Review of Existing Region II-III Reforestation Standards – FINAL CONSENSUS POINTS --October 24, 2015

Consensus findings are shown with blue **F#;** consensus recommendations with red **C#;** research needs with green **R#.**

(K-YES) indicates the consensus point is also applicable to the Kodiak-Afognak area

Language in blue type suggests potential methods for implementing the recommendations.

Existing statutes and regulations			
Topic	**Citation**	**Existing statutes and regulation text**	**Consensus Points**
Goals	AS 41.17.060.	(b) With respect to state, municipal, and private forest land, the following standards apply: […] (4) to the fullest extent practicable, harvested forest land shall be reforested, naturally or artificially, so as to result in a sustained yield of merchantable timber from that land; if artificial planting is required, silviculturally acceptable seedlings must first be available for planting at an economically fair price in the state; […] (c) With respect to state and municipal forest land only, the following standards also apply: […] (4) timber harvesting is limited to areas where data and information demonstrate that natural or artificial reforestation techniques will result in the production of a sustained yield of merchantable timber from that area; (5) there may not be significant impairment of the productivity of the land and water with respect to renewable resources;	No change needed (**C3am**) See also **R9** in the Research Gaps section below
	11 AAC 95.185	(a) This [regulation] chapter implements and interprets AS 41.17 (Forest Resources and Practices). For land outside riparian areas, the purpose of this chapter is to provide protection of important public resources, maintain an economically viable timber industry, prevent or minimize significant adverse effects of soil erosion and mass wasting on water quality and fish habitat, and ensure reforestation to the fullest extent practical, taking into account the economic feasibility of timber operations. […]	No change needed (**C3am**)
General	AS	(7) "**forest land**" means land stocked or having been stocked with forest trees of any	No change needed (**C3am**)

Definitions	41.17.950	size and not currently developed for nonforest use, regardless of whether presently available or accessible for commercial purposes, and includes any such land under state, municipal, or private ownership; (8) "**forest landowner**" means a person who owns forest land, but does not include the owner of mineral or subsurface rights only; (27) "**sustained yield**" means the achievement and maintenance in perpetuity of a high level annual or regular periodic output of the various renewable resources of forest land and water without significant impairment of the productivity of the land and water, but does not require that timber be harvested in a non-declining yield basis over a rotation period;	
	11 AAC 95.900	(63) **"reforest"** means the successful reestablishment of commercial tree species following harvest; (86) **"timber"** means merchantable trees, standing or down, of a commercial tree species; (11) **"commercial tree species"** means any species that is capable of producing a merchantable stand of timber on a particular site or is being grown as part of a Christmas tree or ornamental tree-growing operation;	No change needed (**C3am**)

Applicability	11 AAC 95.190	(a) The provisions of this chapter apply to an operation on state land, other public land, or private forest land if all of the following criteria are met: (1) the operation is on forest land as defined in AS 41.17.950; (2) the operation involves any of the following activities: (A) harvesting, including felling, bucking, yarding, decking, hauling, log dumping, log transfer, log rafting, and related road construction, reconstruction, improvement, or maintenance; (B) road construction or reconstruction, material source development, and maintenance of an existing road or bridge not within the operation area, but connected with, the harvesting operation; (C) site preparation; (D) precommercial thinning; (E) slash treatment; or (F) any other activity leading to, or connected with commercial timber harvest; and (3) a commercial operation that intersects, encompasses, or borders on surface waters or a riparian area, or that, for a single landowner or operator, equals or exceeds in the aggregate the following acreage: (A) 10 acres in Region I; (B) 40 acres in Region II; or (C) 40 acres in Region III for land owners who own more than 160 acres in total; if a landowner has a total ownership of 160 acres or less, then an operation on any of that 160 acres or less is not a commercial forest operation.	No change needed at this time (**C3am**)
		(b) A land use conversion involving a commercial forest operation that meets the criteria in (a) of this section must meet the requirements of 11 AAC 95.200.	No change needed (**C3am**)

Applicability, cont.	11 AAC 95.900	9) **"commercial operation"** and 10) **"commercial timber harvest"** mean: A. in Region I or II, an operation or harvest with an annual production in excess of 10,000 board feet of wood products for sale; and B. in Region III, an operation or harvest with an annual production in excess of 30,000 board feet of wood products for sale;	**F1am.** The focus on sawtimber and board-foot measurements doesn't fully reflect the Region II-III forestry situation which includes a large proportion of harvesting for fuelwood and other biomass energy products. The 30mbf threshold ~ 7 – 9 MCF in the Tanana Valley; 10 MBF threshold ~ 3.5 MCF in Region II. **C22.** The S&TC recommends development of applicability thresholds for Region II and III that reflect non-BF measurements for harvests that are not focused on sawtimber. Regulation or implementation book
		(84) **"surface waters"** means fresh water springs, lakes, or ponds, or a freshwater stream the designated uses of which are protected under 18 AAC 70, regardless if those waters are classified under AS 41.17.950(31) – (41);	No change needed (**C3am**)
Land use conversions	AS 41.17.110	An intention to convert forest land to other uses after timber harvesting may be stated in the notification submitted under AS 41.17.090. In that event, reforestation requirements adopted under this chapter do not apply, except that conversion shall be completed during the time set by regulation for minimum reforestation of the land, and other requirements for revegetation may be imposed to the extent permitted by law. If the commissioner finds at any time that the responsible party has failed to conform to the intent to convert as stated in the notification, the commissioner shall revoke approval of the conversion and require full compliance with reforestation requirements.	No change needed (**C3am**)
	11 AAC 95.200	(a) The requirements of 11 AAC 95.260 - 11 AAC 95.390 do not apply if a landowner intends to convert forest land to another use within five years after timber harvest and the land is converted or in the process of conversion within five years.	No change needed (**C3am**)

Land use conversions Cont.	11 AAC 95.200 Cont.	(b) If, five years after timber harvest, the land is not converted or actively in the process of conversion, a landowner shall meet the reforestation requirements of 11 AAC 95.375 - 11 AAC 95.390 within three years.	
	11 AAC 95.375**.**	(b) A landowner shall reforest harvested forest land to the fullest extent practicable unless: (1) the land will be converted to another use in accordance with 11 AAC 95.200;	No change needed **(C3am)**
	11 AAC 95.900	(13) **"conversion"** means a bona fide land use conversion to a use that is incompatible with timber growing;	No change needed **(C3am)**
Detailed plan of operations	11 AAC 95.220.	(a) Before beginning an operation on forest land, the operator shall file a detailed plan of operations with the state forester at the area office of the division with jurisdiction over the geographic area in which the operations will occur. A detailed plan of operations must be submitted on a form provided by the division and must include the following information: […] (10) reforestation and site preparation methods;	See findings under Natural Regeneration below **C1am.** DPOs need more in-depth information where natural regeneration is the planned reforestation method. Information provided should address the seven indicators of likely natural regeneration success or failure in **F14am** and information on planned or completed site preparation or supplemental planting. Regulation **(K-YES)** **C2.** Deleted and replaced with **F14am** and **C1**
	11 AAC 95.375	a) The reforestation plan included in the detailed plan of operations must identify the preferred target species, regeneration technique, and site preparation method that the land owner will use to accomplish the reforestation requirements identified in this section.	
		(g-partial) To apply for an exemption from reforestation requirements under (b)(2) of this section, a landowner must request an exemption in the reforestation section of a detailed plan of operations under 11 AAC 95.220(10) or a change in operations under 11 AAC 95.230	No change needed **(C3am)**
Harvest unit planning and design	11 AAC 95.340.	(b) A harvest unit must be designed so that felling, bucking, yarding, skidding, and reforestation can be accomplished in compliance with AS 41.17 and this chapter.	No change needed **(C3am)**

<table>
<tr>
<td>Material extraction and disposal sites.</td>
<td>11 AAC 95.325.</td>
<td>(d) An operator shall rehabilitate a material extraction site or a soil disposal site after the material source is exhausted or abandoned, or operations at the disposal site are completed. Within the first growing season after abandonment of an extraction site or completion of disposal operations, an operator shall
(1) remove and place in a stable location all material that has potential for entering surface or standing waters, or that would prevent reforestation of an otherwise plantable area;</td>
<td>No change needed (C3am)</td>
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<tr>
<td rowspan="2">Stocking standards</td>
<td rowspan="2">11 AAC 95.375</td>
<td>(b) A landowner shall reforest harvested forest land to the fullest extent practicable unless:
(4) in Region II or Region III, vigorous, well-distributed residual commercial trees free from significant damage meet or exceed the following standards, or a combination of trees and seedlings approved by the division, meet the following standards:
<table>
<tr><th>Average DBH of Remaining Stand – Inches</th><th>Minimum Stocking Standard (in trees per acre)</th></tr>
<tr><td>Greater than 9</td><td>120</td></tr>
<tr><td>6 to 8</td><td>170</td></tr>
<tr><td>1 to 5</td><td>200</td></tr>
</table>
</td>
<td rowspan="2">F3am. Based on compilation of inventory data from 1985-2015 on state and Native lands in Regions II and IIII, stocking in natural stands is variable, but generally exceeds the stocking standards (11 AAC 95.375(b)(4)) when all size classes are considered. In natural stands, variability in stocking reflects differences in site productivity, regeneration dynamics (e.g., seed availability and site conditions), and mortality.

Tables 1 and 2 (attached) include stocking data by vegetation type for existing stands on state and Native land. Average total stems/acre in white spruce, mixed white-spruce hardwood, and hardwood timber types by size class ranged from:
Sawtimber timber types: 135-1,090 stems/acre
Poletimber timber types: 374- 1,195 stems/acre
Reproduction timber types: 574-2,638 stems/acre.

The average stocking on all but one of the stand types in the inventory exceeded the standard in 11 AAC 95.375(b)(4) for residual stocking by at least 40% when <u>all size categories</u> were considered. The average for one stand type (hardwood sawtimber on Native land) had 97% of the standard for residual stocking.

Based on stocking of <u>sawtimber-size</u> trees alone, only white spruce sawtimber stands on state land in the Fairbanks-Delta area met the stocking standard for</td>
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<tr>
<td>(d)(2) in Region II or Region III, the number of vigorous, undamaged, and well distributed seedlings of commercial tree species must average a minimum of 450 trees per acre and must have survived on site for a minimum of two years;</td>
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</table>

Stocking standards, cont.	11 AAC 95.375 Cont.		residual trees. **F13am.** Based on measurements from Glenn Juday, older white spruce stands (170-250 years) on excellent sites in the Fairbanks area contain about 405 total stems/ac 30-50 years after harvest. This reflects stands on the most productive 5% of sites. Add to **C3am.** The existing (b)(4) standard is acceptable – no change needed. See also **R4, R10,** and **R14am** in Research Gaps section below
		(d)(3) in all regions adequate reforestation means a combination of seedlings and residual trees that will meet the standards set out in this subsection and in (b) of this section	No change needed **(C3am)**
		(d)(4) no more than 10 percent of the harvest area or contiguous areas may be below the stocking levels as set out in (1) or (2) of this subsection.	**F11am.** Spatial distribution of trees in natural stands is variable. Patchiness can arise from site factors including presence of non-stockable ground, and subsequent conditions such as insects, disease, fire, ice breakage, seedfall, random events during the regeneration period, etc. Patchiness produces varying forest structure, e.g., crown size and extent varies depending on the openness of the surrounding stand. Patchiness occurs at varying scales within and between stands and across the landscape. Landscape scale patchiness is addressed at the land planning level. Edge habitat is valuable to some species of wildlife – wildlife responds to varying stand densities. **(K-YES)** **C6am.** The S&TC recommends that the stocking standard in .375(d)(4*)* allow flexibility to reflect natural variation in stocking distribution prior to harvest. If the landowner plans to request a variation, pre-existing patchy conditions within harvest units should be documented in the DPO. DOF should consider site conditions and non-stockable ground when reviewing a request for variation in tree distribution. The target is to achieve a regenerated stand that is similar to or more fully stocked than the stand that existed prior to the

Stocking standards, cont.	11 AAC 95.375 Cont.		harvest. Regulation **(K-YES)** **C8am.** Given information on continued recruitment beyond the current deadlines for reforestation (**F10**), requiring reforestation on 90% of the harvest area within 5-7 years is too stringent. There is not specific information on an appropriate alternative standard currently. Reforestation on 80% of the harvest area is recommended as a more appropriate minimum target based on field experience and the time frame for regeneration surveys defined in the regulations. See also **F11am** and **F12am** regarding the benefits of patchiness for wildlife. Time extensions for achieving this standard may be considered under the procedures for extension in .375(e). regulation **(K-YES)**
	11 AAC 95.900	(11) **"commercial tree species"** means any species that is capable of producing a merchantable stand of timber on a particular site or is being grown as part of a Christmas tree or ornamental tree-growing operation; (67) **"residual trees"** means commercial tree species left standing in a harvest unit or other specified area after completion of harvest or, for purposes of 11 AAC 95.375, immediately before beginning reforestation activities in that unit or area; (71) **"sapling"** means a live tree 1.0 inch to 5.0 inches in DBH; (73) **"seedling"** means a live tree less than 1.0 inches in DBH, or under 10 feet tall	No change needed (**C3am**)
Variation for low stocking	11 AAC 95.375.	(c) In areas within Region II or III where the natural stocking of commercial trees is below the minimum standards in (b)(4) before harvest, the division will consider a variation from the stocking levels required in (d) of this section.	**C12.** The Division of Forestry should consider site conditions and non-stockable areas when reviewing requests for variation from the stocking standard under 11 AAC 95.375(c). Low stocking may reflect both long-term site conditions and conditions that could be remedied by forest management actions. Regulation **(K-YES)**

Natural regeneration	11 AAC 95.380	(a) If a forest landowner in Region II or III intends to rely on natural regeneration for reforestation, the forest landowner shall ensure a seed source of well-formed, vigorous trees of commercial tree species. The seed source must be capable of distributing an adequate amount of seed throughout the harvest area to meet the reforestation requirements set out in 11 AAC 95.375(d). A forest landowner may not harvest the seed source identified for natural regeneration until the division has received a regeneration report showing that the harvest area has met the reforestation requirements set out in 11 AAC 95.375. b) If a forest landowner intends to rely on vegetative reproduction for reforestation, the harvest area must contain aspen, balsam poplar, western black cottonwood, red alder, or paper birch in sufficient distribution and condition to meet the reforestation requirements set out in 11 AAC 95.375.	**C23.** Clarify that .380 (a) applies to natural regeneration from seed rather than vegetative reproduction: "If a forest landowner in Region II or III intends to rely on natural regeneration from seed for reforestation, the forest landowner shall ensure a seed source…" (.380(b) applies to vegetation reproduction.)} Regulation **(K-YES)** **F2am.** In even-aged management systems, the window for white spruce recruitment following disturbance extends for up to 15 years on uplands in Region III, and longer in Region II and on floodplains in Region III. Recruitment success is greatest following abundant seed crops and where soil disturbance exposes mineral soil. In uneven-aged systems and natural disturbances in which some canopy cover is retained, natural reforestation will depend largely on advanced regeneration or low levels of continued recruitment. **F18am.** White spruce seed crops are variable from year to year. Sufficient seed crops to produce adequate regeneration occur on average every 3 to 5 years, and excellent crops occur every 11 years on average. **F5am.** Birch produces adequate seed crops on average every other year. Birch can also reproduce from stump sprouts, but trees sprout less vigorously as they age. Seedfall drops off rapidly with distance from the stand edge into clearcut openings. When seedfall within an undisturbed stand was compared with seedfall in a clearcut, seed catch was reduced by 40% at the stand edge and 90% at the center of a 100m (330') square opening. Seed crops in interior Alaska are adequate for regeneration of clearcuts as wide as 30m at least 1 in every 4 years. (Silvics of North America, vol. 2, L.O. Safford, J.C, Bjorkbom, and J.C. Zasada) **F6.** In Region III, the organisms that cause heart rot in birch are present in most stands. In Region II, they are less common. Relying on reproduction

Natural regeneration Cont.	11 AAC 95.380 Cont.	**Kodiak notes for F19am and F16am:** This section is less applicable to Kodiak-Afognak. Natural regeneration is generally unsuitable because of 1) widespread grass competition 2) single-species silviculture with Sitka spruce, e.g., there are no hardwood pioneer species to regenerate from abundant seed 3) harvesting is on an industrial scale better suited to artificial regeneration 4) it would take some kind of shelterwood system to get natural regen within 25 years 5) Replanting following likely failure of natural regen is costly	from sprouting predisposes stands in Region III to development of heart rot. **F7am.** Aspen regenerates adequately from root suckers following cutting if the roots are not disturbed by subsequent activity. Light seed crops are produced every 1-3 years, and good seed crops every 4 to 5 years, and seeds are carried for many kilometers by air currents. Water also serves as a dispersal agent. (Silvics of North America, vol. 2, D.A. Perala) **F8am.** Balsam poplar and cottonwood require specific conditions for germination: mineral soils with adequate moisture. These conditions are most frequently met in floodplains. These species also reproduce vegetatively by stump sprouts, from buried roots, and root suckering. Adequate balsam poplar and cottonwood seed crops are produced almost every year, but significant annual variation in production can occur by individual stands and trees. Seeds are ideally suited for long distance dispersal by wind. (Silvics of North America, vol. 2, J.C. Zasada and H.M. Phipps; Walker et. Al. 1986) **F19am.** Depending on site conditions and landowner goals, either natural regeneration or artificial regeneration can result in adequate and successful regeneration. • Natural regeneration: Some goals can be best achieved through natural regeneration. For example, natural regeneration contributes to genetic diversity across the landscape that can help forests respond to variability in local site conditions and annual variation in temperature and precipitation. Natural regeneration can provide variability within and between stands that is beneficial for wildlife habitat (see also **F11am, F12am**, and **F17am**). • Artificial regeneration (planting, seeding, and/or site preparation beyond disturbance from harvesting) can provide opportunities to improve tree quality and introduce or maintain specific genetic diversity, e.g., seed sources from various provenances, maintenance

Natural regeneration Cont.	11 AAC 95.380 Cont.		of species that might otherwise decline, or non-native species to respond to changing climates. Artificial regeneration can also be used to control distribution and stocking to optimize site use, provide future supplies for specific products (e.g., spruce sawtimber), and ensure more consistent and better wood quality. Planting is advantageous: • Where needed to remediate regeneration failures • Where *Calamagrostis* is present in the pre-harvest stand. • In the absence of either sufficient residuals or seed sources (due to harvest, infestation, etc.). • Where seedbed conditions aren't conducive to natural regeneration based on lack of exposed mineral soil and presence of deep organic layers. • To increase resilience to climate change by planting seeds or seedlings from a mix of sources. **F15am.** It is important to maintain the capacity and expertise to do planting and site preparation so that these techniques are available when needed, including to remediate regeneration failures and to conduct reforestation research. **(K-YES)** **F16am.** Because of their long rotation age, trees may be subject to significant climate effects prior to harvest that could lead to mortality. Planting is more expensive than natural regeneration, and there is more investment at risk. **F9am.** In Region III and in the Mat-Su Valley, where harvesting occurs without site preparation or planting, harvesting in white spruce stands results in natural regeneration of mixed hardwoods and spruce; when birch or mixed stands that are heavy to birch are harvested it commonly results in grass cover. The abundance of grass cover depends on the amount of grass present prior to harvest, the amount of shade in the remaining stand, and soil moisture. Moist soils favor development of grass cover.

Natural regeneration Cont.	11 AAC 95.380 Cont.		In the Kenai area of Region II, harvesting in white spruce, mixed spruce-birch, and birch stands can result in grass cover. In the Copper River area of Region II, harvesting in white spruce typically regenerates to either white spruce or spruce-aspen cover. Following the spruce bark beetle outbreak, some dead spruce stands regrew to shrub alder. **F10.** Studies by Miho Morimoto on 36 stands with 700 plots in the TVSF in the Fairbanks and Kantishna areas showed 82% of the plots met the reforestation standard using only natural regeneration, and 88% met the standard with a combination of natural regeneration and planting. The study stands were 10 to 40 years post-harvest. Recruitment extends beyond the 7-year timeframe for Regions II and III. **F14am.** The S&TC identified indicators of the likelihood that regeneration without planting will successfully result in a forest that can produce a sustained yield of commercial species: • Seed bed conditions: ○ Moss layers are absent or shallow (e.g., moss is likely to dry out after the stand is opened); ○ For birch and spruce: exposed mineral soil will exist after harvesting and/or site preparation on at least 25% of the harvest unit, and is well-distributed across the unit. • For vegetative reproduction from aspen suckering: soil disturbance is minimized. • Availability of seed sources ○ For white, Lutz, or Sitka spruce: ▪ proximity to seed trees (within 3 tree heights) ▪ exposure to prevailing winds, ▪ Large seed crop in year prior to harvest or current year ○ For birch: proximity to seed trees (within 2 tree heights If wind is

Natural regeneration Cont.	11 AAC 95.380 Cont.		limited by surrounding canopy) ○ For aspen and cottonwood: exposure to prevailing winds. • Risk of vegetative competition is low ○ No more than 2% of the area is covered by *Calamagrostis* prior to harvest (Man et al. 2008). Sites on toe-slopes, fine-textured soils (silt or finer), and other moist sites are more likely to be subject to grass competition. ○ Presence of *Equisetum* prior to harvest indicates good sites for white spruce regeneration (Cater and Chapin, 2000). • Existing stands are not infested with spruce beetles (*Dendroctonus* and *Ips)* • *Tomentosus* root rot is not evident in stands where spruce regeneration is desired • The site is not currently subject to intense herbivory due to ○ peaks in the hare population cycle, ○ dense moose populations, ○ scarcity of browse on the landscape (i.e., isolated patches of reproduction are more vulnerable to herbivory), or ○ microtenes (e.g., tundra voles) on Kodiak-Afognak. **(K-YES)** **C1am.** DPOs need more in-depth information where natural regeneration is the planned reforestation method. Information provided should address the seven indicators of likely natural regeneration success or failure in **F14am** and information on planned or completed site preparation or supplemental planting. Regulation **(K-YES)** **C5am.** Where natural regeneration is the selected method of reforestation, ▪ Based on information in the DPO, the Division of Forestry may allow a period of up to 12 years for natural regeneration in stands where the indicators show a high likelihood of regeneration success *(see **F14am** above)* within that period. ▪ A 12-year period would typically encompass at least one excellent white

Natural regeneration Cont.	11 AAC 95.380 Cont.		or Lutz spruce seed crop in Regions II and III, and one or two smaller, but adequate seed crops, as well as multiple hardwood seed crops. ▪ This would also provide enough time for sufficient hardwood stems to escape browsing in the absence of intense browse pressure. ▪ Require a regeneration report after 5 years to ensure that the stand is on a trajectory that is likely to be successful. If the indicators no longer support an extended period for natural regeneration, corrective measures may be required. Regulation **(K-YES)**
Time frames and extensions	11 AAC 95.375.	(d) Reforestation must be achieved within five years after harvest in Region I and seven years after harvest in Region II and Region III (see also .375(d)(2)) (d)(2) in Region II or Region III, the number of vigorous, undamaged, and well distributed seedlings of commercial tree species must average a minimum of 450 trees per acre and must have survived on site for a minimum of two years; (e) The division will, in its discretion, grant a reasonable extension of time to comply with the requirements of this section if planting or seeding fails or cannot be completed because of circumstances beyond the control of the forest landowner. To be eligible for a time extension the forest landowner must notify the division within 30 days of becoming aware of the circumstances requiring an extension. The written request must identify the reason for the extension and give a reasonable estimation of the time needed to achieve adequate reforestation in accordance with this section.	See also **C5am** above re extended time frames for natural regeneration when consistent with reforestation indicators in **F14am.** See also **C8am** under stocking standards regarding use of .375(e) for extensions to time frames for meeting stocking distribution standards.
Seed source	11 AAC	(f) Seeds used for reforestation must be from a similar latitude, climatic area, and elevation as the harvested area, unless otherwise approved by the division.	**F21. R**ecent research has shown that seeds from more southern latitudes are growing better than local seed sources due to climate change. Seeds from 5-10 degrees south of the planting site have repeatedly been found to grow

Seed source Cont.	95.375 11 AAC 95.375 cont.		better than local seed sources and may be better adapted to changing climate conditions. It is important to maintain flexibility to draw from a variety of seed sources to address variable site conditions and respond to ongoing climate changes. Factors such as slope, aspect, and elevation will affect the suitability of a seed source *(Robertson, 2012).* **(K-YES)** **C13am.** As noted in **F19am**, natural regeneration and artificial reforestation can both be beneficial in achieving reforestation goals. When artificial reforestation is the chosen approach, given changing climate conditions, sound options include 1) Using seed/seedlings of native species from a similar latitude, climatic area, and elevation, 2) Using seed/seedlings of native species from similar conditions in a mix with seed/seedlings from up to 10 degrees latitude south of the planting site *(Robertson, 2012).* Seeds from farther south may be used if they have been demonstrated to be successful. (See **F21**) 3) Including species that have been demonstrated to naturalize in Alaska without becoming invasive, including lodgepole pine and Siberian larch. 4) Providing for systematic evaluation of operational-scale assisted migration trials both within and among species. Regulation **(K-YES)** **C14.** Known invasive species, including species rated higher than 50 on the Alaska Exotic Plants Information Clearinghouse (AKEPIC) list of invasive species should not be planted. For example, bird cherry *(Prunus padus,* rated 74*)* should not be planted as it has been documented to be harmful to native ecosystems. Regulation? **(K-YES)** See also **C15/R7, R9,** and **R12** in the Research Gaps section below
		If site preparation for reforestation is applied, a forest land owner	No change needed (**C3am**)

Site preparation	11 AAC 95.390	(1) shall incorporate reasonable measures to protect residual trees intended to be retained; (2) shall avoid degradation of surface water quality; (3) may not cause significant harm to fish habitat; and (4) shall minimize the use of heavy equipment where soil compaction or impacts to drainage will cause degradation of site productivity.	**F17am.** Site preparation methods that retain dead and downed wood can improve habitat for key wildlife species that have positive impacts on regeneration. For example: • Coarse woody debris and root wads provide natal dens for marten, fox, and lynx (Buskirk and Ruggiero 1994, Koehler and Aubry 1994), all of which prey on snowshoe hares, an important herbivore that can reduce growth or survival of both coniferous and deciduous seedlings and saplings (Radvanyi 1987, Olnes and Kielland 2015). Red foxes and short-tailed weasels (ermine) occur on Afognak and Kodiak islands, and mink have been recently documented on Kodiak. Martens were introduced to Afognak Island, and snowshoe hares were introduced to Afognak and Kodiak islands. • Coarse woody debris also correlates positively with rodents, some of which are the only known means of spore dispersal for particular types of root-associated fungi linked with seedling establishment, nutrient uptake, and tree resilience in Pacific Northwest and European boreal forests (e.g. voles and flying squirrels: Jacobs & Luoma 2008, Schickmann et al. 2012). Woody debris establishes critical security and overwinter cover (Ecke et al. 2001, Sullivan and Sullivan 2014). • Leaning debris in the understory creates subnivean access in winter for martens and weasels to hunt small mammals (Sherburne and Bissonette 1994) that can consume seeds and girdle seedlings. Tundra or root voles *(Microtus oeconomus)* are the only known voles on Afognak and Kodiak Islands. Vole girdling has been mentioned as causing mortality on Sitka spruce and larch seedlings on Afognak Island (Hans Rinke, DOF, pers. comm.) and Kodiak Island (Mitch Michaud, USFS Chugach NF, pers. comm.). However, our present understanding is that vole girdling in the remainder of Regions II and III appears to be less prevalent than hare damage. Hare herbivory in North American forests is notable (Krebs et al. 2001). However, where hares are not as prevalent (e.g. Europe and Fennoscandia), vole impact may be more prominent (Huitu et al. 2012).
Site preparation, cont.	11 AAC 95.390, cont.		

Site preparation, cont.	11 AAC 95.390, cont.		• Snags provide and hunting perches for raptors and songbirds that reduce both animal and insect herbivores, respectively (e.g. Mäntylä et al. 2011, Flower et al. 2014). • Cavity trees (living and dead) provide nesting sites for martens, boreal owls that feed on herbivorous small mammals, and many songbirds that feed on deleterious insects. Retention and configuration of debris on harvested sites may change substantively with whole-tree logging. Tops and limbs are no longer left at the felling site, but rather occur in concentrated piles at landing sites. The impact of whole-tree logging on potentially beneficial wildlife-mediated regeneration outcomes is unknown (e.g. small mammal dispersal of fungal spores linked to seedling establishment (see R7). Whole-tree logging in cold weather may enhance debris dispersal, if more limbs break during felling and skidding. Some prescriptions currently burn green conifer debris, which removes cover. Removal of larger green conifer debris (>4" diameter) may protect adjacent trees from deleterious insects, such as *Ips* beetles (**F24am**). **(K-YES)** **C16.** Mechanical site preparation should avoid driving heavy equipment over known den sites greater than 12" in diameter (e.g., dens for fox, wolves, and bears). FLUP/contract on state land; Education and voluntary cooperation with private landowners under AS 41.17.910 **(K-YES)** **F20am.** Site preparation is beneficial in creating suitable seedbeds when • Deep moss layers impede regeneration, • Harvesting does not provide adequate mineral soil exposure, or to improve seedling survival, e.g., where reduction in grass competition is needed. Site preparation can lead to soil warming and improve nutrient availability. (e.g., Allaby, 2015)

			However, site preparation can • reduce stem density in species that regenerate by suckering • reduce stand structure and diversity in a manner that reduces key habitat for wildlife that can promote regeneration (see F17am). • Excessive scarification can reduce the availability of nutrients and decrease moisture retention when equipment scalps too deeply. **(K-YES)** **F22.** The S&TC recognizes that prescribed fire is a valuable option for site preparation, and should be retained as an option when feasible. **(K-YES)** See also **R8** in the Research Gaps section below.
Exemption standards and procedures	11 AAC 95.375	(b) A landowner shall reforest harvested forest land to the fullest extent practicable unless: (2) the stand is significantly composed of insect and disease-killed, fire killed, wind thrown, or fatally damaged trees; (g) To apply for an exemption from reforestation requirements under (b)(2) of this section, a landowner must request an exemption in the reforestation section of a detailed plan of operations under 11 AAC 95.220(10) or a change in operations under 11 AAC 95.230 and must demonstrate that the affected stand is significantly composed of insect and disease-killed, fire killed, wind thrown, or fatally damaged trees. If required by the division, the request must include a description of the sampling procedure, the sampling data, and a data summary. The data summary must show the number of commercial trees per acre that are dead or fatally damaged, and the percentage of commercial trees in the stand that are dead or fatally damaged. Sample plots must be located without bias throughout the affected stand. For stands 1,000 acres or less, the minimum sample density is 10 plots per 100 acres. For stands greater	**F4.** Climate change has increased some insect populations, and may increase trees' susceptibility to successful attack by insects. When major insect outbreaks occur, the use of the reforestation exemption is likely to increase. From 1991-2004, reforestation exemptions encompassed 73% of the acreage in DPOs on the Kenai Peninsula and 28% in the Copper River basin due to the spruce bark beetle infestation. *(See Fettig et al, 2013; Juday et al. 1997, Juday et al. 1998, Juday et al 2012)* See also **R3am** in the Research Gaps section below **C9am.** New technologies such as satellite imagery, aerial imagery, or lidar in combination with hyperspectral scanning offer additional options for assessing areas of dead and dying trees. The S&TC recommends that methods of survey other than the method listed in .375(g) and (h) be considered that offer adequate review of requests for reforestation exemptions under those sections. regulation **(K-YES)**

Exemption standards and procedures, cont.	11 AAC 95.375, cont.	than 1,000 acres, the minimum sample density is six plots per 100 acres. Fewer plots are acceptable if the sample standard error is less than 10 percent of the mean. Either fixed diameter or variable plot sampling methods are acceptable. Sample plots must average approximately at least five sample trees of commercial value. Trees must be recorded by diameter class as either dead, damaged by insects, disease, fire, or wind, or not impacted. The division may accept other documentation or field evidence in lieu of sampling in cases where the extent of damage is obvious.	
		(h) Following receipt of the exemption request, the division may inspect the site to confirm the information submitted before determining whether the stand is significantly composed of insect and disease-killed, fire killed, wind thrown, or fatally damaged trees. The division will make this determination as part of the review of the detailed plan of operations or change in operations. In areas exempted from reforestation requirements, the landowner and operator shall protect existing reproduction from logging damage where feasible.	
Reporting	11 AAC 95.385	(a) A forest landowner in Region II or III shall conduct a regeneration survey and file a regeneration report with the division. […] A regeneration survey must be conducted in a manner acceptable to the division. In an area reforested by natural regeneration, planting, or artificial seeding, a regeneration report shall be submitted within […] (2) seven years after the timber harvest in Region II or III.	**C10am.** If the deadline for natural regeneration is extended beyond 7 years (see **C5am**), a reforestation report must be submitted within five years of harvest. Regulation **(K-YES)**
		(b) The division will review a regeneration report within 30 days and will inform the forest landowner if field verification is planned. Field verification must occur within 12 months after receipt of the regeneration report. If the report or field verification shows that the reforestation requirements of 11 AAC 95.375 have not been met, the division will direct the forest landowner to correct the deficiencies according to a reasonable	

		timeline set by the division.	
Reforestation interactions with insects or diseases	AS 41. 17.082	**Control of infestations and disease.** (a) All forest clearing operations and silvicultural systems must be designed to reduce the likelihood of increased insect infestation and disease infections that threaten forest resources. […]	See also **F4** and **F6** under Natural Regeneration re birch heart rot and *tomentosus* See **F14am** re beetle infestations and root rot **F23**. When beetle infestations occur, such as the spruce bark beetle epidemic in the 1980s-90s in Region II, large populations of insects can affect regeneration success. Bark beetles can kill residual trees left for seed sources for several years following harvest. **(K-YES)** **F24am**. Green, conifer debris (>4" diameter) is the primary concern for fostering insect outbreaks. Dead wood and hardwood debris do not create conditions for outbreaks and help maintain habitat for wildlife species that can promote successful regeneration (see also **F17am**, **F25**, **F26**, and **R7**) **(K-YES)** See also **R3am** in the Research needs section below
Reforestation interactions with insects or diseases, cont.	11 AAC 95.195 11 AAC 95.195, cont.	**Clearing of spruce trees.** (a) Notwithstanding the provisions of 11 AAC 95.190, in order to minimize the spread of destructive forest insects and reduce the risk of wildfire, a landowner in Region II or III shall perform one or more of the practices identified in (b) of this section within one year, unless notified by the division, of clearing spruce trees, other than black spruce. [Region I…] (b) The following practices may be performed to comply with (a) of this section: (1) spruce trees or limbs greater than five inches in diameter may be disposed of by manufacturing into cants, lumber, houselogs, chips, or firewood; (2) spruce trees or limbs greater than five inches in diameter may be disposed of by burning, subject to applicable regulations; (3) downed and removed spruce trees or limbs greater than five inches in diameter may be treated or stored in an appropriate manner, if they are not burned, manufactured, or otherwise used in a way that will prevent the spread of bark beetles; (4) spruce limbs greater than five inches in diameter may be dried by uniform scattering in areas open to sunshine if they are not burned or chemically treated. (c) The division will, in its discretion, approve other methods for disposal or treatment of downed spruce trees to minimize the spread of bark beetles or reduce the risk of wildfire. (d) If notified by the division, a landowner must provide a slash management plan that addresses the requirements of this section.	

	11 AAC 95.220	**Detailed plan of operations.** (a) *(13) where applicable, measures to be taken for control of insect infestation or disease* outbreak;	
Wildlife interactions with reforestation	AS 41. 17.060	**Regulatory and administrative standards.** (c) With respect to state and municipal forest land only, the following standards also apply: (7) allowance shall be made for important fish and wildlife habitat.	**F12am.** Forest management occurring within a landscape-scale context can affect regeneration. Specifically, it is important to plan the size, location, and timing of timber sales, as all can influence herbivory risk. For example, the distribution of regeneration across a landscape will influence susceptibility of crop trees to browsing. Isolated patches of reproduction may be subject to more intense browsing than areas with multiple patches of reproduction or large openings). Forest practices occurring at the stand-scale can also influence abundance and distribution of wildlife species, which can have positive or negative impacts on regeneration, depending on silvicultural objectives. It is possible, for example, to reduce negative effects of herbivory by hares by promoting habitat of their predators (e.g., lynx, goshawks, great-horned owls), or timing planting to avoid peaks of hare population cycles. It may also be possible to promote positive regeneration effects of important tree-root fungi by providing habitat for the key dispersers of fungal spores (e.g., rodents and flying squirrels) in harvested areas (**F17am**). **(K-YES)** See also **F17am** under Site Preparation **F25.** The overall goal is to sustain the presence and functions of wildlife that benefit forest regeneration. These include • Predators of animals or insects that damage regeneration, and • Dispersers of mycorrhizal fungi that are important to trees. Implement through land use planning and BIF/FLUP or DPO consultation on public land; training and voluntary cooperative work with private landowners under AS 41.17.910 **(K-YES)** **F26.** Retaining coarse woody debris, standing dead trees (snags), and cavity
	AS 41. 17.098	**Interagency coordination and reevaluation.** d) The commissioner shall recognize the expertise of the Department of Fish and Game with regard to fish and wildlife habitat. On private land, the commissioner shall give due deference to the Department of Fish and Game regarding effects on fish habitat from timber operations including variations to riparian standards, designation of alternative site-specific riparian protection plans, and road location decision within riparian areas. On public land, the commissioner shall give due deference to the Department of Fish and Game regarding effects on fish and wildlife habitat from timber operations including timber harvest in riparian areas, variations to riparian standards, and road location decisions within riparian areas. In making decisions under AS 41.17.087, the commissioner shall recognize fish habitat as the primary value in riparian areas. (SMZs in riparian areas on public lands)	
Wildlife interactions with reforestation, cont.	AS 41. 17.910	**Wildlife habitat on private land.** (a) ADF&G and the commissioner shall work cooperatively with private forest landowners and timber owners to protect, maintain, and enhance wildlife habitat to the maximum extent practicable, consistent with the interests of the owners in the use of their timber resources. (b) ADF&G shall provide educational and technical assistance and extension services to owners of private forest land or timber to assist in identifying important wildlife habitat and to assist in designing voluntary management techniques that minimize adverse effects on wildlife habitat.	

		(c) ADF&G and the landowner shall cooperate in identifying areas of important wildlife habitat on private forest land and in developing methods for their protection. Methods of protection for wildlife habitat may include, with the agreement of the landowner, the purchase of fee title, purchase of conservation easements, and land exchanges. […]	trees helps maintain habitat features that support diverse predator populations that can reduce herbivory on seedlings (see also **F17am, R7**). Woody debris also maintains habitat for small mammals that has been found to be important for dispersal of fungi that benefit regeneration. See also **R5am** re research needs on fungal dispersal in Regions II and III. Implement through land use planning and BIF/FLUP or DPO consultation on public land; training and voluntary cooperative work with private landowners under AS 41.17.910 **(K-YES)** See also **R5am, R6am,** and **R13** in the Research Needs section below
New topics			
Invasive species	See also **C13am** re planting options **F27.** Invasive plant species are becoming increasingly widespread in Alaska, and some invasive species have the potential to impact reforestation. For example, bird vetch *(Vicia cracca)* has been documented in forest areas covering seedlings and saplings. **(K-YES)** **F28.** Invasive forest insects and diseases have repeatedly caused severe environmental and economic damage in the contiguous United States. In recent years there have been repeated interceptions of pests that could have profound impacts on Alaskan forests. Examples include Asian Gypsy Moth egg masses which have been repeatedly intercepted offshore on commercial shipping vessels and Sitka Spruce Weevil, the most serious insect pest of Sitka Spruce, which currently is not established in Alaska, but has been detected and eradicated on nursery stock in Anchorage on several occasions, most recently during the summer of 2015. Amber-marked birch leaf miner has become established in Region II and III and has been documented to decrease growth in birch. Exploring ways to reduce Alaska's exposure to these and other pests without creating economic hardship should be a high priority. **(K-YES)** **F29**. Transporting firewood is a well-known means of introducing invasive species in Canada and the Lower 48. It has been documented to bring viable exotic insects and pathogens into Alaska. Pallets, solid wood packing material, and other wood products can also bring in exotic species that are potentially detrimental to reforestation. **(K-YES)** **C17.** Seeds or seedlings imported from outside Alaska should require a phytosanitary certificate. Certificates are already required for imports from Canada. Need to research phytosanitary certificate program **(K-YES)** **C18.** Equipment used for scarification or planting can introduce invasive species to harvested areas. The goal is to prevent introduction of species that could inhibit reforestation; once a species is established eradication is more difficult. Before equipment is used on a reforestation site, it should be cleaned and inspected to	

	minimize introduction of invasive species. *Consider this recommendation for harvest equipment also. The S&TC recognizes that this can be a challenge for landowners and operators and encourages the Implementation Group to consider ways to encourage voluntary adoption, and notes some history of success in other industries, e.g., gravel sales. Need to coordinate with DEC.* Possible regulation or other voluntary methods **(K-YES)** **C19.** Information on invasive plant species and best practices for avoiding spread of invasive species should be provided to operators in advance of operations. Note: DOT and Coop Extension have developed information that may be applicable. Implement through training and education **(K-YES)** See also **R9** in the Research Gaps section below
Kodiak applicability	*The Science & Technical Committee (S&TC) process focused on review of the scientific literature, management results, and reforestation standards for Regions II and III. At the request of the Board, the S&TC has reviewed the consensus points for relevance to reforestation in the Kodiak-Afognak area. The S&TC has identified those recommendations that are likely to be applicable to the Kodiak-Afognak area (noted as **K-YES** at the end of applicable consensus points), but acknowledges that these recommendations are not based on the same extensive review that was conducted for Regions II and III.*
Training needs and institutional knowledge	**C7.** Use of the indicators in **F14am** to prepare and review DPOs and requests for variations will require training for Division of Forestry staff, landowners, and operators. Implement through training **(K-YES)** **C11.** The S&TC emphasizes the importance of capturing and synthesizing institutional knowledge on the role of scientific information in developing the FRPA and regulations, identifying research priorities, and exercising professional discretion in applying the standards. It is important to convey the reasons for developing the standards to agency staff, landowners, and operators. This is particularly important in the context of losses of experienced staff. Implement through administrative actions –compile and document staff knowledge, train new employees, and develop, make available, and publicize training materials. **(K-YES)** Note: UAF and Coop Extension have expertise in developing training materials, including video presentations.

Research needs

R3am. What reforestation and forest development has occurred on harvested areas exempted from reforestation requirements following spruce bark beetle mortality, with and without subsequent burning? *See also Exemption Standards and Procedures section above.*

R4. Based on existing data, including the Levels-of-Growing-Stock (LOGS) study (e.g., Hollingsworth 2002, Packee 2001, 1999(b)), the existing standard in (d)(2) is acceptable. However, additional research is recommended on how stands at densities of 450 trees per acre and higher develop over the rotation in terms of form, growth rate, and mortality. Studies should review both spruce and hardwood stands. *[See also Stocking Standards section above]*

R14am. To better predict future growth and yield, we need better information on the timing and processes that occur between harvesting and canopy closure in both spruce and hardwood stands, particularly on sites where natural regeneration is the means of achieving reforestation.

R5am. In the short term, recent research highlights a need to identify the degree to which key timber species in the Interior rely on root-associated fungi dispersed by red-backed voles, the most common small mammal in Alaska boreal forests. Obligate dispersal of spores by red-backed voles is positively related to extent of forest retention in the Pacific Northwest (Jacobs and Luoma 2008), and recent data for Alaska point to an unexpectedly high amount of fungi in the diet of this species (Baltensperger 2015). Diets of *Microtus* voles in Alaska also include fungi, but to a lesser degree than red-backed voles (Baltensperger et al. 2015). The relative importance of *Microtus* In dispersing key mycorrhizal fungal spores in Alaska is unknown. **K-YES**

R6am. In the long term, a monitoring program of stand- and landscape-level harvest treatments provides the opportunity for adaptive management of both forest regeneration and beneficial ecosystem services of wildlife. Timber harvest in Regions II and III has historically been small (10-40 acre) diameter-limit cuts that reflected the patchiness of the forest, and most research has focused on that type and scale of harvest.

For boreal forests, we recommend research on whether timber harvest could mimic landscape patterns of natural burns by having larger sale units that retain multiple "habitat islands" to mimic unburned patches with late-seral forest characteristics (Hunter 1993). Larger sale units would create more early seral forage that should reduce proportional browsing effects compared to relatively small timber sales in a matrix of mature forest. Retention islands provide interior forest conditions and a wind-firm environment for retention of snags or cavity trees compared to retaining single trees or more open harvest units.

This monitoring strategy for timber sales provides a means of hypothesis testing to determine: (1) the optimal size of "habitat islands" for selected wildlife species or guilds, and (2) the key habitat features that best provide for commercial tree output while sustaining the wildlife populations and key ecosystem services described in the bibliographic summary (e.g. maintain habitat for wildlife species that inoculate soil with mycorrhizal fungi and for species that prey on tree herbivores).

Gaining reliable knowledge through adaptive management (Walters and Holling 1990, Fisher 2002) would be best achieved with (1) explicit objectives for tree and wildlife species and (2) at least 2 plausible cause-effect mechanisms for each treatment variable before logging and reforestation activities begin. Monitoring designs should include non-treatment

(control) sites to discern possible confounding of treatment effects and include the context of spatial scale when interpreting outcomes at specified future dates. **(K-YES)**

R7/C15. Good records on seed source are valuable to assess reforestation success and contribute to research on adaptation to climate change. The S&TC recommends that
1) landowners maintain records of seed and seedling sources,
2) a group be convened to compile and analyze existing records, and address questions of successes and risks in selecting seed sources,
3) information on Alaska tree seed sources be included in the national gene data bank. **(K-YES)** *[See also Seed Source, Site Preparation, Reforestation Interactions with Insects or Diseases, and Wildlife Interaction with Reforestation sections above]*

R8. Research is needed to determine the optimum conditions and timing for use of prescribed fire to achieve tree regeneration in birch-dominated stands where grass competition after disturbance is a concern. *[See also Site Preparation section above]*

R9. Systematic testing of non-native species for potential benefits in adapting to climate change is encouraged, with a focus on species that are known to be capable of naturalizing in Regions II and III (see also **C13am** regarding options for planting). **(K-YES)** *[See also Non-native Species section above]*

R10. Recommend a systematic review to document forest regeneration that has occurred on harvest areas in relation to local site conditions and forest management practices. This would be similar to the study done by Miho Morimoto in the Fairbanks area. Priorities for studies are the Copper Basin, Mat-Su, Kenai, and Tok-Delta areas, as well as more remote areas with a history of harvesting. **(K-YES)**

R12. The S&TC recognizes that climate change is likely to lead to large-scale disturbances (e.g., more frequent and extensive wildfire and insect infestations) that will result in needs for reforestation. The S&TC recommends that the State and other landowners conduct cooperative advanced planning to meet anticipated needs for reforestation. Possible actions include seed collection and maintenance of seed banks. **(K-YES)** *[See also Other Climate Change Issues section above]*

R13. Whole-tree logging alters debris at harvested sites, thus potentially impacting small mammal species that can promote regeneration via dispersal of tree-root fungal spores (**F17am**). The primary research goal is to determine whether differences in debris loading (volume and size class) or dispersion following whole-tree logging are associated with an alteration in peak rodent abundance measured in late summer. Experimental design could evaluate debris patterns and wildlife outcomes before vs. after logging, and compare this to control sites. It may be possible to evaluate outcomes under different winter conditions (extreme vs. moderate temperature vs. snow-free). Logging during extreme cold and/or snow-free conditions is expected to produce the greatest debris shed during skidding. Sampling design should also include the factor of green coniferous debris >4" diameter as a risk factor of *Ips* and spruce beetle damage on surrounding live conifers (**F17am**). Substantive differences in small mammal abundance associated with differences in debris may inform harvest guidelines for maintaining debris on harvested sites as habitat for species that are the primary dispersing agent of key tree-root (mycorrhizal) fungi. **(K-YES)**