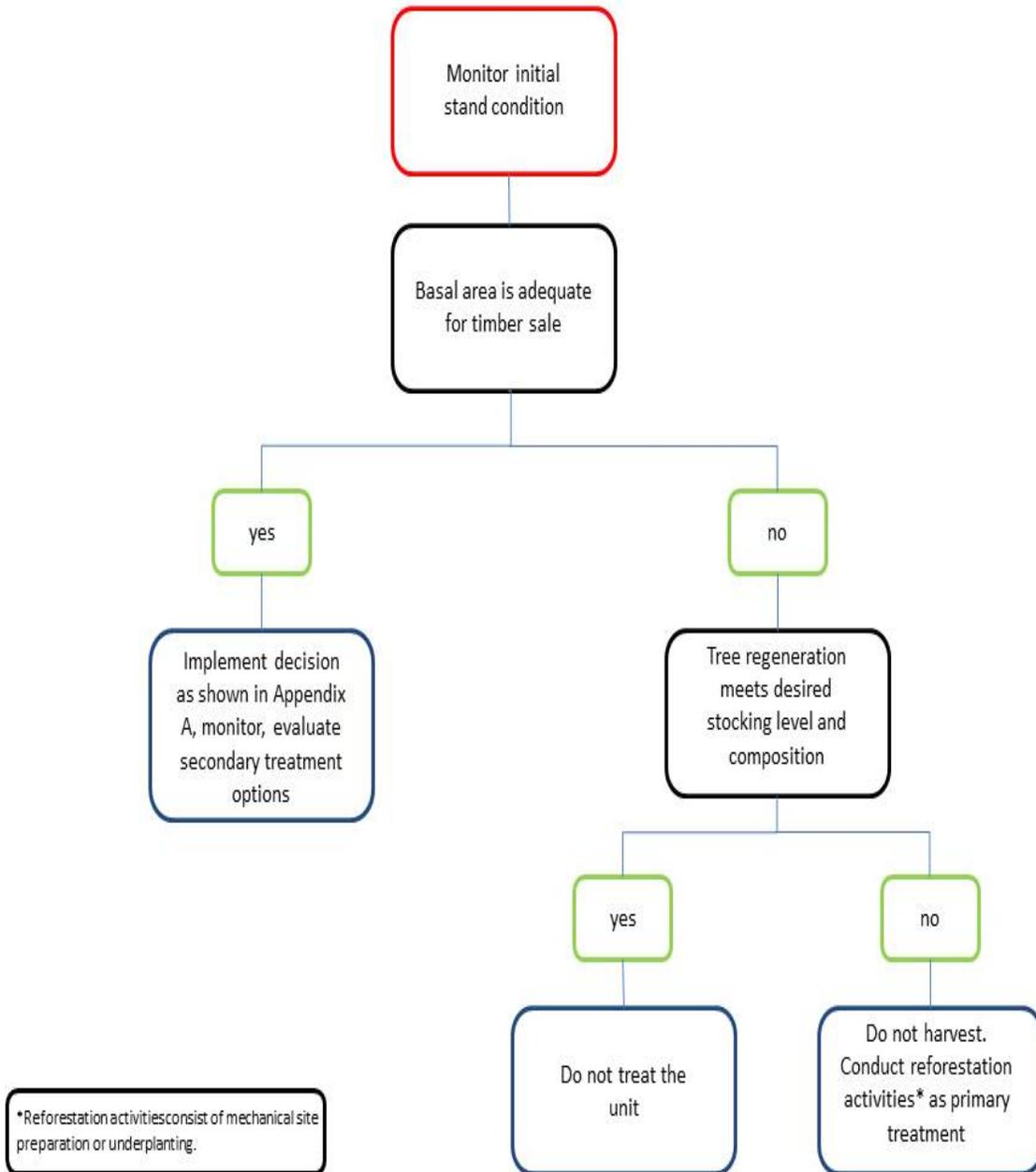


Figure E-2: Phase I Adaptive Management Process for Units listed in Appendix A with Mechanical Site Preparation as the Primary Treatment. Adapted prescriptions may vary depending on stand objectives.

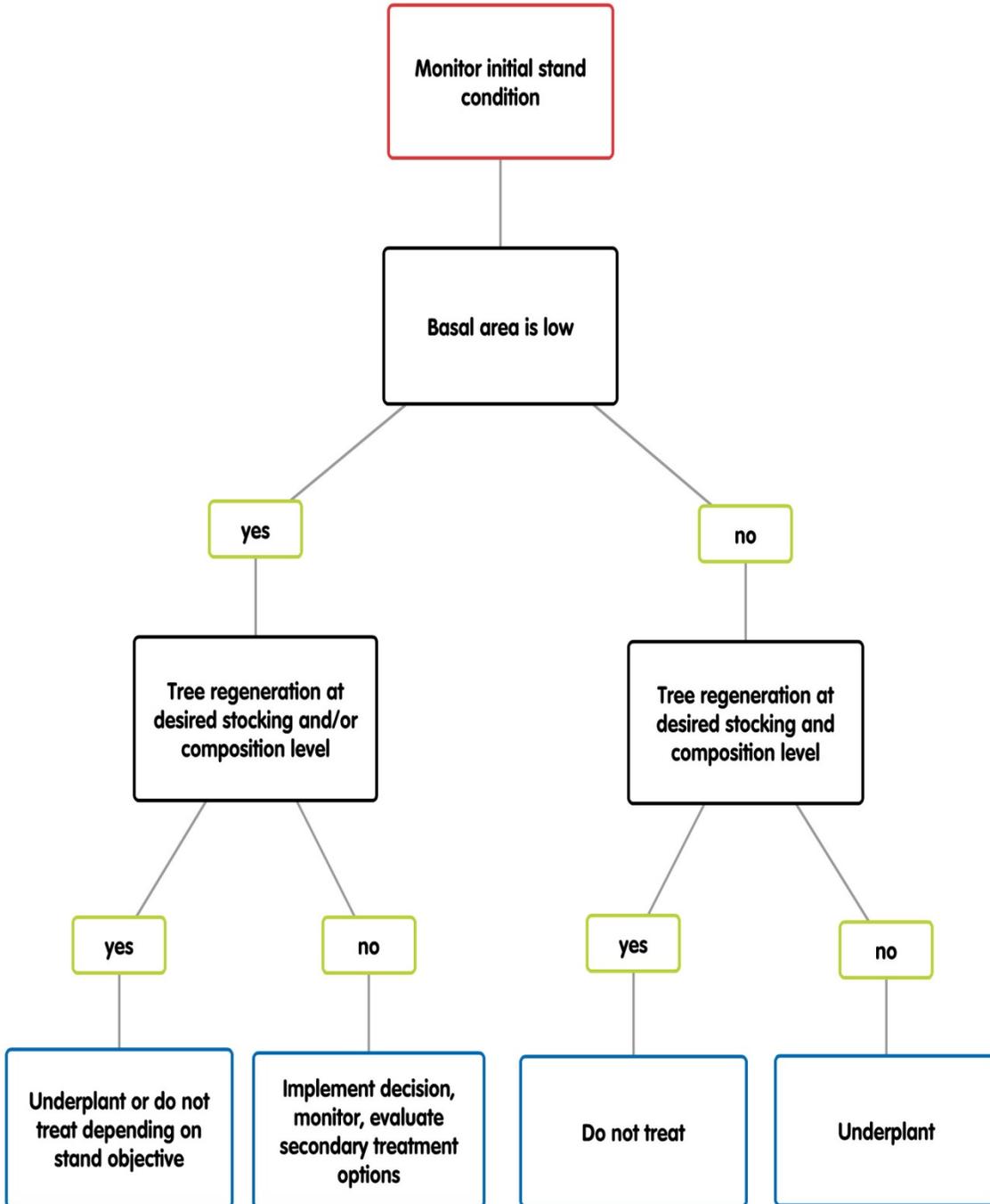
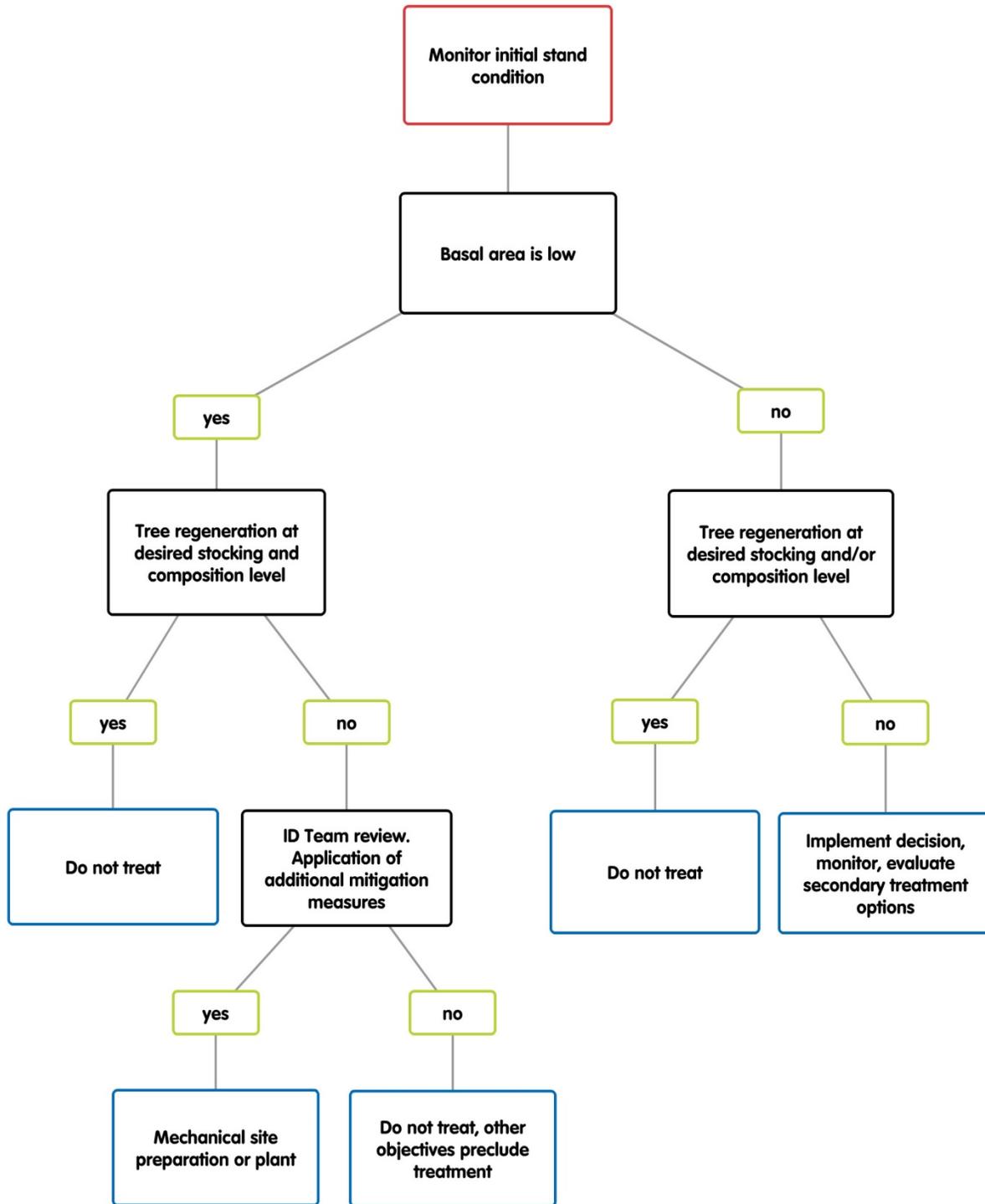


Figure E-3: Phase I Adaptive Management Process for Units in Appendix A with Underplanting as the Primary Treatment. Adapted prescriptions may vary depending on stand objectives.



Phase II: Treatment Effectiveness

Phase II will occur after primary and secondary treatments have taken place. In this phase, there is uncertainty regarding how stands will respond to restoration prescriptions, given the changing climate, increased browsing pressure from deer, and increased competition from grass. Adaptive management in Phase II of the project will address the question, *If reforestation efforts on a site did not meet management objectives, why and how can prescriptions be modified to increase success?* In the North Shore Restoration Project, this question applies primarily to the objective of increasing the conifer or paper birch components in project-area stands.

Trigger points will determine if activities are achieving desired outcomes or whether a different action is needed. After monitoring the outcome of primary and secondary treatments on a site, additional treatments in Phase II will be prescribed based on whether or not the trigger points are exceeded for the indicators shown in Table E-2.

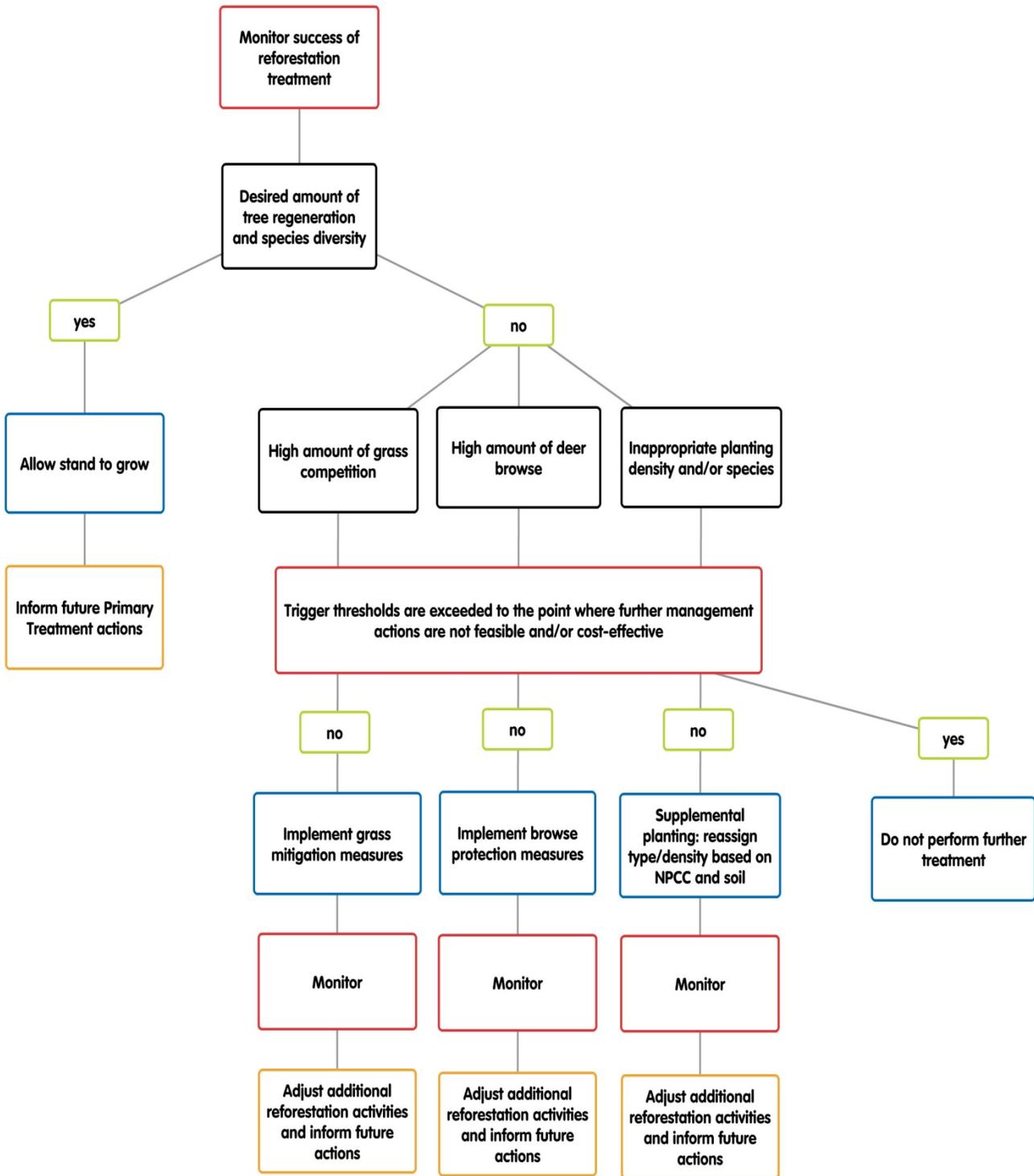
Table E-2: Phase II Adaptive Management Indicators and Trigger Points.

Indicator	Trigger point
Cover of competitive grass, <i>Calamagrostis canadensis</i>	Grass cover, measured using Braun-Blanquet cover-abundance scale rating, exceeds accepted levels to meet stand objectives (Wikum and Shanholtzer 1978)
Deer browsing pressure	Deer browse, measured in proportion of browsed stems, exceeds accepted levels to meet stand objectives (Frerker et al. 2013)
Composition of regenerating tree species	Existing diversity, measured in percentages of species present, is inadequate to meet stand objectives
Stocking level of regenerating tree species	Stocking level, measured by stems per acre of species, is inadequate to meet stand objectives

In Phase II, monitoring will occur throughout implementation of the activities. The information will be used to modify treatments on the site and to inform future primary treatment decisions on sites that have not yet passed through Phase I of the project.

Figure E-4 illustrates the adaptive management process that will be used to evaluate reforestation success. In the Figure, there are two possible learning outcomes. If the desired regeneration is present as a result of reforestation treatments, this success will inform future primary treatments in the project. If the desired regeneration is not present, factors will be evaluated to determine what is hindering success, adapted actions will be implemented, and results will be monitored to continually inform and adjust management prescriptions. Monitoring data will determine 1) if primary treatments are the appropriate actions for meeting forest management objectives, 2) how to best mitigate problems encountered from competing grass and overabundant deer populations, and 3) how to refine species planting mixes and densities based on the native community class and other observable site factors. Because the project will be implemented over a span of many years, using adaptive management will help modify and refine actions so that future treatments in the North Shore project, and in other projects on the Superior National Forest, will be well-informed, efficient and have high rates of success.

Figure E-4: Phase II adaptive management process used to evaluate the success of reforestation efforts.



Monitoring activities that will occur under Alternative 2 are displayed in Table D-3.

Table D-3: Description of Monitoring Activities.

Phase I Adaptive Management: Initial Stand Condition	
Objective	Determine if the primary treatment prescription is appropriate for the site given its condition at the time of implementation.
Methods	Stands will be surveyed and assessed for triggers points listed in Table E-1.
Frequency	Once prior to implementation of primary treatment and again prior to implementation of a secondary treatment if prescribed.
Responsibility	Timber Management Assistant, District Silviculturist, District Wildlife Biologist
Phase II Adaptive Management: Forest Composition/Regeneration	
Objective	Ensure that minimum stocking standards (S-TM-4, Forest Plan p 2-20) are met and desired reforestation objectives have been met. If objectives have not been met, determine how prescriptions can be modified to meet objectives.
Methods	Natural and artificial regeneration areas (following harvest and/or mechanical site preparation) will be surveyed for the number of acceptable trees per acre using Regional Guidelines; additionally, areas will be monitored for trigger points listed in Table E-2. A percentage of areas with underplanting will be monitored for the trigger points listed in Table E-2. Stands planted to white pine will be checked for pruning and release need.
Frequency	Stocking surveys will be conducted after the 1st and 3rd growing season following reforestation treatment; Release and pruning needs will be evaluated at the time of stocking surveys, every other year for 10 years, and after 10 years every 5 years until the branches are 9 ft. off the ground
Responsibility	District Silviculturist
Harvest and Site Preparation Areas	
Objective	Ensure that the mitigation measures and provisions in contracts are implemented, with emphasis on soil compaction
Methods	Visual inspection of treatment stands
Frequency	Treatment areas will be visited on a regular basis during the contract term.
Responsibility	Timber Management Assistant, District Silviculturist
Non-Native Invasive Plants	
Objective	Avoid or minimize an increase in the extent of non-native plant infestation.
Methods	Monitor a sample of harvest units and newly constructed roads after harvest, site preparation, or construction to determine if invasive plants have colonized areas where management activities have occurred
Frequency	Between year one and year three, following the sale
Responsibility	Forest Plant Ecologist
Temporary Roads	
Objective	Ensure that temporary roads are constructed properly and decommissioned after completion of treatment activities
Methods	Inspect temporary road locations as they are being built, during treatments, between treatments, and after they are closed to determine if additional protection/rehabilitation efforts are needed
Frequency	Inspect all temporary road locations that are more than ¼ mile in length.
Responsibility	Timber Management Assistant, Zone Engineer