DEPARTMENT OF NATURAL RESOURCES

Assessing the Former General C.C. Andrews State Forest Nursery to Produce Conservation Grade Container ("Plug") Seedlings

01/15/2025

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Statutory Reference

Laws of Minnesota 2024, Chapter 116, Section 3, Subdivision 4:

$200,000 the second year is from the heritage enhancement account in the game and fish fund to the commissioner of natural resources to prepare and submit a report on reopening General C.C. Andrew State Forest Nursery to provide conservation-grade container seedlings to meet the state's reforestation needs. The report must be submitted to the chairs and ranking minority members of the legislative committees and divisions with jurisdiction over environment and natural resources by January 15, 2025, and include funding recommendations and any statutory changes necessary to reopen the nursery and produce the seedlings. This is a onetime appropriation.

Contents

Executive Summary

This report fulfills the requirements of Laws of Minnesota 2024, Chapter 116, section 3, subdivision 4, which required the Minnesota Department of Natural Resources (DNR) to prepare and submit a report on reopening the former 266-acre site at the General C.C. Andrews (GA) State Forest in Willow River, Minnesota, to produce containerized seedlings, often referred to as "plug seedlings." Currently, no private or public nursery in Minnesota produces enough plug seedlings to meet the State of Minnesota's reforestation needs.

Aptly named, plug seedlings are gown in a greenhouse and transplanted with a soil plug surrounding their roots. This contrasts with "bareroot" seedlings, which are grown outdoors for two to three years depending on the type of seedling, harvested (or "lifted") when dormant, and transported without soil (i.e., with bare roots) to the planting site.

The State Forest Nursery system currently only produces bareroot seedlings, which are grown at the State Forest Nursery facility at Badoura. Plug seedlings can have better survival rates after planting than bareroot seedlings and are strongly preferred for some site conditions. The DNR, as well as counties and nonprofits in Minnesota, currently purchase plug seedlings to supplement bareroot seedling planting efforts. Today, most plug seedlings used in Minnesota are purchased from one Canadian company with a nursery in Michigan. This includes the roughly 650,000 plug seedlings the DNR plants each year. Adding plug seedling production to the State Forest Nursery would reduce DNR's dependence on a single, out-of-state commercial grower.

The GA facility ceased operations as a bareroot tree seedling nursery in 2013 and now houses several other DNR programs. The site retains ample space for constructing and operating nursery greenhouses and buildings for plug seedling production. Some original structures and resources remain on site and could be reconditioned or repurposed to support plug seedling production; however, a substantial financial investment would be needed to construct new buildings and purchase equipment necessary for a fully functional operation.

This report includes a brief assessment of factors regarding locating a plug facility at GA, current uses of the site, and existing building conditions and locations. Based on this information, DNR determined a plug seedling facility could be built at GA. Preliminary estimates of the construction and initial equipment costs necessary to establish a plug seedling facility were also developed; these total $25 to $30 million (in 2024 dollars). Considerable additional evaluation of comparative costs, workforce availability, transportation pathways, and other considerations would be needed to determine the optimal location for a State Forest Nursery plug seedling facility (e.g., at GA, Badoura, or another location).

In the right location, the addition of a modern plug seedling facility to the State Forest Nursery system will help ensure the future of our forests by providing high-quality, Minnesota-grown plug seedlings for the state's reforestation and conservation needs. It is also important to note that no one facility is expected to fully meet the demand for plug seedlings in Minnesota. Given that approximately 2 million plug seedlings currently are planted in Minnesota each year, and that number is projected to increase, additional plug seedling production also is needed at Tribal and private nursery facilities.

Introduction

The Minnesota Department of Natural Resources (DNR) State Forest Nursery program has been essential to reforestation efforts since 1933. To date, more than one billion State Forest Nursery-grown tree and shrub seedlings have been planted on public and private lands across Minnesota.

The conservation-grade, bareroot seedlings currently produced by the State Forest Nursery at Badoura are an important part of forest management in Minnesota. They are used to quickly establish forests after large-scale disturbances such as wildfires, windstorms, insect and disease outbreaks, and timber harvest. They are also used to re-establish forests on idled, open lands that were once converted to other uses such as row-crop agriculture or pasture.

The DNR's conservation-grade seedlings differ from the landscape-grade trees produced by many private nurseries. Conservation-grade seedlings are smaller (5-12 inches long), which makes them easier to plant in large quantities. They are produced from seed collected in Minnesota, thereby helping preserve and promote local genetic diversity and ensure the trees will grow where they are planted.

Currently, the DNR only grows bareroot seedlings at the State Forest Nursery facility in the Badoura State Forest near Akeley, Minnesota. Many forest landowners and managers, including the DNR, also rely on plug seedlings (also known as "containerized seedlings") to help meet planting needs. Plug seedlings are grown in a greenhouse and are transported and planted with a soil plug surrounding their roots. Plug seedlings can have better survival rates after planting and are strongly preferred over bareroot seedlings for some conditions.

For the last few years, the DNR has noted in our annual State Forest Nursery Program Report to the legislature that adding plug seedling production to the program would reduce Minnesota's current dependence on a single, out-of-state commercial grower and help ensure the state has the seedling stock needed for reforestation and climate mitigation efforts. In 2024, the Minnesota Legislature provided funding and direction to the DNR to assess the feasibility of reopening the former General C.C. Andrews (GA) nursery site for containerized (plug) seedling production, as follows (Laws of Minnesota 2024, Article 1, section 3, subdivision 4):

> **Subd. 4. Report on Reopening General C.C. Andrews State Nursery** $200,000 the second year is from the heritage enhancement account in the game and fish fund to the commissioner of natural resources to prepare and submit a report on reopening General C.C. Andrews State Nursery to provide conservation-grade container seedlings to meet the state's reforestation needs. The report must be submitted to the chairs and ranking minority members of the legislative committees and divisions with jurisdiction over environment and natural resources by January 15, 2025, and include funding recommendations and any statutory changes necessary to reopen the nursery and produce the seedlings. This is a onetime appropriation.

This report fulfills the legislative directive, providing an initial feasibility assessment and cost estimate to establish a plug seedling facility at GA. It also outlines key factors that should be considered to determine the best location for a plug seedling facility, including operating costs, access to labor and technology, and distribution routes.

Background on the General C.C. Andrews Nursery Site

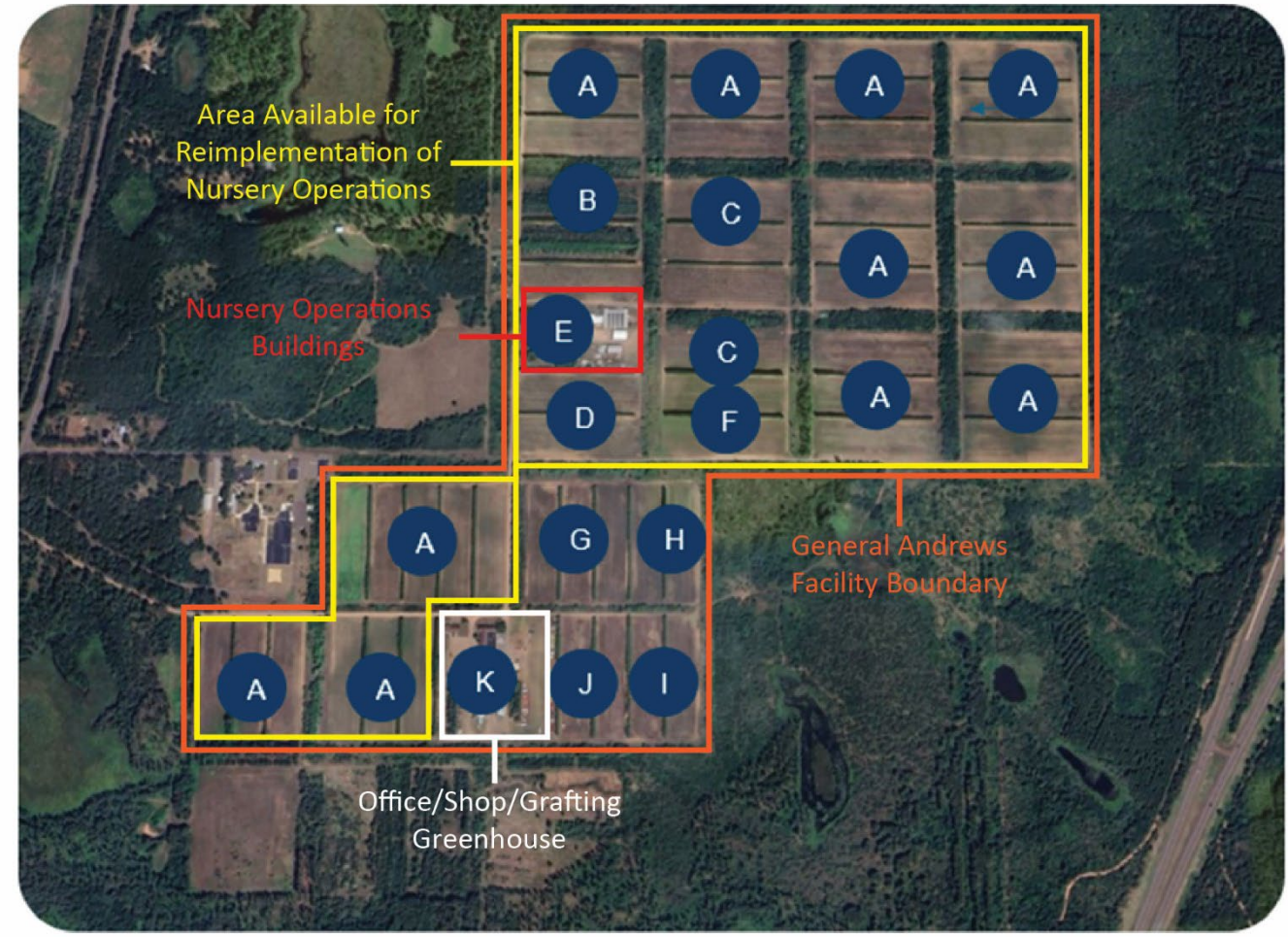
GA was built in 1939 by the Civilian Conservation Corps as the state's second seedling production site for reforestation. Located in the General C.C. Andrews State Forest, near the town of Willow River in the east-central region of the state, GA covers approximately 266 acres. It supplemented the Badoura State Forest Nursery site located near Akeley in the north-central part of the state. The DNR produced a wide variety of bareroot deciduous and coniferous seedlings at GA while it was operational, between 1939 and 2013. Those seedlings were sold to public, nonprofit, Tribal, and private customers for reforestation and conservation efforts. GA was operated exclusively as a seedling production facility until 2013. Legislation passed in 2011 limited new plantings at the Badoura facility to stock for research or use on public lands or private conservation lands with permanent protection, and directed the DNR to create a plan for nursery operations at the Badoura site and provide alternative options for the GA site (Laws of Minnesota 2011, 1st Spec. Sess., Chapter 2, Article 4, section 30). This ultimately led to the cessation of seedling production at GA. Of note, the limitation on new plantings at the Badoura facility was repealed in 2013.

During its operation as a seedling nursery, the soils and terrain at GA were intensely managed for seedling production. When the DNR stopped growing bareroot seedlings at the site, staffing was reduced, buildings were vacated, and nursery equipment was repurposed to the Badoura site or sold. Many of the idled fields were planted to prairie grass to mitigate invasive species, brush intrusion, and wind erosion. Since the cessation of seedling nursery operations, some areas of GA have been repurposed and several DNR programs now use parts of the site and buildings. There are still large sections of the site that are currently not in active use. Figure 1 provides an aerial view of the site, highlighting current usage and areas available for future re-use. Below are the major uses of GA today.

- **Seed Procurement program –** The DNR uses about 13 acres of former GA nursery beds to manage trees to produce seeds. It also maintains a small grafting greenhouse onsite. Large quantities of seed are needed to reach the DNR's seedling production goal of 10 million trees per year. To support this goal, the DNR has recently established a seed procurement program and hired a seed procurement consultant to work out of the GA location. Work is also continuing to convert more of the former nursery beds at GA into seed orchards to help ensure the availability and quality of Minnesota-sourced, climate-adapted seed.
- **Fire program –** The previous nursery mechanics shop and surrounding grounds are currently used to store and repair firefighting equipment the DNR makes available to rural fire departments as part of the Federal Excess Property Program. A building has been repurposed as classroom for state agencies, counties, Bureau of Indian Affairs, universities, Tribes, and others involved in wildfire suppression and prevention. Lastly, a helicopter landing pad supports wildfire suppression activities.
- **Office Space –** Ten DNR staff who work in the areas of fire prevention and suppression, seed procurement, wood utilization and marketing, and fiscal and accounting are currently officed at GA.
- **Other GA Uses –** The University of Minnesota conducts research for the Minnesota Tree Improvement Cooperative at this site. Two fields are currently being used for a natural knapweed control study, a collaboration between the DNR's Terrestrial Invasive Species Program and the University of Minnesota. The DNR Enforcement Division also uses the site for shooting range training and warehouse storage.

Approximately 60% of the original 266-acre GA site is not currently in use by the DNR or others (see Figure 1). About 210 acres could be used to support seedling production or additional seed orchard activities (highlighted in yellow on Figure 1). That area includes a well with an irrigation pump and an indoor storage space. A refrigerated storage cooler building, built in 2007, is located near the original seedling packing and shipping area. The cooler and many other buildings have been empty and unused since 2013. This general area could be used to build a new plug seedling facility and capitalize on some of the existing infrastructure.

Figure 1. *General Andrews Site Plan.*



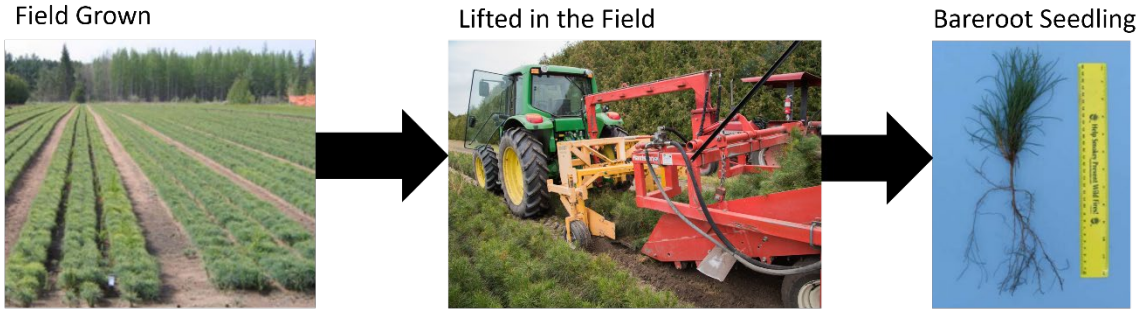
A. Open/available orchard
B. Prairie crabapple orchard
C. White spruce orchard
D. White pine orchard
E. Nursery operations buildings
F. Jack pine orchard
G. Proposed wildfire helipad
H. Knapweed testing
I. Enforcement shooting range
J. ATV training
K. Office/shop/grafting greenhouse area

The Need for Minnesota-Grown Bareroot and Plug Seedlings

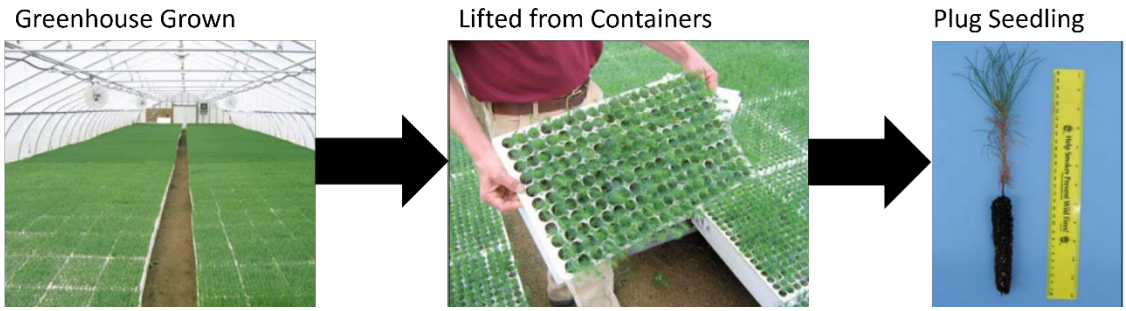
Both bareroot and plug seedlings are needed to support reforestation and conservation in Minnesota. Bareroot seedlings are grown in outdoor fields. After two or three years, they are lifted from the ground when the soil is not frozen, but while the trees are dormant. These dormant seedlings have the soil separated (or gently shaken) from the roots making them lighter and less bulky for shipping.

Plug seedlings are grown indoors in an environmentally controlled greenhouse where fertilizer, temperature, lighting, and water are all automated. After one year these seedlings, with soil plug still attached, are removed from the greenhouse and packaged for shipping. Year-round greenhouse operations support a longer window to lift and distribute seedlings across the state.

Bareroot seedlings grown in an outdoor bed, lifted without soil



Plug seedlings grown indoors, lifted from containers with a soil plug



The reduced size and weight of bareroot seedlings eases packing, shipping and moving the seedlings into reforestation sites. Public land managers use bareroot seedlings because thousands can be planted quickly by skilled contract labor crews over large areas. Private landowners often plant smaller areas for windbreaks or wildlife habitat where lower quantities of larger bareroot seedlings perform well. Bareroot seedlings typically require fewer inputs and cost less to produce than plug seedlings.

Plug seedlings are packed, shipped, and planted with roots protected in moist soil, which improves survivability in shipping, reduces planting shock, and promotes more rapid growth. These advantages can significantly aid survival during periods of drought, on sites with thin soils over bedrock, or in places with a lot of weed competition. Since plug seedlings all have a small, uniform soil and root plug, some people who plant trees find them quicker to plant.

Key Benefits That Plug Seedlings Bring to Minnesota Forests

Bareroot seedlings alone cannot meet the reforestation and conservation needs of Minnesota today or in the future. To ensure forests in our future, Minnesota needs the versatility of both bareroot and plug seedlings. Bareroot production provides a cost-efficient, lower-investment option to supply many millions of seedlings annually. However, the tight labor market for planting contractors, coupled with the short spring window to lift and ship seedlings before they break dormancy, means there is a limit to the number of bareroot seedlings that can be planted each year.

Plug seedlings are more easily stored, which helps extend the planting season and allows land managers to avoid planting in conditions that reduce survival rates, an option that is becoming more important in the face of more frequent extreme-weather events. The following are additional benefits of adding a plug seedling facility to the State Forest Nursery Program:

- **Mitigate unexpected weather impacts.** Bareroot seedlings grown in fields are susceptible to storms, hail, drought, insect infestation, and diseases. Winters with little or no snow can cause seedlings to dry out (winter burn). Unpredictable spring thaws can disrupt lifting operations and increase seedling mortality. Greenhouse-grown plug seedlings provide enhanced reliability because they are raised in controlled conditions.
- **End dependance on a single, out-of-state vendor.** The DNR, as well as counties and nonprofits in Minnesota (such as The Nature Conservancy), currently purchase plug seedlings to supplement tree planting efforts. Over the past decade Minnesota's private nurseries have moved away from production of conservation-grade plug seedlings. Today, most plug seedlings used in Minnesota are purchased from one Canadian company with a nursery in Michigan. For several years, the DNR has advertised requests for bid to private, Minnesota nurseries to increase and diversify the supply of plug seedlings, to no avail. Relying on one out-of-state source for plug seedlings increases the risk of price increases and supply limitations, especially in years when natural disasters impact existing bareroot stock. Adding plug seedlings to the State Forest Nursery program would alleviate some of this risk.
- **Enhance seedling diversity.** As climate change continues to affect natural systems, including how well and where certain tree species grow, forest managers will need tools and options to adapt future forests to new climatic conditions. The shorter growing period and more controlled environment of a plug seedling facility allows nurseries to fine-tune production of tree species and genotypes that are better adapted to the changing climate. For example, using seed sourced in the southern part of the state produces seedlings more able to thrive in warming northern regions.
- **Use seed more efficiently.** Growing seedlings in greenhouses under controlled conditions ensures a better seed germination ratio. This helps address challenges in tree seed supply.
- **Produce more deciduous seedlings.** The demand for climate-adapted deciduous species (e.g., maple, hickory, oak) is projected to increase sharply across Minnesota. The Nature Conservancy (TNC) has identified a goal of reforesting 1 million acres of new forest in Minnesota by 2045 to help mitigate climate change. This would require a more than 8-fold increase in tree planting over current levels. Most (90%) of the reforestation opportunities exist on private lands in parts of Minnesota where deciduous tree species are dominant, which means more deciduous seedlings will be needed for reforestation. Current private and State Forest Nursery bareroot production cannot provide enough deciduous seedlings to meet the projected demand. Further, some deciduous seedlings are difficult to grow in outdoor fields. Adding plug seedlings to the State Forest Nursery program would help meet the growing

need for deciduous species by increasing the overall seedling production capacity and increasing the "in-nursery" survival rate of more sensitive deciduous seedlings.

- **Improve regeneration on difficult sites.** Plug seedlings are critical for maintaining forest on thousands of acres of challenging planting sites where bareroot seedlings have a high risk of mortality, such as areas where there is a thin soil layer over bedrock, or significant weed competition. Keeping forest lands forested is a key objective outlined in the 2023 DNR report to the legislature titled, "Forests and Carbon in Minnesota: Opportunities for Mitigating Climate Change."

Plug Seedling Facility Requirements

A plug seedling production facility requires several key components to plant, grow, lift, pack, and ship seedlings:

1. A large greenhouse(s) with light, temperature, humidity, and water controls.
2. A large, heated building for filling growing containers with soil and seed, and sorting, grading, packing, and shipping the seedlings.
3. Electrical generators for emergency power.
4. A large, paved area for preparing (hardening off) seedlings to transition from the greenhouse to outdoor planting.
5. A large, refrigerated building to store seedlings prior to shipping to prevent spoilage.
6. Storage space for trucks, conveyors, soil mixers, growing containers, and other equipment.

While GA has several attributes making it a reasonable potential location, the DNR would need to evaluate other sites in order to identify the state's best option for developing a plug seedling production facility. Costs and efficiency can vary significantly depending on the site. Key factors to consider in selecting an optimal location include:

- **Transportation.** A plug seedling facility is part of a larger supply chain bringing in seed, soil, fertilizer, equipment, and other materials while shipping out perishable seedlings. A facility should have good access to major highways and proximity to planting sites.
- **Availability and condition of existing buildings**. Some locations, such as GA and the Badoura State Forest Nursery site, have existing buildings for cold storage, packing, and equipment storage. Existing buildings of acceptable size and condition could be reused to reduce construction costs.
- **Redundancy.** Locating a plug seedling facility on a site that can also be used to grow additional bareroot seedlings could help avoid the risk of a crop failures at a single site.
- **Labor availability.** Nurseries compete for seasonal labor during spring planting and lifting. A location closer to larger urban areas may help attract and retain qualified staff. Selecting a greenhouse location will require additional labor analysis.
- **Access to water and energy.** Nursery operations use large volumes of water. Existing wells can reduce initial start-up costs. Greenhouses use a lot of energy for heating during the spring and fall to extend the growing season. Availability of geothermal, solar, and traditional sources of energy must be considered when selecting a location.

Feasibility and Estimated Cost of Repurposing the GA Facility for Plug Seedling Production

As a former State Forest Nursery facility, GA's grounds and buildings have been specifically designed and arranged for growing seedlings. The site retains ample space for constructing and operating greenhouses and other buildings for plug seedling production. An existing refrigerated storage building on site could be repurposed for use in a plug seedling operation. Further, the site has access to water and energy, and there is the potential to attract workers from nearby communities. In light of this, the DNR determined that it would be feasible to construct a plug seedling facility at GA. As explained in the preceding section, this is not the same as determining that GA would be the optimal location.

If GA is determined to be the optimal location for a plug seedling facility, the DNR has identified the area north of the original nursery buildings as the best site (see Figure 1, Area E). To estimate the cost of construction, the DNR assumed a seedling production goal of 1 million plug seedlings annually once fully operational, which is the average amount of plug seedlings the DNR is projected to need each year. This translates to a 65,000 square foot greenhouse building.

Figure 2 shows the location of the existing nursery buildings and the potential location of the buildings that would be needed for a plug seedling facility. Each location identified in Figure 2 is further described on the next page.

Figure 1*2. Close-up view of existing nursery buildings at GA (Area E from Figure 1) with potential new plug-seedling facility components (brown polygons) superimposed.*

Location 1

- New 65,000 square foot container seedling greenhouse(s) facility and concrete grow-out area for hardening the seedlings.

Location 2

- New 1,800 square foot grafting greenhouse.

Location 3

- New 2,500 square foot container packing/storage building.

Location 4

- New 10,000 square foot packing and refrigerated storage (graded seedlings) building. Current packing house would need to be demolished.

Locations 5 and 6

- Current metal storage building and loading dock. Retain and update as needed.

Location 7

- Current refrigerated storage building. Retain.

Location 8

- New storage/shop building to accommodate nursery field equipment and maintenance requirements. Current pole shed storage building at this location would need to be demolished

Location 9

- Current yard storage

Preliminary Construction Cost Estimate: $23,000,000 to $27,500,000

The preliminary construction cost estimate for establishing a plug seedling facility at GA includes the costs of site prep/demolition, design fees, construction contingencies, new building construction, deferred maintenance on existing retained buildings, one-time information technology installation, and other items.

Preliminary Equipment Needs Estimate: $2,000,0000 to $2,500,000

A preliminary estimate for initial equipment needs is not included in the construction cost estimate. These needs include soil/fertilizer mixing equipment, well upgrade or installation, water treatment, container packing/cleaning equipment, conveyors, transplanters, seedling plug extractors, and other equipment.

Total Preliminary Estimated Construction and Equipment Costs: $25,000,000 to $30,000,000 (2024 dollars)

Summary

As investments are being made in tree nurseries across the country to expand forest cover for carbon sequestration and storage along with other forest benefits, Minnesota has an opportunity to develop a plug seedling facility to support our reforestation activities. While much needed upgrades are occurring at the State Forest Nursery facility at Badoura to increase bareroot seedling production, plug seedlings offer a critical element missing within our system to ensure Minnesota's future forests. Over the past decade Minnesota's private nurseries have moved away from production of conservation-grade plug seedlings. Published contract bid requests to purchase plug seedlings from private vendors in Minnesota have not attracted the local production needed to meet the State of Minnesota's reforestation needs.

If a decision is made to expand the State Forest Nursery program to include plug seedling capabilities, several key factors need to be considered in evaluating site options. These include, but are not limited to, transportation access, existing buildings, labor availability, access to water and power, and long-term operational and delivery costs.

The former General Andrews nursery site meets many of the requirements needed for a plug seedling facility. It has available space for expansion, has some existing supporting infrastructure such as refrigerated storage and wells, and is currently the DNR site for seed procurement activities. These attributes make it a feasible location. This is not the same as determining that GA would be the optimal location, however. Considerable additional evaluation of comparative costs, workforce availability, transportation pathways, and other considerations would be needed to determine the optimal location for a State Forest Nursery plug seedling facility.

This report outlined the construction and equipment that would be needed to implement plug seedling production at GA. Overall, DNR's preliminary estimate for construction and equipment costs falls within the range of $25-$30 million (2024 dollars). This information is specific to the GA location and would not necessarily be the same at other locations. Costs and long-term operational efficiencies are highly variable among potential sites.

The DNR considers plug seedlings a vital component of our future forests. The need for plug seedlings and the benefits of expanding the State Forest Nursery operations to include plug seedling production has been outlined in this report and in the annual State Forest Nursery Program legislative reports for the last five fiscal years (see Legislative Reports | Minnesota DNR). The DNR looks forward to working with policy makers, partners, and stakeholders to explore opportunities for the most effective location for such a facility and strategies for resourcing this need.

Appendix A – Existing Nursery Facilities Use and Conditions

Metal Storage Building & Loading Dock (Figure 2, Locations 5 & 6)

Building Information:

- Built 1986
- 4,400 SF
- Condition: Fair

Current Use & Considerations:

- Space currently occupied by Enforcement
- The loading dock ramp has been gravel filled
- Various repairs needed
- Recommendation: Retain for future use and refurbish the loading dock

Old Seedling Packing House (Figure 2, Location 4)

Building Information:

- Built 1956
- 12,450 SF
- Condition: Poor

Current Use & Considerations:

- Being used for some storage
- Recommendation: Tear down and build new.

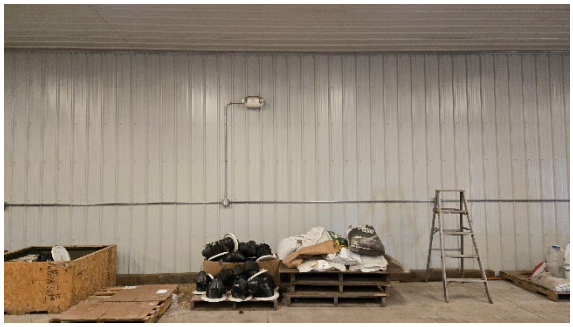
Refrigerated Storage Building (Figure 2, Location 7)

Building Information:

- Built 2008
- 2,895 SF
- Condition: Excellent

Current Use & Considerations:

- Being used for some existing cones and seed storage
- Replace vinyl door strips/curtains.
- Have cooling system tested for any deficiencies and proper balancing.
- Upgrade lighting to LED as required.
- Clean concrete floor.
- Maintain landscape around the building.
- Recommendation: Retain.



Pole Shed Storage (Figure 2, Location 8)

Building Information:

- Built 1976
- 3,200 SF
- Condition: Crisis

Current Use & Considerations:

- Used for storage
- Recommendation: Tear down and build new.

Grafting Greenhouse (Figure 1, K)

Building Information:

- Built 1975
- 1,820 SF
- Condition: Fair

Current Use & Considerations:

- Lighting, humidity control, HVAC, irrigation fixtures and controls need replacement.
- Exterior of the building needs replacement.
- Ideal location with main nursery operations.
- Recommendation: decommission and build new on main nursery operations site.