SAGE
ENVIRONMENTAL

July 18, 2020

Town of Hopkinton Planning Board
Hopkinton Town Hall
One Town House Road
Hopkinton, Rhode Island 02833

RE: Reforestation Plan
310 Main Street Solar
Assessor's Plat 4 Lot 25
Hopkinton, Rhode Island
SAGE Project No. M779

Dear Town of Hopkinton Planning Board:

It has been requested that the reforestation plans that have been submitted as part of the approval process for the solar development project located at Assessor's Plat 4, Lot 25 (hereinafter referred to as "Site") be melded together to be inclusive of all components provided in each of the reforestation plans. To date there have been three different entities that have prepared reforestation plans, they are as follows:

- Prepared by applicant: Land Management Service, revision date: October 3, 2019
- Prepared by Town's Engineering Firm: Crossman Engineering, revision date: December 13, 2019
- Prepared by 3rd Party Firm: Sweet Birch Consulting, LLC.

The reforestation plans can be summarized into nine (9) specific tasks. **Table 1** provides a summary of the reforestation tasks and associated costs as prepared by the above mentioned firms. As noted in **Table 1**, the reforestation plans prepared by Land Management Service and Sweet Birch Consulting did not include some items identified by Crossman Engineering. To determine an overall conservative cost estimate that incorporates all of the reforestation plan tasks, the costs identified by Crossman Engineering for the tasks that were not included in the other reforestation plans have been applied to the Land Management Service and Sweet Birch Consulting reforestation cost estimate.

Table 2 provides a summary of the estimated reforestation costs that includes the Crossman Engineering cost for the tasks that were not included in the Land Management Service and Sweet Birch Consulting reforestation plans. Applying these additional costs to the Land Management Service and Sweet Birch Consulting reforestation cost estimate results in the following total cost estimate:

- Land Management Service Total Cost (*with the additional tasks added*) = $181,463.70
- Crossman Engineering Total Cost = $224,113.00
- Sweet Birch Consulting, LLC. Total Cost (*with the additional tasks added*) = $155,845.38

Table 1
Summary of Reforestation Tasks and Costs

Reforestation Step/Item Description	Reforestation Plan Costs Prepared by		
	Land Management Service	Crossman Engineering	Sweet Birch Consulting
Control of non native invasive plants	*	*	*
Soil erosion control measures, as needed	*	*	*
Initial planting stock costs, labor, equipment, & overhead	$24,188.00	$41,925.00	$14,244.50
		$20,962.50	
	$37,088.00	$5,315.50	$38,700.00
Installation of tree tubes, stakes and ties	$30,000.00	$54,000.00	$30,896.15
Removal of installation of tree tubes, stakes and ties after establishment	Not Included in Plan Cost	$16,000.00	Not Included in Plan Cost
Hiring of professional forester	$5,000.00	$10,500.00	$13,680.00
Post planting monitoring (annual inspections, minimum 5 years)	Not Included in Plan Cost	$7,500.00	
Replanting stock costs	Not Included in Plan Cost	$31,443.75	$4,350.50
Replacing all dead plantings, new tree tubes and bringing	Not Included in Plan Cost		$12,000.00
Contingency (20%)	$19,255.00	$36,466.25	$22,774.23
TOTAL =	$115,531.00	$224,113.00	$136,645.38

* = cost is included in 20% contingency value

Table 2

Reforestation Tasks and Costs

Reforestation Step/Item Description	Reforestation Plan Costs Prepared by		
	Land Management Service	Crossman Engineering	Sweet Birch Consulting
Control of non native invasive plants	*	*	*
Soil erosion control measures, as needed	*	*	*
Initial planting stock costs, labor, equipment, & overhead	$24,188.00	$41,925.00	$14,244.50
		$20,962.50	
	$37,088.00	$5,315.50	$38,700.00

Installation of tree tubes, stakes and ties	$30,000.00	$54,000.00	$30,896.15
Removal of installation of tree tubes, stakes and ties after establishment	*$16,000.00*[1]	$16,000.00	*$16,000.00*[1]
Hiring of professional forester	$5,000.00	$10,500.00	$13,680.00
Post planting monitoring (annual inspections, minimum 5 years)	*$7,500.00*[1]	$7,500.00	
Replanting stock costs	*$31,443.75*[1]	$31,443.75	$4,350.50
Replacing all dead plantings, new tree tubes and bringing			$12,000.00
Contingency (20%)	$30,243.95	$36,466.25	$25,974.23
TOTAL =	$181,463.70	**$224,113.00**	$155,845.38

Notes:
* = cost is included in 20% contingency value
1 = cost is from Crossman Engineering reforestation cost estimate

To provide a conservative cost estimate for the reforestation efforts, the applicant suggests using the greatest total cost for the reforestation cost for this project. As such, the applicant proposes to the Town Planning Board that the cost for reforestation of this Site would be $224,113.00. Note that these costs are in today's dollars. Attached is an updated reforestation plan with this cost and all the tasks identified. Note that the costs of this revised reforestation plan (i.e. $224,113.00) were developed by consensus between Crossman Engineering and Land Management Services in December 2019.

Should you have any questions or concerns, please do not hesitate to contact me.

Sincerely,
SAGE Environmental, Inc.

Nicole Mulanaphy, P.E.
Senior Project Manager

Attachment

LAND MANAGEMENT SERVICES
303 Courthouse Lane, Pascoag, RI 02859
401-568-3410
mstremb@cox.net

July 2, 2020

Reforestation Plan
Maxson Hill, LLC, Solar Project
AP. 4, Lot 25
310 Main Street (RI Route 3), Hopkinton, RI

Purpose:

The proposed development of a solar array on the subject property will involve establishment of access roads, sediment basins, electrical equipment, and the rows of ground-mounted solar panels on a 137.86 acre parcel in Hopkinton, RI. The developed area involves 67.54 acres of that parcel of land, which includes 57.91 acres of existing forestland to be cleared, and 9.63 acres of existing open meadow.

This Reforestation Plan addresses the future process and costs associated with the reforestation of the affected acres upon decommissioning of the solar project. The projected timeframe for this plan is 30 years from its installation, and the plan would be implemented upon completion of the removal of the solar arrays from the property. Therefore the reforestation practices are projected for the year 2050, with present costs calculated. Present costs can be amortized for the year 2050. There are options to renew contracts for energy production, depending on the technology and demand for this type of renewable energy at that time. Projected costs would need to be adjusted for any advanced timeframes at that time.

Scope of Project:

As designed by DiPrete Engineering, the solar array sites on the subject property encompass a total of 67.54 acres of land. Included within that acreage are access roads that should be retained for future use as woods roads. These access roads occupy approximately 3 acres of land, resulting in 64.5 acres of land that will be re-vegetated upon decommissioning of the solar project in 2050. There is a potential of re-establishing agricultural use of the existing open meadows, however this reforestation plan incorporates the planting of tree species on all of the disturbed areas, save the access roads mentioned above.

There are options for the establishment of forest vegetation on the site. They include:

- Bare-root planting of seedlings 3-5’ tall;
- Bare-root shrubs;
- Direct seeding method of acorns and hickory nuts;
- Indirect seeding method of light seeds from pine species;
- Encouraging natural regeneration.

Environmental Factors Impacting Reforestation Efforts:

There are a number of factors that will influence the nature and success of reforestation efforts on this property. The existing soil types, the extent of grading to establish the solar project, soil compaction during the construction and future maintenance of the arrays, disturbance and compaction during the removal of the arrays, vegetation that becomes established during the 30 year period, including non-native invasive plants, the slope and aspect of the planting sites, and any effects that climate change will have on species selection, along with the deer population, will all have roles to play in determining what species to plant and the success of the reforestation efforts in 2050 or beyond.

Further discussion of these factors is provided following the details of the reforestation plan.

Soil Types & Slope Conditions:

- Soil conditions: According to the USDA Soil Survey, the existing soil conditions underlying the proposed solar array sites on the property vary from marginally hydric Freetown and Ridgebury series in the southwest portion of the property, to moderately well-drained Woodbridge and Sutton series in the central areas of the property, to well-drained upland Paxton and Canton/Charlton series in the eastern areas of the property, with a patch of well-drained Canton/Charlton in the northwest corner.

  Wetland delineations have more specifically delineated those areas that, from the Soil Survey, appear to be underlain with hydric soils in the southwest portion of the property.

  For the purposes of this reforestation plan, species selection will depend upon the proximity of wetlands to the areas to be planted, and the potential for seasonally high water tables that will impact tree growth and the particular species that will tolerate any high water tables.

  The USDA Soil Survey includes information on depth to bedrock, soil texture, seasonal water table influences, and suitability for certain tree species. These constraints are factored into the selection of tree species for this reforestation plan.

- Slope and Aspect: Species selected for reforestation must factor in the slope position and aspect of the specific locations for planting, as well as the soil types. South and west-facing upper slopes will require planting with drought-tolerant species, while lower slope sites and east-facing slopes can be planted with a wider variety of species that can take advantage of these more favorable sites.

  Most of the solar array sites are located on the upland ridge and west-facing slope of Diamond Hill, with only the western sites being located on relatively level terrain. Upper level slopes will require planting with more drought-tolerant species such as Pitch pine and White oak, with White pine and Northern red oak planted on the lower slope sites.

  Please refer to the Topographic Map for slope and aspect of the various portions of the project.

REFORESTATION PLAN

The following reforestation process is subject to review and revision prior to its implementation due to any of the factors that may influence the appropriateness of these recommendations in the year 2050 or beyond. Species selection is dependent on climatic conditions and the physical impacts to the soil conditions from installation and decommissioning activities.

Implementation:

Upon decommissioning, the Owner, Town, and/or their agents at the time shall hire a professional forester with experience in implementing large-scale tree planting projects to conduct a review of the site conditions and prepare suitable contracts for the planting project, according to industry standards that are in place at that time. The forester shall adjust the species recommendations according to climatic and soil conditions that are present, and shall oversee the implementation of the planting contract, conduct inspections, and order adjustments and re-planting if survival rates are not adequate to properly re-forest the site.

Additionally, state labor laws and rules in effect at the time of the implementation of the planting project must be taken into consideration with regard to the hiring of non-union contractors and the need to include union participation and fair wage considerations.

Site Preparation:

The following site preparation guidelines are provided with the assumption that the pre-existing topsoil will remain on site during the initial installation of the solar arrays.

- Removal of solar arrays will provide rows of disturbed soils that will now facilitate planting of bare-root seedlings and also provide a mineral soil seedbed for natural seeding of the site.
- Removal of the rows of solar panel mounting poles will provide rows of post holes approximately 10’ apart, separated by a 20’ wide grassy strip. (please refer to the PV Array Distance Schematic attached).
- Upon removal of solar arrays, some site preparation may be necessary, to the extent needed to allow hand planting crews safe access to plant trees.
- Control of any non-native invasive plants that may have become established may be necessary to prevent the site from being dominated by shrubs such as multi-flora rose, Autumn-olive, and non-native trees such as Ailanthus (Tree-of-Heaven). Vines such as honeysuckle and bittersweet may also be present. These shrubs and trees will likely be present on the outer perimeter of the array sites, along the fence lines, and on the edges of the adjacent wooded areas.
- Protection of existing vegetation during the process of solar array removal is necessary to provide erosion control while the tree cover is being established. Some incidental erosion control measures may be needed.

Planting Methods & Practices:

- Tree planting shall be conducted by contracted hand planting crews and/or tractor-drawn field planting equipment, as deemed appropriate for the site conditions at the time by the

supervising forester. Please refer to the sample contract and other information on the use of planting contractors in the Appendix;

- Plant 200 bare-root pine and hardwood seedlings and 100 bare-root shrubs in a staggered fashion, utilizing the disturbed soil within the rows of post holes, to create a full stocking condition of mixed pine and hardwood species interspersed with native shrubs to provide habitat and water quality benefits;
- Protect planted tree seedlings with tree tubes (fact sheet attached) that will allow seedlings to become established without being browsed by deer. Some girdling of seedlings by rodents will occur. Removal of these tree tubes may be required upon successful establishment of the trees to allow their future development;
- The supervising forester and planting crew foreman shall provide supervision and inspection to assure quality control of the planting;
- The supervising forester shall provide annual inspections for a period of five (5) years following the initial planting to determine seedling survival, natural seed establishment, and adequacy of the reforestation effort;
- Excessive mortality must be remedied through additional plantings and additional protection measures, as per contract guidelines.

Tree & Shrub Species Selection:

Based upon the factors that influence the reforestation of the subject site, the following tree and shrub species are recommended for the various soil and slope conditions:

- Well-drained Upland sites with western aspect
    - White oak (*Quercus alba*); Pitch pine (*Pinus rigida*); Pignut hickory (*Carya glabra*); Lowbush blueberry
- Moderately well-drained Lower slope sites with western aspect
    - White pine (*Pinus strobus*); Black oak (*Quercus velutina*); Highbush blueberry; Witch hazel (*Hamamalis virginiana*); Maple-leaved viburnum (*Viburnum acerifolia*); Highbush cranberry (*Viburnum trilobum*)
- Poorly-drained, lower slope to level sites
    - Red maple (*Acer rubrum*); Black gum (*Nyssa sylvatica*); Shagbark hickory (*Carya ovata*); Spicebush; Highbush blueberry

The overall Landscape Plan's Sheet L-O has been marked up to indicate what areas of the proposed solar array sites are appropriate for the three planting scenarios provided above. See Attachment A.

Habitat Enhancement for Wildlife Species:

The RI Wildlife Action Plan identifies a number of amphibians, mammals, and bird species that are of Greatest Conservation Need. At the time of decommissioning and re-forestation, there will be an opportunity to enhance the habitat values of this landscape for a number of these species, with the New England cottontail, a variety of listed birds, pollinating insects, and other scrub/shrub habitat species benefitting from the re-establishment phase of the forest.

The shrub species listed above, as well as some of the tree species, are flowering plants that are known to provide good pollinator food sources, as well as nesting, brooding, and feeding sites for birds and small mammals. The scrub/shrub conditions of the establishment phase provides escape cover that is critical to their survival.

Reforestation Cost Estimates

The following table presents the costs of this reforestation plan as developed by consensus between Crossman Engineering and Land Management Services on 12/13/19, and covers the purchase of seedlings, shrubs, tree tubes, stakes, and ties, along with the labor, equipment costs, and overhead required for conducting the planting operation. It includes 5 years of monitoring and a one-year guarantee period, along with a 20% Contingency. These costs are subject to change depending on specific site conditions and final species selection and plant availability at the time of decommissioning.

1	CONTROL OF NON- NATIVE INVASIVE PLANTS			*
2	SOIL EROSION CONTROL MEASURES, AS NEEDED			*
3	BARE ROOT PINE AND HARDWOOD SEEDLINGS, 18" HEIGHT (200 PER ACRE)	12,900	$3.25	$ 41,925.00
4	BARE ROOT SHRUBS, 18" HEIGHT (100 PER ACRE)	6,450	$3.25	$ 20,962.50
5	INSTALLATION OF 4' HIGH TREE TUBES, STAKES AND TIES	10,000	$5.40	$ 54,000.00
6	REMOVAL OF INSTALLATION OF TREE TUBES, STAKES AND TIES AFTER ESTABLISHMENT	10,000	$1.60	$ 16,000.00
7	HIRING OF PROFESSIONAL FORESTER	14	$750.00	$ 10,500.00
8	POST PLANTING MONITORING (ANNUAL INSPECTIONS, MINIMUM 5 YEARS)	5	$1,500.00	$ 7,500.00
9	1 YEAR GUARANTEE PERIOD **	1	$31,443.75	$31,443.75
10	MOBILIZATION (4% OFTOTAL COST OF ITEMS 3 TO 6	1	$5,315.50	$ 5,315.50
11	CONTINGENCY (20% OF ITEMS 3 - 9)			$36,466.25
*	ITEMS 1 AND 2 ARE INCLUDED IN 20% CONTINGENCY VALUE.			
**	GUARANTEE PERIOD INCLUDES REPLACING ALL DEAD PLANTINGS, NEW TREE TUBES AND BRINGING SITE BACK TO ORIGINAL CONDITIONS (ASSUME 50% REPLACEMENT)			
	Total Reforestation Project Bond Amount = **$ 224,113.00**			

Additional Factors Affecting the Implementation of this Reforestation Plan:

- Grading: The extent of topsoil disturbance and grading during site preparation, and the resulting depth of soil for rooting by trees will have an impact on the success of the reforestation efforts. Shallow topsoil conditions will limit root development, and lack of organic soil conditions, versus nutrient poor sub-soil, will impact seedling survival and limit the development of mature trees.

- Soil compaction: Access by heavy equipment during site preparation and solar array installation and maintenance phases of the project will lead to compacted soils, particularly between the rows of panels. Removal of the panels will also require access by some type of equipment. Disturbance of the soils at each panel location from their removal may help in loosening up compacted soils and create favorable planting conditions.

- On-site vegetation: Vegetation maintenance of the array sites, according the Operation & Maintenance Plan, will include mowing and weed-whacking 2 or 3 times a year to maintain a grassy condition.

  Pioneer seeding of tree seedlings and shrubs will likely occur during the 30-year time period, despite the regular mowing schedule. Root systems will develop with repeated cutting of the plant's stem, and these naturally-seeded trees and shrubs, including non-native invasive species, will then be in a position to respond to the removal of the solar arrays and cessation of mowing activities. This will be particularly true at the edges of the solar array sites, contributing to the screening provided in the Landscape Plan.

  Natural seeding from adjacent vegetation is routine and typical of abandoned fields and habitat clearings promoted by wildlife biologists for creating early-successional habitat. Natural seeding will eventually return this disturbed area to a forested condition, even if no efforts are made to reforest the site. The natural succession process takes time, and there is no control over which species become dominant. The subject site includes forested wetlands stocked with a mix of deciduous trees, with a small patch of White pine just north of the property, and only scattered White pines in the landscape. This source of pine seed is minimal, but certainly a significant component of the pioneer species would consist of pine species, including White and Pitch pines.

- Climate Change: Projections for more frequent drought events, warmer temperatures, and more severe precipitation events require that any reforestation efforts in 2050 or beyond take into consideration the impacts on tree species selection and planting success. Will planting of southern pine species in 2050 be required?

  The Northern Institute of Applied Climate Science have provided projections for the Southern and Coastal New England sub-area, where species such as White pine and Quaking aspen (poplar) are predicted to decline, while other species such as White oak,

Black oak, and Pitch pine are likely to increase their presence in the landscape. (See enclosed Fact Sheet). Southern species, such as Virginia pine and Sweetgum, may be good choices for planting in 2050 and beyond.

New insect and disease problems will also occur between now and 2050 which will impact the final selection of tree species for this reforestation effort. Oaks are susceptible to Gypsy moth defoliations, which may occur with increased frequency as spring droughts become more common, and the Southern pine beetle has been found in Rhode Island. This beetle will feed on and kill Pitch pine.

- Animal damage: Browse impacts from deer, mice, and other species will have an impact on the survival and species composition of the re-forested site. Of particular concern will be the deer population at that time, and what efforts are provided to control its presence during the establishment of the new forest. Although the 6' fence around the site will limit the travel of deer through the site, taller fencing is needed to keep the stronger adult jumpers from getting in and feeding on established plant material. In the event de-commissioning includes removal of all fencing as well as the solar arrays, then other means of protecting planted trees will be required.

  Use of tree shelters will be needed to improve success rates, with subsequent maintenance needed to remove the shelters once trees have attained a suitable height to avoid browse damage.

Prepared By: Marc J. Tremblay, CF

MA Forester Lic #239, CT Certified Forester #F-517, RI Lic. Arborist #104

Certification: I hereby attest that the above Reforestation Plan prepared for the proposed Main Street Solar Project has been prepared according to the appropriate standards and information available, and the information provided is as accurate as current forestry practices allow.

Marc J. Tremblay, CF

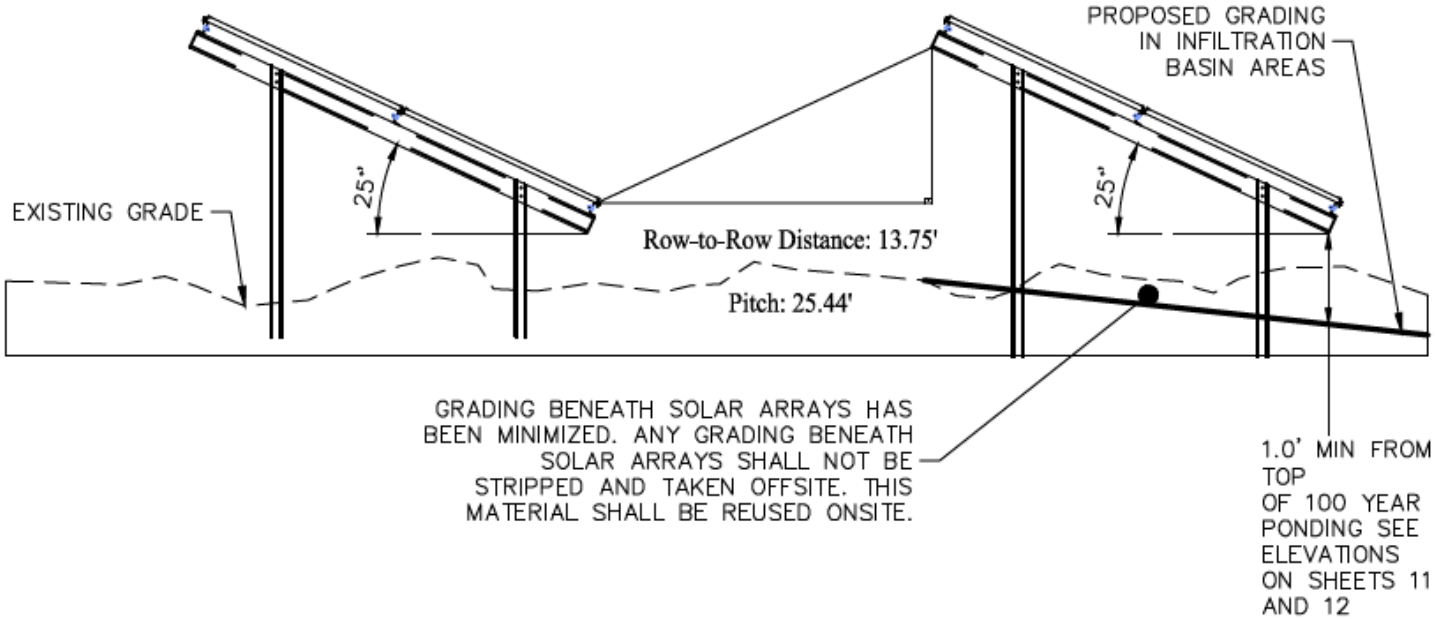
Attachments:

- Plan Detail Showing Distance Between Rows of Panels
- USDA Soil Survey Forestland Productivity Tables (4 pp)
- Climate Change Projections for Individual Tree Species, Southern and Coastal New England – Northern Institute of Applied Climate Science (2 pp)
- Topographic Map
- Schematic of Species to Plant by Soil and Slope
- Protex Pro/Gro Solid Tube Tree Protectors info sheet from Forestry Suppliers, Inc.
- Tree Planting Guidelines, from the USDA Natural Resources Conservation Service, Texas Forestry Technical Note, TX-FS-12-4 (9 pp)
- Planting Contractor Info and Sample Contract

DETAIL OF DETAIL SHEET 1, PG 18 OF 18

SHOWING DISTANCE BETWEEN ROWS OF PANELS

MAIN STREET SOLAR, HOPKINTON



Onsite Grading Material and PV Array

Distance Scheme - Tilt, Angle, and Shading Detail

NOT TO SCALE

The *volume of wood fiber*, a number, is the yield likely to be produced by the most important tree species. This number, expressed as cubic feet per acre per year and calculated at the age of culmination of the mean annual increment (CMAI), indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

Trees to manage are those that are preferred for planting, seeding, or natural regeneration and those that remain in the stand after thinning or partial harvest.

Reference:
United States Department of Agriculture, Natural Resources Conservation Service, National Forestry Manual.

Report—Forestland Productivity

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
ChB—Canton and Charlton fine sandy loams, 0 to 8 percent slopes, very stony				
Canton, very stony	Eastern hemlock	—	—	Beech, Bitternut hickory, Black oak, Eastern hemlock, Eastern white pine, Gray birch, Mockernut hickory, Northern red oak, Pignut hickory, Red maple, Shagbark hickory, Sugar maple, White ash, White oak, Yellow birch
	Eastern white pine	58	100.00	
	Northern red oak	52	29.00	
	Red maple	55	29.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
Charlton, very stony	Eastern hemlock	—	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	65	114.00	
	Northern red oak	65	43.00	
	Red maple	55	29.00	
	Red pine	70	129.00	
	Red spruce	50	114.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
CkC—Canton and Charlton fine sandy loams, 3 to 15 percent slopes, extremely stony				
Canton, extremely stony	Eastern hemlock	—	—	Beech, Bitternut hickory, Black oak, Eastern hemlock, Eastern white pine, Gray birch, Mockernut hickory, Northern red oak, Pignut hickory, Red maple, Shagbark hickory, Sugar maple, White ash, White oak, Yellow birch
	Eastern white pine	58	100.00	
	Northern red oak	52	29.00	
	Red maple	55	29.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
Charlton, extremely stony	Eastern hemlock	—	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	65	114.00	
	Northern red oak	65	43.00	
	Red maple	55	29.00	
	Red pine	70	129.00	
	Red spruce	50	114.00	
	Shagbark hickory	—	0.00	
	Sugar maple	55	29.00	
	White oak	—	—	
FeA—Freetown muck, 0 to 1 percent slopes				
Freetown	American elm	55	0.00	—
	Atlantic white cedar	60	0.00	
	Balsam fir	45	86.00	
	Eastern hemlock	55	0.00	
	Green ash	35	29.00	
	Red maple	50	29.00	
	Red spruce	50	114.00	
HkA—Hinckley loamy sand, 0 to 3 percent slopes				
Hinckley	Eastern white pine	61	100.00	Black oak, Eastern white pine, Pitch pine
	Northern red oak	49	29.00	
	Paper birch	60	54.00	
	Pitch pine	60	—	
	Red pine	54	92.00	
	Red spruce	39	86.00	
	Sugar maple	59	30.00	
	White spruce	52	114.00	

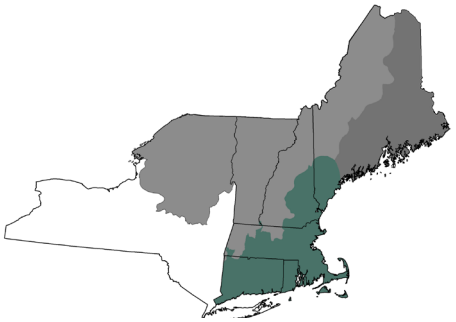
Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
PbB—Paxton fine sandy loam, 0 to 8 percent slopes, very stony				
Paxton, very stony	Black oak	67	—	Eastern white pine, European larch, Northern red oak, Norway spruce, Red pine, Scarlet oak, Sugar maple, Tuliptree, White ash, White oak
	Eastern white pine	66	114.00	
	European larch	80	—	
	Northern red oak	65	43.00	
	Red pine	67	114.00	
	Scarlet oak	67	—	
	Sugar maple	75	43.00	
	White ash	89	—	
	White oak	60	—	
Rf—Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony				
Ridgebury, extremely stony	Eastern white pine	63	114.00	American elm, Blackgum, Green ash, Pin oak, Red maple, Swamp white oak, Yellow birch
	Northern red oak	66	43.00	
	Red maple	62	—	
	Sugar maple	56	29.00	
	White ash	60	—	
Leicester, extremely stony	Eastern white pine	69	129.00	Green ash, Red maple, Tuliptree
	Northern red oak	56	43.00	
	Red maple	70	43.00	
	Yellow birch	—	—	
Whitman, extremely stony	Blackgum	52	—	—
	Eastern white pine	56	100.00	
	Northern red oak	70	—	
	Red maple	60	29.00	
	Red spruce	44	86.00	
	White oak	57	—	
SuB—Sutton very stony fine sandy loam, 0 to 8 percent slopes				
Sutton	Black cherry	72	43.00	Eastern white pine, European larch, Norway spruce, White spruce
	Eastern white pine	62	114.00	
	Northern red oak	62	43.00	
	Red spruce	50	114.00	
	Sugar maple	54	29.00	

Forestland Productivity–State of Rhode Island: Bristol, Kent, Newport, Providence, and Washington Counties				
Map unit symbol and soil name	Potential productivity			Trees to manage
	Common trees	Site Index	Volume of wood fiber	
			Cu ft/ac/yr	
W—Water				
Water	—	—	—	—
WoB—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony				
Woodbridge, very stony	Black oak	77	—	Ash, Northern red oak, Sugar maple, Tuliptree, White oak
	Eastern white pine	67	114.00	
	Northern red oak	72	57.00	
	Red pine	65	114.00	
	Red spruce	50	114.00	
	Sugar maple	65	43.00	
	Yellow poplar	84	—	

CLIMATE CHANGE PROJECTIONS FOR INDIVIDUAL TREE SPECIES

SOUTHERN AND COASTAL NEW ENGLAND

The region's forests will be affected by a changing climate during this century. A team of forest managers and researchers created an assessment that describes the vulnerability of forests in New England and northern New York (Janowiak et al. in press). This report includes information on the current landscape, observed climate trends, and a range of projected future climates. It also describes many potential climate change impacts to forests and summarizes key vulnerabilities for major forest types. This handout is summarized from the full assessment.



Remember that models are just tools, and they're not perfect. Model projections don't account for some factors that could be modified by climate change, like droughts, wildfire activity , and invasive species. If a species is rare or confined to a small area, Tree Atlas results may be less reliable. These factors, and others, could cause a particular species to perform better or worse than a model projects. Human choices will also continue to influence forest distribution, especially for tree species that are projected to increase. Planting programs may assist the movement of future-adapted species, but this will depend on management decisions.

TREE SPECIES INFORMATION:

This assessment uses two climate scenarios to "bracket" a range of possible futures. These future climate projections were used with two forest impact models (Tree Atlas and LANDIS) to provide information about how individual tree species may respond to a changing climate. More information on the climate and forest impact models can be found in the assessment. Results for "low" and "high" climate scenarios can be compared on page 2 of this handout.

Despite these limits, models provide useful information about future expectations. It's perhaps best to think of these projections as indicators of possibility and potential change. The model results presented here were combined with information from published reports and local management expertise to draw conclusions about potential risk and change in the region's forests.

SPECIES	ADDITIONAL CONSIDERATIONS
LIKELY TO DECREASE	
Balsam fir	Requires cold climate and susceptible to drought, fire, and insects
Eastern white pine	Good disperser, but susceptible to drought and insects
Paper birch	Early-sucessional colonizer, but susceptible to insects and drought
Quaking aspen	Early-sucessional colonizer, but susceptible to heat and drought
Red spruce	Needs a particular type of habitat, limited seedling establishment
Striped maple	Shade tolerant and easily established, but susceptible to drought
MAY DECREASE	
American beech	Affected by beech bark disease, extremely shade tolerant
Bigtooth aspen	Early-sucessional colonizer, but susceptible to drought
Eastern hemlock	Hemlock woolly adelgid causes mortality
Gray birch	Disperses easily, but susceptible to drought, fire, and insects
Red pine	Fire-adapted, but susceptiple to some insects
Yellow birch	Good disperser, but susceptible to fire, insects, and disease
NO CHANGE	
Black cherry	Susceptible to insects and fire, but tolerates some drought
White ash	Emerald ash borer causes mortality

SPECIES	ADDITIONAL CONSIDERATIONS
MAY INCREASE	
American elm	Affected by Dutch elm disease, grows across a variety of sites
Black oak	Drought-tolerant, but susceptible to insects and disease
Eastern hophornbeam	Grows across a variety of sites and tolerates shade
Eastern redcedar	Drought-tolerant, but susceptible to insects and fire
Pitch pine	Susceptible to some insect pests
Shagbark hickory	Susceptible to some insect pests
White oak	Fire-adapted and grows on a variety of sites
MIXED MODEL RESULTS	
Chestnut oak	Grows on a variety of sites, but susceptible to insects and disease
Northern red oak	Susceptible to some insect pests
Pignut hickory	Grows on a variety of sites, but susceptible to drought and insects
Red maple	Competitive colonizer tolerant of disturbance and diverse sites
Scarlet oak	Drought- and fire-adapted, but susceptible to insects and disease
Sugar maple	Grows across a variety of sites and tolerates shade
Sweet birch	Susceptible to drought, fire topkill, and insects

SOURCE: Janowiak et al. in review. New England and New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. ***www.forestadaptation.org/new-england/vulnerability-assessment***

NIACS
Northern Institute of Applied Climate Science

www.forestadaptation.org

FUTURE PROJECTIONS

Data for the end of the century are summarized for two forest impact models under two climate change scenarios. The Climate Change Tree Atlas (www.fs.fed.us/nrs/atlas) models future suitable habitat, while LANDIS models changes in forest growth over time (future tree density presented in this table; additional data are available in the assessment).

▲ **INCREASE**
Projected increase of >20% by 2100

● **NO CHANGE**
Little change (<20%) projected by 2100

▼ **DECREASE**
Projected decrease of >20% by 2100

★ **NEW HABITAT**
Tree Atlas projects new habitat for species not currently present

ADAPTABILITY

Factors not included in the models, such as the ability to respond favorably to disturbance, may make a species more or less able to adapt to future stressors.

+ high
Species may perform better than modeled

· medium

– low
Species may perform worse than modeled

	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		
SPECIES	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	ADAPT
American basswood	●		▲		·
American beech	●	●	▼	▼	·
American chestnut	●		●		·
American elm	▲		▲		·
American holly	●		▲		·
American hornbeam	●		▲		·
American mountain-ash	●		●		–
Bald cypress	★		★		·
Balsam fir	▼	▼	▼	▼	–
Balsam poplar	▼		▼		·
Bigtooth aspen	●		▼		·
Black ash	▼		▼		–
Black cherry	●	●	●	●	–
Black hickory			★		·
Black oak	▲	●	▲	●	·
Black spruce	▼	▼	▼	▼	·
Black walnut	★		★		·
Blackgum	▲		▲		+
Blackjack oak			★		+
Boxelder	●		●		+
Bur oak	●		▲		+
Cherrybark oak			★		·
Chestnut oak	▲	▲	▲	▼	+
Chinkapin oak			★		·
Common persimmon	★		★		+
Eastern hemlock	●	●	▼	▼	–
Eastern hophornbeam	●		▲		+
Eastern redbud	★		★		·
Eastern redcedar	▲		▲		·
Eastern white pine	▼	▼	▼	▼	·
Flowering dogwood	▲		▲		·
Gray birch	●		▼		·
Green ash	●		▲		·
Hackberry	●		▲		+
Loblolly pine	★		★		·
Mockernut hickory	▲		▲		+
Mountain maple	●		▼		+
Northern red oak	●	●	▼	●	+
Northern white-cedar	▼	▼	▼	▼	·
Overcup oak			★		–

	LOW CLIMATE CHANGE (PCM B1)		HIGH CLIMATE CHANGE (GFDL A1FI)		
SPECIES	TREE ATLAS	LANDIS	TREE ATLAS	LANDIS	ADAPT
Paper birch	▼		▼		·
Pignut hickory	▲	●	▲	▼	·
Pin cherry	●		●		·
Pin oak	▲		▲		–
Pitch pine	▲	●	●	●	·
Pond pine	★		★		–
Post oak	▲		▲		+
Quaking aspen	▼	▼	▼	▼	·
Red maple	●	●	▼	●	+
Red pine	●		▼		·
Red spruce	▼	▼	▼	▼	–
Sassafras	▲		▲		·
Scarlet oak	▲	●	▲	▼	·
Serviceberry	●		▼		·
Shagbark hickory	▲	●	▲	●	·
Shingle oak			★		·
Shortleaf pine	★		★		·
Silver maple	▲		▲		+
Slippery elm	●		▲		·
Sourwood	▲		▲		+
Southern red oak	★		★		+
Striped maple	▼		▼		·
Sugar maple	●	●	●	▼	+
Sugarberry			★		·
Swamp chestnut oak	●		▲		·
Swamp tupelo	★				–
Sweet birch	▲		▼		–
Sweetbay	★				·
Sweetgum	★		★		·
Sycamore	▲		▲		·
Tamarack (native)	▼		▼		–
Virginia pine	★	●	★	●	·
Water oak			★		·
White ash	●	●	●	●	–
White oak	▲	●	▲	●	+
White spruce	▼		▼		·
Willow oak			★		·
Winged elm	●		▲		·
Yellow birch	●	●	▼	▼	·
Yellow-poplar	▲	▲	▲	●	+

TOPOGRAPHIC MAP

MAXSON HILL SOLAR, LLC

HOPKINTON, RI

PLANTING SPECIES BY SOIL/SLOPE

SCALE: 1" = 150'

0 75' 150' 300' 450'

GRAPHIC SCALE

GENERAL NOTES:

1. SEE ENGINEER'S PLANS FOR ALL SITE LAYOUT, GRADING, DRAINAGE, AND UTILITY DESIGNS (SEE REFERENCE 1).
2. ALL WORK AND MATERIALS SHALL BE IN CONFORMANCE WITH THE RHODE ISLAND STANDARD SPECIFICATIONS, AS AMENDED.
3. CONTRACTOR SHALL VERIFY ACTUAL AS-BUILT ON-SITE CONDITIONS PRIOR TO COMMENCING CONSTRUCTION PROCEDURES.
4. UTILITIES ARE PLOTTED FROM BEST AVAILABLE INFORMATION AND SITE OBSERVATIONS. CONTRACTOR SHALL VERIFY UTILITY LOCATIONS BY CONTACTING DIG SAFE (888-DIG-SAFE (344-7233) or (Dial 811)), IN ACCORDANCE WITH THE LAWS OF THE STATE OF RI. CONTRACTOR SHALL PROTECT EXISTING UTILITIES DURING CONSTRUCTION. DAMAGE TO ANY ABOVE OR BELOW GROUND UTILITIES SHALL BE REPAIRED BY THE CONTRACTOR AT HIS OR HER OWN EXPENSE.
5. NO TOPSOIL IS TO BE REMOVED FROM THE SITE. MINIMIZE DISTURBANCE TO ALL TOP SOIL TO THE GREATEST EXTENT PRACTICABLE. ALL LOAM/TOPSOIL IN DISTURBED AREAS TO BE STOCKPILED AND re-USED ON SITE.
6. ALL EXCESS VEGETATIVE DEBRIS, BOULDERS, STUMPS, AND OTHER UNSUITABLE MATERIALS SHALL BE DISCARDED OFFSITE IN AN ACCEPTABLE MANNER TO ALL STATE, AND MUNICIPAL REGULATIONS. ALL MATERIALS THAT ARE REMOVED AND DISPOSED SHALL BE DONE IN A LEGAL MANNER AND FOLLOW THE SOIL EROSION CONTROL PLAN AT OWNER'S DIRECTION.
7. CONTRACTOR TO PERFORM DAILY HOUSEKEEPING DUTIES. CONTRACTOR SHALL SWEEP DAILY ANY TRACKING ONTO EXISTING PARKING AREA TO PREVENT FROM ENTERING THE DRAINAGE SYSTEM.
8. PERIMETER FENCING:
   - 8.1. UNLESS OTHERWISE NOTED, PERIMETER FENCING SHALL BE 6' HT. GALVANIZED CHAINLINK FENCE. PERIMETER FENCING ALONG THE EASTERN PROPERTY LINE AS WELL AS PROPERTY LINES ABUTTING RESIDENTIAL PARCELS A.P. 4, LOTS 23, 26, AND 28 (WHERE INDICATED) SHALL BE BLACK VINYL COATED. PERIMETER FENCING ALONG A.P. 4, LOTS 31, 33, 57, AND 40 SHALL BE 8' HEIGHT SOLID PANEL STOCKADE FENCING WITH GALVANIZED SCHEDULE 40 POSTS. ALL FENCE POSTS SHALL BE ON INSIDE EDGE OF FENCE (FABRIC AND STOCKADE PANELS TO FACE ABUTTING PROPERTIES). SEE ENGINEER'S PLANS FOR FINAL SPECIFIED LOCATIONS AND DETAILS.
   - 8.2. WHERE PERIMETER FENCING IS PLACED WITHIN EXISTING VEGETATED BUFFERS TO REMAIN, PROVIDE 5' WIDE TEMPORARY LIMIT OF DISTURBANCE FOR INSTALLATION OF FENCING. FINAL FENCING ALIGNMENT SHALL BE ADJUSTED AS NECESSARY WITHIN WOODED BUFFER TO AVOID SUBSTANTIAL VEGETATION.
   - 8.3. BOTTOM OF ALL PERIMETER FENCING SHALL BE RAISED SIX INCHES (6") ABOVE THE GROUND SO AS TO ALLOW MIGRATORY PASSAGE OF SMALL SPECIES THROUGH THE SITE (SEE ENGINEER'S PLANS).
9. SPECIFIED VEGETATION WAS BEING PROPOSED TO SUPPLEMENT EXISTING VEGETATION MAINTAINED WITHIN THE PERIMETER BUFFER AREAS OF THE SUBJECT PARCEL AT THE FACILITIES BOUNDARY. IT IS INTENDED TO OBSCURE THE VIEW OF THE SOLAR ARRAY FROM ABUTTING PROPERTIES AND PUBLIC ROADWAYS FROM A VIEWPOINT OF THE FIRST FLOOR OF ANY STRUCTURE BUILT OR MAINTAINED THEREON.
10. LANDSCAPE PLAN DIMENSIONS AND DETAILS: FOR ENLARGEMENTS, PLANS OF LANDSCAPE FOCUS AREAS, TYPICAL SUPPLEMENTAL BUFFER PLANTINGS, PLANT SCHEDULES, AND STANDARD PLANTING DETAILS, SEE SHEETS L1 THROUGH L-6.
11. PLANTING DETAILS: SEE SHEET L4 FOR ALL TYPICAL PLANTING INSTALLATION DETAILS.

LEGEND

- PROPERTY LINE
- ABUTTING PROPERTY LINE
- BUILDING ON ABUTTING PROPERTY
- APPROXIMATE EDGE OF EXISTING VEGETATION AND FORESTED AREAS. AVERAGE HEIGHT OF VEGETATION IN FORESTED AREAS APPROXIMATELY 40' +/-
- APPROXIMATE EDGE OF PROPOSED VEGETATION AND FORESTED AREAS TO REMAIN. AVERAGE HEIGHT OF VEGETATION IN FORESTED AREAS APPROXIMATELY 40' +/-
- CROSS SECTION CUT LINES (SEE SHEETS L-7 AND L-8)
- PROPOSED 6' HEIGHT GALVANIZED CHAINLINK FENCE (SEE NOTES)
- PROPOSED 6' HEIGHT BLACK CHAINLINK FENCE (SEE NOTES)
- PROPOSED 8' HEIGHT SOLID PANEL STOCKADE FENCE (SEE NOTES)
- PROPOSED CRUSHED STONE ACCESS DRIVE (SEE ENGINEER'S PLANS)
- PROPOSED SOLAR ARRAY & COMPONENTS (SEE ENGINEER'S PLANS); CLEAR WOODY VEGETATION AS NEEDED AND LOAM AND SEED ALL DISTURBED SURFACES IN AND AROUND ENTIRE ARRAY FOLLOWING INSTALLATION OF ARRAY (SEE ENGINEER'S PLANS AND GENERAL NOTES, THIS SHEET)

LANDSCAPE NOTES:

1. THE CONTRACTOR SHALL INSTALL ALL PLANT MATERIAL IN CONFORMANCE WITH THE RHODE ISLAND DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, LATEST EDITION, AND THE CURRENT PLANTING PROCEDURES ESTABLISHED BY THE AMERICAN NURSERY & LANDSCAPE ASSOCIATION, FORMERLY THE AMERICAN ASSOCIATION OF NURSERYMEN.
2. ALL PLANT MATERIAL SHALL MEET THE AMERICAN NURSERY & LANDSCAPE ASSOCIATION, FORMERLY THE AMERICAN ASSOCIATION OF NURSERYMEN, STANDARDS FOR NURSERY STOCK, LATEST EDITION, AND ITS AMENDMENTS. PLANT ONLY DURING SEASONS NORMAL TO THE PARTICULAR VARIETY.
3. SPECIFIED PLANT VARIETIES, QUANTITIES, AND SIZES ARE SUBJECT TO AVAILABILITY AT TIME OF ORDERING AND INSTALLATION. ALL PLANT SUBSTITUTIONS AND/OR CHANGES IN PLANT LOCATION OR SIZE MUST BE APPROVED BY THE OWNER'S REPRESENTATIVE.
4. ALL PLANTINGS SHALL BE SIZED IN ACCORDANCE WITH THE SIZES INDICATED ON THE PLANT SCHEDULE, UNLESS OTHERWISE APPROVED BY OWNER'S REPRESENTATIVE.
5. THE CONTRACTOR IS RESPONSIBLE FOR KEEPING THE SITE CLEAN OF MISCELLANEOUS DEBRIS THROUGHOUT THE CONSTRUCTION PERIOD. ALL WASTE MATERIAL IS TO BE DISPOSED OF IMMEDIATELY TO AN OFF-SITE LOCATION, UNLESS OTHERWISE INDICATED ON THE PLANS.
6. THE CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS, AND SHALL OBTAIN ALL NECESSARY PERMITS FOR THE PROJECT.
7. CONTRACTOR SHALL PROVIDE A ONE (1) YEAR WARRANTY ON ALL NEW PLANTINGS. SHOULD NEW PLANT MATERIAL DIE (OR DECLINE TO THE POINT WHERE PLANT IS EXPECTED TO DIE) WITHIN THIS WARRANTY PERIOD (OTHER THAN DUE TO NATURAL FACTORS, NATURAL DISASTER, OR NEGLECT), CONTRACTOR SHALL REMOVE THE PLANT AND REPLACE SAID PLANT MATERIAL WITH NEW PLANTING IN ACCORDANCE WITH THE SIZE AND VARIETY SPECIFIED. ALL REPLACEMENT PLANT MATERIAL SHALL CARRY A NEW ONE (1) YEAR WARRANTY STARTING FROM THE DATE OF REPLACEMENT.
8. FINAL LOCATIONS OF ALL NEW PLANTINGS SHALL BE ADJUSTED AS NECESSARY BASED ON FINAL AS-BUILT LOCATIONS OF ALL NEW AND EXISTING UTILITIES AND OTHER SITE IMPROVEMENTS.
9. PROTECTION OF EXISTING PLANTINGS: UNLESS SPECIFIED FOR REMOVAL OR REMOVAL IS NECESSARY FOR PROPER, SAFE, OPERATION OF SOLAR FACILITY, MAINTENANCE OPERATIONS SHOULD BE MADE TO SAVE TREES OR OTHER PLANT SPECIMENS OUTSIDE OF LIMIT OF WORK, WHICH ARE LARGE FOR THEIR SPECIES, NEAR TO THE AREA, OR OF SPECIAL HORTICULTURAL OR LANDSCAPE VALUE. CONTACT OWNER/LANDSCAPE ARCHITECT BEFORE REMOVING ANY SPECIMEN OF THIS TYPE UNLESS OTHERWISE NOTED ON THE PLANS. PROTECTIVE BARRIERS ARE TO BE REGULATED, WHERE NECESSARY, AROUND EACH PLANT AND/OR GROUP OF PLANTS THAT ARE TO REMAIN ON THE SITE. BARRIERS SHALL NOT BE SUPPORTED BY THE PLANTS THEY ARE PROTECTING, BUT SHALL BE SELF SUPPORTING. THEY SHALL BE A MINIMUM OF FOUR FEET (4') HIGH AND CONSTRUCTED OF A DURABLE MATERIAL, SUCH AS SNOW OR SILT FENCE, THAT WILL LAST UNTIL CONSTRUCTION IS COMPLETED.
   - 9.1. PROTECTION OF EXISTING VEGETATION TO REMAIN SHALL BE IN CONFORMANCE WITH SECTION 10.5.1, APPENDIX A, OF THE TOWN OF HOPKINTON LAND DEVELOPMENT AND SUBDIVISION REGULATIONS.
10. ALL LOAM USED AS PLANTABLE SOIL SHALL HAVE A SANDY LOAM TEXTURE RELATIVELY FREE OF SURFACE MATERIAL, STONES, ROOTS, LUMPS OF SOIL, TREE LIMBS, TRASH, CONSTRUCTION DEBRIS, OR OTHER OBJECTIONABLE MATERIAL. NEW PLANTING BEDS SHALL BE AMENDED WITH WELL AGED COMPOST.
   - 10.1. COMPOST SHALL BE A WELL DECOMPOSED, STABLE, WEED FREE ORGANIC MATTER SOURCE. IT SHALL BE DERIVED FROM AGRICULTURAL, FOOD, AND/OR YARD DEBRIMENTS. THE PRODUCT SHALL CONTAIN NO SUBSTANCES TOXIC TO PLANTS AND SHALL BE REASONABLY FREE (LESS THAN 1 PERCENT BY DRY WEIGHT) OF MAN-MADE FOREIGN MATTER.
11. THOROUGHLY WATER ALL PLANTS WHEN 1/3 OF BACKFILL HAS BEEN PLACED TO ENSURE ALL AIR POCKETS ARE REMOVED. FIRMLY TAMP SOIL AROUND PLANT. ENSURE PROPER WATERING OF PLANT MATERIAL UNTIL ESTABLISHMENT.
12. ALL PLANTING MATERIAL SHALL BE PRUNED IN ACCORDANCE WITH GOOD HORTICULTURAL PRACTICES, AND IN SUCH A MANNER AS TO MAINTAIN THE NATURAL FORM OF THE PLANT. PRUNING SHALL BE COMPLETED UTILIZING ONLY CLEAN SHARP TOOLS. USE OF AXES FOR PRUNING IS UNACCEPTABLE.
   - 12.1. PRUNE ALL PLANT MATERIAL TO REMOVE ANY AND ALL DEADWOOD.
13. MULCH: ALL PLANTINGS SHALL BE MULCHED AS INDICATED ON DETAIL DRAWINGS. PLANTINGS INSTALLED IN CLUSTERS, OR WITHIN PLANTING BEDS SHALL BE MULCHED AS SUCH, INSTALLING MULCH THROUGHOUT THE ENTIRE PLANTING BED. MULCH TO BE 3"-4", OR AS OTHERWISE NOTED, IN DEPTH AND REDUCED TO LESS THAN 3" AT ROOT FLARE OF EACH PLANT.
14. LOAM AND SEED:
   - 14.1. LOAM AND SEED ALL DISTURBED AREAS. ALL NEW LAWN AREAS SUBJECT TO EROSION SHALL BE STABILIZED UTILIZING JUTE MESH OR APPROVED EQUAL.
   - 14.2. LOAM UTILIZED OR RETAINED FOR LAWN AREAS SHALL BE SANDY LOAM, 4"-6" IN DEPTH, AND CONFORMING TO THE REQUIREMENTS OF THE USDA FOR LAWN PLANTINGS. ON-SITE NATIVE LOAM MAY BE UTILIZED FOR LAWN AREAS, BUT SHALL BE AMENDED AND MIXED AS NECESSARY TO CONFORM TO THE REQUIREMENTS OF ANY OFF-SITE LOAM.
   - 14.3. SEED MIX UTILIZED SHALL BE AS NOTED ON ENGINEER'S PLANS AND OPERATIONS AND MAINTENANCE MANUAL.

PLANT SCHEDULE: Main Street (Ri Route 3) Meadow/Fencing Buffer

KEY	Scientific Name / Common Name	QTY	Size / Comment	Spacing
AG	Andropogon gerardi / Big Blue Stem	45	#2 (2 Gal.) / Container	36" O.C.
PV	Panicum virgatum / Switchgrass	80	#2 (2 Gal.) / Container	36" O.C.
SN	Sorghastrum nutans / Indian Grass	50	#2 (2 Gal.) / Container	24" O.C.

Notes:

1. The above quantities reflect the minimum quantity of each variety of plants illustrated on this drawing to be planted along the Western Property Line abutting existing meadow areas where no Solar Array or components are proposed.
2. All other Supplemental Buffer Plantings at the project Perimeter are illustrated and detailed on sheets L-1 through L-6 of this Plan Set.
3. Final Locations and Quantities of supplemental plantings shall be field adjusted to minimize any conflicts with existing wooded buffer vegetation to remain and to infill any potential gaps in existing vegetation to obscure the solar array and components from abutting properties.

LANDSCAPE REQUIREMENTS

(TOWN OF HOPKINTON, RI, TOWN ORDINANCE, CHAPTER 246: NON-RESIDENTIAL PHOTOVOLTAIC SOLAR ENERGY SYSTEMS (PSES))

REQUIRED: PSES Design Guidelines, Section C2.b: 'All appurtenant structures and equipment shall be screened from view by vegetation and joined or clustered to avoid adverse visual impacts to any adjacent property that is residentially zoned or used for residential purposes.'

PROPOSED: Existing Vegetation maintained to the greatest extent practicable at the perimeter buffer areas closest to adjacent roadways and residential parcels (57.50' minimum width vegetative buffer to remain along perimeter property lines). Supplemental buffering vegetation has been added to these perimeter vegetative buffer areas, to further obscure the view of the solar array from the abutting residential properties, Main Street (RI Route 3), and Mawson Hill Road, and to avoid adverse visual impacts (see sheets L-1 through L-6 for Details).

REQUIRED: Planning Board Review, Section D2.a: (Plan shall show) Existing Areas of Tree Cover, including average height of trees, on the site parcel and adjacent parcels within One hundred (100) feet.

PROPOSED: Limits of Existing Areas of Tree Cover have been illustrated on this sheet. Average height of trees is approximately 40'-50'.

(TOWN OF HOPKINTON, RI, ZONING ORDINANCE, AS AMENDED): ZONING: RFR-80

REQUIRED: Section 240.9.2.D.3: 'Where parking facilities will adjoin a parcel on which there is a residence, an opaque hedge or fence not less than five (5) feet in height shall be erected and maintained between such area and the adjoining residential district'

PROPOSED: Mixed Buffer Plantings either maintained or supplemented around entire perimeter of no Project Site, including all crushed stone access drives and turnarounds.

(TOWN OF HOPKINTON, RI, LAND DEVELOPMENT AND SUBDIVISION REGULATIONS, AS AMENDED): ZONING: RFR-80

REQUIRED: Section 10.4.1H: 'Trees shall be retained whenever feasible. Areas within the drip line should be temporarily fenced...protected against damage during construction.'

PROPOSED: All vegetation proposed to be retained will be protected in accordance with Landscape Notes, this sheet, and section 10.5.1, Appendix A, of the Town of Hopkinton Land Development and Subdivision Regulations.

REQUIRED: Section 10.4.1H: 'All areas not covered by structures should be landscaped'

PROPOSED: All Areas not proposed to be covered by Structures or Access Drives/Parks, shall be landscaped.

REQUIRED: Section 10.4.1K: 'Adjacent residential and non-residential uses should be segregated. A screen along the lot line should be provided.'

PROPOSED: A Segregated Buffer, (25' minimum width) is proposed to be maintained and/or supplemented with native mixed vegetation consisting of Evergreen Trees and Large Shrubs along all property lines (See sheets L-1 through L-6 for Details).

REQUIRED: Section 10.4.1M: '...where a parking lot or loading area adjoins a public street...a landscape strip of land shall be constructed or maintained along the entire street frontage...'

PROPOSED: A continuous 25' minimum width Landscape Strip of native mixed vegetation (Evergreen and Deciduous) is proposed along the entire Main Street (Ri Route 3) street frontage of the subject parcel. A continuous 50' minimum width Landscape Strip of native mixed vegetation (Evergreen and Deciduous) is proposed along the entire Mawson Hill Road street frontage of the subject parcel.

REQUIRED: Section 10.4.1N: 'A landscaped buffer strip at least ten feet wide, shall be established adjacent to any public road the Planning Board deems would unduly detract from the adjacent streetscape.'

PROPOSED: A continuous 25' minimum width Landscape Strip of native mixed vegetation (Evergreen and Deciduous) is proposed along the entire Main Street (Ri Route 3) street frontage of the subject parcel. A continuous 50' minimum width Landscape Strip of native mixed vegetation (Evergreen and Deciduous) is proposed along the entire Mawson Hill Road street frontage of the subject parcel.

REVISION HISTORY:

DATE	ISSUED FOR

REFERENCES:

1. Plan Entitled: 'Overall Site Layout Plan: Main Street Solar', Prepared for: Mawson Hill LLC, Prepared by: DiPrete Engineering, Dated: 1-12-2018, Scale: 1" = 150', as amended.
2. Site Observations by Kevin M. Alverson, LA, on 1/8/18 and 1/15/18.
3. Aerial Photography and Off-Site Elevational Data as available through Google Earth Pro, Imagery Date: 8/21/16

Main Street Solar

A.P. 4, Lot 25
Main Street (RI Route 3)
Hopkinton, RI

Applicant:
Mawson Hill LLC c/o Anthony DelVicario
43 Creston Way,
Warwick RI 02886

Kevin M. Alverson
LANDSCAPE ARCHITECTURE
360 Annaquatucket Road 401 - 538 - 0044
Wickford, RI 02852 KevinMAlversonLA.com

Overall Landscape Plan

Project #: 2.142.205	Sheet 1 of 7
Scale: 1" = 150'	L-0
Drawn By: KMA	
Checked By: KMA	
Date: January 31, 2018	

UPLAND SPECIES = RED

LOWER SLOPE SPECIES = BLUE

LOWLAND SPECIES = GREEN

Protex® Pro/Gro Solid Tube Tree Protectors

Acts as a miniature greenhouse.

★ ★ ★ ★ ★ 12 customer reviews

Availability: In Stock

Stock Number: 17141

Size: 48"H

Quantity	Price
1+	$2.95
200+	$2.75
400+	$2.55

Quantity: 1 Add To Cart

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Share on:

Description | Specifications | Reviews (12) | Q&A (3)

48" Protex Pro/Gro Solid Tube Tree Protectors

Each 4" diameter tube speeds photosynthesis by trapping moisture, thereby raising relative humidity and ambient temperature inside the tube. Also protects the tree from animals, wind desiccation, small rodents, and insects. Use optional cable ties to install optional bamboo stakes or wood guard stakes with each tube for support. Stakes and cable ties sold separately. Constructed of type 2 recyclable polyethylene.

Natural Resources Conservation Service
Texas Forestry Technical Note, TX-FS-12-4

Tree planting is a widely used method to regenerate cutover sites and return cropland or pastures back to forested land. Planting trees allows one to adjust tree species and density on their acres while influencing wildlife habitat as well. Tree planting can also be used to create windbreaks and shelter belts providing a buffer from wind, snow, dust and noise.

Seedling Planting Guidelines

CAUTION – READ

1. Safety – the planting operation should be performed safely as the environment will have several hazards that can make walking difficult such as briars, down woody material, etc.
2. Seedling care – Seedlings should not be exposed to extreme temperatures, wind or contaminants (fuel or herbicides).
3. Seedling roots must not be exposed to excessive drying conditions – do not hold a handful of seedlings while you are planting or leave the bag or box of seedlings open.
4. Planting quality – Seedlings should be planted to the proper depth and firmly packed to ensure the highest likelihood of survival. One can tell if the seedlings are packed tight by grasping a few needles and pull upward – If the seedling moves it is not firmly packed, if the needles pull off then it is firmly packed.

Seedling handling: Handling involves seedling storage, transit and field handling.

Seedling Storage:

1. Avoid damaging seedling bags or boxes to minimize damage to seedlings, tape up any hole to prevent moisture loss and drying of the seedlings.
2. Keep seedlings and their containers out of direct sunlight.
3. Allow space for air circulation between seedling boxes/bags.
4. Don't allow seedlings to freeze. (Don't plant seedlings frozen for more than 2 days)
5. Plant seedlings within two weeks of lifting if possible.
6. Seedlings four weeks or older should be carefully checked for mildew, mold or decay.

Transit:

1. Prevent injury when lifting seedling bags or boxes by keeping your back straight and lifting with your legs.
2. Keep seedlings shaded and covered. A tarp will work if the vehicle is not covered (ie. van or truck with camper shell.
3. Drive at speeds allowed by law and road conditions.

4. Keep seedlings away from contamination commonly fuels or herbicides.
5. Keep the area with seedlings free from sharp objects.
6. Don't allow seedlings to freeze.
7. Don't stack seedlings more than 2 boxes/bags deep without spacers to provide support.

Handling seedlings before and during planting:

1. Keep seedlings moist – Dry roots kill seedlings.
2. Keep seedlings shaded and covered - High temperatures kill seedlings.
3. Don't prune the roots unless the laterals are long (5" or longer) – prune the laterals with a sharp machete to 3 to 4 inches in length. A good root system is essential to seedling growth and survival.
4. Don't beat seedlings against objects to remove clay slurry
5. Close boxes or bags and place out of direct sunlight
6. Remove only minimum number or seedlings that can be planted quickly to avoid exposing roots to wind and sun very long.
7. Discard cull seedlings – seedlings with a stem diameter smaller in diameter than a kitchen match, dry seedlings, or seedlings without a good root system.
8. Don't dump out the whole box or bag of seedlings to sort them before planting.

Hand Planting:

Hand planting allows areas to be planted not suitable for machinery due to debris, terrain, wet conditions and availability of suitable machines.

1. If area has duff, litter, etc., rake to bare mineral soil to ensure proper seedling depth and tightness.
2. Remove no more than 3 or 4 seedlings (drop any culls) from the planting bag.
3. Make the planting hole wide and deep enough to insert the root system so the seedling is straight and the roots are straight down in the planting hole. (It is highly undesirable to have the roots curled up in the planting hole).
4. Lift the seedling up in the hole until the root collar is slightly below the soil level for loblolly, slash and shortleaf pines and for longleaf pine plant the root collar at the soil level keeping the terminal bud above ground.
5. Pack the seedling firmly using your planting tool eliminating the air pockets. See diagram at the back of this document.
6. Plant when there is good soil moisture.
7. Don't plant when the ground is frozen.

Tools for hand planting include a dibble bar, hoe dad, or sharp shooter shovel. A planter bag worn around the waist makes the planting faster and more efficient keeping the seedlings moist and readily available. Seedlings properly planted by hand should have a high percentage of surviving trees.

Hand planting with bare-root seedlings usually occurs between late December and early April. The seedlings have to "harden off" or set buds at the end of the growing season and in southern nurseries this usually does not occur until late November or early December. This hardening off is a little easier to

visualize with hardwood seedlings as the leaves fall off and one can easily see the buds. In planting loblolly, slash or shortleaf pines and the hardwood species, the seedlings should be planted at the root collar which is the location the seedling grew in the nursery (where the above ground and below ground portion of the seedling meet). Longleaf seedlings should be planted at a depth where the root collar is slightly above the soil line ensuring that the terminal bud stays above the ground.

The earlier one can plant their seedlings (Jan – Feb) the more time the seedling will have to establish their root systems. The better the roots get established, the better the seedlings can survive dry conditions that will occur during the summer months.

Containerized seedlings have a wider window for planting beginning in late October and going through April. Containerized seedlings are grown in tubes that help the seedling develop a dense root system that is fairly easy to plant. Containerized loblolly, slash and shortleaf pines can be planted with the entire root plug placed in the planting hole. The terminal bud is well away from the ground line. Containerized longleaf pines however are planted in the grass stage meaning that you have a root plug, a very short stem and a terminal bud surrounded by the needles. Plant containerized longleaf pine with a small portion of the plug above the planting hole to ensure the terminal bud is above the ground.

The photo shows an example of hand planting hardwood seedlings. Some positive things to notice is only one seedling out of the container, a wide planting bar, seedlings with their roots protected and moist in the bucket.

Some common hand planting errors include:

- Planting the seedling too shallow: The root collar and roots are exposed above the soil drying out the roots.
- Planting the seedling too deep: The hardwood seedlings root collar is 2” or more below the soil surface and loblolly/shortleaf/slash pines terminal bud is within 2” of the ground line while longleaf pines has the terminal bud below the soil line.

- J or U Roots: Roots form a J or U shape from the seedling being pushed into the planting hole resulting in the primary root to point to the side or back upward. This problem contributes to poor root development and seedling problems. (Avoid by making the planting hole a little wider before planting the seedling.
- Seedling too loose: A firm pull on the seedling should not move the plant. The seedling should be packed firmly in the soil.
- Seedling not erect: The tap root should not be planted at more than 30° from perpendicular.

Machine Planting:

Machine planting can be accomplished on areas that have received good site preparation, have little debris remaining on the site; areas that have been windrowed or bedded; old fields or farmland being converted back to forests.

There are many safety concerns to consider during machine planting operations as a person is being pulled behind a tractor or dozer. Some items to consider for safety are how the planter communicates with the tractor operator, first aid kit, personal safety gear, fire extinguisher, etc.

1. Only open enough seedlings to fill the planting box. Keep the seedlings upright with the roots down out of the wind. A little water can be added to the planter box to keep the roots moist.
2. Do not cut or prune the roots.
3. Do not leave unplanted seedlings exposed to sun and wind.
4. Plant seedlings along the contour.
5. Do not plant the seedlings to deep or to shallow, when holding the seedlings and placing them in the planting rip do not release them until the packing wheels start to close the rip. Otherwise the seedlings will drop to deep covering the terminal bud. On the other side, do not pull the seedlings upward as the seedling will be planted to shallow exposing some roots.
6. Periodically check the planted seedlings for firmness or packing, planting depth and number of seedlings per acre.
7. Look for skips in planting as the planter may have difficulty in getting seedlings out of the holding tray.
8. The planting operation needs to occur at speeds where the proper number of seedlings are planted which takes coordination between the operator and planter.

Machine planting is an effective method of planting seedlings if the operator and planter work as a team. The operator has to be constantly aware of the safety hazards and protect the individual riding in the planter.

- With machine planting, make sure the seedling depth is satisfactory and that the seedlings are not leaning due to being dragged by the planter. The seedlings should be upright and firmly packed in the soil.

How many seedlings per acre:

Everyone has their reasons for a particular planting density and spacing. One might want to mow between the planted rows so the rows need to be wider than the available equipment. There are many options available (see Table 1). You can calculate the number of seedlings needed per acre by multiplying the spacing between seedlings, for example (10 X 10 = 100); dividing 43,560 sq ft per acre by the sq ft spacing provides the number of seedlings needed per acre. Our example: 43,560/100 = 436 seedlings per acre. Thus, you can substitute any spacing and determine the number of seedlings needed per acre.

Table 1: Various spacings and initial planting densities for tree seedlings

Spacing (feet)	Square Feet per	Number of Tree/Shrub Seedlings per Acre
5 x 5	25	1,742
6 x 6	36	1,210
6 x 8	48	907
8 x 8	64	680
8 x 10	80	544
10 x 10	100	436
10 x 14	140	311
12 x 12	144	302
12 x 16	192	227
14 x 14	196	222
10 x 20	200	218

Ideally, the planting operation should be checked out by personnel with the Texas Forest Service. However, in some instances the TFS may not be available so an approved Technical Service Provider may be used. Thirdly, NRCS personnel may be used to evaluate the planting operation. If this is the case, here are some tips on checking out a planting job.

How to quickly check behind a planting operation:

What needs to be checked? Proper planting of seedlings – depth and firmness; number of seedlings properly planted per acre.

How many seedlings per acre?

A quick way to determine the number of seedlings planted on an acre is to obtain a cane pole or an extending fishing pole at least 12 feet in length. Mark on either a point at 11’8” long. This distance is equivalent to a 1/100th acre plot radius. Holding the pole over a fixed point and then move the pole around making a circle and count each seedling that is contained in the 1/100th acre plot. Each seedling represents 100 seedlings per acre. For plantings with fewer than 600 trees per acre a 1/50th acre plot may be used (16.7’ plot radius). Sample multiple plots and average the seedlings per acre.

For example: The goal is to hand plant 545 trees per acre (8 X 10) spacing. The planting check found:

Plot 1 = 5 seedlings; Plot 2 = 6 seedlings; Plot 3 = 5 seedlings; Plot 4 = 5 seedlings, you would have 525 seedlings planted per acre. That's the average number of seedlings tallied in the sampled plots. The field measurements are compared against the targeted seedlings per acre and should be within 10% for a satisfactory planting job. The 525 is within the 10% guide for number of seedlings per acre. The question is now how many of the seedlings were satisfactorily planted. From this example, 21 seedlings were located on our 1/100th acre plots so no more than 2 seedlings can be unsatisfactory, if 3 or more are unsatisfactory then the planting will fail.

The following provides a guide in determining number of plots needed per acre by tract acreage:

1 to 60 acres – 1 plot per acre
61 – 90 acres – 1 plot per 2 acres for hand plantings to 5 acres for machine plantings
91+ acres – 1 plot per 3 acres

Tract maps can be created with plots laid out on the proper spacing to fulfill the requirements provided above using newer versions of ArcGIS or other GIS mapping software.
Once at the tract, the inspector should orient their self and use their map to navigate to plot 1.

- Mark the center of the plot with a pin flag
- Using a plot radius tape or device, count and check all seedlings in the specified plot radius.
- Seedlings should be checked for proper planting depth, proper closure of the hole, and proper packing of the seedling in soil. To check that seedlings are properly packed, grab a seedling by 3 to 5 needles and gently pull on the seedling, if the seedling moves up or down then the seedling is not properly packed.
- Results should be documented on the seedling inspection form
- When between plots (i.e. traveling from one plot to the next) carefully dig up two seedlings and check for underground planting problems but properly replant seedlings to maximize survival. **(This is not required for container plantings)**
- Results should be documented on the seedling inspection form
- Continue to next four plots and repeat.
- After plot 5 the inspector will need to calculate the excavation factor. The excavation factor is the percentage of good seedlings being dug up and can be calculated by dividing the number of good trees that have been dug up by the total number of seedlings that have been dug up. (See example below)

Calculating Excavation Factor:
After 5 plots
10 total trees dug up
1 J-root for a total of 9 good out of the 10
Good trees divided by total = percentage or in this case 9 ÷ 10 = 0.90 or 90%

The excavation factor should be calculated after every 5th plot. If at any time during the inspection the percentage falls below 90% the inspector should begin digging up four trees rather than two. While digging up four seedlings, if the percentage rises back above 90% then the inspector may resume digging up only two seedlings.

Once the entire tract has been inspected the inspector should then determine the total trees per acre. The total trees per acre should be within 10% above or below the original planting prescription. Above ground problems should be documented for each plot and deducted from the plot total while below ground problems will be deducted from the total inspection number and both will be used to determine whether the tract passes or fails.

Above ground

1. Examine a planted seedling as it should be planted close to the root collar where it grew in the nursery. For longleaf pine, be sure the terminal bud is not buried and is above the soil line. For other pine species, the root collar can be planted below the soil line but do not cover the terminal bud, in fact it should be 2" or higher above the soil line.
2. For pine species, pull upward on a few needles. If the seedling is planted firmly, the needles should pull off in your hand. If the seedling starts lifting out of the ground, the seedling is not firmly planted. No seedling should be capable of moving up or down easily in a planting hole.
3. Seedlings not firmly planted will dry out in the planting hole and not survive.
4. The main root should be completely below the soil line.
5. For pine seedlings, the green side goes up.
6. For Hardwood seedlings, the root collar should not be more than 2" below the soil line.
7. Hardwood seedlings should be firmly packed in the soil and if pulled on they should not easily move in the planting hole.
8. Be observant in the field, you may find discarded seedlings, piles of roots that have been cut off of the seedlings, unplanted seedling boxes or bags exposed to full sunlight. These are practices that you do not want occurring on your planting site.
9. Spacing – improper spacing will cause either too many or too few seedling per acre.
10. Planting hole not closed up, additional holes created to close the planting hole should be stomped shut.
11. Excessive lean in seedlings.

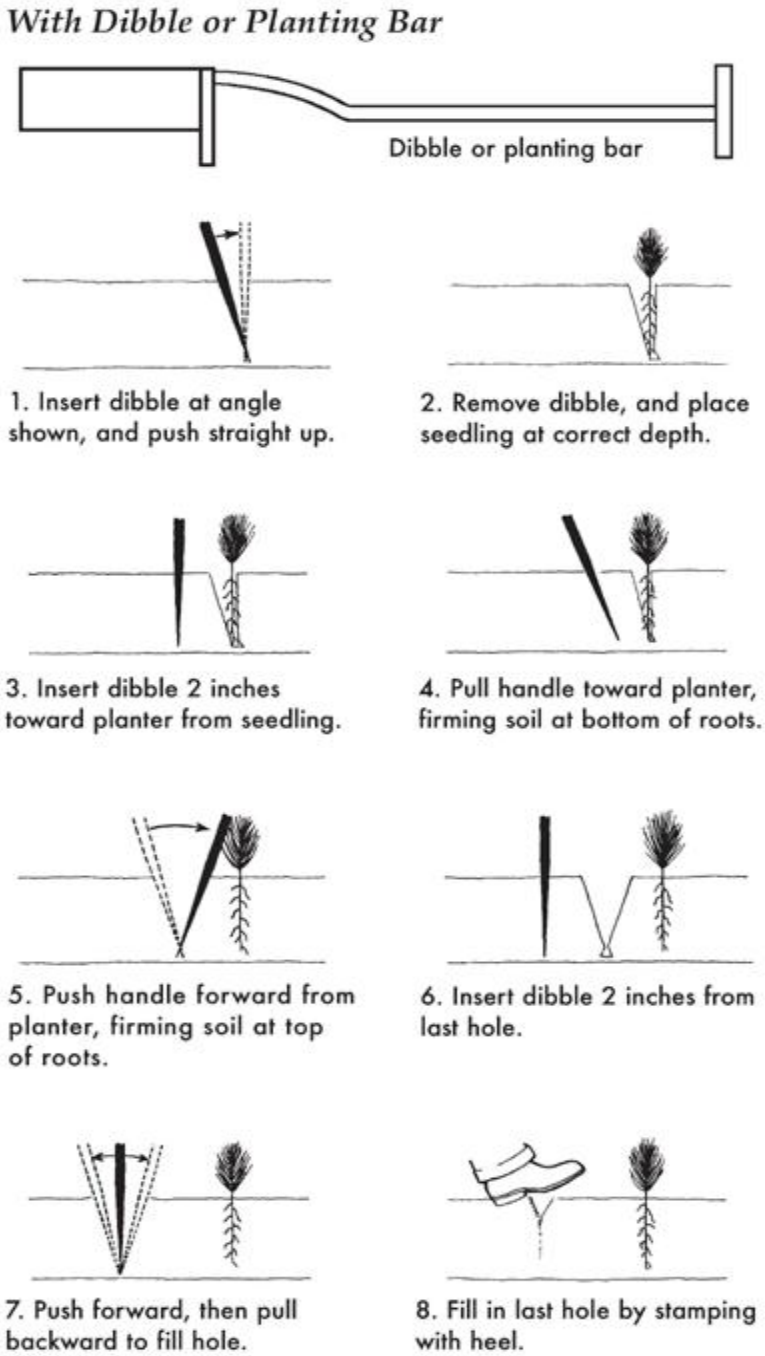
Below ground

12. A few seedlings will need to be dug up to examine for J, L or U roots by using a shovel. Carefully remove the soil and notice the shape of the roots. No more than 10% of all seedlings planted should have J, L or U roots (the primary tap root).
13. Tap root not 5 inches long, the tap root should be a minimum of 5 inches or be culled.
14. Cull seedlings less than 1/8th inches in diameter.

A planting check-out form is available labeled "*planting check sheet*" that you can use to document the planting operation. Ninety percent of the planted seedlings should be satisfactory.

Written by: Williams, Richard, State Forester-Texas NRCS and Shane Harrington, Farm Bill Coordinator, Texas Forest Service.

The following illustration shows the proper hand planting technique:



Machine planting a cut-over site.

Machine planting pine seedlings. (note: the green side is up, nearly straight with the roots below the ground line, minimal soil disturbance)

Planting hardwood seedlings.

Hardwood seedling roots, note where the root was undercut in the nursery, new root growth

WILLIAMS FORESTRY & ASSOCIATES

www.wfatrees.com/turnkey

Williams Forestry & Associates offers Turn Key Services for all types of restoration projects. No matter if it's a Bare Root planting, Containerized planting or a B&B planting. Williams Forestry & Associates has you covered with our turn key services which include the following;

Locating and purchasing of planting stock

Over the 30 plus years we have been in business, Williams Forestry & Associates has created long lasting relationships with quality nurseries all over the east and Mid-Atlantic regions. We have the ability to source your Bare Root, Containerized and B&B planting stock needs. Williams Forestry & Associates also has its own nursery in Chatsworth, GA called Native Forest Nursery.

Bare Root Refrigeration, Storage and Transport to the project site

Once the seedlings are purchased and delivered handling is extremely critical to the health and survival of the seedlings until they are planted. Bare Root seedlings need to be kept moist and in cold storage until they are planted. Here at Williams Forestry & Associates we repack all seedlings the day we receive them. We do this to ensure the seedlings are damp and stored properly, which is one reason Williams Forestry & Associates has a higher survival rate and better quality than other contractors in the industry. We also will transport your seedlings from our depot to your project site in a refrigerated trailer, keeping the seedlings in cold storage until they are ready to be planted.

Containerized and B&B Storage and Transport to the project site

Just like the Bare Root seedlings, Williams Forestry & Associates takes pride in caring for your planting stock. Once we pick up or receive our clients' containerized or B&B planting stock, we immediately start taking care of them. Williams Forestry & Associates has the space and ability to yard tens of thousands of containerized trees and shrubs as well as thousands of B&B trees. Once the planting stock is received, it is inventoried, inspected and marked for each individual project. Next we water-in the containerized stock and continue to monitor their watering needs until they are delivered to the planting site. B&B trees are heeled in with mulch after delivery and watered regularly until they are ready to be transported to the field for planting. Once the project is ready for planting we load all of the containerized planting stock into enclosed trailers or trucks. We use enclosed trailers or trucks to prevent wind shear damage during shipment. The B&B trees are loaded on flatbed trucks or trailers and covered with a landscape tarp to protect the planting stock from wind shear during the delivery from our depot to your project site.

Supply and installation of Protection Devices
No matter the project type or size, Williams Forestry & Associates has the protection devices for a successful establishment of your project.

We can supply Tubex tree shelters and shrub shelters for your bare root and tree band (small containerized) planting projects. We have come to trust the quality and performance of the Tubex brand over all others.
For larger planting stock, Williams Forestry & Associates can provide plastic or metal deer fence enclosures to reduce deer browse and buck rubbing which can be detrimental to your trees.

Systemic repellents is another tool in our arsenal. Williams Forestry & Associates has been working with Repellex for the past 10 years and this product along with the tree shelters and deer fencing provide outstanding results.

For competitive vegetation control we offer 24" Diameter Coco Mats. These Coco Mats provide a natural weed barrier as well as keeping the soil moist. After this mat is installed it has superior water holding capacity due to the natural coco fibers.

Project Logistics
Williams Forestry & Associates prides itself on our ability to coordinate complex operations involving many individuals, facilities and supplies to implement projects smoothly and efficiently. No matter what size project we take the individual care to meet the demands and timelines required for our client's needs. Williams Forestry & Associates will communicate and coordinate with all parties and agencies involved throughout the entire process to insure everyone is aware of the stage and status of the project.

Post Planting Monitoring
After a project has been implemented Williams Forestry & Associates can provide post-planting monitoring if requested. Our staff members can visit the project site once or twice a year to take individual plots and assess the overall survival rates. We will then submit our finding to you along with any suggestions we may have to increase survivability, reduce competitive vegetation and deer and or rodent damage.

Customized Guarantees
Williams Forestry & Assoicates has been offering our clients survival guarantees since 2001. We realize that each project will have its own set of survival requirements and that a PFO wetland will have a longer monitoring period than a riparian buffer. That is why we offer customized guarantees to meet the demands of your projects. We can provide guarantees for 1 year, 3 years or more and from 70-100% survival, depending on the requirements of your individual project needs.

SECTION I-B: SPECIFICATIONS FOR THE ACTIVITY

Contractor shall transport and plant Seedlings as described below.

B-01 Workers, Supervision, and Equipment

Contractor shall provide:

A. A minimum crew size of 12 workers (does not include non-planting foreman), unless otherwise approved by the Compliance Forester;

B. Adequate crew supervision, including at least one qualified non-planting, English speaking foreperson per twelve (12) person crew, unless otherwise allowed by the Compliance Forester. The foreperson must have one season (at least three (3) months) of tree planting experience. Documentation of a foreperson's experience shall be provided to DNR upon request;

C. A vehicle that ensures Seedlings shall be transported to the Unit in a covered, unheated compartment, such as an enclosed truck or pickup with canopy. Tarps are not acceptable covering for transport. Shelving or sufficient floor space shall be available so that containers of Seedlings are not stacked more than five high without intermediate support;

D. Planting shovels for each worker, with minimum blade dimensions of five (5) inches wide and eleven (11) inches long for most Seedlings species. The one exception is that shovel blades shall be at least five (5) inches wide and twelve (12) inches long for red alder Seedlings; and

B-02 Boundaries

The boundaries depicted on Unit Map (Section II-B) delineate the planting area. Contractor is responsible for completing all Work to boundaries. The planting boundaries will consist of easily identifiable features (including but not limited to roads, streams, or abrupt changes in forest type or age). Flagging will be used for areas where identifiable features are absent. Contractor is responsible for understanding the location of all boundaries. Failure to complete Work to boundaries in any Unit renders Work in that Unit incomplete, and no payment will be made to Contractor for any Work on that Unit. No payment will be provided for Unit(s) with Work that extends beyond Unit boundaries. Work extending beyond Unit boundaries will be considered breach of contract. See Clause A-23, above.

B-03 Seedling Supply

DNR will supply Seedlings at the cooler location specified on the map (Section II-D). If DNR's supply of Seedlings is temporarily interrupted, it could cause a delay for Contractor. If needed, the contract may be extended by written agreement to permit completion, or that part of the contract that cannot be completed because of lack of supply will be voided at DNR's discretion.

B-04 Substitution of Type of Seedling Stock Types

If DNR has to substitute Seedlings, adjustment of per acre Bid Price will be made based on the stock type of new Seedlings pursuant to the following schedule:

Seedling Stock Type as Per Bid Invitation	Substitute Seedling Stock Type	Percent Unit Bid Price Adjustment
1+1 or P+1 or P+1/2 Or 2+0 or 1+0 or P+0(> $10in^3$)	P+0 (≤ $10in^3$)	-10%
P+0 (≤ $10in^3$)	1+1 or P+1 or P+1/2 Or 2+0 or 1+0 or P+0 (> $10in^3$)	+10%

Table 1: Substitution of Seedling Stock Types

In the event that more than one stock type of Seedlings are required for a planting Unit, the adjustment in Unit Bid Price will be prorated based on the acreage planted with each stock type. In such cases, the entire Unit will use the adjusted price. However, there will be no price adjustments if substitute Stock Type quantities constitute less than 5 percent of the total trees planted on a Unit.

B-05 Weather Conditions

Planting operations will be halted when the Compliance Forester determines weather conditions are injurious to the Seedlings. Weather conditions during which DNR may not allow planting include, but are not limited to:

A. Air temperature of less than 32 degrees F (32°F) or greater than 65 degrees F (65°F);

B. Wind velocity greater than twenty (20) miles per hour;

C. Soil frozen more than one-half (1/2) inch deep;

D. Snow cover greater than one (1) inch; or

E. Less than 50 percent Relative Humidity (RH)

If any of these conditions exist on the site, the Compliance Forester may direct the foreperson to cease operations until weather conditions improve.

B-06 Seedling Care During Transportation and Handling

Contractor shall transport Seedlings from storage to the Unit(s). Contractor shall comply with all of the following specifications for Seedling care during transportation and handling:

A. Containers of Seedlings shall be carefully handled at all times. No throwing, dropping, crushing, etc.;

B. Containers of Seedlings shall be shaded from the sun with a reflective tarp and shielded from winds. Contractor shall have water available on-site for dipping Seedling roots prior to being placed in the planting bags. At the Compliance Forester's verbal request, Seedling roots shall be moistened with water and/or planting bags lined with damp packing material;

C. Containers of Seedlings shall be stored in a manner that will provide air circulation around each container. When containers are stored in snow banks, snow shall be placed around each container;

D. Seedlings will be distributed to the workers so that no more than one container per Seedling stock type will be open at the assembly point at one time;

E. Opened containers of Seedlings shall be immediately resealed. Contractor shall supply tape and/or stapler to reseal and have them available on the Work site at all times;

F. Seedlings carried by a worker shall be in a planting bag and arranged for easy removal of one Seedling at a time. Planting bags shall not be overfilled. Seedlings should be placed in planting bags without shaking or removing soil from the roots. Seedlings should be placed in the planting bag by cupping the roots and guiding the roots into the bag. Seedlings should not be grabbed at the root collar and stuffed into the planting bag;

G. Seedlings shall not be removed from the planting bag before a planting hole has been prepared;

H. Seedlings shall be planted as received without pruning or culling, unless directed to do so by the Compliance Forester;

I. If mold, dry roots, freezing, drying, or evidence of other injury is observed on any Seedlings, Contractor shall cease planting such damaged Seedlings, and the condition shall be immediately reported to the Compliance Forester. If available, other Seedlings shall be used until the Compliance Forester has decided whether or not the damaged Seedlings can be planted;

J. At the end of the Work day, Seedlings which have been distributed but not planted shall be sealed and returned to the cooler; and

K. Contractor shall keep Seedlings free from damage at all times, including but not limited to: drying, heating, smothering, freezing, drowning, or mechanical injury.

B-07 Spacing and Number of Seedlings

Contractor shall plant Seedlings as follows:

A. Total Seedlings Per Acre

'Total Seedlings per Acre' means the estimated number of Seedlings to be planted per acre, averaged over an entire Unit, or a contiguous area within a Unit. This number varies between Units, and is listed in the Unit Description (Section II-A).

B. Seedlings Per Acre by Species

'Seedlings per Acre by Species' means the number of Seedlings of an individual species to be planted per acre, averaged over an entire Unit, or a contiguous area within a Unit. If only one

species is to be planted over a Unit, or a contiguous area within a Unit, this number is the same as the Total Seedlings per Acre. If multiple species are to be planted over a Unit, or a contiguous area within a Unit, then the sum of all the Seedlings per Acre by Species will equal the Total Seedlings per Acre.

C. **Average Spacing**
'Average Spacing' means the average distance (in feet) between planted Seedlings in the Unit, that will result in the correct number of Total Seedlings per Acre after planting, when Seedlings are planted in a grid pattern. Average spacing may be different for each unit, or for contiguous areas within a Unit, therefore Seedlings will be planted over the Unit at the Average Spacing listed in the Unit Description (Section II-A).

D. **Minimum Spacing**
Seedlings shall not be planted closer together than the Minimum Spacing (in feet) specified in the Unit Description (Section II-A), from:

1. Another Contractor-planted Seedling;

2. An acceptable previously planted Seedling; or

3. An acceptable natural Seedling.

Acceptable previously planted or natural Seedlings are conifer Seedlings which are at least six (6) inches tall, well formed, and vigorous.

E. **Variation to Average Spacing**
The spacing of individual Seedlings may vary within the limits of the Minimum Spacing, so long as average spacing is maintained.

B-08 Line Planting Method
Contractor's planting crew(s) will use the "line" method of planting, unless otherwise permitted by the Compliance Forester. Each worker will only plant one (1) line at a time on each pass. Seedlings planted within each line, and adjacent lines, will both be at the Average Spacing as specified in the Unit Description (Section II-A).

B-09 Satisfactorily Planted Seedlings
Contractor shall plant Seedlings according to all of the following criteria in order for Seedlings to be considered 'Satisfactorily Planted'.

A. **Preparation of Planting Spot**
A 'Planting Spot' is a spot where a Seedling is planted, that meets all the conditions for Preparation, Clearing, and Scalping as described here:

1. 'Preparation' for planting a Seedling shall include the Clearing and/or Scalping to mineral soil to a minimum diameter of one (1) foot located as near the center of the Planting Spot as is practicable.

2. 'Clearing' means the removal of duff up to eight (8) inches deep, loosely compacted slash up to two (2) feet deep, and other debris accumulations such as rock, rotten wood, snow, and ice which can be removed by kicking, dragging, or the use of a planting tool.

3. ‘Scalping’ means the removal of sod and vegetation less than two (2) feet tall with a base diameter of one-fourth (1/4) inch or less.

B. **Unplantable Spots**

An ‘Unplantable Spot’ is a spot that does not meet the conditions for Preparation, Clearing, or Scalping, or is closer than the Minimum Spacing specified in the Unit Description (Section II-A). Examples of spots that are considered ‘Unplantable’ include, but are not limited to, large stumps, boulders, areas of exposed bedrock, sites with large woody brush, and sites with debris accumulations deeper than two (2) feet. Contractor shall not attempt to plant Seedlings in Unplantable Spots.

C. **Planting Hole Location and Excavation**

The planting hole shall be located and excavated as follows:

1. The planting hole shall be located in mineral soil and as near the center of the Planting Spot as is practicable;

2. Where possible, the planting hole shall be located near stumps, logs, dead brush, or other dead shade to provide protection from animal damage, winds, and solar radiation; and

3. The planting hole shall be vertical, broken out on three sides, and shall be wide and deep enough to fully accommodate the roots of the Seedling being planted.

D. **Seedling Placement in Planting Hole**

Seedling placement in the planting hole shall be as follows:

1. All Seedlings shall be suspended near the center of the planting hole with the roots in a near natural arrangement;

2. Seedlings shall be at a depth that after filling, packing and leveling, the soil comes to a point midway between the top lateral roots and the lowest needles or branches;

3. The roots shall not be doubled up, twisted, tangled, or bunched;

4. Moist mineral soil shall be filled in and firmly packed around roots. The Seedling should not pull loose after a firm tug on the main stem; and

5. The planted Seedling shall have the main stem and roots vertical and free to grow.

B-10 Seedling Waste by Contractor

Dumping, discarding, mishandling, damaging, or otherwise wasting Seedlings shall be considered a breach of contract. See Clause A-23, above.

B-11 Special Planting Requirements

A. Starting Date for Work

Contractor shall begin Work on **January 13st, 2014** unless alternative plans are approved by the Contract Manager, or the Compliance Forester anticipates Seedling supply issues (Clause B-03) or unfavorable weather conditions (Clause B-05).

B. Holidays – Work Not Guaranteed

Work is not Guaranteed on the State Holidays of Monday, January 19th and February 16th.

C. Inspection Plots to be Installed by Contractor Foreperson

A Contractor foreperson shall perform at least two Inspection Plots for every five acres of each Unit according to the requirements listed in Clause C-02. The foreperson will perform all the tasks assigned to the Compliance Forester for this clause. The foreperson's Inspection Plots will not replace those of the Compliance Forester, nor will they be used to determine the Seedling Planting Performance Rating for any Unit(s). The foreperson will flag and number each Inspection Plot, and provide completed plot cards to the Compliance Forester, so the Compliance Forester can check the plots.

SECTION I-C: UNIT COMPLIANCE INSPECTION AND PAYMENT

C-01 Field Inspections

The Compliance Forester will conduct periodic inspections. Inspections may be done concurrently with Work but will be completed no later than five (5) business days after Work completion on the Unit.

C-02 Inspection Plots

The Compliance Forester will install Inspection Plots to assess whether Seedlings have been Satisfactorily Planted (Clause B-09) and meet all Special Planting Requirements (Clause B-11, if applicable), according to the spacing and species requirements listed in the Unit Description (Section II-A). Inspection Plots shall be circular and be one fiftieth ($1/50^{th}$) acre in size (16.7 foot radius). There will be a minimum sample of five (5) plots, or two (2) plots for every five (5) acres of Unit, whichever is greater. The Inspection Plots will be well distributed throughout the Unit. The Compliance Forester will record the number of Planting Spots, Seedlings Planted, Satisfactorily Planted Seedlings, Dropped or Wasted Seedlings, and make written comments for each Inspection Plot as described below. In addition to making observations about planted Seedlings, the Compliance Forester may dig up one or more planted Seedlings per Inspection Plot to determine if Seedlings are Satisfactorily Planted.

A. Planting Spots

The number (#) of Planting Spots will be calculated for each Inspection Plot as follows:

# of Planting Spots = # of Expected Planting Spots – # of Unplantable Spots

1. The number of 'Expected Planting Spots' is calculated for each Inspection Plot by dividing the Total Seedlings per Acre (from the Unit Description, Section II-A) by 50 and rounding to the nearest whole number.

2. The number of Unplantable Spots (Clause B-09-B) is calculated for each Inspection Plot by visually estimating the percentage of the area of the Plot that is Unplantable, multiplying it by the number of Expected Planting Spots, and rounding to the nearest whole number.

Example: Total Seedlings per Acre = 500 and 20% of the Inspection Plot is Unplantable.

The number of Expected Planting Spots is:	500 / 50 =	10
The number of Unplantable Spots is:	20% x 10 =	2
The number of Planting Spots is:	10 – 2 =	8

B. Seedlings Planted

'Seedlings Planted' is the number of Contractor-planted Seedlings within the Inspection Plot, including both Seedlings that are Satisfactorily Planted and those that are not. Although this number is not used in the Seedling Planting Performance Rating (Clause C-03), it may be used by the Compliance Forester to demonstrate examples of Unsatisfactorily Planted Seedlings to the Contractor, when the number of Seedlings Planted is greater than the number of Satisfactorily Planted Seedlings.

C. **Satisfactorily Planted Seedlings**

The number of Satisfactorily Planted Seedlings is the number of Contractor-planted Seedlings within the Inspection Plot that meet all applicable specifications of Clause B-09, Clause B-11 , and the Unit Description (Section II-A). This number will be less than or equal to the number of Seedlings Planted because Seedlings that are not Satisfactorily Planted will be deducted. Examples of Seedlings that will not be counted include, but are not limited to, those that have been planted: closer than the Minimum Spacing (Clause B-07-D); without proper Preparation, Clearing, or Scalping of the Planting Spot (Clause B-09-A); or in Unplantable Spots (Clause B-09-B). In addition, planted Seedlings will not be counted if the planting hole has been improperly located or excavated (Clause B-09-C), or if the seedling placement in the hole is inadequate because the roots are damaged or bent, the Seedling is buried too deep, or the soil is not packed firmly around the roots (Clause B-09-D).

D. **Dropped or Wasted Seedlings**

The Compliance Forester will record the combined number of dropped and wasted (as defined in Clause B-10) Seedlings found on the Unit. Such Seedlings can be on individual Inspection Plots, elsewhere in the Unit, or where Seedlings are unloaded prior to planting. Wasted Seedlings include those that are damaged by the Contractor to the extent that they cannot be planted or replanted, due to Contractor's failure to meet the requirements for transportation and handling (Clause B-06), Satisfactorily Planted Seedlings (Clause B-09), or other Special Planting Requirements (Clause B-11, if applicable).

C-03 Seedling Planting Performance Rating

The Compliance Forester will calculate the 'Seedling Planting Performance Rating' for each Unit. The Seedling Planting Performance Rating will be expressed as a percent and will be calculated using the sum (or aggregate) of all Inspection Plots in a Unit. The total of all recorded values for Satisfactorily Planted Seedlings (Clause C-02-C), divided by the total of all recorded values for Planting Spots (Clause C-02-A), multiplied by one hundred (100), equals the Seedling Planting Performance Rating percent:

$$\frac{\text{Total Satisfactorily Planted Seedlings}}{\text{Total Planting Spots}} \times 100 = \text{Seedling Planting Performance Rating \%}$$

C-04 Determination of Payment by Unit

The acceptability and the Rate of Pay for planting Work performed will be based on the Seedling Planting Performance Rating (Clause C-03) for each Unit.

A. **Satisfactory Planting Performance**

'Satisfactory Planting Performance' on the Unit is when the Seedling Planting Performance Rating is between 92 percent and 105 percent.

B. **Unsatisfactory Planting Performance**

'Unsatisfactory Planting Performance' on the Unit is when the Seedling Planting Performance Rating is greater than 105 percent or less than 92 percent, or the Unit is not planted to boundaries.

C. **Rate of Pay**

The 'Rate of Pay' is the actual amount (in dollars) that the Contractor will be paid per acre for each Unit. The Rate of Pay is equal to the Unit Bid Price for Units with Satisfactory Planting Performance. The Rate of Pay is the Unit Bid Price minus any reductions in payment (Clause C-04-D) for Units with Unsatisfactory Planting Performance. The Rate of Pay will not exceed the Unit Bid Price for any Unit.

D. **Reduction in Payment**

The reduction in payment for Unsatisfactory Planting Performance on a Unit will be calculated for the Unit as follows:

1. If the Seedling Planting Performance Rating is less than 92 percent but equal to or greater than 80 percent, the Rate of Pay will be equal to the Unit Bid Price reduced by 3 percent for every 1 percent the Seedling Planting Performance Rating is less than 92 percent.

2. If the Seedling Planting Performance Rating is less than 80 percent, or if the Unit is not planted to boundaries, there will be no payment.

3. If the Seedling Planting Performance Rating is greater than 105 percent, the Rate of Pay will be equal to the Unit Bid Price reduced by 3 percent for every 1 percent the Seedling Planting Performance Rating is above 105 percent.

4. The Contract Manager will deduct from Contractor's payment three dollars ($3) per Seedling found dropped or otherwise wasted by Contractor (Clause C-02-D).

C-05 Payment Examples

Example A: The Unit Bid Price is $40 per acre and the Seedling Planting Performance Rating is 87 percent.

The Seedling Planting Performance Rating of 87 percent is 5 percentage points less than the 92 percent minimum performance threshold. A 3 percent reduction for each of the percentage points below that threshold equals a total reduction in the Unit Bid Price of 15 percent. Therefore, 100 percent minus 15 percent equals 85 percent. The Rate of Pay for the Unit is calculated by multiplying 85 percent by $40/acre = $34.00/acre.

Example B: The Unit Bid Price is $65 per acre and the Seedling Planting Performance Rating is 107 percent.

The Seedling Planting Performance Rating of 107 percent is 2 percentage points greater than the 105 percent maximum performance threshold. A 3 percent reduction for each of the percentage points above that threshold equals a total reduction in the Unit Bid Price of 6 percent. Therefore, 100 percent minus 6 percent equals 94 percent. The Rate of Pay for the Unit is calculated by multiplying 94 percent X $65/acre = $61.10/acre.

C-07 Re-work of Unsatisfactory Units

The Compliance Forester may require Contractor to re-work a Unit that has an Unsatisfactory Seedling Planting Performance Rating (Clause C-03). The Compliance Forester may require the re-work to be completed prior to starting Work on a new Unit. The Compliance Forester will

take new Inspection Plots and calculate a new Seedling Planting Performance Rating for re-worked Units, which will replace the previous Seedling Planting Performance Rating.

If Contractor refuses to re-work the Unit, DNR may then pursue its available remedies for either breach (Clause A-23) or default (Clause A-24) of contract. If Contractor re-works the Unit and it is rated unsatisfactory a second time, DNR may consider this breach or default of contract.

The Compliance Forester is not required to give Contractor the opportunity to re-work Unit(s) with Unsatisfactory Seedling Planting Performance Ratings (Clause C-03). In some cases, DNR may not have the additional staff needed to perform contract compliance for such re-work, and Contractor's overall performance on this contract may indicate that Contractor will be unable to improve the quality of Work enough to justify the additional time and expense of re-working Unit(s). In these cases, the Compliance Forester may choose to simply calculate the correct reduction in payment in accordance with Clause C-04-D and allow Contractor to continue Work on other Unit(s).

C-08 Payment Schedule

Details of the payment schedule will be discussed in the Pre-Work Conference (Clause A-19) and will be set forth in the Work schedule. Payment shall be made as follows:

A. **L&I Insurance Premiums**
DNR shall retain ten percent (10%) of all payments due to Contractors who hire workers as security for Labor & Industries industrial insurance premiums owed for its workers. After completion of the contract, and upon determination that Contractor has met all financial obligations for industrial insurance premiums related to the contract, the 10% retainage will be returned to Contractor.

B. **Partial Payment**
Contractor may request partial payment when part of a Unit is completed.

C. **Unit Completion Form**
Contractor or Designated Contract Representative shall sign the Unit completion form after completion of each partial Unit being submitted for payment, or at the conclusion of Work and completion of the Compliance Inspection for each Unit. The Compliance Forester will make payment recommendations for the invoice and forward the Unit completion form to the Contract Manager for processing.

D. **Verification Traverse**
If a Unit's acreage is disputed, Contractor may request a verification traverse by DNR. The request must be in writing and signed by Contractor. DNR will base the rate of pay on the acres determined from the verification traverse. If the net acres specified in the Unit Description (Section II-A) are correct within plus or minus five percent (±5%) after the verification traverse, Contractor shall pay for the verification traverse at a rate of ten dollars ($10.00) per one hundred (100) feet of traversed boundary.