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Interpreting the History of the Hugo Sauer Nursery and the Rhinelander Research Field Laboratory

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Abstract

This report presents a comprehensive history of the Hugo Sauer Nursery and the USDA Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies located near Rhinelander, Wisconsin from 1931 to 2023. It details the evolution of the nursery, which started as a Depression-era federal nursery created to reforest the national forests in the upper Midwest, became a state-operated nursery leased by the Wisconsin Conservation Department, and transformed into an experimental testing ground for cutting-edge forestry research. The establishment of the Institute of Forest Genetics adjacent to the nursery in 1957 initiated a new era of valuable genetic and physiological forestry research. As new challenges arose, the laboratory expanded its research programs to meet the needs of foresters and ecosystem managers, becoming the Forestry Sciences Laboratory in 1978 and the Institute for Applied Ecosystem Studies in 2007. The report documents the significant research programs conducted at the laboratory over the decades, which have impacted and continue to impact natural resources management on a national and international level.

Keywords: Hugo Sauer Nursery, Rhinelander Nursery, Institute of Forest Genetics, Forestry Sciences Laboratory, Institute for Applied Ecosystem Studies, Northern Research Station, Civilian Conservation Corps, Rhinelander, Wisconsin, history, interpretation, research

Cover Photograph: Civilian Conservation Corps enrollees seeding red pine at the Hugo Sauer Nursery in October, 1939. Photograph courtesy of the Forest History Society, Durham, NC.

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Contents

Background and Objectives

In 1996, in compliance with federal statutes and regulations (e.g., 36 CFR 800, Protection of Historic and Cultural Properties), the Hugo Sauer Nursery property was formally evaluated to determine whether it met National Register of Historic Places (NRHP) eligibility criteria. The Wisconsin State Historic Preservation Officer (WISHPO) concurred that the entire 79-acre property, including the original buildings, structures, objects, and cultural landscape elements, were part of an eligible historic district (Bruhy 2002, McKay 1996).

The Forest Service, an agency of the U.S. Department of Agriculture, has determined that future management goals are incompatible with maintaining the site's historic values. To this end, a mitigation plan needed to be developed in consultation with WISHPO that included historical documentation and interpretive products to share the site's history with the public.

In 2018, interpretive consultants from the University of Wisconsin-Stevens Point were contracted to identify and document the significant history, historical context, and contributions of the Hugo Sauer Nursery and the associated USDA Forest Service field laboratory.

The objectives of the historical research are to:

1. Provide documentation that satisfies the mitigation requirements of WISHPO to redevelop portions of the Hugo Sauer Nursery site.
2. Create educational opportunities for residents, visitors, and students, which includes the development of interpretive media and programming that will enhance outreach efforts by the Forest Service.

From 2018 to 2023, the consultant team collected historical information through oral interviews with past and current employees of the nursery and lab, research of primary and secondary documents (research reports, newspaper articles, organizational directories, photographs), site visits (nursery and lab, regional and statewide historical societies and museums), and present-day photographic documentation.

The results of this research have been compiled and are presented as a chronological narrative in this report. This information was used as a foundation to develop interpretive media and programs that share the significant stories of the Hugo Sauer Nursery and the Rhinelander field laboratory.

Introduction and Timeline

The Hugo Sauer Nursery and the adjacent Rhinelander research field laboratory (today called the USDA Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies) have been integral to the success of reforestation efforts in the northern Lake States by improving forestry practices and leading forest genetics and landscape ecology science throughout the world.

Table 1 is a timeline of significant events related to the nursery and field laboratory. From 1931 to 1950, the Forest Service operated the nursery, which produced 200 million seedlings planted primarily in national forests throughout the northern Lake States. The Wisconsin Conservation Department (now the Department of Natural Resources) leased the nursery from the federal government in 1951 and continued to operate it until 1974, producing another 74 million seedlings for farmers, private landowners, industrial plantations, and state forest lands. Management of the nursery land was then returned to the Forest Service.

In 1957, the Forest Service Northern Institute of Forest Genetics was opened adjacent to the Hugo Sauer Nursery. It provided leading-edge research in the fledgling discipline of forest genetics, which contributed to an increase in marketable timber by producing faster-growing, larger, and disease- and pest-resistant trees. As research efforts evolved and broadened over the decades, so too did the name of the Rhinelander research field laboratory, changing from its original name, the Northern Institute of Forest Genetics (1957), to the Institute of Forest Genetics (1963), to the Forestry Sciences Laboratory (1978), to its current name, the Institute for Applied Ecosystem Studies (2007). The facility is nationally and internationally renowned for its research in the fields of genetics, wood formation, short-rotation woody crops, biotechnology, landscape ecology, climate change, and phytotechnologies. The Hugo Sauer Nursery, whether under state or federal management, has served and continues to serve as an essential experimental field site for these studies.

Table 1.—Timeline of major events at the Hugo Sauer Nursery and Rhinelander research field laboratory

Year	Event
1930	Site selected for nursery two miles west of Rhinelander
1931	**USDA Forest Service Rhinelander federal nursery** established on 20 acres donated by Oneida County
	G. Willard Jones hired as first nurseryman
	Pumphouse #1, warehouse #1, irrigation system built; windbreaks planted
1932	First trees distributed: 2.4 million red and white pine seedlings
1933	Civilian Conservation Corps (CCC) side camp established at nursery
	Seed extractory (largest in the state) and office built
	10 million trees distributed (full capacity of original 20-acre land)
	4.8 acres of land added to nursery (24.8 acres total size)
1934	31.14 acres of land added to nursery (56 acres total size)
	Cone shed #1 built
1935	Seed storage shed, field warehouse, pumphouse #2 built
	Works Progress Administration (WPA) workers assist CCC with nursery duties
1936	Forest Service nursery dedicated as **Hugo Sauer Nursery**
	22.32 acres of land added to nursery for dedicated road (78 acres total size)
	Nursery reaches peak of production: 29.8 million trees distributed
	Bunkhouse, mess hall, kitchen, and shower house built for CCC side camp
	Repair shop, implement shed, cone shed #2/packing plant, and nursery dwelling built
1944	Barbadian laborers housed at side camp for potato harvest
1945	Prisoners of War housed at side camp for potato harvest
1946	Jamaican and Mexican laborers housed at side camp for potato harvest
1950	Forest Service announces it will close federal nursery; 200 million trees grown over 19 years

(continued on next page)

Table 1 (continued).—Timeline of major events at the Hugo Sauer Nursery and Rhinelander research field laboratory

Year	Event
1951	**Wisconsin Conservation Department** leases nursery from federal government
	Alvin E. Nelson hired as first manager of state nursery; moves into dwelling with family
1954	Forest Service Lake States Forest Experiment Station first receives funding for genetics research
1955	Hal Berndt hired as manager of state nursery; moves into dwelling with family (until 1972)
	Site selected adjacent to nursery for Forest Service genetics field laboratory
	Hans Nienstaedt hired as geneticist and Project Leader of forest genetics program
1956	Concrete block office and laboratory built for genetics field laboratory
	Genetics research begins led by Hans Nienstaedt (until 1984)
	Researchers begin to use nursery for experimental plots
1957	**Northern Institute of Forest Genetics** officially established by Forest Service
	Hans Nienstaedt becomes Director's Representative[a] of institute (until 1976)
	Record year for local cone production; seed extractory runs 24/7
	Fertilizer shed built by state
1958	Addition built on cone shed #2/packing plant by state
1959	Greatest number of trees produced in a year during state operation: 7.6 million
1960	Two-story office/lab building constructed to house genetics institute
1962	Philip Larson awarded "pioneering scientist" designation
	Physiology of wood formation research begins under Philip Larson (until 1985)
	Pumphouse #3 built by Forest Service
1963	Field laboratory renamed **Institute of Forest Genetics**
1965	Radiation studies led by Thomas Rudolph begins (until 1974)
1966	Forest Service North Central Forest Experiment Station established in a merger of Lake States and Central States Forest Experiment Stations
	Institute of Forest Genetics becomes RWU[b] of North Central Forest Experiment Station
1970	Short-rotation woody crops research program led by David Dawson begins
1972	Harshaw Forestry Research Farm established
	New wing added to genetics institute building to house growing research teams
1974	**State nursery closes:** 76 million trees grown over 23 years
	Nursery returns to Forest Service; continues to be used for research experimental plots
1975	New headhouse and greenhouse added to south side of institute building wing
	Seeds from lab exchanged on first international space mission (Apollo-Soyuz)
	Nursery office and dwelling auctioned and moved off site
1976	David Dawson becomes Project Leader and Director's Representative (until 1982)
1978	Field laboratory renamed **Forestry Sciences Laboratory** to reflect expanded research
1980	Delegation of Chinese foresters visit, the first in a program of scientific exchanges
1982	Edward Hansen becomes Director's Representative (until 1989)
1983	Biotechnology RWU established with Neil Nelson as Project Leader and Bruce Haissig (until 2000)
1984	Forest regeneration RWU established to study northern red oak with Judson Isebrands as Project Leader (until 1990)
1985	First genetically modified tree in the world produced at lab, an herbicide-resistant poplar
1987	Landscape ecology RWU established with Thomas Crow as Project Leader (until 1998), the first research unit focused on emerging landscape ecology discipline in the Forest Service

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Table 1 (continued).—Timeline of major events at the Hugo Sauer Nursery and Rhinelander research field laboratory

Year	Event
1989	Judson Isebrands becomes Director's Representative (until 2002)
1992	Climate change/pollution research RWU begins with Judson Isebrands as Project Leader (until 2004)
1998	Aspen FACE experiment begins at Harshaw Forestry Research Farm (until 2011)
	Eric Gustafson becomes Project Leader of landscape ecology RWU
1999	Phytotechnology RWU established with Don Riemenschneider as Project Leader
	White spruce cut from nursery property for U.S. Capitol Millennium Christmas tree
2000	Earth Liberation Front (ELF) vandalizes property in protest of genetic modification research
2002	Eric Gustafson becomes Director's Representative of field laboratory (until 2006)
2004	Neil Nelson becomes Project Leader of climate change/pollution RWU
2007	Forest Service Northern Research Station created from merger of North Central and Northeastern Forest Experiment Stations
	Field laboratory renamed **Institute for Applied Ecosystem Studies: Theory and Application of Scaling Science in Forestry**
	All separate RWUs reorganized into a single RWU
	Neil Nelson designated Project Leader of RWU (until 2009); Don Riemenschneider becomes Director's Representative (until 2009)
2009	Eric Gustafson becomes Project Leader and Director's Representative (until 2012)
2012	Deahn Donner becomes Project Leader and Director's Representative
2015	Rhinelander Experimental Forest is established
2022	RWU renamed **Landscape Ecology and Sustainability in the Lake States Forests**

[a] A Director's Representative designated at the field site oversees the facility's safety program, administration operations, and external relations not associated with a specific RWU.

[b] Within the USDA Forest Service's research and development mission area, research programs are administratively organized as research work units (RWU) led by Project Leaders or Program Managers who lead research programs and activities of the unit. Prior to 2007, there were multiple RWUs and Project Leaders co-located at the Rhinelander research field laboratory.

Prior to the Establishment of the Rhinelander Nursery

The site where the Rhinelander Nursery would eventually be established was the traditional home of the Ojibwe, who hunted, fished, and gathered on the land and in the waters. The Mole Lake band of the Ojibwe had a village near modern-day Rhinelander. In 1842, this area, along with most of the land bordering the southern shore of Lake Superior, was ceded to the federal government in a treaty often referred to as the Copper Treaty because it opened lands in the north to copper mining. In exchange, the tribal members received continued hunting, fishing, and gathering rights in the ceded territory, along with annuity payments in cash, goods, and services for 25 years. In 1850, however, just 8 years after the treaty was signed, President Zachary Taylor signed an order to remove the Ojibwe from their traditional homeland to the Minnesota territory (Satz 1991).

Destruction of Wisconsin's Forests

When the first European settlers arrived in the Wisconsin territory, vast pineries covered much of the northern part of the state. In the mid-1800s, large-scale logging began. White pine logs were cut and skid in winter by horses to stream banks. During spring runoff, logs were floated down rivers to sawmills that dotted the state. In the 1870s and 1880s, railroads advanced into northern Wisconsin, allowing lumber companies to cut farther from stream sources. Wisconsin led the nation in the production of lumber between 1890 and 1899 (McKay 1996, USDA FS 2006).

After 1900, the vast white pine forests had been depleted, and lumbering turned toward the large remaining stands of hemlock, cedar, basswood, elm, and ash. Piles of smaller logs and slash were left in the cutover lands, which created a tinderbox for fire. Devastating wildfires raged through the state, destroying thousands of acres of mature timber, young growth, and soil humus and leaving behind scarred and unproductive land. By 1923, uncontrolled cutting and fires left fewer than 2 million acres of forest available for timber, compared with the 30 million acres that once covered the state. By 1929, most viable stands of timber had been depleted, and the logging era ended (McKay 1996, USDA FS 2006).

With vast holdings of cutover and burned lands, lumber companies created land speculation companies, which sold the land at low prices to unsuspecting families as prime farmland. Much of the cutover land was unproductive, and the climate in northern Wisconsin significantly limited the growing season. These factors, coupled with the dropping prices of agricultural goods during the 1920s, resulted in many families not being able to pay their property taxes and having to abandon their farms. The tax-delinquent property was returned to county ownership. In addition, with the large red and white pines harvested and the young pines eliminated by slash fires, there was no longer a seed source for natural regeneration. The once vast northern forests had been reduced to burned-over patches of stumps and brushy fields (Fig. 1) (McKay 1996, USDA FS 2006).

Figure 1.—The Rhinelander nursery site prior to development in 1931. Stumps and brush were representative of cutover forested areas in northern Wisconsin. USDA Forest Service photo archives.

Establishment of National Forests

Officials from the State of Wisconsin and the federal government realized that something had to be done to return lands to their original productiveness. In 1925, Wisconsin passed the Enabling Act, which allowed the federal government to purchase, control, and administer lands in the state as national forests. Most northern communities were in favor of federal ownership because it would bring income, employment opportunities, and road building. During the late 1920s and early 1930s, the federal government received the majority of lands that would become Wisconsin's national forests (McKay 1996, USDA FS 2006).

The initial property that became the Chequamegon-Nicolet National Forest was created from several land purchases between 1928 and 1932. Initially, the entire property was designated as the Nicolet National Forest in March 1933. However, due to continuing land purchases, the forest was split into Nicolet East and Nicolet West that July. In November 1933, President Franklin Roosevelt officially established Nicolet East as the Nicolet National Forest and Nicolet West as the Chequamegon National Forest. In 1998, the two national forests were brought back together to be managed as the single Chequamegon-Nicolet National Forest (USDA FS 2006).

Rhinelander/Hugo Sauer Federal Nursery: 1931–1942

While some cutover forests were naturally reseeded by adjacent forests, several million acres in Wisconsin required artificial reforestation because repeated wildfires had destroyed seed trees and sterilized the soil. To reestablish productive forests, the state needed millions of trees and an army of people to plant them. Nurseries and federal work relief programs developed together in the early 1930s to achieve this monumental undertaking. During the Great Depression, the Rhinelander/Hugo Sauer Nursery produced the majority of trees planted to reforest cutover lands in the Nicolet National Forest (McKay 1996).

Establishment of the Rhinelander Nursery

In Wisconsin, state nurseries and reforestation efforts began as early as 1914. Federal nurseries, like the Rhinelander Nursery, were established in the early 1930s to reforest the major tracts of land being acquired for national forests (McKay 1996).

To be successful, nursery sites required specific landscape features. They needed to be flat or gently sloping to accommodate machinery. Water sources, such as lakes or streams, were needed for irrigation, along with soil and vegetation types similar to the areas that the nursery seedlings would be planted. The sites were also typically located near communities for labor and supplies (McKay 1996).

Oneida County's poor farm, located approximately two miles west of Rhinelander and adjacent to Langley Lake, was identified as an ideal site for the proposed Rhinelander Nursery. Prior to social security programs, county poor farms were publicly funded agricultural sites where the needy, often people who were older or who had disabilities, raised crops and livestock in exchange for food and a place to live. According to the Rhinelander New North on May 3, 1894, "The county board . . . took up the question of adopting the county system of taking care of the poor, and after considerable discussion of the matter, adopted a resolution that all paupers of the county hereafter be supported by the county at a poor house." A three-person committee was appointed to find a suitable site for the poor farm. Later that year, the Oneida County Poor House was established at the north end of Rhinelander, along with the 80-acre poor farm located to the west.

In December 1930, the local newspapers announced that a federal nursery for "growing stock to be used in replanting federal forest reserves" would be established near Rhinelander (Rhinelander Daily News 1930, Rhinelander New North 1930). In March 1931, Oneida County donated 20 acres of its poor farm to the federal government for the nursery. According to S.E. Schoonover, acting regional forester, the nursery would be the largest of its kind in the United States, and possibly the world (Rhinelander New North 1931b).

Nursery Dedicated to Hugo Sauer

Because the federal budget was insufficient to begin work on the nursery right away, the Wisconsin-Upper Michigan District of Kiwanis International offered to donate funds toward the project. Hugo Sauer served as the chairman of the district's Conservation and Reforestation Committee in 1931 and 1932. A Milwaukee native, Sauer had advocated for locating the nursery in Rhinelander instead of Three Lakes or Eagle River. He successfully coordinated a fundraising effort to raise $6,000, which was donated to the Forest Service to begin nursery operations (McKay 1996, Rhinelander Hodag Shopper 1981).

Originally called the Rhinelander Nursery, the nursery was dedicated to Hugo Sauer on April 28, 1936, three years after Sauer's death in 1933. Sauer's widow and two sons, Louis and Hans, attended the dedication service. Also present at the dedication were Axel Lindh, Nicolet Forest supervisor; Harper Gatton, international Kiwanis president; federal forest officials; and members of the Oneida County board. Preceding the dedication, a camp-style dinner was served by a squad of Civilian Conservation Corps (CCC) men from Camp Blackwell who were stationed at the nursery. During the ceremony, a monument was unveiled consisting of a metal plaque honoring Hugo Sauer affixed to a granite boulder (Rhinelander Daily News 1936a, 1936b). The monument still stands at the entrance to the nursery (App. 2, Figs. 121, 122).

Figure 2.—A worker cuts brush by hand on the Rhinelander nursery site using a scythe, 1931. USDA Forest Service photo archives.

Preparing the Rhinelander Nursery

G. Willard Jones of Rhinelander was hired as the first nurseryman of the federal nursery in late March 1931. His first order of business was to clear the 20-acre tract of land covered in brush and stumps. About 15 laborers cleared much of the brush with scythes and blasted the stumps to remove them. After the brush and stumps were removed, the ground was broken with a heavy breaking plow followed by discing (Figs. 2, 3, 4) (McKay 1996).

Nursery properties were laid out based on the variation of landscape features and soil. Typically, a nursery would be divided into numerous, equal-sized square or rectangle plots called blocks. At the Rhinelander site, however, the uneven terrain and poorly drained areas required the nursery blocks to be irregularly shaped and sized. The blocks were then

Figure 3.—Brush piles stacked and ready for burning after being cut on the Rhinelander nursery site, 1931. USDA Forest Service photo archives.

Figure 4.—Breaking ground at the nursery after the brush and stumps had been removed, 1931. USDA Forest Service photo archives.

divided into four-foot-wide seedbeds separated by two-foot-wide paths. While the sandy loam soil of the nursery was ideal for growing conifers, it did not retain moisture well, so irrigation systems were necessary and often a major expense. Conifer nurseries, like the one in Rhinelander, typically used an overhead irrigation system. The maximum length of a bed was dictated by the irrigation pipe, and anything longer than 525 feet would not deliver adequate water. Each block and bed within were named with a specific Roman numeral or letter to maintain accurate records. At its height, the Hugo Sauer Nursery had 10 blocks labeled with Roman numerals (Fig. 5), which were later reduced to eight blocks labeled A–H (McKay 1996).

In 1931, while the original 20 acres were being cleared, Oneida County allowed the Forest Service to use 3 acres of already-cleared land adjacent to the property (Rhinelander New North 1931a). By June, 442 temporary nursery beds had been constructed on the county property, with 34 rows of nursery beds and 13 beds to a row. Work was underway to plant the beds with white and red pine seeds, for an expected yield of 2.2 million young trees.

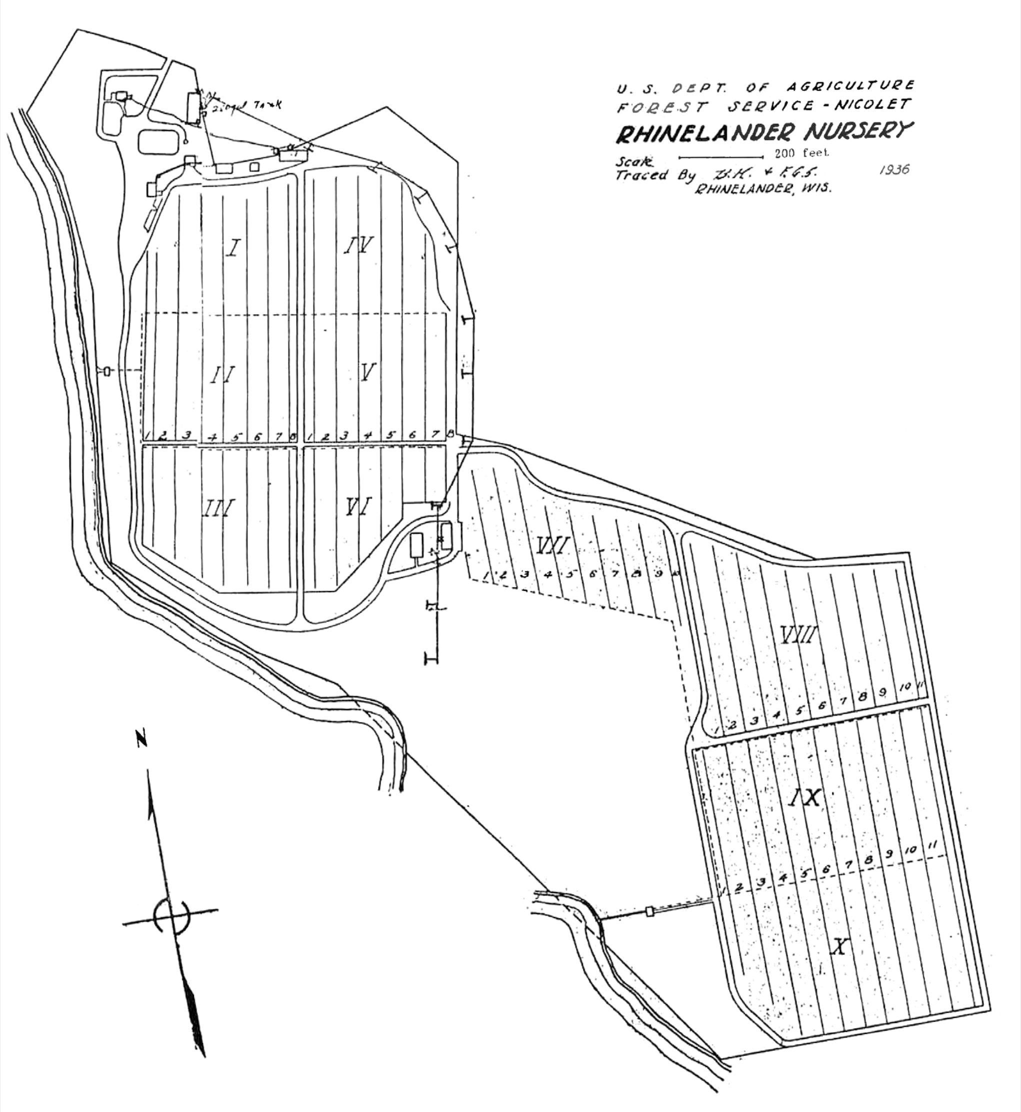

Figure 5.—1936 map of the Rhinelander Nursery showing the irregular shape of the original 10 planting blocks, the two pumphouses, and irrigation system pipes (dotted lines). USDA Forest Service photo archives.

The irrigation pipes were also being laid from a pumping house on Langley Lake (which was still under construction) to the nursery beds. A Skinner overhead, oscillating sprinkler system was installed to keep the trees watered in the light soils (Rhinelander Daily News 1931).

Permanent nursery beds were planned for the 20-acre land still being cleared by nursery employees. The newly cleared area would be divided into distinct nursery beds, with one bed planted each year. The trees would grow for 2 to 3 years before being sent to reforestation projects. Nurseryman Jones expected that the permanent nursery would produce 10 million trees each year. By fall of 1931, about a third of the tract had been cleared and planted (Rhinelander Daily News 1931).

Starting in 1931, cedar and spruce hedges were planted on the east and west sides of the nursery to serve as windbreaks (Fig. 6). These windbreaks are still growing today. To protect against grazing animals, a 5-foot-high, woven-wire and barbed-wire fence was erected around the nursery between 1932 and 1937 (McKay 1996, Rhinelander Daily News 1931).

Depression-Era Nursery Operations

Once established, nurseries followed a consistent yearly pattern. The first step was collecting enough native pinecones to provide seeds for planting. A portion of the annual pinecones were purchased locally from private individuals. Others were collected by CCC enrollees working in the Nicolet and Chequamagon National Forests in Wisconsin, along with the four national forests in Upper and Lower Michigan (Fig. 7) (USDA FS 1935). The pinecones were placed in a cone shed, where they were spread in thin layers on trays and

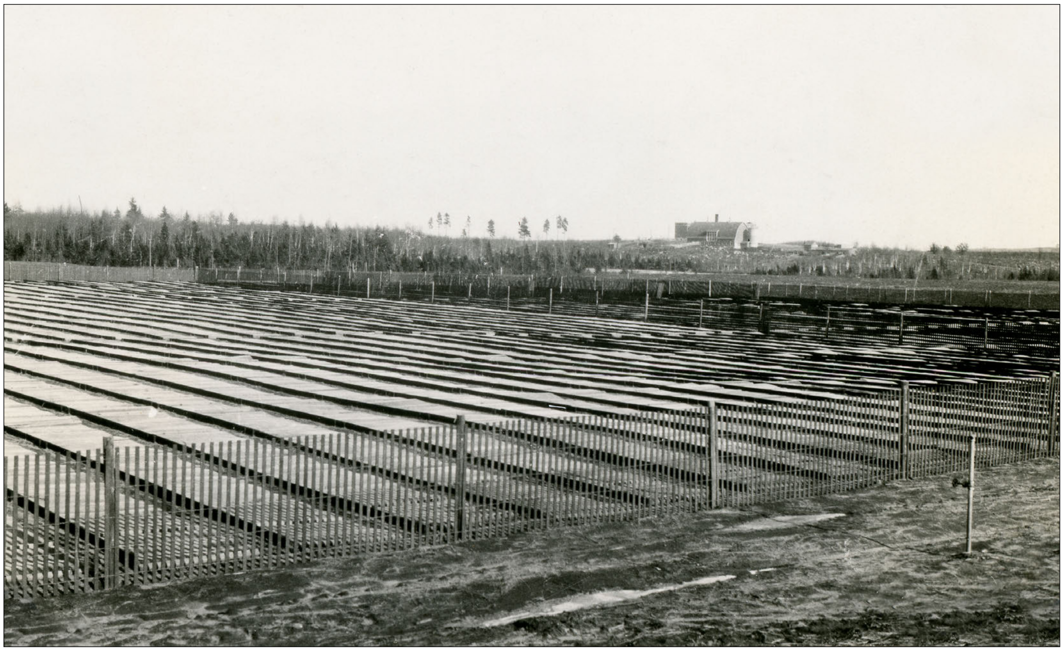

Figure 6.—Block I of the Hugo Sauer Nursery, with a wooden lattice fence serving as a windbreak until the cedar and spruce hedges grew, 1931. USDA Forest Service photo archives.

turned daily to dry. The pre-drying lasted for about two months, after which the cones were stored in the cone shed or another warehouse (McKay 1996).

In winter, the pinecones were transferred to an extractory, where the seeds were removed. Cones were placed on screen trays and heated in special forced-air kilns for 8 to 16 hours to open the scales. They were then put into a cone shaker, a large wire mesh drum that removed dirt and separated the seeds. The seeds that collected under the cone shaker were placed into a mechanical dewinger that removed the seed wings and scales. For long-term storage, the seeds were sealed in air-tight containers and moved to an insulated, cold-storage seed house (McKay 1996).

Federal nurseries in Wisconsin planted primarily conifers to produce two-year red pine, white pine, jack pine, and smaller numbers of white spruce and black spruce. In early spring, the seedbeds and transfer beds were prepared for planting. Established beds were plowed and harrowed. Seedbeds were worked with a shovel and raked (Fig. 8). The beds were leveled just prior to planting (Fig. 9), which usually occurred in May, depending on the weather. Seeds were planted in one of two ways: they were either planted evenly over the entire bed by hand, or they were planted in rows with a mechanical seed drill. By 1932, workers at the Rhinelander nursery were using a 10-row, mechanical seed drill that planted seeds in rows 4 inches apart and covered the seeds after, speeding up the planting process (Fig. 10) (McKay 1996).

Figure 7.—Civilian Conservation Corps workers at the Huron-Manistee National Forest in Michigan with about 1,000 bushels of jack pinecones awaiting shipment to the Rhinelander extractory, August 1935. Photograph courtesy of the Forest History Society, Durham, NC.

Figure 8.—Civilian Conservation Corps workers raking the seed beds at the Hugo Sauer Nursery, 1939. Photograph courtesy of the Forest History Society, Durham, NC.

Figure 9.—Civilian Conservation Corps enrollees leveling seed beds at the Hugo Sauer Nursery prior to planting, 1939. Photograph courtesy of the Forest History Society, Durham, NC.

Figure 10.—Nursery staff using a 10-row mechanical seed drill to plant the seed beds, 1932. USDA Forest Service photo archives.

After planting, the beds were cared for intensively, requiring daily watering during germination and for two months after (Fig. 11). Shade fences provided ideal conditions for growing conifers. After 5 to 6 weeks of growing, seedlings were thinned by hand. Weeding was done by hand or by using cultivation equipment. Between the first and third year of growth, crowded seedlings were often moved to transplant beds. Transplant stock survived better in cutover areas than trees planted directly from the seedling beds (McKay 1996).

When the seedlings were ready to be shipped for planting in the national forest, they were "lifted" from the bed with spading forks or lifting machines and put into small boxes (Fig. 12). This process retained soil around the roots, which prevented damage to the fine root systems and protected important soil microorganisms. The seedling boxes were taken to a central packing shed where they were culled, root pruned, and packed for shipment. If they were shipped immediately, they were packed in burlap-lined crates or bundles of 100 seedlings each, with damp sphagnum moss between the seedling layers. Plants could also be stored up to a week with moist soil packed around their roots. During winter, seedlings were stored between layers of moist sphagnum and snow and stored in small cellars, or they were packed in boxes with wet peat moss and stored in a refrigerated tree storage building such as the basement of cone shed #2 at the Rhinelander nursery (McKay 1996).

Two-year-old seedlings, ranging from 6 to 8 inches in height, were typically planted in the Nicolet National Forest. Planting took place in the spring and fall by large crews of Works Progress Administration (WPA) and CCC enrollees (McKay 1996).

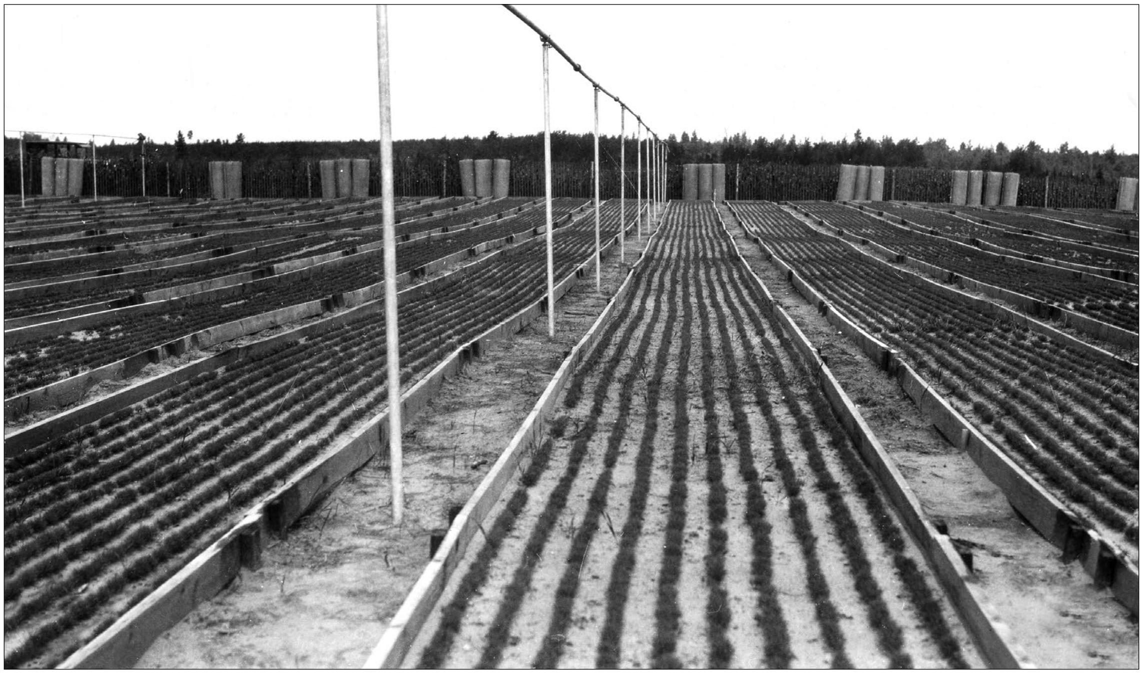

Figure 11.—Rhinelander Nursery seed bed after planting, with overhead irrigation system and fencing visible, 1932. USDA Forest Service photo archives.

Figure 12.—Civilian Conservation Corps enrollees lifting and grading jack pine seedlings at the Hugo Sauer Nursery, 1939. Photograph courtesy of the Forest History Society, Durham, NC.

Expanding the Nursery Operations

In the fall of 1932, the nursery distributed its first trees, approximately 2.4 million 2-year-old red and white pine seedlings for planting in Wisconsin and Upper Michigan national forests (Rhinelander Daily News 1953b). In January 1933, Oneida County donated an additional 4.8 acres in the northwest corner of the property, where many of the nursery buildings were constructed. By fall of 1933, the original nursery grounds reached the full production capacity of 20 acres, shipping 10 million 2-year-old seedlings. To meet increasing demand, in January 1934 the nursery purchased an additional 31.15 acres located southeast of the original tract from Oneida County, which expanded the nursery to 56 acres (McKay 1996). By the summer of 1934, the nursery had 33 million trees growing, with 18 million trees ready to be shipped in fall for transplanting in national forests in Wisconsin and Michigan. Typically, only a few employees were needed to operate the nursery, but in fall and spring, the need increased to 50 or 60 staff, with CCC enrollees providing much of the extra labor (Rhinelander Daily News 1934a). (See “New Deal Work Relief Programs: Civilian Conservation Corps and Works Progress Administration” below.)

In June 1935, the newsletter The Nicolet Forum reported that the seed extractory had been operating continuously since August 25 of the year before, except on Christmas, New Year’s Day, and Easter. The newsletter estimated that 17,000 bushels of cones, collected by CCC enrollees and purchased from private individuals, had been extracted. The total amount of seed extracted included 6,300 pounds of white pine, 3,000 pounds of white spruce, 2,700 pounds of jack pine, and 750 pounds of red pine. Seed was not only used on the Rhinelander nursery, but also shipped out to other nurseries in the region (USDA FS 1935).

The seedlings that grew from those seeds were ready for a spring shipment in May 1936, and 50 additional CCC enrollees arrived from Camp Himley Lake to assist in preparing the planting stock (Rhinelander New North 1936). By the end of the month, the nursery had supplied 3.3 million seedling trees for the largest spring planting in the history of the Nicolet National Forest. The planting was carried out on more than 3,000 acres of the forest's five ranger districts. The seedlings were 1-year-old jack pine and 2- to 4-year-old white spruce. The nursery had about 150 employees (100 of those being local men) with 56 million trees growing (Rhinelander Daily News 1936c). In April of the same spring, Oneida County donated an 800-foot right-of-way from County K to the northwest corner of the nursery for a road—a total of 22.32 acres. This addition provided permanent access to the site with space on the sides for beautification of the drive. The donation increased the total nursery size to 78.29 acres; however, only 35 acres were suitable for raising seedlings (McKay 1996).

By the end of 1936, the nursery had reached its peak, having sent out 29.8 million trees for planting (Rhinelander Daily News 1953b). During the late 1930s, the nursery maintained about 23 million growing trees and shipped out about 8.5 million annually for planting in the national forests of Wisconsin, Michigan, and Minnesota (McKay 1996).

New Deal Work Relief Programs: Civilian Conservation Corps and Works Progress Administration

The Rhinelander Nursery was established as the United States slipped into the economic depths of the Great Depression. In 1932, Franklin Delano Roosevelt was elected president and enacted several work relief programs as part of his New Deal to employ citizens who had lost their jobs. One of these, the Civilian Conservation Corps (CCC), provided young men with manual labor jobs in conservation and natural resources.

The CCC camps in Wisconsin were formed from enrollees processed through the Sixth Army Corps Headquarters in Fort Sheridan, Illinois (near Chicago). Forestry districts were formed, and the Sparta District in northern Wisconsin included CCC camps working on the Nicolet and Chequamegon National Forests. After basic training, CCC enrollees were assigned to 200-man camps. Between 1933 and 1942, CCC "main" camps near Three Lakes, Laona, Eagle River, and Phelps provided much of the CCC labor for the nursery. Starting in 1933, a CCC "side" camp was established on the Rhinelander Nursery property. Side camps were smaller, temporary work locations stationed close to a specific job site away from the main camp. The duties in Rhinelander were rotated among the main camps about every 6 to 12 months. CCC enrollees typically worked at the nursery between April and November, especially during the spring planting and spring/fall transplanting seasons. The workers constructed buildings, prepared seedbeds, planted seeds, weeded, lifted and graded seedlings, bundled seedlings for shipment, and removed snow (McKay 1996).

The following CCC camps were documented as sending enrollees to the Hugo Sauer Nursery side camp between 1933 and 1942 (McKay 1996):

- Company 643, Virgin Lake (near Three Lakes): 1933
- Company 645, Camp Scott Lake (near Three Lakes): 1934–1939

- Company 646, Camp Pine River (near Three Lakes): 1935
- Company 3674, Section 11 (near Three Lakes): 1935
- Company 641, Nine Mile (near Eagle River): 1935–1936
- Company 1655, Camp Himley Lake (near Wabeno): 1936–1937
- Company 604, Camp Blackwell (near Laona): 1937
- Company 1680, Camp Phelps (near Phelps): 1941

The first CCC groups at the nursery side camp lived in tent camps and used some of the early buildings (Fig. 13). In 1933, crews of 12 to 30 men from Company 643 commuted from Camp Virgin Lake near Three Lakes to perform nursery work in the summer and fall. They constructed the seed extractory (still standing on the site), in which they were housed and fed prior to it being used for nursery operations (McKay 1996). The next year, 20 men from CCC Company 654 at Camp Scott Lake (Fig. 14) were housed in cone storage shed #1 (no longer standing) before it was used as a storage facility. The men assisted G. Willard Jones in constructing additional buildings and general nursery work year-round (Rhinelander Daily News 1934b).

Figure 13.—Hugo Sauer Nursery office/administrative building circa 1935. Workers in the foreground are preparing the site where the Hugo Sauer monument boulder will be placed in 1936. Civilian Conservation Corps tents are located where the nursery dwelling will be built in 1938. Photograph courtesy of the Wisconsin Conservation Hall of Fame, Stevens Point, WI.

Figure 14.—Civilian Conservation Corps Company 654 (Camp Scott Lake) at the Rhinelander Nursery side camp, 1934. Photograph courtesy of the Pioneer Park Historical Complex, CCC Museum, Rhinelander, WI.

During the winters of 1934 and 1935, CCC workers extracted 14,000 bushels (7,500 pounds) of white pine, red pine, and jack pinecones for seeds used for growing seedlings. More jack pinecones were needed, and the Forest Service offered to pay 75 cents per bushel to private individuals who collected them (Rhinelander New North 1935).

Company 1655 at Camp Himley Lake was assigned to the side camp in 1936 and 1937. According to the Himley Lake Ripples, the company newsletter, 50 CCC enrollees were sent to the nursery in 1936 to lift trees ready for planting in spring, cultivate the seed beds during the summer, and plant the seed beds in fall. Twenty members were kept on during the winter for various tasks.

In an interview, former CCC enrollee Harold Morrow of Macomb, Illinois, described his experience. Morrow joined Company 1655 shortly after it was stationed at Camp Himley Lake in 1936, and he was transferred to the Rhinelander nursery side camp just a month later. He described his time at the nursery:

> I got transferred with 49 other guys to the Rhinelander forest nursery. . . . We had a forester working with us and directing the work. One of my jobs was after the Forest Service planted 100 seeds in a plot, I would come around in a few weeks and count the number of seeds that had germinated. They could then figure out how many trees they had to work with and how many could be sent out to the camps. It was big operation. There was one group of guys who had to watch over a 150-acre overhead sprinkler system for the trees. They had a pump house by the lake that collected water plus nearby swamp water was drained to serve the system and it was their job to make sure it was working up to snuff at all times [Moore 2011].

The enrollees of Company 1655 also began constructing a more permanent side camp at the nursery, replacing tents with buildings. Commenting on the camp under construction in the Himley Lake Ripples, an enrollee observed, "Friends were made and friends have gone, but even though a small group, we find it quite pleasant here although we do not have all the necessities and luxuries we would like to have. We are rapidly building a camp which will be a pleasure for enrollees to live in" (CCC 1937).

By 1937, the side camp included a bunkhouse, mess hall, kitchen, and shower house. The site was sometimes referred to as Camp Stiles (McKay 1996). While no specific description of the camp layout has been found, a 1938 aerial photograph (Fig. 16) shows at least five buildings associated with the camp: two long buildings on the west side of the grounds (likely a bunkhouse and shower house/wash room), a long building on the south side (likely the mess hall), a smaller building south of the mess hall (likely the kitchen), and a long building on the east side (the still-standing implement shed constructed in 1936). A photograph from 1941 labeled "Side Camp, Hugo Sauer Nursery" shows the two longer buildings on the west side of the grounds (Fig. 15). The building in the foreground appears to be a bunkhouse, and the one in the background is likely the shower house and washroom. This fits the location of the shower house described by Hal Berndt, who became the manager of the state nursery in 1955 when the building was still standing. A concrete pad still marks the location of the small kitchen building, which was used into the 1960s.

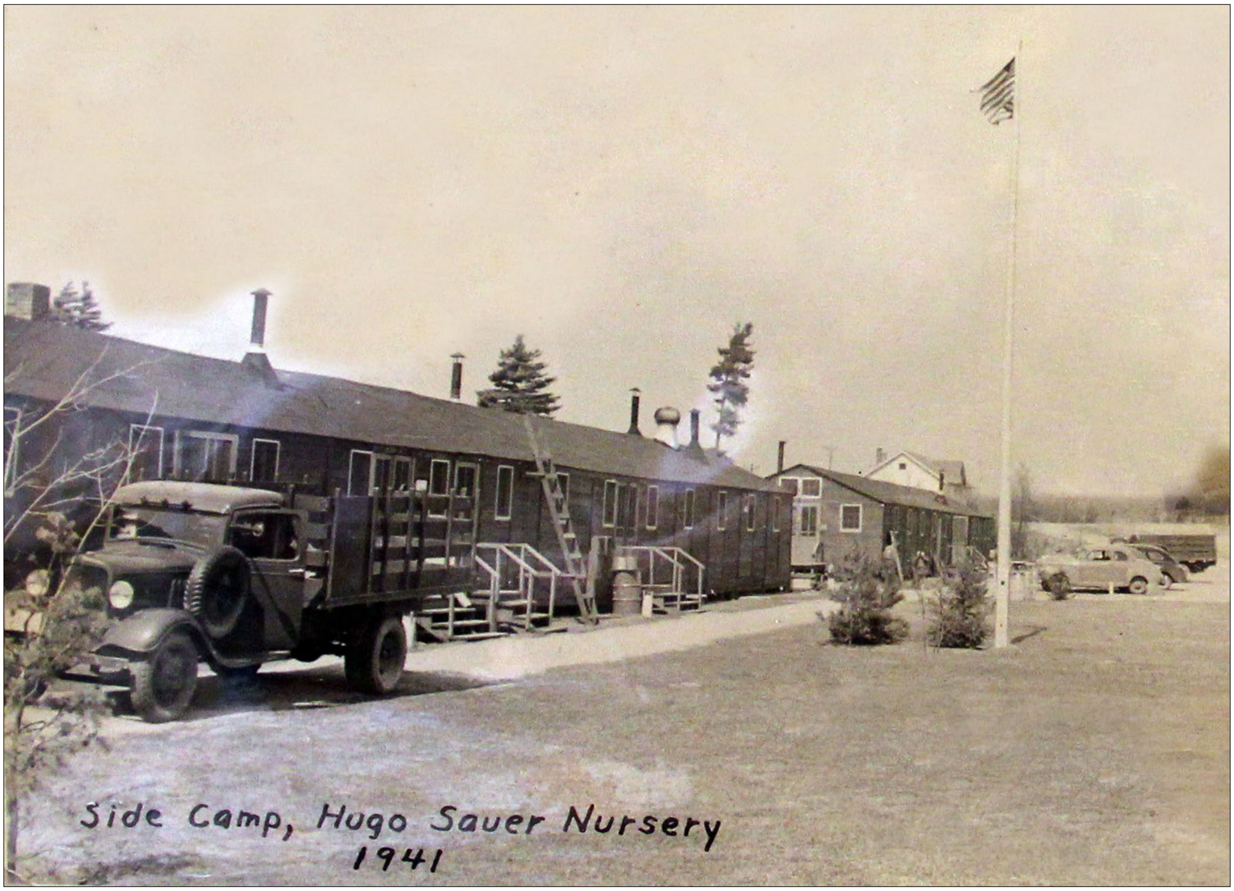

Figure 15.—The Civilian Conservation Corps side camp at the Hugo Sauer Nursery in 1941 shows two long frame buildings, likely a bunkhouse in the foreground and a shower house in the background. The building behind the shower house is the field warehouse constructed in 1935. Photograph courtesy of the Pioneer Park Historical Complex, CCC Museum, Rhinelander, WI.

The Works Progress Administration (WPA), enacted in 1935, was the largest and most ambitious New Deal program, employing millions of citizens to carry out public works projects throughout the country. The Forest Service sponsored numerous work projects in its national forests. At the Rhinelander Nursery, WPA laborers worked alongside CCC crews to perform nursery operations and construct buildings in 1935, 1936, 1940, and 1941. The nursery work included preparing seedbeds, planting, weeding, watering, and packing trees. WPA workers constructed the implement shed at the CCC side camp in 1936 (McKay 1996).

In the early 1940s, preparation for World War II led to economic growth and increasing employment in the private industry. The federal government could no longer financially support the New Deal programs. The CCC was disbanded in 1942 and the WPA the following year.

Construction of Federal Nursery Buildings

Many buildings constructed during the 1930s (Fig. 16) are still standing on the nursery property, although their functions have changed over time. While not always documented, it is likely that CCC and WPA workers played a major role in constructing many of the structures. According to the National Register of Historic Places Nomination Form (McKay 1996), the buildings were constructed in a simplified version of the late Rustic Style, which was often used by the Forest Service for its service buildings. The attractive frame buildings were sided with clapboard and protected by a gable roof, often with a gabled overhang at the entrance. Simple decorative elements included knee braces, exposed end rafters, and multi-lite windows (small panes of glass separated by glazing bars) (McKay 1996). See Appendix 2 for a site map and photographs of the existing buildings and landscape elements in 2019.

Pumphouse #1

The oldest building on the property, the original pumphouse along the shoreline of Langley Lake, was designed and constructed in 1931 by nurseryman G. Willard Jones (App. 2, Figs. 89–93) (McKay 1996). The Rhinelander Daily News reported in 1931 that the concrete foundation of the pumphouse was finished by June, but the roof would not be constructed until the two motor pumps were installed (Fig. 17). Once installed, the pumps provided irrigation for the original seedbeds on the north side of the nursery. With its gabled roof, clapboard siding, and windows, the building looked like a miniature house. It still stands on the site, but the concrete foundation is deteriorating. An associated diesel fuel storage shed, documented in 1996, no longer exists.

Warehouse #1

In August 1931, construction began on a two-story warehouse south of the nursery entrance (App. 2, Figs. 81–83). It was completed in 1932 (McKay 1996). Its location against a hill provided access to the lower level on one side and the upper level on the other. The warehouse was used to store equipment, which continues today.

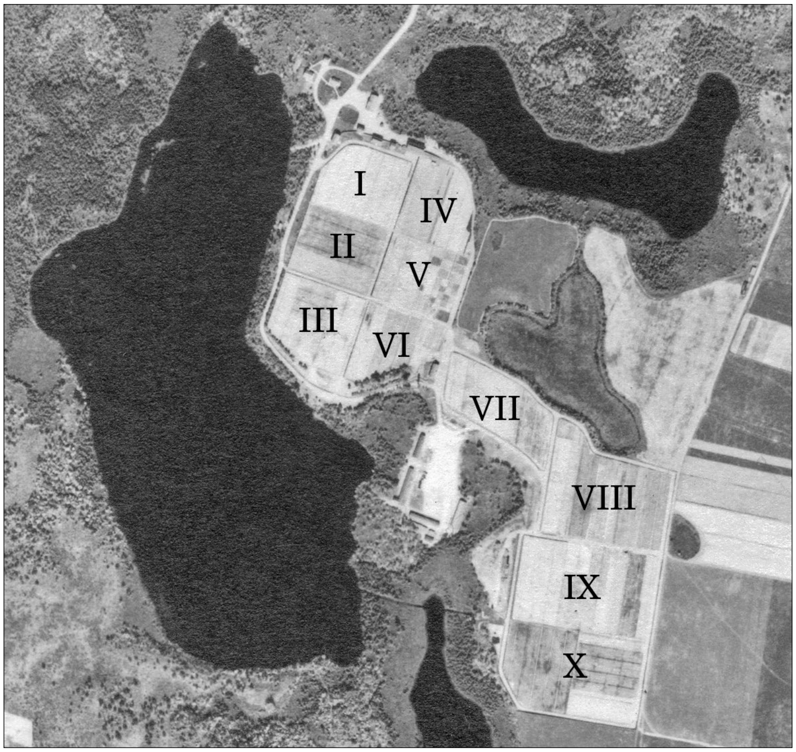

Figure 16.—1938 aerial photograph showing the layout of the original planting blocks of the Hugo Sauer Nursery (Roman numerals added) and the nursery buildings. The office and dwelling are located northwest of block I where the nursery road enters. The repair shop, warehouse #1, seed extractory, seed storage shed, and cone shed #2 are clustered nearby on the north side of blocks I and IV. The field warehouse is located between blocks VI and VII. Buildings of the CCC Side Camp are visible in the clearing to the south of block VII. USDA photo archives.

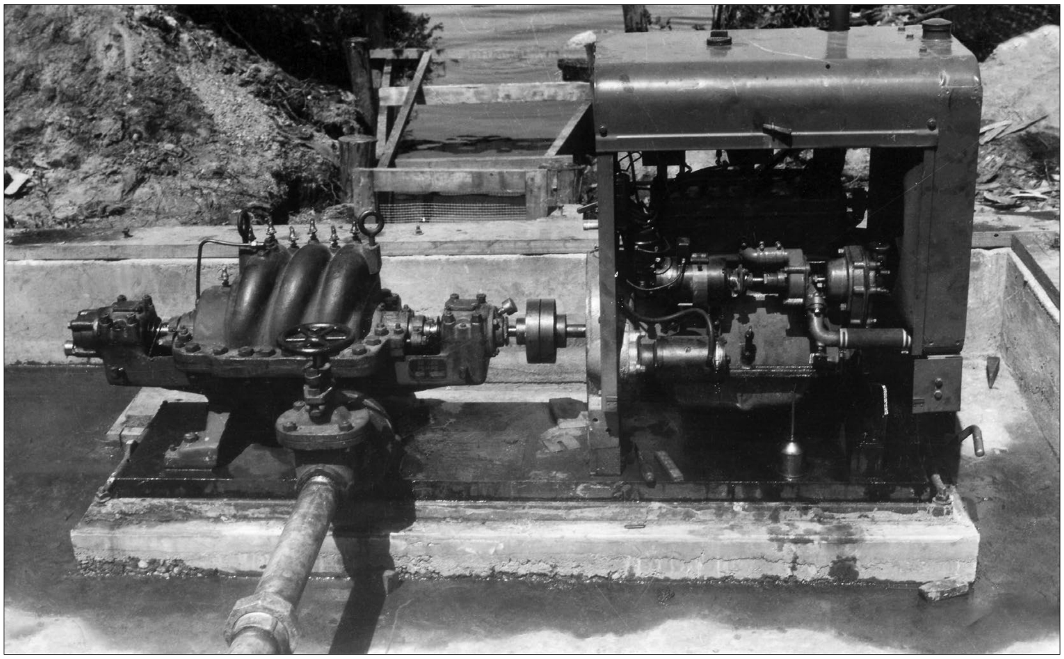

Figure 17.—Pumping unit installed in 1931 with intake canal from lake, prior to the walls and roof being constructed on pumphouse #1. USDA Forest Service photo archives.

Seed Extractory

CCC workers from Camp Virgin Lake constructed the two-story seed extractory in 1933, which housed machinery used to extract seeds from pinecones (Fig. 18; App. 2, Figs. 79–80). The upper level included a kiln to dry and open the seeds, a rotating drum called a shaker that shook the seeds from the cones, a dewinger that removed wings from the seeds, and a fanning mill that cleaned the seeds by blowing off the chaff. The lower level contained the furnace that supplied heat to the kiln (McKay 1996, USDA FS 1935). The extractory was the largest in Wisconsin (Berndt, H. 2019). Only the lower level of the extractory still stands and is now used for storage.

Office/Administration Building

In 1933, a one-story administration building was constructed on a hill near the nursery entrance (Fig. 19). It stored all of the nursery operations records and served as a site for conducting seed testing and soil analysis. It also included a bedroom for the site caretaker until a dwelling was built in 1936 (McKay 1996). It was sold and moved offsite in 1975 (Rhinelander Daily News 1975a).

Cone Shed #1

Constructed by 1934, the first cone shed was used to house CCC men from Camp Scott Lake prior to the side camp buildings being erected. The shed was used to store and dry cones before seed extraction. It was located between the extractory and the seed storage shed. The building burned down on an unknown date (McKay 1996).

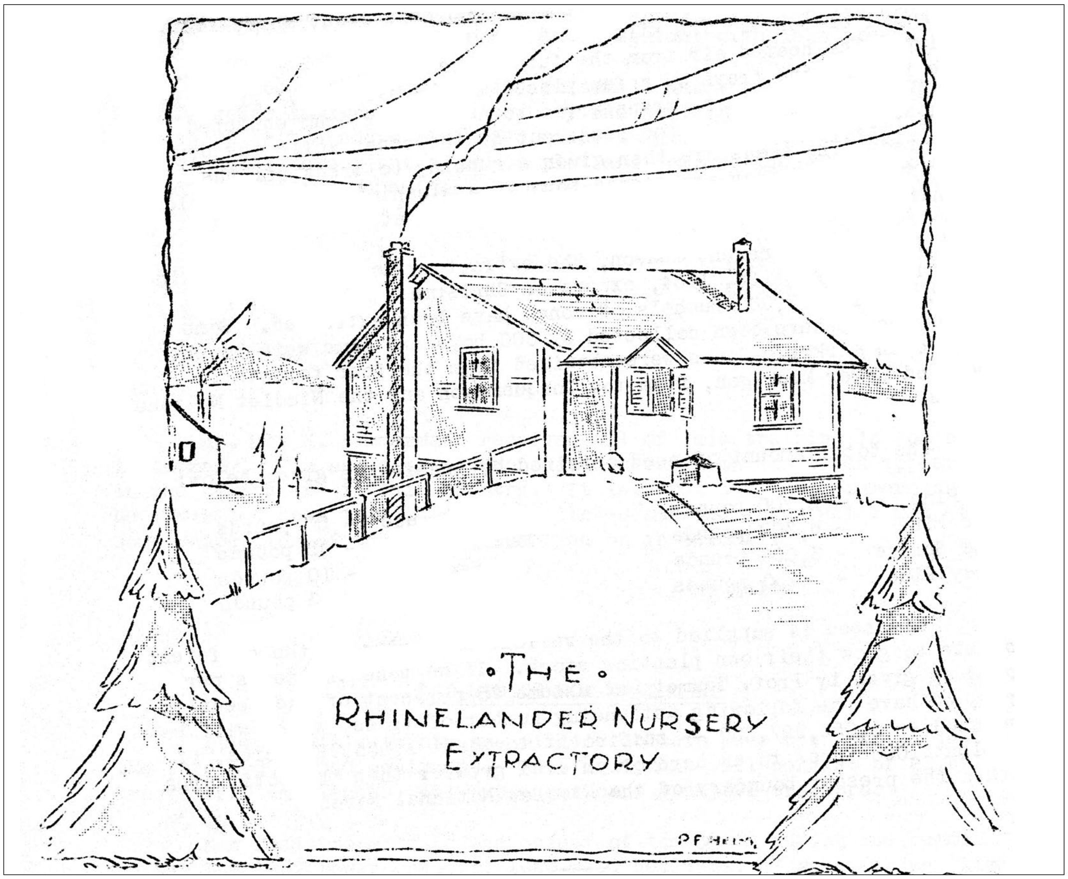

Figure 18.—A drawing of the seed extractory at the Rhinelander nursery, which was the cover design for a newsletter called The Nicolet Forum, June 1935. USDA Forest Service photo archives.

Figure 19.— August 1938 photograph of the nursery office/administration building constructed in 1933. Photograph courtesy of the Forest History Society, Durham, NC.

Seed Storage Shed

In 1935, a building to store seeds was constructed just east of the extractory. It was originally used to store the extracted seeds in a cool, dry environment that inhibited seed germination. The building's insulated walls and construction against a hillside allowed it to maintain ideal temperatures for seed storage without refrigeration units (McKay 1996). The building still stands and is now used for storage (App. 2, Figs. 84–86).

Field Warehouse/Warehouse #3

A second warehouse was erected in 1935 in the center of the nursery and was used for equipment storage and as a truck repair shop. It became known as the state repair shop after 1951, when the state began operating the nursery under a special use permit. It was also used as a radio repair shop for Wisconsin Department of Natural Resources vehicles (McKay 1996). It is now used for storage (App. 2, Figs. 94–96).

Pumphouse #2

A second pumphouse was constructed in 1935 on a small southeast extension of Langley Lake (App. 2, Figs. 106–109). It provided irrigation for the seedbeds on the southern portion of the property. The original diesel pumps were replaced with an electric pump, which is still used to pump water to the nearby experimental forestry plots today (McKay 1996). An associated diesel fuel storage shed, documented in 1996, no longer exists.

Repair Shop/Warehouse #2

In late 1935 or early 1936, a repair shop/warehouse was constructed at the entrance to the nursery. It was funded through the Economic Recovery Appropriations Act (ERA), which supported both WPA and CCC workers. The building was used as an automotive repair shop and for truck storage (McKay 1996). It continues to serve the same function today (App. 2, Figs. 113–116).

Implement Shed

An implement shed was constructed in 1936 on the east side of the CCC side camp, likely with the assistance of WPA workers. Its purpose was to store large equipment and implements, and it continues to be used for storage today. It features 12 impressive hinged-bay doors (App. 2, Figs. 98–101) (McKay 1996).

Cone Shed #2/Cold Storage/Packing Plant

In October 1936, construction began on a multipurpose building to the east of the seed storage shed. The building was completed in 1937. The upper level was used for storing and drying cones prior to seed extraction. The lower level provided cold storage, which was needed to prevent seedlings from growing prior to shipment, as well as packing facilities in two separate spaces. A major addition was constructed on the east side by the Wisconsin Conservation Department in 1958 (App. 2, Figs. 87, 88, 127) (McKay 1996). The building has been used by the USDA Animal and Plant Health Inspection Service (APHIS) Wildlife Services unit for office space and storage since 1988.

Nursery Dwelling and Garage

In 1936, a two-story "country ranger house style" dwelling and adjacent two-car garage were built by the CCC near the entrance to the nursery to house the nurseryman and his family (Fig. 20). It was located next to the office building, which allowed the nurseryman to respond to emergencies quickly (Fig. 21) (McKay 1996, Rhinelander Daily News 1937).

Figure 20.—August 1938 photograph of the two-story nurseryman dwelling, constructed in 1936 by CCC enrollees. Photograph courtesy of the Forest History Society, Durham, NC.

Irrigation System

Although not a building, the irrigation system was an integral structure of the nursery operations. A portable, oscillating overhead irrigation system was installed beginning in 1931 and expanded through the end of 1936. The system included 2,210 feet of galvanized pipe buried below the ground at least 14 inches, along with 47 vertical, 6-foot-high risers that brought water from the underground pipes to the surface (Fig. 22). The overhead sprinkler pipes were able to be moved to different locations throughout the growing season. Oscillating motors on the overhead pipes could throw water approximately 28 feet on both sides of the pipe (Fig. 23). Most of the underground portion of the system is still intact and operational (McKay 1996). (See Fig. 5 for a map of the original underground pipe system and App. 2, Fig. 123, for a photograph of irrigation risers.)

Figure 21.—Photograph from 1938 of the nurseryman dwelling (left) constructed in 1936 and the nursery office building (right) constructed in 1933. The Hugo Sauer Nursery dedication boulder is visible in the foreground. Photograph courtesy of the Forest History Society, Durham, NC.

Figure 22.—The Rhinelander nursery's overhead irrigation system as it appeared when installed in 1931. The vertical pipe risers connect the overhead sprinkler pipes with the underground water pipes. The wire screen over the beds protects the seedlings from birds and rodents. USDA photo archives.

Figure 23.—Two employees observing newly planted trees in the Hugo Sauer Nursery while the overhead irrigation system waters another bed, circa 1960. USDA photo archives.

World War II Era: 1942–1950

During World War II, the federal government significantly reduced its reforestation efforts, but it continued to operate the nursery on a lesser scale until 1950. The country faced a shortage of labor, and the abandoned CCC side camp at the nursery was repurposed to assist area potato and bean farmers.

Barbadian Laborers: 1944

To assist with farm labor shortages, the federal government brought experienced farm workers into the country from Jamaica, the Bahamas, British Honduras, and Barbados (all British subjects) (Thompson 2013). In late August 1944, 45 young men from Barbados arrived at the former CCC camp at the Hugo Sauer Nursery. Marvin Beltz, their supervisor, gave them a tour of the camp, which included clean bunks, a shower room, a cookhouse, and a recreational hall. They lived at the camp for four weeks, helping area farmers with the potato harvest (Rhinelander Daily News 1944).

Prisoners of War Branch Camp: 1945

By the end of World War II in 1945, Wisconsin held approximately 20,000 captured prisoners of war (POWs) at Camp McCoy in Monroe County, which had been designated in 1942 as one of the POW base camps in the United States. The prisoners offered a perfect opportunity to fill labor shortages in the state, especially in agriculture. Wisconsin opened 38 "branch" camps for POWs throughout the state, including one near Rhinelander (Miazga 2004). According to the local newspaper, the prison compound was “set up at the former CCC camp two miles west of Rhinelander” (Rhinelander Daily News 1945). Although the nursery was not identified by name, the location describes the nursery side camp that had been used to house farm laborers the year before (Cowley 2002, Miazga 2004).

Approximately 190 POWs were stationed at the Rhinelander branch camp to harvest beans and potatoes for the Oneida County Farm Labor Association. The POWs came in two waves, with 90 arriving on August 29, 1945, and an additional 100 arriving on September 4. According to Cowley (2002), the former CCC camp “needed only a good cleaning to prepare it for new occupants.” The prisoners slept in the largest CCC barracks, while Commander Captain Kunze and 40 guards slept in an adjacent dormitory. The old mess hall and shower house were still usable. Security was minimal, with no fences, guard stations, or towers.

Each morning, the prisoners were transported in school buses and trucks to area farms, accompanied by U.S. Army Military Police. The prisoners were clearly identified with large “P.W.” stamps on the backs of their shirts and pants. In the evening, they returned to camp, where they were fed dinner and allowed to play cards, read, and write letters. The POW camp closed at the end of October 1945 after the potato harvest had ended (Cowley 2002).

Jamaican and Mexican Laborers: 1946

In 1946, with 5,000 acres of potatoes to be harvested, the Oneida County Farm Labor Association Cooperative was forced to ask for state aid to recruit foreign laborers. In August of that year, the local newspaper reported that as many as 225 laborers from Jamaica or Mexico were expected to assist with farming. The workers were to be housed at the old CCC camp at the Hugo Sauer Nursery (Rhinelander Daily News 1946).

Hugo Sauer State Nursery: 1950–1974

After World War II, the federal government intended to shut down the Rhinelander nursery, but the State of Wisconsin stepped in to begin a new chapter in the nursery’s history.

State of Wisconsin Leases Nursery

In 1950, the Forest Service announced plans to discontinue the operation of the Hugo Sauer Nursery. During its 19 years under federal ownership, the nursery had produced about 200 million seedlings of mostly red pine and jack pine, but funding for forest restoration had been reduced at the federal level, and stock requirements for the Nicolet and Chequamegon National Forests were being met by a larger, more centrally located nursery at Watersmeet, Michigan (Rhinelander Daily News 1950, 1974a).

Although the demand for federal land was reduced, demand for private land plantings was high. The successful forestry program at Trees for Tomorrow, a forest-restoration initiative begun in the 1940s, resulted in state nurseries being able to meet only half the demand for seedlings. According to the Rhinelander Daily News, closing the Hugo Sauer Nursery "would have made the situation even more acute since its surplus trees were available to state nurseries for distribution through regular sales" (Rhinelander Daily News 1953a).

The Wisconsin Conservation Department (now called the Department of Natural Resources) was interested in leasing the nursery from the Forest Service, but it did not have the budget to support the endeavor. The Rhinelander Paper Company stepped in with a $20,000 loan to keep the nursery running. In 1951, the Hugo Sauer Nursery was leased to the Wisconsin Conservation Department. The loan was repaid over time with tree seedlings planted on the paper company land (Rhinelander Daily News 1953a, Rhinelander Hodag Shopper 1981).

Managing the State Nursery

In 1951 Alvin E. Nelson, who had worked at the Griffith State Nursery in Wisconsin Rapids, became the first manager of the state-operated Hugo Sauer Nursery (Fig. 24). As part of the Wisconsin Conservation Department position, he also became manager of the 55,000-acre American Legion State Forest. He moved into the nursery residence on August 24 with his wife, Connie, and their 7-year-old twin sons, Martin and David (Fig. 25). In 2002 Nelson remembered the assignment as "probably the best I ever had with the Forest and Parks Division."

Figure 24.—Alvin E. Nelson, manager of the Hugo Sauer Nursery for the state of Wisconsin from 1951 to 1955. Courtesy photograph from the Nelson family.

Nelson inherited two knowledgeable foremen who had worked at the Federal nursery since its founding in 1931: Raymond "Butch" Reader and Henry "Whitie" Wiedeman, who continued working at the nursery until it closed in December 1973 (Berndt, H. 2019, Rhinelander Daily News 1974b). These two men were the only permanent employees hired by the state to assist the nursery manager in running the nursery. Much of the labor at the nursery was provided by prisoners. As part of his American Legion State Forest job, Nelson was assigned to coordinate a 40-man prison crew from the McNaughton state prison camp near Lake Tomahawk (Berndt, H. 2019, Nelson 2002). During the first three years, the prisoner workforce was kept busy removing scrub oak. During the winters, Reader and Wiedeman operated the seed extractor and repaired equipment (Nelson 2002). When the state took over in 1951, the nursery soil was very acidic due to the use of hydrochloric acid over the years to treat damping-off, a soil-borne fungal

Figure 25.—Alvin E. Nelson with his sons, Martin and David, on the steps of the nursery residence, circa 1953. Courtesy photograph from the Nelson family.

disease. Seedlings that grew in the acidic soil were stunted, so they were grown to 3 years old, rather than the more typical 2 years, to make up for the loss in height. To mitigate the acidic conditions, Nelson had the prisoner crew break the duff layer in surrounding woodlands to collect leaf mold, spread it on the nursery beds, and till it into the soil. Soybeans were also planted in the beds and tilled in after growth. In addition, several tons of lime were added to the soil. Once the soil pH became more neutral, the nursery seedlings grew faster and hardier (Berndt, H. 2019, Nelson 2002).

In July of 1955, Harold "Hal" Berndt was appointed assistant nursery superintendent and assistant manager of the American Legion Forest under Nelson (Fig. 26). A year later, Nelson was transferred to Trout Lake on the Northern Highland State Forest (Nelson 2002). Berndt became the acting manager of the nursery, where he worked until 1972, two years before the nursery closed. He moved into the nurseryman house with his wife, Lu, and their four children: Luan, Julie, Marti, and Terry (Fig. 27). In a 2019 interview, Berndt said that during his 40 years of working for the state, his 17 years at the nursery were his best. His daughter, Julie Berndt (2019), who grew up at the nursery, recalled fond memories in an interview: "When my friends in high school came out here, they called it nirvana, you were in heaven, because you had access to the lakes, you had access to all of the land." Julie remembers bicycling the nursery roads with her siblings after the nursery gates were closed at the end of each day.

Berndt also managed the American Legion State Forest, where he designed seven campgrounds and three picnic areas (Berndt, H. 2019) and managed the McNaughton state prison camp workforce. Prisoners assisted in all nursery operations, including transplanting young trees, pulling seedlings for forest planting, weeding nursery beds, preparing nursery beds for planting, cutting firewood, and maintaining the grounds (Figs. 28, 29) (Rhinelander Daily News 1962).

Figure 26.—Harold "Hal" Berndt, manager of the Hugo Sauer Nursery for the state of Wisconsin from 1955 to 1972. Courtesy photograph from Hal Berndt.

Figure 27.—Hal Berndt with his wife, Lu, and their four children in 1961. Courtesy photograph by Hal Berndt.

Figure 28.—A prison crew from the McNaughton state prison camp working in the Hugo Sauer nursery beds, 1964. Courtesy photograph by Hal Berndt.

Figure 29.—Dry fertilizer being applied to seedlings in the Hugo Sauer Nursery. Courtesy photograph by Hal Berndt.

During the busy spring season at the nursery each year, there were approximately 120 people working to plant seeds, transplant seedlings, and package trees for shipment (Figs. 30, 31, 32, 33). About half were inmates from the prison camp, and the other half were hired from the local area (Berndt, H. 2019, Rhinelander Daily News 1974a). Local women were typically hired to do the transplanting because they were better at threading the seedlings quickly into the planting machines (Berndt, H. 2019).

Figure 30.—Local women sorting and bundling seedlings at the Hugo Sauer Nursery, 1964. Courtesy photograph by Hal Berndt.

Figure 31.—Trees lifted from the Hugo Sauer Nursery being wrapped in brown paper, 1958. Courtesy photograph by Hal Berndt.

Figure 32.—Bundled trees from the Hugo Sauer Nursery being loaded onto a truck for shipment, 1964. Courtesy photograph by Hal Berndt.

Figure 33.—A truck load of bundled trees from the Hugo Sauer Nursery ready for shipment, 1958. Courtesy photograph by Hal Berndt.

By 1953, the state nursery was producing 5 million trees annually for farmers, private landowners, industrial plantations, and state forest lands (Rhinelander Daily News 1953c). Unlike the federal operation, which had focused primarily on growing red pine and jack pine, the state operation expanded the variety of trees available for planting to include white spruce, white pine, balsam fir, Norway spruce, and white cedar (Rhinelander Hodag Shopper 1981). Like the Forest Service, the Wisconsin Conservation Department purchased pine and spruce cones from private citizens each year. In 1953, the going rates per bushel were $1.50 for white pine, $2.50 for jack pine, $6 for red pine, and $7 for white spruce. Over the winter, the seeds were extracted, producing just .075 pound of seed for each bushel of pinecones (Figs. 34, 35) (Rhinelander Daily News 1953c).

A record cone-producing year occurred in 1957, and the state purchased nearly 4,000 bushels of cones from approximately 700 residents for the Hugo Sauer Nursery. To keep up with the unusually high numbers, the extractory operated 24 hours a day, 7 days a week. Seed was sold all over the United States (Berndt, H. 2019). That year, Berndt emphasized the importance of the operation in an interview with the local newspaper, saying “These small seeds, 50,000 to the pound, which in themselves seem small and insignificant, are vital to the welfare and economy of everyone, especially those in this part of Wisconsin” (qtd. in Rhinelander Daily News 1957a).

Also in 1957, the Northern Institute of Forest Genetics was established adjacent to the nursery, beginning a close partnership between Forest Service researchers and the state-operated nursery that lasted until 1974 (see “Establishment of the Northern Institute of Forest Genetics: 1957,” below). As demand for seedlings in the state began to fall, empty seed beds were shared with Forest Service researchers for experimental planting studies. Berndt also used prison laborers to assist with various federal projects. For example, inmates painted the first Forest Service concrete block laboratory building in 1957 (Berndt, H. 2019).

Figure 34.—A worker filling trays in the extractory with cones that were heated to open the scales, 1954. Courtesy photograph by Ed Steigerwaldt, Wisconsin Department of Natural Resources.

Figure 35.—Cleaned white pine seeds being funneled into an air-tight galvanized canister, which was moved to a cold storage seed house until spring, 1954. Courtesy photograph by Ed Steigerwaldt, Wisconsin Department of Natural Resources.

State Nursery Closes

In May 1974, the state of Wisconsin ended tree production at the Hugo Sauer Nursery (Fig. 36). With advanced mechanization, the state was able to close three of its six nurseries and still meet the statewide demand of 18–20 million trees annually (Rhinelander Daily News 1973a, 1974a). In a newspaper interview, Berndt said, “It’s sort of sad to watch the end of an era which has meant so much to northern Wisconsin.” While being operated by the state from 1951 to 1974, the nursery had produced about 76 million seedlings of red pine, white pine, white spruce, jack pine, and white cedar. The most trees produced in one year was 7.6 million in 1959 (Rhinelander Daily News 1974a).

The Wisconsin Department of Natural Resources (which had changed its name from the Wisconsin Conservation Department in 1968) turned the nursery site over to the Forest Service. The state continued to lease various buildings on the property, including the radio repair shop (field warehouse) and the former cone shed #2/packing plant (McKay 1996).

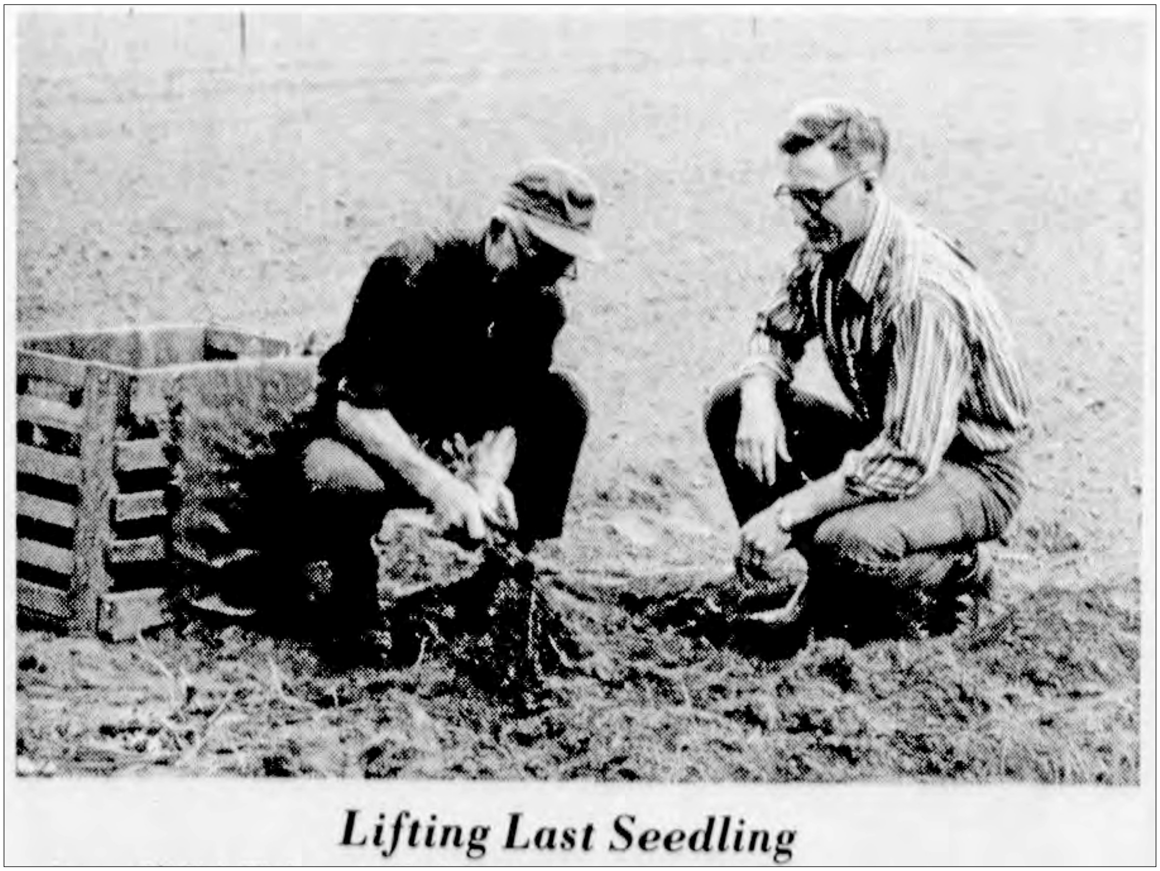

Figure 36.—A Rhinelander Daily News article that ran on May 31, 1974, included this photograph of Henry “Whitie” Wiedeman (left), retired nursery foreman, and Hal Berndt (right), former nursery manager, lifting the last tree seedling produced at the Hugo Sauer Nursery during state management. Courtesy photograph by The Rhinelander Daily News.

Construction of State Nursery Buildings

The Wisconsin Conservation Department continued to use most of the buildings that had been constructed by the Forest Service. Several new buildings were constructed during this time, and an existing building was expanded to meet changing needs (Figs. 37, 38). See Appendix 2 for a site map and photographs of the existing buildings and landscape elements in 2019.

Figure 37.—The northern Hugo Sauer Nursery planting blocks in October 1957. The field warehouse is in the lower right of the image. The cone shed #2/packing shed building is in the upper left of the image at the top of the windbreak plantings. From here moving left are the seed storage shed, oil house, seed extractory, and repair shop. Courtesy photograph by Staber Reese, Wisconsin Department of Natural Resources.

Fertilizer Shed

In 1957, the Wisconsin Conservation Department built a shed to store fertilizer at the location of the former CCC side camp (App. 2, Figs. 104, 105) (McKay 1996). The old CCC shower house was in disrepair and torn down to make room for the fertilizer shed (Berndt, H. 2019).

Figure 38.—The southern Hugo Sauer Nursery planting blocks in October 1957. The site of the old CCC side camp is visible in the center left, where the implement shed and another smaller building, likely the original kitchen, are standing on the shore of the Langley Lake inlet. Courtesy photograph by Staber Reese, Wisconsin Department of Natural Resources.

Packing Shed and Office Addition

In 1958, the Wisconsin Conservation Department constructed a two-story, 40-foot-long addition on the east side of the 1937 cone shed #2 building (App. 2, Figs. 87, 88, 127) (McKay 1996). The upper level of the addition was used to dry and store seed cones. The lower level was refrigerated for packing trees for shipping (Berndt, H. 2019). In 1988, the USDA Animal and Plant Health Inspection Service (APHIS) Wildlife Services unit moved into the building and converted the upper floor to office space and the lower floor to storage. They continue to use the building today.

Pumphouse #3

In 1961 or 1962, the Forest Service constructed a third pumphouse on a small lake (sometimes referred to as Long Lake) north of the packing shed and office addition (McKay 1996). The pumphouse was likely constructed to provide additional irrigation for experimental test plots planted by the Northern Institute of Forest Genetics.

Office, Dwelling, and Garage

On April 29, 1975, the office/administration building, dwelling, and garage were sold by the Forest Service as government surplus (Rhinelander Daily News 1975a). The house and garage were moved to nearby locations in the Rhinelander area and are still standing today (Berndt, H. 2019). The fate of the office building is unknown.

Establishing the Forest Service Rhinelander Research Field Laboratory: 1915–1966

Evolution of Forest Research

Early in its existence, the Forest Service recognized the need for research to guide its efforts. In 1915, research was consolidated into the newly created Branch of Research. The first regional forest experiment stations were created in 1921. In 1923, the Lake States Forest Experiment Station was established on the St. Paul campus of the University of Minnesota. Its purpose was to "secure by scientific investigation reliable information as to the management, protection, growth, reforestation, and life histories of the forests of Michigan, Wisconsin, and Minnesota" (Rudolf 1985).

Early genetics research focused on identifying seed sources that would improve the survival and growth of conifers. In 1928, noted forest researchers Carlos Bates and Paul Rudolf began collecting seeds to study genetic variations in red pines. In 1932, Bates planted seeds from eight spruce species at the Hugo Sauer Nursery, and in 1936 the seedlings were field planted in several national forests. These trees formed the basis for later genetics research. Rudolf coordinated several other genetics studies as well, including analyzing jack pines in plantations throughout the northern states (Rudolf 1985).

Research into nursery production was also important in the early years because nurseries needed to produce millions of seedlings each year for reforestation efforts. In 1937, Joe Stoeckeler, a contemporary of Bates, began comprehensive nursery studies at the Hugo Sauer Nursery. The studies tested the effects of nursery practices, such as density of planting seeds, watering frequencies and amounts, chemical weed control, and fertilizer applications on conifer species. The studies also determined how long stock could be stored before planting (Rudolf 1985). Stoeckeler would later coauthor "Forest Nursery Practices in the Lake States," a definitive 124-page publication that presented the results of observations and experiments designed to maximize nursery production. The Hugo Sauer Nursery is featured prominently in many of the studies (Stoeckeler and Jones 1957).

Establishment of the Northern Institute of Forest Genetics: 1957

Early research efforts demonstrated that genetic improvements could increase the quality and quantity of timber production, but a more concentrated and organized research program was needed. In 1954, the Lake States Forest Experiment Station in St. Paul received its first funding to study forest genetics specifically. Bob McCulley and Paul Rudolf, foresters working for the station, conducted a region-wide search for a field laboratory site in 1955 (Jeffers 1971, Rudolf 1985). Wisconsin was chosen, and Congressman Alvin E. O'Konski, who represented northwestern Wisconsin from 1943 to 1973, advocated for the genetics facility to be located near Rhinelander rather than Madison. Rhinelander was an economically depressed area, and he saw the benefits that the new federal laboratory could bring to the community (Bauer 2019). The Forest Service selected a site for their genetics facility adjacent to the Hugo Sauer Nursery near Rhinelander for several reasons (Rhinelander Daily News 1957c):

1. The site was centrally located in the region covered by the Lake States Forest Experiment Station.

2. The site was within easy reach of most forest types found in the Lake States area.
3. National forest land was already available for the construction of buildings and roads.
4. The site was adjacent to the state-operated nursery that could be used to grow seedlings for experimentation.

The local newspaper expressed its support, writing:

> The institute is ideally located for its experimental work. Immediately adjacent to it is the Hugo Sauer Nursery, operated by the Wisconsin Conservation Department in cooperation with the U.S. Forest Service and producing 7 to 9 million young trees each year for forest planting. It offers excellent facilities for observing early survival and growth of experimental stock [Rhinelander Daily News 1960a].

In 1955, Hans Nienstaedt became the first full-time geneticist at the Lake States Forest Experiment Station and was named Project Leader of the field site. The new research program would focus on the genetics of spruces, northern pines, and birches (Rudolf 1985).

On June 6, 1957, the Northern Institute of Forest Genetics officially opened in Rhinelander as a specialized field laboratory and research project of the Lake States Forest Experiment Station. It was one of only three forest genetics institutes in the country, with the others in Placerville, California and Gulfport, Mississippi (Rudolf 1985). M.B. Dickerman, director of the Lake States Forest Experiment Station in 1960, explained the significance of the institute:

> The research conducted here is of vital importance to the people of the northeastern United States. If we can develop faster growing trees with desirable wood qualities and resistant to insects and disease, it will be possible to multiply the value of timber yields in this area several times and thus affect the well being of our whole economy [Wisconsin Rapids Daily Tribune 1960].

Dickerman predicted accurately that the Rhinelander research field laboratory would attract foresters from throughout the country and around the world to observe and be involved in the research activities (Rhinelander Daily News 1957b).

Building Space in the 1950s and 1960s

The initial genetics research project was housed in the Nicolet National Forest headquarters in downtown Rhinelander. In 1955 and 1956, an 1,800-square-foot concrete block office and laboratory was built adjacent to the Hugo Sauer Nursery. A portion of the concrete building served as a headhouse for a 1,000-square-foot greenhouse constructed in 1957. A second greenhouse was added in 1959, increasing the greenhouse space to 2,400 square feet (Rudolf 1985). The original concrete block building is still standing and today houses a shop, wet lab, and office space. The location of the original greenhouses was converted into garage space.

With the support of U.S. Representative Alvin E. O'Konski, a 9,660-square-foot, two-story building was constructed in 1959 and 1960 into a hill to the east of the original concrete block building (Fig. 39). The rectangular building was roughly oriented north-south, with only the upper floor accessible from the east. Both floors were exposed on the west side. The cost was $170,000. The modern building provided office space, four laboratories, and four controlled-growth rooms where light and temperature could be regulated (Rhinelander Daily News 1959a, 1960b). A dedication ceremony was held on September 30, 1960, with Hans Nienstaedt serving as the master of ceremonies (Rhinelander Daily News 1960a).

By 1963, the institute included two buildings with office space for a dozen scientists and science support staff, several laboratories, four growth control chambers, four 20-foot-by-50-foot greenhouse sections with automatic controls, a lath house, cold frames with bottom heating, and good nursery facilities (Figs. 40, 41) (Rudolf 1963).

Figure 39.—A southeast view of the newly constructed Institute of Forest Genetics building in 1962, showing both stories exposed with exterior stonework and laminated columns. USDA Forest Service photo archives.

Figure 40.—A greenhouse at the Institute of Forest Genetics in 1962. USDA Forest Service photo archives.

Figure 41.—The inside of a lath house at the Institute of Forest Genetics in 1965. USDA Forest Service photo archives.

Changing Names—Institute of Forest Genetics: 1963

When it opened in 1957, the field laboratory in Rhinelander was originally named the Northern Institute of Forest Genetics. After 1963, the field laboratory was renamed the Institute of Forest Genetics, dropping "Northern" from its name (Rudolf 1985).

In 1966, the various field research projects of the Lake States Forest Experiment Station and two-thirds of the Central States Forest Experiment Station were merged into the newly formed North Central Forest Experiment Station, which included the states of Wisconsin, Minnesota, Michigan, Illinois, Indiana, Missouri, and Iowa. The Institute of Forest Genetics became a field laboratory unit of this new station (Rudolf 1985).

Research at the Rhinelander Field Laboratory Unit: 1950s to the Present

The following sections summarize the major research projects undertaken at the Rhinelander research field laboratory from 1956 to the present. While dozens of individual research projects conducted at the laboratory have improved forest trees and practices in the northern Lake States, six main research programs have garnered national and international attention:

1. Genetics and physiology (1956–1985)
2. Short-rotation woody crops (1970–1998)
3. Biotechnology (1983–2000)
4. Landscape ecology (1990–present)
5. Atmospheric pollution and climate change (1992–present), notably Aspen FACE (1992-2011)
6. Phytotechnologies and ecosystem services (1999–present)

It is often challenging to delineate the programs into their own distinct research projects because researchers from different areas worked together, sharing their expertise, experimental techniques, and results toward common goals. This collaboration, together with changing research priorities, culminated in reorganizing the multiple research programs into a single research project, the Institute for Applied Ecosystem Studies: Theory and Application of Scaling Science in Forestry, in 2007. The new research project formalized the interdisciplinary approach to studying forestry and broader ecosystem issues and incorporated the increasing recognition in the scientific community of the importance of scaling issues to ecological processes. In 2022, the research project was renamed Landscape Ecology and Sustainability in the Lake States Forests, with the mission to develop and deliver scientific knowledge and tools that integrate ecological changes and resource management across scales and disturbance gradients with sustaining forests, restoring landscapes, and conserving populations.

Genetics and Physiology Era: 1950s and 1960s

When the institute in Rhinelander was established in 1957, the primary research project focused on the fledgling field of forest genetics. A few years later, the focus expanded to include the physiology of wood formation and the effects of radiation on forests.

Genetics of Northern Forest Trees: 1956–1984

The genetics research project began with the hiring of Hans Nienstaedt, who developed the program and coordinated the genetics studies (Fig. 42). He also served as the administrative Director's Representative of the facility until 1976, when he stepped down to devote himself to research full time. Nienstaedt was considered one of the world's leading specialists on spruces. He collected seeds internationally, and his efforts on spruce genetics benefitted the local forests of Wisconsin and beyond (Marr 1978c).

The purpose of the genetics research project was to develop faster-growing conifer and hardwood trees with desirable wood qualities and to breed varieties that were resistant to disease and insects through selection and hybridization. Speaking to a Lions Club in 1957, Nienstaedt said:

> Only recently have foresters entered the field of genetics. Although the corn-geneticist, for example, can tell the exact genetic makeup of his inbred lines, the forester hardly knows whether a particular character is inherited. He is starting from scratch: for practically every characteristic he wants to study means he first has to find out to what extent it is controlled by inheritance and how much it is influenced by the environment [Rhinelander Daily News 1957c].

In the same speech reported by the Rhinelander Daily News, Nienstaedt emphasized that the importance of this forest tree improvement program was due to steeply rising demands for wood products expected in the future.

Figure 42.—Hans Nienstaedt measuring pine seedlings in the Hugo Sauer Nursery, circa 1969. USDA Forest Service photo archives.

Research expanded into the genetics of jack pine with the arrival of Thomas Rudolph, who joined the institute as a Research Forester in 1959 (Rhinelander Daily News 1959b). Rudolph's research focused on jack pine seed source plantings. He was interested in jack pines because their large genetic diversity allowed for selective breeding of specific traits. His initial efforts were to speed up generations of jack pine trees through cultural methods, such as starting seedlings in a greenhouse, and genetic methods, such as selecting individual trees for earlier flowering. In 1963, Rudolph was reassigned to lead ionizing radiation studies (see below), but he returned to the genetics project when funding for radiation research ended in 1974 (Rudolph 2019).

Genetics research further expanded into hardwood species, particularly birches, with the addition of Knud Clausen in 1961 (Rudolf 1985). In 1965, Jerome Miksche began pioneering research on conifer DNA reassociation kinetics. The editor of "Modern Methods in Forest Genetics" (1976), Miksche became the director of the USDA Plant Genome Research Project in 1990 (Isebrands 2020, Neale 1995). The first compilation of research studies conducted at the Institute of Forest Genetics was prepared by Richard Jeffers in 1971, who joined the genetics program in 1969.

By the late 1960s and early 1970s, the researchers on the genetics project identified the following objectives (Dawson 1968):

1. To determine the range and heritability of genetic variation for important northern tree species.
2. To increase understanding of the effects of radiation on forest trees.
3. To develop efficient means for vegetative propagation of forest trees.
4. To develop efficient breeding techniques and better strains of commercially important species.

To accomplish these objectives, the genetic research project was divided into several main research focus areas.

Seed Source Studies

One of the main objectives of the genetics research project was to study the variation among different strains of the same species. This research was done with provenance or seed source studies, in which seeds from different geographic locations were collected, planted in separate plots in the Hugo Sauer Nursery, field planted in different environments, and evaluated for many years (Figs. 43, 44). The purpose was to find the seed sources that were best adapted to the area where the trees would be planted. Scientists established provenance tests for white spruce, jack pine, red pine, white pine, tamarack, balsam fir, white cedar, Norway spruce, and yellow birch (Dawson 1968, Jeffers 1971).

The research built on the work of one of the oldest seed source studies that Carlos Bates and Paul Rudolf had started in 1928 with red pine. Over 100 seed sources and individual tree progeny were studied throughout the natural range of the species. The results showed that the best genetic seed sources could increase height in red pine trees by 3 to 4 percent, and which, if selected for, would result in a 9 percent increase in timber production (Dawson 1968, Jeffers 1971).

Figure 43.—Workers maintaining the genetics research seed source beds at the Hugo Sauer Nursery, circa 1962. USDA Forest Service photo archives.

Figure 44.—Hal Luedtke (left), administrative assistant, and Hans Nienstaedt, director of the Institute of Forest Genetics, measuring white spruce plantings in the Hugo Sauer Nursery, circa 1962. USDA Forest Service photo archives.

In another study from 1951, jack pine seeds were collected from 29 stands in Minnesota, Wisconsin, and Michigan. After 10 years of growth, the height data showed that seedlings from Lower Michigan grew the best throughout Michigan and Wisconsin. Seedlings from north central Minnesota, on the other hand, worked best for northern Minnesota (Dawson 1968, Jeffers 1971).

Inheritance Studies

Studies that focused on the differences of the same tree species growing within a stand were conducted to help establish the best breeding methods. White spruce was the primary species used in heritable studies. In 1956, 4-year-old white spruce seedlings were selected from a nursery based on their superior growth and planted in the field. They were measured again after 7 and 18 growing seasons. Researchers found these “super spruce” trees continued to be taller (by 30 percent) and more resistant to frost than randomly selected seedlings (Nienstaedt 1981). Studies concluded that selecting superior seedlings to plant and collecting seeds from the faster-growing parent trees would result in a significant increase of merchantable timber. Another study focused on developing white spruce varieties that were less susceptible to frost by choosing for individuals that budded out at later dates (Dawson 1968, Jeffers 1971).

Disease and Insect Resistance Studies

These studies focused on breeding varieties of trees that were resistant to diseases and insects. Jack pine seedlings from various seed sources, for example, differed in resistance to various insects and diseases (Dawson 1968).

Exotic Tree Species

Numerous exotic tree species were studied to determine if they would grow faster or produce more wood than native species. Researchers also studied hybridization between exotic and native species. As of 1972, the station had grown 26 species of birch and 27 species of spruce from around the world (Jeffers 1971).

Interspecies Hybrids

By combining different tree species together, hybrids could be produced that grew better, faster, and/or were more resistant to insects and diseases than purebred trees. In 1972, research projects focused on spruce and birch hybridization. Of the 52 combinations of spruces attempted, 27 crosses produced seedlings. Some of the best hybrids were 20 to 40 percent taller than the parent trees (Jeffers 1971).

Vegetative Propagation

Propagating trees by asexual methods allowed researchers to maintain the genetics of an individual, which was essential for tree improvement programs. Different techniques to grow trees through vegetative propagation were integrated into the program. Studies included research on tree root formation (how to get cuttings to create roots), using jack pine needle fascicles to grow seedlings, and extending the season for grafting (joining two plants into one) (Jeffers 1971).

Cell Biology

In the early 1970s, cell biology studies were introduced into the research project to investigate the growth and reproduction of tree cells. Studies included investigations into the time required for nuclear division, determining the variation in DNA among species, and calculating the metabolic activities of different regions of the tree (Jeffers 1971).

Genetics Research Continues

By 1978, the combined genetics studies had evolved into identifying the best possible breeding strategies to develop improved seed. Describing the evolution, Nienstaedt said, "In the past we were primarily involved in evaluating variability and selecting material. Now we are looking at what the best strategy will be for utilizing that material in the future" (qtd. in Marr 1978c). Among the interesting discoveries was a study that found white spruce from southeastern Ontario grew 30 percent faster in Wisconsin than local seed sources, and that jack pine seeds planted 100 miles north of where they had been collected would increase pulpwood yields (Marr 1978b).

Other notable genetic research in the 1970s included the physiology of parent trees and cuttings to determine new rooting techniques. The work was led by Bruce Haissig, who joined the genetics research project in 1973 and was awarded three patents for hormones that improved the initiation of rooting in cuttings (Boyles et al. 1983a, 1983b; Haissig et al. 1981; Marr 1978c). Haissig became the Project Leader for the new biotechnology project in 1984. Thomas Rudolph, who transferred back to genetics when his radiation research ended in 1974 (see "Radiation Genetics/Radiobiology: 1963–1976," below), resumed his research into the success of jack pine trees in producing seeds and seedlings. One of his greatest accomplishments was establishing several generations of inbred lines of jack pine, which created hybrid vigor that has been shown to improve hybridized offspring (Rudolph 2019). Robert Cecich, a plant anatomist who joined the team in 1973, studied the flowering of jack pine trees to reduce the age at which female flowers were formed. Hyun-Chung Kang, a population geneticist from South Korea who joined the team in 1979, worked to improve breeding techniques for trees (Marr 1978c).

Even though the Genetics of Northern Forest Trees research project formally ended in 1984, genetic research remains a core component of many other studies conducted at the Rhinelander field research laboratory. Current research is focusing on studying genotype-by-environment interactions similar to provenance genetic studies but within the context of changing climate conditions (e.g., common garden experiments with various seed sources).

Physiology of Wood Formation: 1962–1985

In 1956, Philip Larson, a World War II Navy fighter pilot, was hired based on his cutting-edge thesis work at Yale University on the effects of tree crowns on wood formation (Fig. 45). The Forest Service awarded him the first agencywide "pioneering scientist" designation in 1962, which gave Larson the creative license to conduct research independent of technical and administrative supervision at the facility (Isebrands and Zalesny 2020).

Figure 45.—Philip Larson, leader of the Physiology of Wood Formation Project from 1962 to 1985, working in a greenhouse at the Institute of Forest Genetics in the 1960s. USDA Forest Service photo archives.

Larson founded the Physiology of Wood Formation research project at the Rhinelander field laboratory with a set of established goals and best methods separate from the overall genetics research project (Isebrands and Zalesny 2020, Marr 1978a, Rudolf 1985). His research showed how water, soil nutrients, carbon dioxide, and solar energy impact the development of a tree. He also studied the anatomy of wood to determine how different types of wood cells are formed. The main objective, Larson explained, was to "develop a concept of wood formation, develop a total understanding of wood from tree growth" (qtd. in Marr 1978a). Free of programmatic constraints, Larson was able to pursue basic laboratory research of his choosing. The results were rarely directly applicable to forest practitioners, but instead aimed at other scientists and university professors who used the findings in field tests or teaching (Marr 1978a).

The physiology research project expanded into studying the physiology of poplars with the hiring of John Gordon, a biochemistry-trained plant physiologist, in 1965 and Judson Isebrands, trained in the physiology of wood formation and microscopy, in 1968. In 1970, research began on carbon-nitrogen relations in poplars by Richard Dickson (Fig. 46), a plant physiologist specializing in photosynthesis and translocation. Research was enhanced by several visiting scientists from around the world who joined the project on yearly assignments throughout the 1960s and 1970s (Isebrands and Zalesny 2020, Marr 1978a).

By the late 1970s, Larson had attained national and international stature in the field of tree physiology. In 1975, he received a Distinguished Service Award from the U.S. Department of Agriculture for research leading to new scientific interpretation of wood formation (Rhinelander Daily News 1975b). In 1977, he received an award from the New York

Botanical Garden for his "outstanding contribution to the fundamental aspects of botany." His research provided a comprehensive picture of vascular development in growing shoots (Marr 1978a).

By October 1978, Larson felt that the main objective of understanding wood formation had almost been reached, and his team was moving into the finishing touches (Marr 1978a). When Larson retired in 1986, the research project ended and the remaining scientists moved to other ongoing research projects within the Rhinelander research unit. Larson spent several years writing a book, "The Vascular Cambium: Development and Structure," which summarized his lifelong research. It is still recognized today as the most comprehensive treatment of how wood is formed (Isebrands and Zalesny 2020).

Radiation Genetics/Radiobiology: 1963–1976

In 1963, as Cold War tensions between the United States and the Soviet Union heightened, the Atomic Energy Commission became interested in the impacts that a nuclear disaster might have on forests. With the support of U.S. Representative Alvin O'Konski, the Institute of Forest Genetics was chosen as a site to study ionizing radiation effects. Thomas Rudolph was asked to move from the genetics research project and lead the radiation studies. He traveled to the Oak Ridge National Laboratory in Tennessee and the Brookhaven National Laboratory in New York for intensive training in working with ionizing radiation sources (Rudolph 2019).

Figure 46.—Richard Dickson, research plant physiologist, observing a machine running a plant analysis, circa 1969. USDA Forest Service photo archives.

Commenting on radiation studies being applied to forests, Rudolph said, "This pioneering study of radiation is the outgrowth of related investigation work done primarily on annual plants at other laboratories" (qtd. in Davis 1966).

The program had four major objectives (Dawson 1968):

1. To determine the effects of ionizing radiation on forest tree species (both as background levels that lead to natural variation and the potential of a nuclear catastrophe).
2. To develop the use of ionizing radiation as a genetics tool by inducing genetic changes in trees.
3. To compare the effects of gamma radiation with other types of radiation and chemical mutagens.
4. To induce mutations that would develop improved varieties of trees.

In 1964, Rudolph supervised a major excavation of the first radiation site, which was located about three-quarters of a mile southwest of the field laboratory headquarters and west of the Hugo Sauer Nursery across Langley Lake. A 6.5-acre radiation field was surrounded by earthen embankments 15 to 20 feet high (Fig. 47). An 8-foot chain link fence with barbed wire on top was installed around a 40-acre area, with the radiation field in the center. In 1965, a radiation source was added, obtained through the cooperation of the Atomic Energy Commission. The 1,500-curie tube of Cesium-137 could be raised and lowered into a shielding well below the ground (Fig. 48). A "sky shine" shield was placed over the top of the Cesium to eliminate vertical radiation, and the horizontal radiation was mostly absorbed by the embankments (Davis 1966, Jeffers 1971, Rudolph 2019).

Figure 47.—Hal Luedtke (left), administrative assistant, and Art Flancher (right), engineer, establish final grade for the original radiation field at the Institute of Forest Genetics in 1964. USDA Forest Service photo archives.

Figure 48.—A Cesium-137 radiation source that could be raised and lowered into the ground was added to the radiation field at the Institute of Forest Genetics in 1965. USDA Forest Service photo archives.

Trees were planted in plots at different distances from the radiation source to test different amounts of exposure (Fig. 49). At the embankments farthest from the source, the trees received very little radiation and served as controls for the experiment. Starting in 1965, the trees were irradiated for 20 hours every day during the growing season. A safe period of four hours between noon and 4 p.m. daily allowed researchers to take measurements and make observations (Fig. 50). A siren would go off at 4 p.m. to warn that the radiation source would be exposed again (Rudolph 2019).

An additional self-contained gamma irradiator was located inside of the main laboratory building and used to expose seeds, pollen, small seedlings, and cuttings to ionized radiation. Researchers could then determine the effect of radiation on germination and growth (Davis 1966, Jeffers 1971). Results of the study showed that Norway spruce, white spruce, and Scotch pine seeds were most sensitive to radiation, and jack pine seeds were most resistant. Another study showed that white spruce pollen irradiated at low dosages increased seed production by approximately 25 percent (Dawson 1968, Jeffers 1971).

In 1967, the Atomic Energy Commission wanted to expand the research to investigate how large-scale northern forest communities would respond to massive dosages of gamma radiation (Rudolph 1974). This experiment would be the third funded by the Atomic Energy Commission to study the effects of gamma radiation on forest ecosystems. (The first study was conducted in an oak-pine forest at the Brookhaven National Laboratory in New York, and the second was in a montane rain forest on what is now the Caribbean National Forest in Puerto Rico.) To make the study in Wisconsin successful, a larger land base was needed. In 1969, Oneida County leased a large tract of land located approximately 15 miles southeast of the field laboratory headquarters in the township of Enterprise to the Forest Service (Rhinelander Daily News 1969).

Figure 49.—Trees in the Institute of Forest Genetics radiation field were planted at different distances from the ionizing radiation source, circa 1970. USDA Forest Service photo archives.

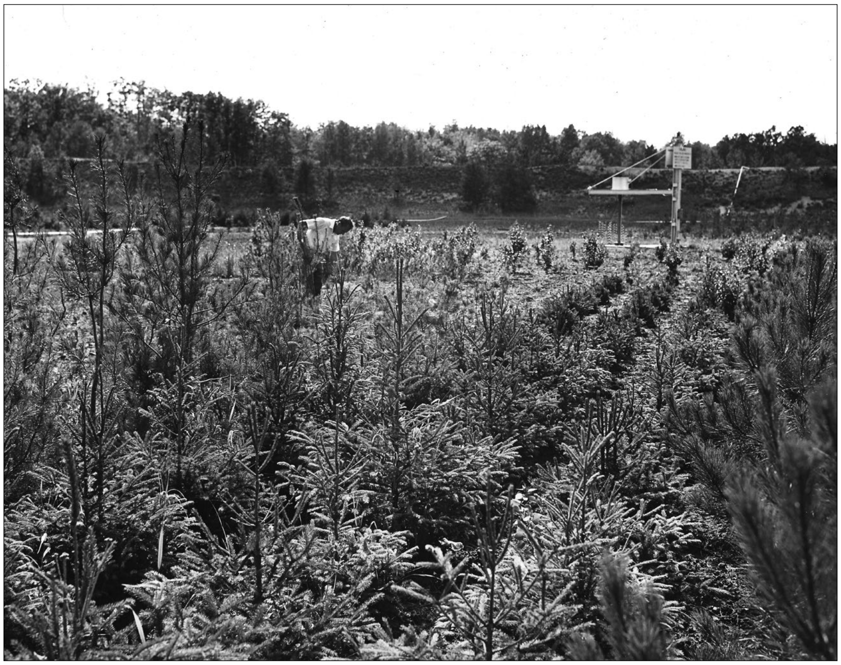

Figure 50.—Workers measuring trees in the Institute of Forest Genetics radiobiology field, circa 1966. USDA Forest Service photo archives.

From 1969 to 1972, Rudolph supervised the development of the 1,440-acre Enterprise radiation site, which consisted of two forest types: aspen and maple-aspen-birch. The area was enclosed by six miles of 8-foot-high chain link fence, which cost $250,000. A 10,000 curie Cesium-137 source was transferred from the research study site in Puerto Rico for installation in the Enterprise radiation plot (Rudolph 1974, 2019).

Ultimately, only one growing season of irradiation occurred at the Enterprise site, running from May 2 to October 16, 1972. The Atomic Energy Commission withdrew funding for radiation research in June 1974 to focus resources on the energy crisis of the early 1970s. Ten researchers were affected by the sudden closure (Rhinelander Daily News 1973b). Rudolph and many of the other employees rejoined the Genetics of Northern Forest Trees research program.

Despite the closure, scientists collected data. Between 1968 and 1972, researchers gathered a large amount of ecological baseline data prior to irradiating the site, and the studies were compiled by Rudolph into a report book entitled "The Enterprise, Wisconsin, Radiation Forest Preirradiation Ecological Studies" (1974). Studies conducted during and after the irradiated growing season were compiled by Jarsolav Zavitkovski into another report book entitled "The Enterprise, Wisconsin, Radiation Forest: Radioecological Studies" (1977). The studies reported that sensitivity to radiation in the forest communities increased from the lower to higher trophic plants—mosses and lichens were the most resistant, while trees were the most sensitive (Zavitkovski 1977). But the long-term value of the Enterprise study was the comparison among different forest ecosystems in Wisconsin, New York, and Puerto Rico. The radiosensitivity of northern forest ecosystems was found to be less than other temperate deciduous forests and about the same as that for the montane rain forest in Puerto Rico (Crow 2021).

A great deal of valuable information was lost due to the abrupt termination of the radiation project. Had the project continued and data on the recovery after radiation exposure of the two northern forest types collected, it is likely that the aspen and maple-aspen-birch forests would have been shown to be more resilient than either the oak-pine or montane rain forest due to the underground suckering by aspen. The soil protected this reproductive mechanism from the gamma radiation (Crow 2021).

The radiation source was removed from the Enterprise site shortly after the project ended in 1975. The fencing was taken down and reinstalled around the Oneida County airport adjacent to the Hugo Sauer Nursery. The radiation source at the original site near the field laboratory headquarters building was officially removed in the early 1990s, but the fencing remains to remove deer browsing pressure from current phytoremediation studies being conducted on the site (Rudolph 2019).

Diseases of Northern Conifers and Shelterbelts: 1962–1967

In the early 1950s, a Forest Diseases Division was established at the headquarters of the Lake States Forest Experiment Station in St. Paul, Minnesota. From 1962 to 1967, two researchers, William Phelps and Ray Weber, were stationed at the Rhinelander field laboratory to study the physical appearance, growth, and formation of spores of white pine blister rust cankers in Wisconsin and Minnesota. They discovered three distinct types of cankers, which would assist in future chemical treatments. They also found that canker growth rate and spore production decreased as the trees grew older and larger (Phelps and Weber 1969).

Silviculture and Ecology of Northern Hardwoods in the Lake States: 1965–1982, 1989–2005

The silviculture research project focused on managing hardwood stands by studying the impacts of different logging practices on tree growth, quality, and regeneration. Although the project was initiated by a field station in Marquette, Michigan, it was run by Richard Godman, a research forester stationed at the Rhinelander field laboratory. Godman operated and coordinated research on the nearby Argonne Experimental Forest that had been ongoing since the 1940s. As a result of Godman's research, uneven-aged management in sugar maple forests continues to be widely applied throughout the Lake States. His studies also showed that even-aged approaches are feasible for high-value hardwoods such as yellow birch (Crow 2021).

When the Marquette field station closed in 1982, Godman was transferred to the Establishment and Early Growth of Northern Forest Species research project at the Rhinelander field laboratory, where he continued his silvicultural work until his retirement in 1985. Gayne Erdmann, a research forester who had been stationed in Marquette, joined Godman in Rhinelander from 1984 to 1988 (Isebrands 2021).

Godman was well known for his numerous scientific publications on hardwood management and for translating this information into practical guides called "Northern Hardwood Notes" for forestry practitioners (Kern et al. 2014). He trained many of the foresters in the Upper Midwest on silvicultural practices (Isebrands 2021). Godman was inducted into the Wisconsin Forestry Hall of Fame in 1991 for his numerous contributions (WISAF 1991).

In 1989, the silviculture research and associated personnel transferred to a new research project, Silviculture in the Northern Lake States, headquartered in the Grand Rapids, Minnesota, field laboratory. Edward Hansen was named the Project Leader, and he relocated to Grand Rapids, a move that ended the Intensively Cultured Plantations for Biomass and Energy Production project (see below). Even though the project was based out of Grand Rapids, two research foresters, Terry Strong and Dan Netzer, remained at the Rhinelander station (Strong 2021). Strong and Netzer studied different ways to manage a land based on landowner needs. In 1991, Strong said, "We want to be able to provide the landowner with a method whereby [they] can manage the hardwoods, but also provide sustainable profit through responsible logging forever" (qtd. in Miller 1992b).

Around 1997, the research project was reorganized as the Ecology and Silviculture of Northern Lake States Forest. John Zasada, a research ecologist with Rhinelander's Physiological Mechanisms of Growth project, was named the Project Leader and transferred to Grand Rapids. The Rhinelander researchers within this project continued the important long-term silvicultural studies on the Argonne Experimental Forest, Dukes Experimental Forest (near Marquette, Michigan), and national forests throughout the northern Lake States. Strong, for example, studied the influence of canopy gaps to determine how different sized forest canopy openings influenced microclimate and vegetation growth (Strong 2021). The legacy of long-term forest management studies and the canopy gap studies has continued through the work of Christel Kern, who located to the Rhinelander field laboratory in 2015.

Short-Rotation Woody Crops Era: 1970s

A wood shortage was projected in the early 1970s because demand for wood products outpaced production and because forest lands were being set aside for purposes other than timber. In addition, domestic oil production began declining in the United States, leading to greater dependence on foreign oil from the Middle East. When the Organization of Arab Petroleum Exporting Countries (OAPEC) announced an embargo on oil shipments to the United States in 1973, the price of oil soared. The wood shortage and energy crisis brought major changes to the research programs being conducted at the Institute of Forest Genetics (Marr 1978b, Michele 1977).

Production of Maximum Fiber Yield from Woody Species/Maximum Yield Research and Development Program: 1971–1982

The wood shortage and energy crisis of the early 1970s spurred a new research project, the Production of Maximum Fiber Yield from Woody Species, which was launched in 1971 to study methods for maximizing fiber production under short rotations with intensive management. The Project Leader was David Dawson, who came from the Natural Resources Conservation Service in North Dakota (Fig. 51). His agronomy background was well suited for maximizing fiber production from trees (Zalesny 2019). Forests needed to produce more wood fiber to meet the rising demand for paper. Dawson described the project in this way:

> When we consider the growing needs of the nation for wood fiber, it becomes evident we are going to run out. It becomes a question of supply. The tonnage is there but it isn't the kind of quality we had 50 years ago. The composition of the woods is changing. What we are here for is to supply information to practicing foresters on how to grow more and better trees [qtd. in Marr 1978b].

Dawson (1976) called for "intensive culture," defining it as the "application of several—as opposed to one or two—cultural practices to the establishment and management of plantations with the objective of increasing the quantity and quality of wood produced." He defined "maximum yield" as "the amount of fiber produced when *all* environmental and genetic factors affecting tree growth are optimized." Dawson emphasized the unique, structure of the program, which drew together several specialties working toward a common goal—genetics, silviculture, physiology, wood technology, and harvesting engineers.

Dawson's team was not concerned about the size of the trees, but rather the overall amount and quality of fiber for producing paper and other products. The research used farming techniques as a basis for increasing the fiber yield, which involved planting a large number of smaller trees and using fast-growing hybrid strains. The plots were intensively irrigated, weeded, and fertilized (Marr 1978b, Rhinelander Daily News 1970).

To begin the study, tree species needed to be selected that would serve as good candidates for growing quickly and at close spacings. Of the 30 different hybrid poplar varieties

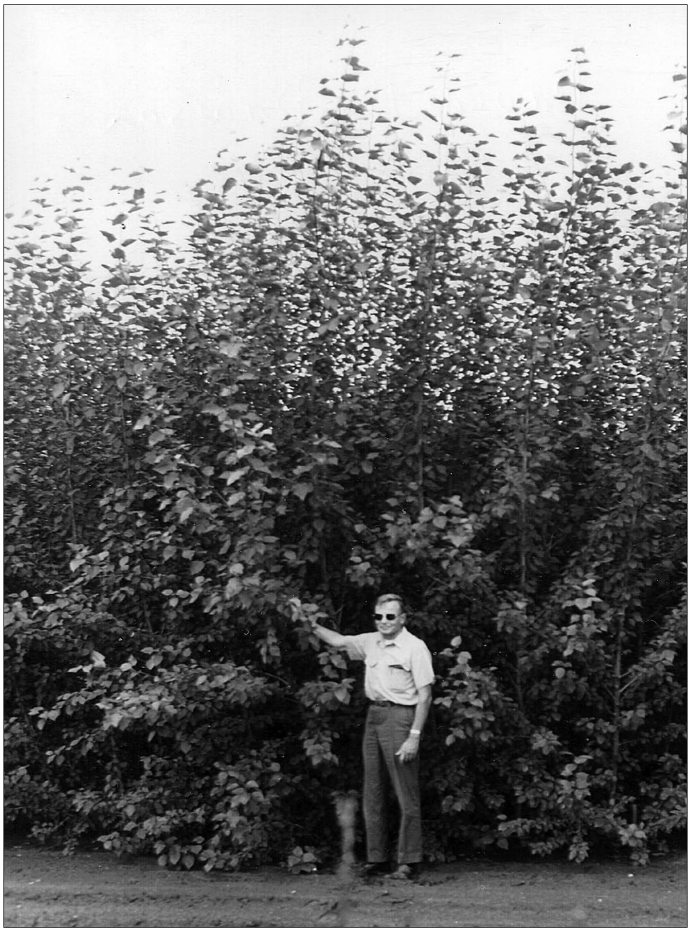

Figure 51.—David Dawson, leader of the Production of Maximum Fiber Yield from Woody Species program at the Rhinelander lab, in front of a fast-growing hybrid poplar in 1976. Courtesy photograph by J.G. Isebrands.

tested, 10 to 15 of them showed potential (Marr 1978d). Jack pine and tamarack were also included in the early studies, with green ash, European alder, and silver maples added later. The original experimental plantings were established in the Hugo Sauer Nursery, and some are still growing today (Dawson 1976, Isebrands and Zalesny 2020, Rhinelander Daily News 1977).

In response to the energy crisis of 1972–1973, the U.S. Department of Energy partnered with the Forest Service to develop "short-rotation woody crops"—trees that were bred and selected to have extremely high rates of growth, allowing them to be harvested after a short growing period. The trees could be used to produce domestic energy, thus reducing U.S. dependence on foreign sources of oil (Isebrands and Zalesny 2020). The Production of Maximum Fiber Yield project already running in Rhinelander was the perfect fit. Wood could be burned to create steam for driving electric generators, converted to wood alcohol, or used in the chemical industry as an alternative to oil (Marr 1978d). Speaking at the time, Dawson said, "our work has attracted the attention of the energy people as a result of the energy crisis. The world is looking at other sources of energy other than petroleum—and wood offers other possibilities" (qtd. in Marr 1978b).

In 1977, with funding support from the U.S. Department of Energy, the maximum yield project at Rhinelander was expanded to become the Maximum Yield Research and Development Program for the North Central Forest Experiment Station. Dawson continued to coordinate the maximum yield effort while also serving as the Director's Representative of the Rhinelander research field laboratory. Two cooperating research projects were created under this broader program: Intensively Cultured Plantations for Biomass and Energy Production and Physiology and Raw Material Evaluation of Intensively Cultured Plantations (Isebrands and Zalesny 2020).

Intensively Cultured Plantations for Biomass and Energy Production: 1977–1988

The Intensively Cultured Plantations for Biomass and Energy Production project continued the field studies started by David Dawson under the leadership of Jaroslav Zavitkovski, who had taken over the radiation studies from Tom Rudolph in 1974. Zavitkovski described the project as ". . . the last link between the research done at the lab and eventual user of the findings by all the projects. Essentially, the main assignment is the establishment of plantations in the field" (qtd. in Marr 1978d). After Dawson and his team had determined the best poplar species and genotypes for growing intensively cultured plantations, the next step was to identify silvicultural practices that would increase the yield grown for fiber and energy. Studies investigated optimal spacing, vegetation management, fertilization, and managing for pests and insects (Isebrands and Zalesny 2020, Marr 1978d).

Zavitkovski's role in the project focused on analyzing the potential fiber production and energy accumulation in the plantations. Other scientists within the project included Edward Hansen, a hydrologist who determined irrigation and fertilization amounts for rapid tree growth, and Howard Phipps, a plant physiologist who studied propagation and establishment of seedlings. Terry Strong managed and maintained the plantations in the Hugo Sauer Nursery near the lab, and Daniel Netzer managed and operated the 500-acre Harshaw Forestry Research Farm for the experimental plantings. Netzer also tested the effects of herbicide treatment on poplars planted in both the nursery and the research farm (Marr 1978d).

Hansen led the project from 1985 through 1988. In 1986, he established a network of research and demonstration short-rotation poplar plantations across Wisconsin, Minnesota, Iowa, North Dakota, and South Dakota, which were cooperatively supported by the North Central Forest Experiment Station, the University of Minnesota, and the U.S. Department of Energy. A major objective of the research was to identify suitable hybrid poplar clones for large-scale biomass plantations. The studies continued as part of the Silviculture in the Northern Lakes States project in the early 1990s and as part of the Ecophysiological Processes of Northern Forest Ecosystems project through 1998 (Hansen et al. 1994, Isebrands and Zalesny 2020).

Physiology and Raw Material Evaluation of Intensively Cultured Plantations: 1977–1984

The Physiology and Raw Material Evaluation of Intensively Cultured Plantations project aimed to understand how trees grew so that yield could be increased. Judson Isebrands moved from the physiology research project to become the Project Leader. The research emphasized identifying traits important to maximum production, such as the area of leaves, branch angle, or the ability to make more food during the day than is respired at night. Geneticists then bred for these traits to increase fiber production. Researchers also evaluated the raw materials from trees, such as wood, branches, bark, and leaves, for making useable end products. They studied whether fertilizer and irrigation changed the chemical and physical properties of the raw materials, which could impact how they were used (Isebrands and Zalesny 2020, USDA FS 1979).

The project built on the poplar work that Philip Larson and Isebrands had conducted in the Physiology of Wood Formation project. Isebrands coordinated research on translocation, that is, the movement of sugars from a tree's leaves to its other tissues. Neil Nelson joined the team in 1977 and served as the research plant physiologist, focusing on photosynthesis and leaf area development. Soon after, John Christ, a wood scientist and expert on using a scanning electron microscope, joined to study wood quality and raw material (Marr 1978b, Isebrands and Zalesny 2020).

Legacy of the Maximum Fiber Yield Program

In the 1970s and early 1980s, the Rhinelander field laboratory was internationally renowned as a leader in studying short-rotation woody crops. Researchers from around the country and the world visited and studied at the lab.

In 1983, the Forest Service closed many of its intensive culture plantation research projects due to budgetary constraints. However, research on short-rotation woody crops continued with U.S. Department of Energy funding through the Intensively Cultured Plantations for Biomass and Energy Production project at the lab (Isebrands and Zalesny 2020). By this time, the maximum yield program had achieved some success. In just 9 years, hybrid strains of poplar had grown to the same diameter as native 40-year-old trees. Using hybrid poplars and intensive cultivation, landowners could potentially increase wood yields by 5 to 10 times compared to more conventional forest practices. Even landowners with 2- to 4-acre plots could grow enough wood to heat their homes in perpetuity. Results on other hardwoods, such as maple, ash, and birch, were less successful, according to Edward Hansen, the Project Leader, who commented that the hardwood results did not "even come close" to the results they saw with poplar (qtd. in Stowers 1982).

Of special note, David Dawson was appointed to represent the United States on the International Energy Agency Task Force on Biofuels after retiring in 1983 (Rhinelander Northwoods River News 2013).

Other Significant Events of the 1970s

Establishment of the Harshaw Forestry Research Farm: 1972

In 1972, with the support of the U.S. Department of Energy, the Forest Service established the Harshaw Forestry Research Farm for experiments on short-rotation intensive plantings of hybrid poplars (Fig. 52). Although earlier plantings had been done in the Hugo Sauer Nursery, Harshaw farm became the primary field site for the short-rotation woody crops program. The cooperative program was administered by the Biomass Production Program based at the Oak Ridge National Laboratory in Tennessee (Isebrands and Zalesny 2020). The 500-acre research farm was located 7.5 miles northwest of the Institute of Forest Genetics on agricultural land that had been farmed for potatoes and small grains for 50 years. Studies on the site led to large-scale industrial plantings for fiber production (USDA FS 2008). In 1998, Harshaw farm became the site of the Aspen Free-Air Carbon Dioxide and Ozone Enrichment (Aspen FACE) experiment (see "Aspen FACE Experiment: 1998-2011," below). Today, it makes up the West Unit of the Rhinelander Experimental Forest and is part of the Forest Service experimental forest national network (see "Other Significant Events of the 2000s," below).

Figure 52.—The Harshaw Forestry Research Farm in 1980, which was established by the Institute of Forest Genetics in 1972 for genetics plantings and the maximum yield project. USDA Forest Service photo archives.

Building Expansions: 1972 and 1975

As research continued to expand at the Institute of Forest Genetics, the need for more space was essential to house the growing number of researchers and science support staff. Championed by U.S. Representative Alvin O'Konski, U.S. Representative Dave Obey, and U.S. Senator Gaylord Nelson, funds were allocated to expand the Rhinelander field laboratory in the 1970s. In a 1967 statement of appropriation, O'Konski made a case for the funding:

> The present laboratory is overcrowded. A staff of 12 scientists is now housed at the laboratory. This is four more than optimum capacity for this space. In addition, there are 10 supporting personnel. To help accommodate these people and their work, men are doubled up in offices, the conference room is used for office space, and men are officed in the headhouse-greenhouse building [O'Konski 1967].

Funds for the addition were approved in 1968 (Rhinelander Daily News 1967). In August of 1972, the institute celebrated the opening of a new wing added to the southeast corner of the main building and oriented east-west (Fig. 53). It included 6,000 square feet of additional office and laboratory space (Rhinelander Daily News 1972b). In summer of 1975, a 4,000-square-foot headhouse and 1,700-square-foot greenhouse were constructed on the south side of the new wing (Fig. 54). The cost was $295,000 (Rhinelander Daily News 1974b).

Figure 53.—The Forestry Sciences Laboratory in the mid-1970s showing the 1972 wing addition (left) attached to the original building (right). USDA Forest Service photo archives.

Figure 54.—The Forestry Sciences Laboratory in 1980 showing the 1972 wing addition (center with black roof) and the 1975 headhouse/greenhouse addition behind. USDA Forest Service photo archives.

As of 1978, the laboratory had about 40 permanent employees and 30 temporary staff. The laboratory had one of only 20 scanning electron microscopes in the state, walk-in growth chambers that controlled the growing environment of trees, and several greenhouses (Marr 1978b).

Apollo-Soyuz Space Tree Seed Exchange: 1975

The first crewed international space mission, carried out by the United States and Soviet Union in 1975, included a small token of the Rhinelander lab's work on genetics. When U.S. astronauts Vance Brand, Thomas Stafford, and Donald "Deke" Slayton boarded the Apollo spaceship in July, they brought along several gifts, including genetically superior white spruce seeds from the Institute of Forest Genetics in Rhinelander (USDA FS 1975). The seeds were developed to grow one-third faster than the average white spruce. Soviet Union cosmonauts aboard the Soyuz ship brought Siberian larch seeds. When the Apollo and Soyuz docked together above Earth, the astronauts and cosmonauts exchanged the tree seeds as a sign of goodwill. The mission was considered the end of the Space Race that began in 1955 (Rhinelander Daily News 1975c).

The spruce seeds were planted in Russia, and the larch seeds were planted outside the Rhinelander field laboratory (Fig. 55). Several Siberian larch trees are still growing (Fig. 56). A metal plaque on a stone monument outside the main lab building commemorates the space exchange.

Figure 55.—Photograph showing the monument installed at the entrance to the Rhinelander lab in 1975 to commemorate the exchange of seeds between U.S. astronauts and Soviet Union cosmonauts and the Siberian larch tree seedlings that were grown from the seed exchange, 1980. Courtesy photograph by J.G. Isebrands.

Figure 56.—2019 photograph showing the growth of the Siberian larch trees that surround the commemorative marker at the Rhinelander lab. Courtesy photograph by Schmeeckle Reserve.

Youth Conservation Corps Assistance

An echo of the 1930s Civilian Conservation Corps assistance at the nursery, two programs in the 1970s provided work experience for young adults at the laboratory. Created in 1970, the Youth Conservation Corps (YCC) was a voluntary summer youth work program operated by the U.S. Department of Agriculture and the U.S. Department of the Interior. In 1972, the Trump Lake YCC Camp, sponsored by the Nicolet National Forest, assisted researchers at the Institute of Forest Genetics with plantation experiments (Rhinelander Daily News 1972a). In the late 1970s, the Young Adult Conservation Corps (YACC) provided young people with year-round employment and education in conservation-related positions. By 1978, several YACC employees were hired at the laboratory (Marr 1978b). Although the YCC and YACC programs were largely defunded in the early 1980s, YCC crew members continued to work with Rhinelander forest researchers until 1983. According to Adam Wiese (2019), a member of the final YCC group to work at the field laboratory and a current employee, the crews assisted with thinning, pruning, and invasive species control.

Establishment of the Forestry Sciences Laboratory: 1978

In 1978, 21 years after its founding, the Institute of Forest Genetics was renamed the Forestry Sciences Laboratory. David Dawson, Director's Representative of the facility, stated that the institute was given the new name to better reflect the expanded programs of the research facility, which had diversified from the original genetics focus (Rhinelander Daily News 1978). The station would be known as the Forestry Sciences Laboratory until 2007, when it was reorganized as the Institute for Applied Ecosystem Studies.

Biotechnology Era: 1980s

As the energy crisis subsided in the 1980s, the research at the Forestry Sciences Laboratory again evolved to meet the changing needs of practitioners in the field and expanded into ecosystem scale studies.

Biotechnology/Genetic Transformation of Forest Trees in Microculture: 1984–2000

In the late 1970s, the potential for using tissue culture (i.e., growing cells on an artificial medium) to produce clones was promising. Creating tree clones with tissue culture was much faster than traditional breeding approaches. In 1983, the Forest Service initiated a research program on the genetic engineering of forest trees, the first such program in the world. Half of the program was called the Biotechnology Multiproject Research project, which was formally organized in 1984 and headquartered at the lab in Rhinelander. The purpose of the project was to use biotechnologies, such as genetics and breeding, tissue culture, somatic hybridization, and recombinant DNA, to impart herbicide and disease resistance to selected forest trees, and to develop genetic guidelines for the regeneration of trees in tissue culture. The cooperative program included scientists at the Rhinelander, Madison, and St. Paul research locations within the North Central Forest Experiment Station, and researchers at five universities and three biotechnology companies (Nelson 1985).

Neil Nelson transferred from the physiology project to become the Program Manager for the entire North Central Forest Experiment Station's biotechnology program. Other scientists in the new program were Bruce Haissig, a biochemical plant physiologist from the Genetics of Northern Forest Trees program who served as the Rhinelander Project Leader, Don Riemenschneider and Robert Cecich who transferred from the Genetics project in 1985, and Charles Michler, a horticulturist with expertise in tissue culture of woody plants who joined in 1988 (Isebrands and Zalesny 2020, Miller 1992a, Nelson 1985).

The biotechnology researchers attempted to grow several different tree species in tissue culture by controlling conditions. Poplars were by far the most successful. In 1985, the team transferred an herbicide-resistant gene that had been used in agricultural crops into a hybrid poplar. The seedlings were viable, marking the creation of the first successful genetically modified trees. This development led to funding from the U.S. Department of Energy to develop herbicide-resistant poplar germplasm, a living tissue from which new plants could be grown (Isebrands and Zalesny 2020, Miller 1992a). Michler and Haissig were awarded a patent for their cutting-edge methods of regenerating herbicide-tolerant poplar trees (Michler and Haissig 1994).

In 1993, the project was reorganized as the Genetic and Molecular Transformation Bases of Forest Trees Stress Tolerance following Haissig's retirement and the transfer of scientists to other research projects. Michler became the Project Leader (Isebrands and Zalesny 2020).

The success of creating genetically modified trees had unintended consequences. National and international environmental groups, along with U.S. politicians, expressed concern that the modified trees would escape and contaminate native poplars, which led to a significant decrease in financial support for the project. The biotechnology program continued in Rhinelander until 2000 (Isebrands and Zalesny 2020). In protest of the genetically modified poplars, an ecoterrorism group called the Earth Liberation Front (ELF) vandalized plantations and equipment in the Hugo Sauer Nursery on July 21, 2000 (see "Other Significant Events of the Late 1990s and Early 2000s," below).

Forest Regeneration/Establishment and Early Growth of Northern Forest Species: 1984–1990

The interdisciplinary Forest Regeneration research project began in 1984 to study the establishment and early growth of northern forest species, particularly northern red oak. Red oak trees are valuable for wildlife food and habitat, timber and veneer, and aesthetics, and researchers had noticed a distinct lack of regeneration of red oak in Lake States forests. The project focused on understanding the basic biology of red oak to develop better natural and artificial regeneration strategies through studies conducted in the laboratory, growth chambers, greenhouses, nursery, and field (Fig. 57) (Isebrands and Dickson 1994, Isebrands and Teclaw 2002).

Figure 57.—Ron Teclaw, shown in this 1992 photograph (left), oversaw the field planting experiments for the Establishment and Early Growth of Northern Forest Species project at the Rhinelander lab, which focused on the regeneration of northern red oak. Research ecologist John Zasada (right) stands nearby. Courtesy photograph by J.G. Isebrands.

The project was led by Thomas Crow until 1987, when he became the Project Leader of a newly formed Landscape Ecology research work unit (see 1990s). Judson Isebrands took over as the Project Leader in 1987, working with scientists Richard Dickson and Patricia Tomlinson. Dickson, a research plant physiologist who joined from the Physiology of Wood Formation team, focused on the biochemistry of red oaks, studying how they used carbon to determine the trees' exact growth stage (Miller 1992b). Tomlinson, a research plant physiologist who joined the team in 1990, studied how drought and weeds impacted seedling growth and reported that "that northern red oak trees grow well in a laboratory setting, so there must be rate limiting factors, or stresses, in the environment" (qtd. in Miller 1992b).

A problem addressed by the team was the poor quality of red oak stock coming out of nurseries in the state. The researchers recommended improvements in seed sources, seed handling, and nursery practices to produce higher quality seedlings, all of which are still being followed today. The team also developed silvicultural methods to improve red oak regeneration in the field, such as leaving mature oak and pine trees standing as part of a timber harvest, which creates better light and soil characteristics for oak growth (Isebrands and Teclaw 2002).

In 1987, a northern red oak from the project was planted on the front lawn of the Forestry Sciences Lab to commemorate the bicentennial of the U.S. Constitution. Ronald Lindmark, director of the North Central Forest Experiment Station, visited during the planting (Rhinelander Daily News 1987). The tree is still growing.

In 1989, sponsored by the U.S. Environmental Protection Agency, scientists Dickson and Isebrands collaborated with researchers at Michigan Technological University and the Northeastern Forest Experiment Station to study ozone damage at test sites in Ohio and Michigan. This effort led to the research project being rebranded in 1991 as the Ecophysiological Processes of Northern Forest Ecosystems, which broadened the study to include atmospheric pollution and climate change (Isebrands and Zalesny 2020).

Other Significant Events of the 1980s

Chinese Delegation Visit: 1980

In 1979, the United States reestablished full diplomatic relations with the People's Republic of China, which for many years had been isolated from the rest of the world. The new relationship opened an era of scientific exchange between China and the United States. The first group of Chinese professionals to visit the United States was a delegation of foresters, who arrived in 1980 for a one-month tour of forestry facilities around the country. From September 27 to October 1, they visited the Forestry Sciences Laboratory in Rhinelander (Fig. 58). Talks were presented by David Dawson, Hans Nienstaedt, Philip Larson, Judson Isebrands, and Edward Hansen. Commenting on the visit in a newspaper article, Dawson said:

> The visit by the Chinese is a result of President Richard Nixon's visit years ago to China, where the concept of scientific exchange was talked about. . . . Forestry was just one area, and Rhinelander was one those sites chosen for their visit. We are, of course, very proud of that [Rhinelander Our Town 1980].

The Chinese foresters were interested in northern hardwoods management and tree physiology. Other Chinese delegations visited the station several times throughout the 1980s.

Antique Forest Service Truck Donated: 1989

In May of 1989, an antique 1947 International KB-5 flatbed truck was donated by the Forest Service to the National Association of Civilian Conservation Corps Alumni (NACCCA). The truck had originally been used to haul trees for planting on the Argonne Experimental Forest, where it was stored in a warehouse for many years. When the warehouse was torn down, the truck was moved to a garage at the Hugo Sauer Nursery. At the time of the donation, the truck was in working order and had only 27,000 miles on its odometer. The truck was accepted by Roland Applin, the Rhinelander CCC Museum director, and Frank Belec, vice president of the local NACCCA chapter, both of whom had served in the CCC (Fig. 59). It was transported to the Jefferson Barracks Museum in St. Louis, where it was displayed as part of an exhibit of CCC memorabilia from Wisconsin (North Central Forest Experiment Station News 1989). The museum closed in 2008.

Figure 58.—David Dawson greeting the delegation of Chinese foresters at the Forestry Sciences Laboratory in Rhinelander, 1980. USDA Forest Service photo archives.

Figure 59.—Joel Holtrop (left), deputy supervisor of the Nicolet National Forest, and Judson Isebrands (second from left), director of the Forestry Sciences Laboratory, handing off the keys in May of 1989 to an antique 1947 flatbed truck that had been stored at the Hugo Sauer Nursery to Roland Applin (second from right), director of the Rhinelander CCC Museum, and Frank Belec (right), vice president of the local CCC alumni chapter. USDA Forest Service photo archives.

Landscape Ecology/Atmospheric Pollution and Climate Change Era: 1990s to the Present

In response to global environmental concerns, the Rhinelander field laboratory shifted its research focus during the late 1980s and early 1990s. The change continues to have a significant influence on research programs today.

In the 1980s, the cumulative impacts of broadscale changing land use to meet increasing demand for more commodities became a global concern. Urban sprawl, forest clearcutting, pollution, and other human disturbances were causing large-scale degradation of ecosystems throughout the world. The negative impact of habitat loss and fragmentation on plants, animals, and other ecological processes were detected on a massive scale. Ecology as a discipline saw a paradigm shift toward viewing ecosystems as open, dynamic, and interacting systems, instead of the more traditional model of each isolated system moving toward a stable equilibrium. Landscape ecology emerged as a unifying discipline because of its emphasis on using scale and hierarchical theory to better understand spatial pattern-process relationships across ecosystem and multiple spatial and temporal scales. In addition, advances in global satellite imagery, computer technology, and geographical information system software provided the tools to begin integrating and studying these theories and ecosystem behaviors. Resource managers and policies began recognizing the importance of a landscape perspective in decision-making and policies.

Also during this time, the United States became concerned about acid rain, elevated carbon dioxide levels, and how the changing climate would impact people and their environments, including forests. The U.S. Global Change Research Program was founded in 1990 with a large budget to conduct climate change studies by multiple federal agencies. The Forest Service created a National Global Change Research Program in response, with a regional Northern Global Change Program that focused on northern forests. The program funded studies to determine the effects of elevated ozone and carbon dioxide on northern forest species (Isebrands and Zalesny 2020).

Applying Principles of Landscape Ecology to Managing Temperate Forests: 1988–2006

In 1986, Harvard professor Richard Forman published "Landscape Ecology," the first book on a new interdisciplinary field focused on the science of studying and improving the relationship between spatial pattern, heterogeneity, and ecological processes in a landscape at multiple scales. The next year, a new research program centered on landscape ecology began at the Rhinelander lab. Led by Thomas Crow, it was the first such program in the Forest Service and a significant shift in forest management. Reflecting on the 1987 research program, Crow (2020) said:

> We were borne out of appeals and challenges to forest plans in Wisconsin in both the Chequamegon and Nicolet National Forests. The management on these national forests was adversely affecting biological diversity, primarily through forest fragmentation and the creation of forest edges. . . . We thought the science of landscape ecology would be a better way of proceeding.

Over the decades, landscape ecology has come to serve as a unifying concept across the research station's work. Crow (2020) explained it this way:

> You're looking at systems, at multiple scales, at hierarchical scales, at relationships at many different scales, and looking at these processes from a variety of different points of view. I think landscape ecology [was] that integrating concept.

Early research focused on the broad patterns of forest vegetation to determine the impact that changes in the landscape have on the overall ecology of an area and sustaining forest biodiversity. Most notably, Crow led and summarized the results of a scientific roundtable on biological diversity that was convened by the Chequamegon and Nicolet National Forests, which also served as the justification for the new research program (Crow et al. 1994).

The focus on biodiversity extended to wildlife such as bird communities within regenerating and mature broadleaf forests in the Lake States with the transfer of John Probst, a research ecologist, from the St. Paul headquarters in the late 1980s. Probst began integrating landscape ecology principles into recovery efforts and habitat management of the Kirtland's Warbler (*Setaphaga kirtlandii*), which was one of the first species listed under the 1973 Endangered Species Act. Deahn Donner joined the project as a wildlife biologist in 1992 to help expand these studies into long-term population persistence, and after completing her doctoral degree in 2011 expanded these studies as a research landscape ecologist into investigating the effects of changing climate on the future distribution of Kirtland's Warbler habitat. Results of these studies, in combination with 50 years of Forest Service research on the Kirtland's Warbler that focused on the effect of habitat quality and spatial variability at several spatial scales on demographics and population abundance, were major contributions to the official federal delisting of the bird in November 2019. Donner continues to apply concepts of landscape ecology and scale to wildlife populations of conservation concern and is incorporating new approaches such as landscape genetics to assess functional connectivity in changing landscapes.

Predicting wildlife habitat quality using spatial modeling techniques was adopted and pioneered in the late 1990s and early 2000s by Eric Gustafson, a research landscape ecologist who joined the lab in 1992, in collaboration with Patrick Zollner, who transferred to Purdue University in 2010. Their work advanced the field of modeling animal movement (specifically dispersal) through complex landscapes as a way to assess how landscape pattern might affect population viability.

With increasing technology in the early 1990s, forest landscape modeling became a tool to investigate forest changes in response to multiple disturbances by integrating spatial information within a geographical information system. Gustafson developed a spatial simulation model, HARVEST, to assess the landscape spatial pattern implications of two strategic forest management options (clearcutting versus group selection) on the Hoosier National Forest. Few such models were in existence at the time, but their power for conducting forest landscape ecology research quickly became apparent. In the late 1990s, Gustafson was invited to join the team developing the Landscape Disturbance and Succession (LANDIS) model (He and Mladenoff 1999), with the specific task of designing a HARVEST module for the model (Gustafson et al. 2000). LANDIS and the HARVEST extension soon became the most widely used forest landscape model for research purposes.

In a move that reflected the utility of a landscape perspective for managing natural resources, David Cleland was detailed to the project from the National Forests in Region 9 and later from the Washington Office. As part of a team, Cleland led the Great Lakes Assessment, a project that provided contextual information about the condition of forests at a regional scale for national forest planning. Following completion of the Great Lakes Assessment, Cleland expanded the effort to a national level for the Forest Service as part of the Terrestrial Condition Assessment, a project that aims to provide a holistic and integrated assessment of ecosystem integrity (Cleland et al. 2017). Today, the National Forest System has a Landscape Ecology Program Leader in its national office, and the agency's State, Private, and Tribal Forestry mission area has adopted a landscape perspective as a guiding principle for its work.

While in Rhinelander, Cleland and other scientists developed a hierarchical system for ecological units ranging from regional to local. The framework involved classification and mapping, and it improved the Forest Service's ability to implement ecosystem management. At the local level, the hierarchy of ecological units provided detailed information for project-level planning and analysis. At the regional level, information is provided for multi-forest and multi-agency analysis and assessment. The Forest Service has adopted the approach nationally (Crow 2021).

Increased fire events and fire suppression costs during the 1990s precipitated the National Fire Plan. To integrate landscape ecology principles with fire and other natural disturbances such as insect outbreaks, Brian Sturtevant, a research landscape ecologist, was hired in 2001 to adapt LANDIS to these emerging issues. The effort culminated in LANDIS 4.0, a fully modularized version of LANDIS with the capacity to explicitly investigate interactions among human and natural disturbances, including projections of fire risk (Sturtevant et al. 2004b). At this time, LANDIS development reached a crossroad when tree biomass was introduced as a new currency in the model. A next generation model, LANDIS-II, was programmed to initiate a new era in "distributed" model development, allowing programmers across the globe to contribute to the customization of the model for rapid evolution and innovation. Because LANDIS-II has been able to simulate many ecological processes (e.g., tree growth and competition, disturbances such as fire, wind, insects, harvest, and climate effects of drought, temperature and elevated CO_2), the model has accounted for interactions among all the processes and generated robust projections of future landscape composition and spatial pattern. LANDIS and LANDIS-II have become the most widely used forest landscape models for research purposes, with hundreds of users around the world. Eric Gustafson and Anatoly Shvidenko, of the International Institute of Applied Systems Analysis in Vienna, Austria, are using LANDIS to simulate biome shifts driven by climate changes across a large latitudinal gradient in Siberia as part of a long-term partnership. Sturtevant studies the impact of spruce budworm on forests using LANDIS through a Canada-U.S. Forest Health collaborative.

Although the distinct landscape ecology project ended when the Institute for Applied Ecosystem Studies was formed in 2007, landscape ecology and the concepts of scale remain at the core of the current interdisciplinary research conducted at the Rhinelander field laboratory. As such, the research program has been reorganized to highlight the growing importance of spatial ecology and scaling concepts in solving forestry contemporary conservation issues (see "Institute for Applied Ecosystem Studies: Theory and Application of Scaling Science in Forestry, 2007–2023," below).

Integrated Approaches to Wildlife and Fish Management/Ecology and Management of Riparian and Aquatic Ecosystems: 1990–2002

The mission of the Wildlife and Fish Management project was to develop, improve, and evaluate integrated resource management strategies affecting wildlife and fish habitat. Researchers studied how wildlife responded to land management practices from the large ecosystem level to individual species (Miller 1992a). Although the work unit was headquartered in St. Paul, fisheries biologist Clayton Edwards was stationed at the Rhinelander field laboratory. In 1997, the project was reorganized and renamed Ecology and Management of Riparian/Aquatic Ecosystems. Edwards was joined by wildlife biologist Richard Buech, who had been a member of the radiobiology project and studied the effect of gamma radiation on the population dynamics of small mammals (Crow 2021). In 1992, Edwards reported that different subspecies of walleyes, identified only through genetics, thrived in different types of aquatic habitats. Other research focused on whether beaver dams could cause winterkill of brook trout due to the decreased amount of oxygen in stagnated water. Researchers also studied the effect that new growth versus old growth forests had on the dynamics of streams (Miller 1992a).

Ecophysiological Processes of Northern Forest Ecosystems/Physiological Mechanisms of Growth and Multiple Stress Responses: 1991–2006

In response to pollution and global climate change concerns, the Establishment and Early Growth of Northern Forest Species project started in 1984 was reorganized and became the Ecophysiological Processes of Northern Forest Ecosystems project in 1991 and the Physiological Mechanisms of Growth and Multiple Stress Responses project in 1992 (Isebrands 2021). These projects were funded through the newly established U.S. Global Change Research Program and focused on the impacts of pollution and climate change on forests. Judson Isebrands, who was involved in the formation of the Forest Service's Global Change Research Program and served on the technical advisory committee of the Northern Global Change Program, became the project leader. Other scientists at the Rhinelander field laboratory who transferred into the new research project were Richard Dickson, Patricia Tomlinson, and Don Riemenschneider. The researchers studied the effects of elevated levels of ozone and carbon dioxide on trees in open-top chambers (Fig. 60). They found that high levels of ozone negatively impacted photosynthesis and the root growth of poplar clones. They also tested whether increased levels of carbon dioxide could counteract the negative effects of ozone, with varying results based on specific clone strains (Isebrands and Zalesny 2020).

Figure 60.—Open-top chambers for studying elevated levels of ozone and carbon dioxide in 1993, part of the Physiological Mechanisms of Growth and Multiple Stress Responses project at the lab. Courtesy photograph by J.G. Isebrands.

Aspen FACE (Free-Air Carbon Dioxide and Ozone Enrichment) Experiment: 1998–2011

Although the open-top chambers described above provided useful information for specific trees, a large-scale field experiment would better replicate the conditions of natural forests. In 1996, a massive cooperative experiment, the Aspen Free-Air Carbon Dioxide and Ozone Enrichment (Aspen FACE) project, began in collaboration with Michigan Technical University with funding from the U.S. Department of Energy. Using technology developed at the Department of Energy's Brookhaven National Laboratory, the FACE system allowed researchers to control carbon dioxide and ozone concentrations over large areas. Aspen FACE was established at the Harshaw Forestry Research Farm, an ideal site since it already had an 80-acre fenced research plot that had been used for short-rotation woody crop studies (Isebrands and Zalesny 2020, Kubiske et al. 2015).

The experimental site was prepared in 1996 and 1997. Quaking aspen, aspen clones, paper birch, and sugar maple seedlings were planted in 12 rings, each 30 meters in diameter, and spaced 100 meters apart in the fenced area. The tree species were selected because they were common competitors on northern hardwood sites and of major economic and aesthetic importance. Each ring consisted of a series of vertical PVC pipes that vented increased levels of carbon dioxide, ozone, or both into the center of the ring (Fig. 61). To compare results, three rings were designated as controls (no added gases), three were exposed only to carbon dioxide, three were exposed only to ozone, and three were exposed to a combination of carbon dioxide and ozone (Dickson et al. 2000).

Figure 61.—The Aspen Free-Air Carbon Dioxide and Ozone Enrichment (Aspen FACE) experiment site, consisting of 12 circular plots planted with aspen, birch, and maple trees surrounded by PVC pipes that vented carbon dioxide and ozone gas. Courtesy photograph by John Couture, UW-Madison.

Environmental parameters such as humidity, lighting, temperature, and moisture were monitored throughout the study. More than 2 million measurements were taken daily and packaged for researcher use (Karnosky and Pikkarainen 2004, Teclaw 2019).

The Aspen FACE experiment was unique for several reasons: it was the largest FACE system in the world, it was the only FACE system to include ozone exposures, it studied exposed plants from seedlings to maturity, and it included three different tree species (quaking aspen, paper birch, and sugar maple) and five aspen clones. The experiment's long-term goal was to investigate the interacting effects of elevated carbon dioxide and ozone on trees. Above-ground studies included photosynthesis/gas exchange, canopy architecture and leaf phenology, leaf surface characteristics and cellular antioxidants, water relations, and insects and disease. Below-ground studies looked at root growth and turnover, soil carbon fluxes, soil biota-chemistry, and leaf litter (Dickson et al. 2000).

The Aspen FACE experiment operated from 1998 until 2011 and involved more than 70 researchers from nine countries. Judson Isebrands led the program initially, followed by Mark Kubiske, a research plant physiologist, in 2002 and Neil Nelson in 2004. Kubiske remained with the experiment until it ended in 2011 and compiled much of the final research (Isebrands and Zalesny 2020). More than 125 scientific publications were published in multiple journals based on the findings. Data from the experiment contributed to Our Changing Planet (2001), a report by the U.S. Global Change Research Program as a supplement to the President's Fiscal Year 2002 Budget. It also impacted the 2006 rewriting of the U.S. Environmental Protection Agency's ozone pollution criteria document (Kubiske et al. 2015).

The overall results of the experiment showed that the direct effects of increasing greenhouse gases on forests were real and dynamic. Elevated carbon dioxide increased net primary productivity by 39 percent across all community types, and elevated ozone decreased it by 10 percent (Talhelm et al. 2014). The results also showed how different tree species and different individuals within a species responded to elevated levels of greenhouse gases.

In 2009, a large-scale biomass harvest of the Aspen FACE site was conducted to analyze the above-ground and below-ground biomass produced. During the winter of 2009–2010, the remaining aspens and birches were harvested from the site to allow the forest to resprout. In 2010, a Phase II regeneration study investigated the effect of elevated carbon dioxide and ozone on forest regrowth (Kubiske et al. 2015).

Even though the experiment was decommissioned in 2011, the archived data from the study are still being integrated into current research programs. For example, Gustafson used computer modeling to scale the plot data to landscape scales using LANDIS to integrate climate change, competition, succession, and disturbance interactions (Gustafson et al. 2020).

Genetic and Silvicultural Systems for Sustainable Intensive Forestry: 1998–2002

In 1998, research projects were again reorganized, which led to the formation of the Genetic and Silvicultural Systems for Sustainable Intensive Forestry project that continued the short-rotation woody crop research. The project focused on the genetics of rooting hardwood cuttings, and it established field trials of short-rotation hybrid poplars to study genotype-environment interactions (GxE). Field sites were planted in Wisconsin, Minnesota, Iowa, and Michigan (Bauer 2021). Don Riemenschneider became the Project Leader and was joined by Ron Zalesny, Jr., a Ph.D. graduate student who would later lead phytoremediation studies at the lab (Isebrands and Zalesny 2020). By 1999, researchers were using gene mapping technology to optimize breeding and selection of new hybrid poplar species for improving yield. Their research showed that one 50,000-acre plantation of hybrid poplars could produce as much fiber as an entire national forest (USDA FS 1999). They also studied how the poplar plantings could stabilize riparian areas, and they became involved in establishing the lab's first phytoremediation project, i.e., the use of living plants to restore contaminated natural areas. (For more on the project, see "Phytotechnologies and Ecosystem Services Studies: 1999 to the Present," below).

Other Significant Events of the 1990s and early 2000s

Millennium U.S. Capitol Christmas Tree: 1999

In 1999, a 70-foot-tall white spruce was harvested from the Hugo Sauer Nursery grounds to serve as the Christmas tree for the U.S. Capitol in Washington, DC. The "Millennium Tree," as it was called, was the tallest tree at the time to be displayed on the west lawn of the Capitol, and the first to come from the Forest Service's research branch (Fig. 62) (USDA FS 1999).

Figure 62.—Top: Judson Isebrands standing below the 70-foot-tall white spruce on the Hugo Sauer Nursery site prior to it being cut for the U.S. Capitol Christmas tree in 1999. Courtesy photograph by J.G. Isebrands. Bottom: The Millennium Tree from the Hugo Sauer Nursery installed on the U.S. Capitol grounds. Photo credit: Architect of the Capitol.

Estimated to be approximately 65 years old when it was cut, the spruce may have been planted by silviculturist Paul Rudolf. In 1934, Rudolf planted seedlings grown from several spruce species in five field stations around the Lake States, including the Hugo Sauer Nursery (Grieco 1999, USDA FS 1999). The tree was located near the former site of the CCC side camp, at the start of the circle drive near the implement shed.

After it was cut, the tree was loaded onto a special delivery truck and began a tour of 32 Wisconsin communities. Celebrations included residents signing the side of the truck as a giant, mobile holiday card to the nation. Children were encouraged to make ornaments from natural materials, and fourth graders could participate in an essay contest. The tree was then loaded onto a train for its journey to Washington, DC. When it arrived on November 29, the Millennium Tree had traveled a total of 3,000 miles. It was decorated with 10,000 lights and 5,000 handmade ornaments. On December 9, the tree was lit during a special ceremony by U.S. Speaker of the House, Dennis Hastert, accompanied by Wisconsin Governor Tommy Thompson and his wife, Forest Service Chief Mike Dombeck, and fourth graders who won the essay contest (USDA FS 1999).

Julie Berndt (2019), daughter of state nursery manager Hal Berndt, recalled growing up alongside the big spruce, saying, "The tree that they chose for the Millennium Tree was *my* tree. My sister and I had our fort under that tree."

Earth Liberation Front (ELF) Vandalism: 2000

On the night of July 21, 2000, members of an ecoterrorist group called the North American Earth Liberation Front (ELF) swarmed onto the Forestry Sciences Laboratory property to protest experiments resulting in genetically modified trees. A loosely organized movement, ELF was committed to eradicating activities its adherents believed to be harmful to the environment, including commercial activities, land development, and genetic research.

ELF members girdled bark and used saws and machetes to cut down nearly 500 trees, destroying approximately two-thirds of the experimental plantings, which were valued at $750,000 (McCombie 2000). According to Judson Isebrands, the destruction set the research project back by 10 to 15 years. Members also spray-painted various messages on eight vehicles and spread acid on the windshields, causing $20,000 in damage to the fleet (Fig. 63) (Maller 2000). Further damage may have occurred had the vandals not been caught in the act by a temporary worker returning to his campsite on the property (Dietzman 2004).

ELF members believed that genetic engineering would destroy natural forests. However, bioengineering had not been used on any of the destroyed trees. In an interview with the Madison Isthmus newspaper, Don Riemenschneider explained that the trees were native and were being propagated to naturally resist two common diseases (McCombie 2000). In an interview with the Milwaukee Journal-Sentinel, Isebrands said, "This was not biotechnology. All of our work was done using traditional plant-breeding techniques that have been around for years. We simply took a genetically superior tree and matched it with another tree. Then you just hope to get a better plant" (qtd. in Maller 2000).

Figure 63.—A Forest Service truck vandalized by the Earth Liberation Front (ELF) on July 21, 2000. Courtesy photograph by J.G. Isebrands.

Phytotechnologies and Ecosystem Services Era: 1999 to the Present

Decades of work in genetics, physiology, silviculture, climate change, short-rotation woody crops, and landscape ecology at the Rhinelander lab have culminated in large-scale, multidisciplinary research efforts that continue to have impacts on the global ecosystem.

Phytotechnologies and Ecosystem Services Studies: 1999–2006

The rich legacy of producing hybrid poplars for short-rotation woody crops made the study of phytotechnologies a natural fit for the Rhinelander lab. "Phytotechnologies" use plants and trees to solve environmental problems. "Phytoremediation" studies the use of living plants to destroy, remove, and stabilize contaminated soils, sludges, sediments, and water (Zalesny 2019).

Phytoremediation studies began in 1999 under Don Riemenschneider's Genetic and Silvicultural Systems for Sustainable Intensive Forestry project described above (Isebrands and Zalesny 2020). Poplars and willows were found to be ideal for phytoremediation because they grew quickly, had deep root systems, and used water efficiently (Banegas 2018). Planting beds and irrigation systems in the Hugo Sauer Nursery were again revived for planting poplar and willow clones as part of the phytoremediation studies (Zalesny 2019).

Riemenschneider, Judson Isebrands (Project Leader of the Physiological Mechanisms of Growth and Multiple Stress Responses), Ed Bauer (a genetics technician), and Ron Zalesny, Jr. (a graduate student) established the first long-term, field-based phytoremediation project at the closed Rhinelander municipal landfill in 1999. The Wisconsin Department of Natural Resources found high levels of nitrates and other pollutants in a creek adjacent to the landfill. Approximately 2,000 hybrid poplar and willow trees were planted at the landfill in 1999, followed by an additional 3,000 the next year (Bauer 2021). The study evaluated whether polluted water could be used to irrigate field-planted poplars and willows without adverse effects to human health and the environment, and it sought to determine whether trees could reduce runoff and filter water before reaching the creek (Isebrands and Zalesny 2020). The team found that specific poplar and willow clones worked better to remediate different types of contaminants (Isebrands and Zalesny 2020).

In 2003, Zalesny was hired as a research plant geneticist and worked with the Oneida County Solid Waste Department to determine whether landfill leachate could be used to irrigate and fertilize poplar trees. Zalesny and his team developed a testing process called phyto-recurrent selection to identify the ideal tree species capable of remediating specific contaminants. This significant best practice has been replicated for phytoremediation projects throughout the world. According to Zalesny, the key to phytoremediation is "finding the right variety of the right species for the particular contaminant being addressed" (qtd. in Banegas 2018). Using trees for cleanup also saves money, costing just 25 to 33 percent of what other remediation technologies cost.

When Riemenschneider retired in 2008, Zalesny assumed leadership of the Phytotechnologies and Ecosystem Services studies at the Rhinelander lab. Phytotechnologies created a major shift in direction for the short-rotation woody crop research, from maximizing the amount of biomass that could be produced in the 1970s and 1980s to studying the genetic diversity of poplars and willows to determine the best clones that would clean up contaminated sites. Speaking about the work in 2019, Zalesny said that scientists have "maintained the integrity of the genetics work [of the past] and used it for an application in this day and age that is very powerful no matter where you are in the world, because everybody has contamination."

Since 2016, with funding from the Great Lakes Restoration Initiative, Zalesny and his colleagues have planted more than 20,000 trees for runoff reduction and phytoremediation at 16 waste sites in southeastern Wisconsin and Michigan's Upper Peninsula. This field experiment is the largest known replicated phytoremediation study in the world (Banegas 2018, Isebrands and Zalesny 2020). The team has also continued the lab's long-term efforts to produce short-rotation woody crops for biomass, bioenergy (wood burned to produce electricity or converted to liquid fuel), and bioproducts. Their work has been noticed by the Forest Service, which summarized the work in 2013: "The Northern Research Station of the U.S. Forest Service is producing fast-growing poplars that can meet the energy needs and restore water and soil quality, as well as deliver the traditional wood products of pulp and lumber" (USDA FS 2013). In addition, the phytoremediation studies have again brought international notice to the Rhinelander lab, with Zalesny and his team partnering with organizations all over the globe. International interns assist in the studies (Fig. 64), and through a long-term partnership and scientific exchange with the University of Novi Sad,

Figure 64.—David Karlsson, an intern from Sweden, conducting physiological measurements at a landfill in southeastern Wisconsin as part of a phytoremediation study. USDA Forest Service photograph courtesy of Ronald S. Zalesny, Jr.

Serbia, Andrej Pilipović and Zalesny are developing a set of phytotechnology best management practices (Zalesny 2019).

Institute for Applied Ecosystem Studies

In 2007, the Forest Service's North Central and Northeastern Forest Experiment Stations merged to become the Northern Research Station. The merger allowed related research to be placed under a single management team, make better use of smaller administrative staffs, and facilitate multidisciplinary, integrated, landscape-scale research programs. The two research stations reorganized and consolidated their research projects into broader science-based programs than in the past (GAO 2010).

As a result of this reorganization, the Forestry Sciences Laboratory was renamed the Institute for Applied Ecosystem Studies: Theory and Application of Scaling Science in Forestry, which became a research unit of the Northern Research Station. To formalize the multidisciplinary approach that the lab had already been engaged in, the separate research projects were reorganized into a single research work unit, or project, with the mission to "develop the theory and application of scaling science to provide knowledge at policy-relevant scales in forestry" in four problem areas (Donner 2021):

1. Study the link between energy, climate, and tree genetics to develop fast-growing tree crops as energy feedstocks and to understand the effects of climate change on forests.
2. Research climate change impacts on forest productivity, species composition, and the biogeochemistry of terrestrial ecosystems at multiple scales. Develop methods for assessing the hazards, risks, and opportunities of forest management to make recommendations for mitigating climate change effects on forest ecosystems.
3. Use landscape ecology to make reliable predictions to guide management and policy decisions by studying the reciprocal link between the spatial and temporal dynamics of landscape elements and ecological processes.
4. Develop innovative scaling concepts and tools to integrate disciplinary research and translate forestry knowledge to policy-relevant scales.

Neil Nelson became the Project Leader and Director's Representative in 2007 followed by Eric Gustafson in 2009. In 2012, Deahn Donner became the Project Leader and Director's Representative and continues to lead the research project (Donner 2021, Isebrands and Zalesny 2020). Gustafson, Brian Sturtevant, and Ron Zalesny continue their research studies in landscape ecology and phytotechnologies, respectively. After Mark Kubiske retired, Dustin Bronson, a research plant physiologist, joined the research project in 2019 to continue the climate change and pollution research studies. Bronson is incorporating the Hugo Sauer Nursery and the Rhinelander Experimental Forest nursery areas for testing the response of trees species and different seed sources under changing climates and environmental conditions. Instead of focusing on merchantability of timber, short-rotation woody crops, and pollution effects, the new studies will investigate regeneration and growth tolerances (e.g., common garden experiments) for potential assisted migration due to expected drought conditions with changing climates and replacement tree species due to loss of black ash from Emerald Ash Borer.

In 2022, the research work unit description was revised to reflect changes in the research program direction and lines of science that better align to research, management, and policy needs. The project title became Landscape Ecology and Sustainability in the Lake States Forests with a mission to develop and deliver scientific knowledge and tools that integrate ecological changes and resource management across scales and disturbance gradients with sustaining forests, restoring landscapes, and conserving natural resources. Three core research problems areas were identified:

1. Developing knowledge to sustain forests under contemporary and future stressors by integrating scaling science to address the lack of science-based knowledge across many ecosystems and multiple dimensions of time and space. The goal of this problem area is to support ecosystem resilience and populations at multiple scales to continue delivery of goods and services today and as future conditions change.
2. Applying this knowledge to develop tools and techniques to achieve land restoration and ecosystem services goals and objectives set by public and private agencies. The goal of this problem area is to provide knowledge applications and tools for sustainable forestry, which includes actively managing forest ecosystems for wood production and recreation as well as noncommodity values such as clean water and air and biological diversity.

3. Managing the newly established Rhinelander Experimental Forest that can provide research opportunities and study sites for problems 1 and 2.

These highly integrated problems are transferrable across land ownerships and flexible to accommodate emerging issues given the rate of large-scale changes and disturbances occurring. The key research elements under problem 1 are to increase understanding of key processes and feedbacks affecting ecosystem dynamics by further developing the LANDIS-II forest landscape dynamics model, assess wildlife responses to landscape pattern, and assess forest growth, productivity, and wood properties of northern forest ecosystems in response to changing environmental conditions. Under this problem, the emerging field of landscape genetics and using environmental DNA (eDNA) approaches to investigate large-scale movement processes were identified as key areas to develop and foster. In 2022 Rachel Toczydlowski was hired, becoming the unit's first landscape geneticist to conduct research on organismal-based aquatic ecology and build eDNA capabilities at the laboratory.

The key research elements under problem 2 are to advance the use of short rotation woody crops and develop phytotechnologies using these crops for remediation and restoration of contaminated sites, to evaluate alternative future forest ecosystem scenarios using LANDIS-II and other spatial modeling techniques across large landscapes, and to evaluate fire as a tool to restore fire-adapted communities including at-risk species. The effects of fire and using prescribed burning for restoration were identified as research areas to develop over the next decade.

Other Significant Events of the 2000s

Energy-Efficient Remodeling of West Wing: 2003

In 2003, the west wing of the laboratory building was renovated to reduce maintenance costs, improve energy efficiency, improve space utilization, and provide better wheelchair accessibility. The project included installation of modern HVAC systems, a central air-handling unit to filter and humidify air, and removal of asbestos pipe insulation and flooring. The cost was $490,000. A grand opening celebration was held in July (Rhinelander Daily News 2003).

Patent for Weed Compaction Roller System: 2004

In 2004, Adam Wiese, Daniel Netzer, and Don Riemenschneider were awarded a patent for a weed compaction roller system, a device designed to flatten and crimp invasive weeds prior to herbicide applications and thus reduce the amount of herbicide needed as well as drift. Weed control was important to promote the growth of short-rotation woody crops (Wiese 2019; Wiese et al. 2004, 2006).

Establishment of the Rhinelander Experimental Forest: 2015

In 2015, the Forest Service established the Rhinelander Experimental Forest, which consists of two units. The West Unit, at 501 acres, incorporated the Harshaw Forestry Research Farm that was used for short-rotation intensive plantings (1972–1997) and as the site of the Aspen FACE experiment (1998–2011). The East Unit, at 184 acres, was located immediately west of the administrative complex and Hugo Sauer Nursery. It incorporated the lab's original radiation testing site (1963–1976). The experimental forest is considered administrative lands of the Chequamegon-Nicolet National Forest, being outside the proclaimed official boundaries of the forest (USDA FS 2015).

The purpose of establishing the Rhinelander Experimental Forest was to provide land for conducting research on managing northern forests (including continued genetics studies); to offer education opportunities and facilities for the public, Forest Service staff, and other cooperating partners; and to provide experimental sites for long-term environmental monitoring data (USDA FS 2015).

Remodeling of 1960s Genetics and Physiology Laboratories: 2023

During the winter of 2023, the 1960s genetics and physiology laboratories in the upper west wing were renovated and modernized to better align with current research needs (e.g., landscape genetics and environmental DNA), improve space utilization, and reduce deferred maintenance costs. Also, the upper-level 1970s analytical laboratories in the east wing were removed and replaced with a large conference room and office space to accommodate the needs of a growing workforce. These laboratories will be moved to alternate locations within the facility in the future. The $1.2 million project was funded through the Great American Outdoors Act, which gave the USDA Forest Service opportunities to deliver benefits to the public through major investments in infrastructure that contribute to economic growth and job creation in rural America. At the time of this writing, the renovations were not yet completed, but a grand opening celebration is being planned.

Conclusion

Over the past 90 years, the history of the USDA Forest Service's Hugo Sauer Nursery and Rhinelander research field laboratory has been driven by the goal of improving forests and ecosystems. As operations and research have evolved to meet the changing needs of the day, the Hugo Sauer Nursery has been a physical constant. The nursery played a fundamental role in reforesting the cutover lands of Wisconsin and beyond starting in the 1930s. It also provided justification for siting the Institute of Forest Genetics in Rhinelander in the 1950s, serving as an invaluable field-testing site for researchers over the decades. Today, it continues to provide opportunities for researchers tackling worldwide issues, while at the same being a place of recreation and leisure for forest visitors who now enjoy the quiet nursery roads surrounded by trees and lakes (Fig. 65). Because of the vision of establishing a federal nursery here in 1931, Rhinelander is recognized nationally and internationally by the professional forestry community.

Although scientists have changed over the years, the research project at the Rhinelander research field laboratory continues to focus on taking an interdisciplinary approach toward better understanding of the scale at which ecological drivers of change most impact populations and ecosystem processes. In 2022, the research program was renamed to Landscape Ecology and Sustainability in the Lake States Forests with the mission to develop and deliver scientific knowledge and tools that integrate ecological changes and resource management across scales and disturbance gradients with sustaining forests, restoring landscapes, and conserving populations. The research project will continue to build knowledge to sustain forests under contemporary and future stressors by integrating scaling science, applying this knowledge to develop tools and techniques to achieve land restoration and ecosystem services goals and objectives set by public and private agencies, and managing the newly established Rhinelander Experimental Forest.

The team of landscape ecologists, geneticists, tree physiologists, and simulation modelers continue to work together, developing field and computer experiments at a variety of scales that help to inform ecosystem management on local, national, and international levels.

Figure 65.—Today, the tree-lined Hugo Sauer Nursery roads provide quiet paths for walking, wildlife watching, and other recreational activities. Courtesy photograph by Schmeeckle Reserve.

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References

Banegas, D. 2018. **In the Great Lakes Region, special trees have an absorbing role.** Washington, DC: U.S. Department of Agriculture, Forest Service. https://www.fs.usda.gov/features/great-lakes-region-special-trees-have-absorbing-role (accessed 7 February 2021).

Bauer, E. 2019. Personal communication. Retired genetics technician, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Bauer, E. 2021. Personal communication. Retired genetics technician, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Berndt, H. 2019. Personal communication. Retired Hugo Sauer Nursery manager, Wisconsin Department of Natural Resources, Rhinelander, WI.

Berndt, J. 2019. Personal communication. Daughter of H. Berndt who lived at the Hugo Sauer Nursery, Rhinelander, WI.

Boyles, D.; Gaines, J.; Haissig, B., inventors. 1983a (October 25). **Auxin compositions of N-Phenyl and N-Chloro Phenyl Indolyl-3-Alkylene amides and their use as auxin growth regulators.** U.S. Patent 4,411,684.

Boyles, D.; Gaines, J.; Haissig, B., inventors. 1983b (November 15). **Auxin compositions of Phenyl Thioesters of Indole-3-Alkanoic acids and their use as auxin growth regulators.** U.S. Patent 4,415,350.

Bruhy, M. 2002. **Hugo Sauer Nursery (originally named Rhinelander Nursery) operation and maintenance considerations relative to National Register of Historic Places eligibility.** On file with: U. S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Civilian Conservation Corps [CCC]. 1937 (February 3). **Sauer nursery.** In: Himley Lake Ripples: a newsletter of CCC Company 1655, Camp Himley Lake F-45. [Wabeno, WI]: 2. 17 p.

Cleland, D.; Reynolds, K.; Vaughan, R. [et al.]. 2017. **Terrestrial condition assessment for national forests of the USDA Forest Service in the continental US. sustainability.** 9(11): 2144. https://doi.org/10.3390/su9112144.

Cowley, B. 2002. **Stalag Wisconsin: inside WWII prisoner-of-war camps.** Oregon, WI: Badger Books Inc. 311 p.

Crow, T. 2020. Personal communication. Retired landscape ecologist, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Crow, T. 2021. Personal communication. Retired landscape ecologist, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Crow, T.R.; Haney, A.; Waller, D.M. 1994. **Report on the scientific roundtable on biological diversity convened by the Chequamegon and Nicolet National Forests.** Gen. Tech. Rep. NC-166. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station. 55 p. https://doi.org/10.2737/NC-GTR-166.

Davis, M. 1966. **Genetics lab embarks on new study.** Rhinelander Daily News. 21 July: 12.

Dawson, D.H. 1968. **The research program of the Institute of Forest Genetics at Rhinelander, Wisconsin.** In: Proceedings: Northeastern Area 20th Nurserymen's Meeting: [Place of publication unknown]: 88–100.

Dawson, D.H. 1976. **History and organization of the maximum yield program.** In: Intensive plantation culture: five years research. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 1–4.

Dietzman, D. 2004. **Vandalism prompts security changes at USFS experiment station.** Forest Operations Review. Spring/summer 2004. Rockville, MD: Forest Resources Association Inc. 26.

Dickson, R.E.; Lewin, K.F.; Isebrands, J.G. [et al.]. 2000. **Forest atmosphere carbon transfer and storage (FACTS-II) the Aspen Free-Air CO_2 and O_3 enrichment (FACE) project: an overview.** Gen. Tech. Rep. NC-214. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 68 p. https://doi.org/10.2737/NC-GTR-214.

Donner, D. 2021. Personal communication. Project leader and research landscape ecologist, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Grieco, M. 1999. **Millennium Christmas tree tours state on its way to nation's capitol.** Rhinelander Our Town. 21 November; Sect. 1: 4.

Gustafson, E.J.; Miranda, B.R.; Sturtevant, B.R. 2020. **How do forest landscapes respond to elevated CO_2 and ozone? Scaling Aspen-FACE plot-scale experimental results.** Ecosphere. 11(6): e03162. 18 p. https://doi.org/10.1002/ecs2.3162.

Gustafson, E.J.; Shifley, S.R.; Mladenoff, D.J. [et al.]. 2000. **Spatial simulation of forest succession and timber harvesting using LANDIS.** Canadian Journal of Forest Research. 30(1): 32–43. https://doi.org/10.1139/x99-188.

Haissig, B.; Gaines, J.; Giacoletto, G., inventors. 1981 (October 27). **Tree rooting using synthetic auxins.** U.S. Patent 4,297,125.

Hansen, E.; Ostry, M.; Johnson, W. [et al.]. 1994. **Field performance of Populus in short-rotation intensive culture plantations in the north-central U.S.** Res. Pap. NC-320. St Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 13 p. https://doi.org/10.2737/NC-RP-320.

He, H.S.; Mladenoff, D.J. 1999. **Spatially explicit and stochastic simulation of forest-landscape fire disturbance and succession.** Ecology. 80(1): 81–99. https://doi.org/10.1890/0012-9658(1999)080[0081:SEASSO]2.0.CO;2.

Isebrands, J. 2020. Personal communication. Retired program leader, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Isebrands, J. 2021. Personal communication. Retired program leader, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Isebrands, J.G.; Dickson, R.E. 1994. **Biology and silviculture of northern red oak in the North Central Region: a synopsis.** Gen. Tech. Rep. NC-173. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 68 p. https://doi.org/10.2737/NC-GTR-173.

Isebrands, J.G.; Teclaw, R.M. 2002. **Oak regeneration in the Lake States: an overview of 20 years of research.** In: Sung, S.; Kormanik, P.P.; Ostrosina, W.J. [et al.], eds. Eighth workshop on seedling physiology and growth problems in oak plantings (abstracts). 2001 September 9-12; Hiwassee, GA. Gen. Tech. Rep. NC-224. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station: 6. https://doi.org/10.2737/NC-GTR-224.

Isebrands, J.G.; Zalesny Jr., R.S. 2020. **Reflections on the contributions of Populus research at Rhinelander, Wisconsin, USA.** Canadian Journal of Forest Research. 51(2): 139-153. https://doi.org/10.1139/cjfr-2020-0248.

Jeffers, R.M. 1971. **Research at the Institute of Forest Genetics, Rhinelander, Wisconsin.** Res. Pap. NC-67. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 31 p.

Karnosky, D.; Pikkarainen, J., ed. 2004. **Facing the future: the FACTS II (Aspen FACE) newsletter.** [Place of publication unknown]: [Publisher unknown]. 3(1): 2, 8–9.

Kern, C.; Erdmann, G.; Kenefic, L. [et al.]. 2014. **Development of the selection system in northern hardwood forests of the Lake States: an 80-year silviculture research legacy.** In: Hayes, D.C.; Stout, S.L.; Crawford, R.H. [et al.], eds. USDA Forest Service experimental forests and ranges research for the long term. New York: Springer: 201–223.

Kubiske, M; Foss, A.; Burton, A. [et al.]. 2015. **Supporting 13 years of global change research: the history, technology, and methods of the Aspen FACE Experiment.** Gen. Tech. Rep. NRS-153. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, North Central Research Station. 50 p. https://doi.org/10.2737/NRS-GTR-153.

Maller, P. 2000. **Activists destroy research trees.** Milwaukee Journal-Sentinel. 22 July: 1, 9.

Marr, G. 1978a. **Area scientists are world experts on wood formation: part four in series on the Forestry Science Lab.** Rhinelander Our Town. 8 October; Sect. 1: 19, 21.

Marr, G. 1978b. **Providing wood for the future: part one in series on the Forestry Science Lab.** Rhinelander Our Town. 17 September; Sect. 1: 12–14.

Marr, G. 1978c. **Genetic research is an integral part of the Forestry Sciences Lab: part three in series on the Forestry Science Lab.** Rhinelander Our Town. 1 October; Sect. 2: 4, 12.

Marr, G. 1978d. **Lab experiments in tree farming: part two in series on the Forestry Science Lab.** Rhinelander Our Town. 24 September; Sect. 1: 19, 14.

McCombie, B. 2000. **Ecoterrorists!** Madison Isthmus. 10 November: 9–10.

McKay, J. 1996. **National Register of Historic Places nomination form: Rhinelander Nursery.** Washington, DC: U. S. Department of Interior, National Park Service. 122 p.

Miazga, M.J. 2004. **Tales of the Northwoods: echoes from Rhinelander's past.** Savage, MN: Hodag Press. Vol. 2.

Michele, T. 1977. **Forest resources well taken care of.** Rhinelander Daily News. 25 June: Sect. Entering Century III—Summer 1977: 9.

Michler, M; Haissig, B., inventors. 1994 (October 11). **Methods of high frequency tissue regeneration, regeneration of herbicide-tolerant Populus plants therewith, and the herbicide-tolerant plants made thereby.** U.S. Patent 5,354,943.

Miller, K. 1992a. **Forest Service conducts leading-edge research in Rhinelander.** Rhinelander Our Town Today. 22 March; Sect. 2: 1, 3.

Miller, K. 1992b. **Seed exchange with Russia was out of this world! second of two articles on current research at the North Central Forest Experiment Station in Rhinelander.** Rhinelander Our Town Today. 29 March; Sect. 2: 1, 8.

Moore, R.J. 2011. **The Morrow brothers of Macomb, Illinois, and the Civilian Conservation Corps.** Journal of the Illinois State Historical Society. 104(4): 336–369.

Neale, D.B. 1995. **Jerry Miksche, plant genome program director, retires.** Dendrome: Forest Tree Genome Research Updates. 2(2): 11.

Nelson, A.E. 2002. **Transcription of oral history.** Series 402 Society of American Foresters. Stevens Point, WI: Nelis R. Kampenga University Archives. 2 p.

Nelson, N.D. 1985. **North Central Forest Experiment Station biotechnology program: application to tree improvement.** In: Proceedings of the eighteenth Southern Forest Tree Improvement conference. Long Beach, MS: 14–22.

Netzer, D. 2019. Personal communication. Retired forestry technician, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Nienstaedt, H. 1981. **"Super" spruce seedlings continue superior growth for 18 years.** Res. Note NC-265. St Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 4 p.

North Central Forest Experiment Station News. 1989. **Antique truck goes to its final parking place.** St. Paul, MN: U.S. Department of Agriculture, Forest Service. August: 4.

O'Konski, A. 1967 (March 15). **Statement in support of an appropriation for $31,000 in planning funds for a laboratory addition to the Institute of Forest Genetics at Rhinelander, Wisconsin.** Department of the Interior and related agencies appropriations for 1968. Hearings before a subcommittee of the committee on appropriations, House of Representatives, Ninetieth Congress, First Session. Washington, DC: U.S. Government Printing Office: 173–174.

Phelps, W.R.; Weber, R. 1969. **Characteristics of blister rust cankers on eastern white pine.** Res. Note NC-80. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 2 p.

Rhinelander Daily News. 1930. **County board proceedings.** 30 December: 5.

Rhinelander Daily News. 1931. **Hope to start planting pine seeds at federal nursery here this week.** 4 June: 2.

Rhinelander Daily News. 1934a. **Progress is shown at forest nursery.** 30 August: 2.

Rhinelander Daily News. 1934b. **To establish side camp at nursery here.** 19 June: 2.

Rhinelander Daily News. 1936a. **Kiwanians, forest officials gather to dedicate nursery.** 27 April: 2.

Rhinelander Daily News. 1936b. **Nursery here is dedicated to Hugo Sauer.** 29 April: 2.

Rhinelander Daily News. 1936c. **Three million trees planted in U.S. forest.** 29 May: 2.

Rhinelander Daily News. 1937. **CCC work on Nicolet area was valuable.** 3 April: 2.

Rhinelander Daily News. 1944. **Barbadians are here, ready to help in harvest.** 29 August: 2.

Rhinelander Daily News. 1945. **POW camp has strict rules.** 31 August: 2.

Rhinelander Daily News. 1946. **225 laborers to be imported for potato harvest.** 6 August: 2.

Rhinelander Daily News. 1950. **Forest nursery here may close after 1951 season.** 26 December: 3.

Rhinelander Daily News. 1951. **Pine cone quota filled for season.** 19 September: 2.

Rhinelander Daily News. 1953a. **Company's action kept Hugo Sauer Nursery open here.** 5 June: 80.

Rhinelander Daily News. 1953b. **Cooperation tells story of growth of nursery here.** 17 September: 4.

Rhinelander Daily News. 1953c. **Take a Northwoods stroll, there's money in pine cones.** 19 September: 2.

Rhinelander Daily News. 1957a. **Area pine cone pickers get $22,700 for harvest.** 22 October: 10.

Rhinelander Daily News. 1957b. **Genetics institute to make city mecca for foresters.** 7 June: 1.

Rhinelander Daily News. 1957c. **Interesting talk heard by Lions on forest genetics.** 24 May: 2.

Rhinelander Daily News. 1959a. **Bids sought for genetics laboratory building here.** 3 April: 2.

Rhinelander Daily News. 1959b. **Geneticist joins staff of forest research center.** 26 February: 2.

Rhinelander Daily News. 1960a**. Dedication of laboratory set at forest genetics institute.** 8 September: Logging Congress ed.: 13.

Rhinelander Daily News. 1960b. **Forest genetics institute moves into new building.** 5 February: 1–2.

Rhinelander Daily News. 1962. **Camp McNaughton unique in land of camps, lakes.** 19 May: 3.

Rhinelander Daily News. 1967. **Genetics lab project plans to cost $60,000.** 25 April: 1.

Rhinelander Daily News. 1969. **County board proceedings: United States governmental lease for experimental study area.** 24 October: 8.

Rhinelander Daily News. 1970. **Summer employees assist in research.** 20 July: 4.

Rhinelander Daily News. 1972a. **Nicolet forest, college to operate youth camp.** 5 April: 3.

Rhinelander Daily News. 1972b. **Open house Thursday at institute.** 7 August: 8.

Rhinelander Daily News. 1973a. **James Marten nearing requirements for Eagle.** 25 June: 8.

Rhinelander Daily News. 1973b. **Radiation project being abandoned.** 20 December: 1.

Rhinelander Daily News. 1974a. **Nursery ends tree production.** 31 May: 1.

Rhinelander Daily News. 1974b. **Obey to break ground for institute project.** 9 August: 2.

Rhinelander Daily News. 1975a. **Government surplus property for sale.** 24 April: 10.

Rhinelander Daily News. 1975b. **Larson recognized for wood research.** 3 June: 8.

Rhinelander Daily News. 1975c. **Seeds from area taking space trip.** 14 July: 1.

Rhinelander Daily News. 1977. **Lab gives nature a push.** 9 September: 1–2.

Rhinelander Daily News. 1978. **Forestry lab renamed.** 5 July: 6.

Rhinelander Daily News. 1987. **Bicentennial of the United States Constitution northern red oak planting.** [Undated newspaper clipping].

Rhinelander Daily News. 2003. **Energy-efficient remodeling completed at Forestry Sciences Laboratory.** 8 July; Sect. A: 1.

Rhinelander Hodag Shopper. 1981. **Hugo Sauer Nursery was instrumental in reforestation.** 1 April.

Rhinelander New North. 1894. **A county poor farm.** 3 May: 1.

Rhinelander New North. 1930. **Federal forest nursery to be established in Oneida County.** 18 December: 1.

Rhinelander New North. 1931a. **Federal nursery for Rhinelander.** 19 February: 5.

Rhinelander New North. 1931b. **Largest tree nursery in the U.S.** 2 April: 1.

Rhinelander New North. 1935. **CCC News.** 21 March: 7.

Rhinelander New North. 1936. **Sauer planting gets underway.** 7 May: 1.

Rhinelander Northwoods River News. 2013. **David H. Dawson obituary.** 17 October: http://www.rivernewsonline.com/main.asp?SectionID=3&SubSectionID=28&ArticleID=59091 (accessed 7 February 2021).

Rhinelander Our Town. 1980. **Chinese foresters visit area.** 12 October; Sect. 1: 12–13.

Rudolf, P.O. 1963. **Forest tree improvement in the Lake States, 1953–1963.** In: Proceedings of the sixth Lake States Forest Tree Improvement Conference. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Lake States Forest Experiment Station: 6.

Rudolf, P.O. 1985. **History of the Lake States Forest Experiment Station.** St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 290 p.

Rudolph, T., ed. 1974. **The Enterprise, Wisconsin, radiation forest: preirradiation ecological studies.** TID-26113. Oakridge, TN: Technical Information Center, Office of Information Services, U.S. Atomic Energy Commission. 150 p.

Rudolph, T. 2019. Personal communication. Retired forester, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Satz, R.N. 1991. **Chippewa treaty rights: the reserved rights of Wisconsin's Chippewa Indians in historical perspective.** Transactions. 79(1): 33-49.

Stoeckeler, J.H.; Jones, G.W. 1957. **Forest nursery practice in the Lake States.** Agriculture Handbook no. 110. Washington, DC: U.S. Department of Agriculture, Forest Service. 124 p.

Stowers, B. 1982. **Tests turn trees to fuel—quickly.** Madison Capital Times. 16 August: 28.

Strong, T. 2021. Personal communication. Retired forestry technician, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Talhelm, A.F.; Pregitzer, K.S.; Kubiske, M.E. [et al.]. 2014. **Elevated carbon dioxide and ozone alter productivity and ecosystem carbon content in northern temperate forests.** Global Change Biology. 20(8): 2492-2501. https://doi.org/10.1111/gcb.12564.

Teclaw, R. 2019. Personal communication. Retired biologist, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Thompson, W.F. 2013. **The history of Wisconsin: continuity and change, 1940–1965.** Madison, WI: Wisconsin Historical Society Press. Vol. 6. 830 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 1935. **The Nicolet forum.** Rhinelander, WI: (1)3.

U.S. Department of Agriculture, Forest Service [USDA FS]. 1975. **Space gift: an acre of trees for USSR.** Picture Story 291. Washington, DC: Office of Communication. 6 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 1979. **Forestry Sciences Laboratory, Rhinelander, Wisconsin.** Brochure FTS 8-362-1012. St. Paul, MN: North Central Forest Experiment Station. 4 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 1999 (October/November). **NC news: North Central Forest Experiment Station.** St. Paul, MN: Research Station. No. 19.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2006. **Northwest Howell project: final supplement to the Environmental Impact Statement.** Chequamegon-Nicolet National Forest: 10–14.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2008. **Harshaw Forestry Research Farm, Rhinelander, Wisconsin.** Reprinted from NRS-INF-07-09. Rhinelander, WI: Northern Research Station, Institute for Applied Ecosystem Studies. 2 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2013. **Fast-growing poplars provide solutions for both energy and pollution problems.** Research Review. Newtown Square, PA: North Central Research Station. 6 p.

U.S. Department of Agriculture, Forest Service [USDA FS]. 2015. **Establishment record for Rhinelander Experimental Forest.** [Place of publication unknown]. 46 p.

U.S. Government Accountability Office [GAO]. 2010 (October**). Forest Service Research and Development: improvements in delivery of research results can help ensure that benefits of research are realized.** Report to the Majority Leader, U.S. Senate. GAO-11-12. Washington, DC: 31–34.

Wiese, A. 2019. Personal communication. Forestry technician, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Wiese, A.; Netzer, D.; Riemenschneider, D., inventors. 2004 (January 8). **Combination foliage compaction and treatment method and apparatus.** U.S. Patent US-20040003535A1.

Wiese, A.; Netzer, D.; Riemenschneider, D.; Zalesny Jr., R. 2006. **A weed compaction roller system for use with mechanical herbicide application.** Northern Journal of Applied Forestry. 23(1): 66–69.

Wisconsin Rapids Daily Tribune. 1960. **Dedicate Forest Genetics Lab at Rhinelander Sept. 30.** 24 September: 2.

Wisconsin Society of American Foresters [WISAF]. 1991. **Richard M. Godman induction into the Wisconsin Forestry Hall of Fame.** [Place of publication unknown]: Wisconsin Society of Foresters. https://www.wisaf.org/wisconsin-forestry-hall-of-fame/1991-richard-m-godman (accessed February 6, 2021).

Zalesny Jr., R. 2019. Personal communication. Supervisory research plant geneticist, U.S. Department of Agriculture, Forest Service, Northern Research Station, Institute for Applied Ecosystem Studies, 5985 Highway K, Rhinelander, WI 54501-9128.

Zavitkovski, J., ed. 1977. **The Enterprise, Wisconsin, radiation forest radioecological studies.** TID-26113-P2. U.S. Energy Research and Development Administration, Division of Biomedical and Environmental Research, Technical Information Center. 211 p.

Appendix 1

Timeline of Research Projects and Personnel at the Rhinelander Field Laboratory

This appendix presents a timeline of the major research projects and programs conducted at the USDA Forest Service Rhinelander field laboratory from 1956 to 2023.

Table 2 is divided into primary research projects of the lab sorted by the year created. Permanent and long-term temporary (≥ 5 years) Forest Service researchers and science support personnel are identified followed by their position, years they worked at the Rhinelander lab, and additional details of their position. Some overlaps of dates occur due to researchers working on multiple projects or studies simultaneously.

Table 3 is divided into the three different names that the Rhinelander field laboratory has been called since 1957, with Director's Representatives identified and the years each held the position.

The tables represent a compilation of research sources that include USDA Forest Service organizational directories, reports that document specific programs or eras of the laboratory, and interviews with current and former employees of the lab. Projects began, changed, transitioned into new projects, and ended based on the funding sources or relevant lines of science at the time. The start and end years for the projects and personnel have been identified based on the best available information but may differ slightly depending on the records used.

Table 2.—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Genetics of Northern Forest Trees: 1956–1984			
Hans Nienstaedt (Figs. 66, 69)	Project Leader and Scientist	1956–1984	Retired
Philip Larson (Fig. 67)	Scientist	1956–1961	Moved to Physiology of Wood Formation
Thomas Rudolph	Scientist	1959–1963 1974–1984	Moved to Radiobiology of Northern Forest Communities, 1968–1974
Robert Hill	Science Support	1959–1966	
Kenneth Kessler	Science Support	1960–1962	
Dorothy Vancos	Science Support	1960–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Knud Clausen	Scientist	1961–1975	
James King	Science Support	1961–1966	
Jim Jozwiak	Science Support	1962–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Fred Mermuys	Science Support	1963–1978	
Jerome Miksche	Scientist	1965–1976	
Kenneth Hanson	Science Support	1973–1983	
Joe Ginzl (Fig. 68)	Science Support	1966–1981	

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Genetics of Northern Forest Trees: 1956–1984			
Werner Bigalke	Science Support	1967–1982	
Richard Jeffers (Fig. 69)	Science Support	1969–1978	
Bill Shulstum	Science Support	1970–1982	
Bruce Haissig	Scientist	1973–1983	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Robert Cecich	Scientist	1973–1984	Transferred to research project in Columbia, MO
Edmund Bauer	Science Support	1975–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Larry Petersen	Science Support	1975–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
James Bushey	Science Support	1976–1984	Moved to Intensively Cultured Plantations for Biomass and Energy Production
Hyun-Chung Kang	Scientist	1979–1984	
Don Riemenschneider	Scientist	1980–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Pioneering Research: Physiology of Wood Formation: 1962–1985			
Philip Larson (Figs. 67)	Project Leader and Scientist	1962–1985 (lead)	Retired
John Gordon	Scientist	1967–1970	
Judson Isebrands (Fig. 70)	Scientist	1969–1977	Moved to Physiology and Raw Material Evaluation of Intensively Cultured Plantations
Richard Dickson (Fig. 71)	Scientist	1970–1983	Moved to Establishment and Early Growth of Northern Forest Species
Carol Bruchard	Science Support	1963–1977	
Gary Garton	Science Support	1965–1984	Moved to Establishment and Early Growth of Northern Forest Species
Gary Buschacher (Fig. 70)	Science Support	1966–1984	Moved to Establishment and Early Growth of Northern Forest Species
Ray Lange	Science Support	1981–1985	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Radiobiology of Northern Forest Communities: 1963–1976			
Thomas Rudolph	Project Leader and Scientist	1968–1974 (lead)	Returned to Genetics of Northern Forest Trees
Ron Nelson	Science Support	1968–1976	Transferred to Nicolet National Forest
Richard Blank	Science Support	1968–1976	
Marg Olander	Science Support	1969–1974	Transferred to Nicolet National Forest
Jaroslav Zavitkovski (Fig. 72)	Project Leader and Scientist	1970–1973 1974–1976 (lead)	Also worked on Production of Maximum Fiber Yield from Woody Species
Edmund Bauer	Science Support	1967–1974	Moved to Genetics of Northern Forest Trees
Richard Buech	Scientist	1971–1976	Transferred to research project in St. Paul. Returned to Ecology and Management of Riparian/Aquatic Ecosystems in 1997
Brad Salmonson	Scientist	1971–1976	
Thomas Crow (Fig. 73)	Scientist	1972–1976	Transferred to International Institute for Tropical Studies in Puerto Rico; returned to Establishment and Early Growth of Northern Forest Species in 1984

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Diseases of Northern Conifers and Shelterbelts: 1962–1967			
William Phelps	Scientist	1962–1967	
Ray Weber	Science Support	1962–1967	
Silviculture and Ecology of Northern Hardwoods in the Lake States: 1965–1982			
Richard Godman (Fig. 74)	Scientist	1965–1982	Moved to Establishment and Early Growth of Northern Forest Species
Production of Maximum Fiber Yield from Woody Species: 1971–1976 **Maximum Yield Research and Development Program: 1977–1982**			
David Dawson	Project Leader and Scientist	1971–1982 (lead)	Retired
Jaroslav Zavitkovski (Fig. 72)	Scientist	1974–1976	Moved to Intensively Cultured Plantations for Biomass and Energy Production
Howard Phipps	Scientist	1975–1976	Moved to Intensively Cultured Plantations for Biomass and Energy Production
Dan Netzer	Science Support	1971–1982	Moved to Intensively Cultured Plantations for Biomass and Energy Production
Pam Stava	Science Support, Greenhouse Manager	1977–1982	
Dave Tolsted	Science Support	1978–1982	Moved to Intensively Cultured Plantations for Biomass and Energy Production
Intensively Cultured Plantations for Biomass and Energy Production: 1977–1988 (Project of the Maximum Yield Research and Development Program)			
Jaroslav Zavitkovski (Fig. 72)	Project Leader and Scientist	1977–1984 (lead)	
Edward Hansen	Project Leader and Scientist	1977–1984 1985–1988 (lead)	Moved to Silviculture in the Northern Lake States
Howard Phipps	Scientist	1977–1982	Transferred to research project in Bedford, IN
Daniel Netzer	Science Support	1983–1988	Moved to Silviculture in the Northern Lake States
Willis Rietveld	scientist	1983–1988	Transferred to research project in Carbondale, IL
Terry Strong	Science Support	1977–1988	Moved to Silviculture in the Northern Lake States
Kent Eggleston	Science Support	1983–1988	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
James Bushey	Science Support	1985–1988	Moved to Establishment and Early Growth of Northern Forest Species
Dave Tolsted	Science Support	1983–1988	Moved to Establishment and Early Growth of Northern Forest Species
Nonan Noste	Scientist	1980–1984	Moved to research project in Missoula, MT
Physiology and Raw Material Evaluation of Intensively Cultured Plantations: 1977–1984 (Project of the Maximum Yield Research and Development Program)			
Judson Isebrands (Fig. 70)	Project Leader and Scientist	1977–1984 (lead)	Returned to Establishment and Early Growth of Northern Forest Species in 1986 after a sabbatical
John Crist	Scientist	1977–1980	Moved to State and Private Forestry in Morgantown, WV
Neil Nelson	Scientist	1977–1984	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Ronald Teclaw (Fig. 75)	Science Support	1979–1984	Moved to Establishment and Early Growth of Northern Forest Species
Joanne Nelson	Science Support	1977–1982	
Paul Ehlers	Science Support	1976–1984	Moved to Nicolet Technical College, Rhinelander

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Biotechnology/Genetic Transformation of Forest Trees in Microculture:1984–1992 Genetic and Molecular Transformation Bases of Forest Trees Stress Tolerances: 1993–2000			
Neil Nelson	Program Manager	1984–1986 (lead)	Transferred to University of Minnesota; returned to lab in 2004 and took over Aspen FACE
Bruce Haissig	Project Leader and Scientist	1984–1993 (lead)	Retired
Charles Michler	Project Leader and Scientist	1988–1992 1993–2000 (lead)	Transferred to another research work unit, Purdue, IN
Don Riemenschneider	Scientist	1985–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Edmund Bauer	Science Support	1985–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Dorothy Vancos	Science Support	1984–1987	Moved to Biotechnology/Genetic Transformation of Forest Trees in Microculture
Jim Jozwiak	Science Support	1985-1987	
Larry Petersen	Science Support	1985–1992	Transferred to IT
Ray Lange	Science Support	1985–2000	Moved to Aspen FACE experiment
Anita Foss	Science Support	1986–2000	Moved to Physiological Mechanisms of Growth and Multiple-Stress Responses in Northern Forest Species
Therese Hubacher	Science Support	1988–2000	Moved to Physiological Mechanisms of Growth and Multiple-Stress Responses in Northern Forest Species
Kent Eggleston	Science Support	1989–1990	Transferred to greenhouse manager position in research project in UT
Paula Marquardt	Science Support	1991–2000	Moved to Physiological Mechanisms of Growth and Multiple-Stress Responses in Northern Forest Species
Craig Echt	Scientist	1992–1997	Transferred to another research laboratory in TX
Patricia Tomlinson	Scientist	1994–2000	Transferred to a university
Paul Anderson	Scientist	1994–2000	Transferred to University of MN
Establishment and Early Growth of Northern Forest Species: 1984–1990			
Thomas Crow (Fig. 73)	Project Leader and Scientist	1984–1985 (lead) 1986–1987	Moved to Applying Principles of Landscape Ecology to Managing Temperate Forests
Judson Isebrands (Fig. 70)	Project Leader and Scientist	1986–1990 (lead)	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Gayne Erdmann	Scientist	1984–1988	
Richard Dickson (Fig. 71)	Scientist	1984–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Ronald Teclaw (Fig. 75)	Science Support	1984–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Patricia Tomlinson	Scientist	1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Gary Garton	Science Support	1989–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Gary Buschacher (Fig. 70)	Science Support	1989–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
James Bushey	Science Support	1989–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems
Dave Tolsted	Science Support	1989–1990	Moved to Ecophysiological Processes of Northern Forest Ecosystems

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Applying Principles of Landscape Ecology to Managing Temperate Forests: 1988–2006			
(Studies continued as part of the Institute for Applied Ecosystem Studies: 2007–present)			
Thomas Crow (Fig. 73)	Project Leader and Scientist	1988–1997 (lead)	Transferred to Michigan State University, Intergovernmental Personnel Assignment, temporary Endowed Chair
Eric Gustafson	Project Leader and Scientist	1992–1997 1998–2006 (lead)	Continued in Institute for Applied Ecosystem Studies
John Probst	Scientist	1989–2006	Continued in Institute for Applied Ecosystem Studies
David Cleland	Scientist	1992–2006	Detailed from Region 9
Deahn Donner	Science Support	1997–2006	Continued in Institute for Applied Ecosystem Studies
Lucy Tyrrell	Scientist	1999–2000	Transferred to Northern Research Station Research Natural Area Coordinator
Brian Sturtevant	Scientist	2001–2006	Continued in Institute for Applied Ecosystem Studies
Patrick Zollner	Scientist	2002–2006	Continued in Institute for Applied Ecosystem Studies
David Buckley	Scientist	1993–1998	Transferred to University of Tennessee
John Wright	Science Support	1995–2004	Moved to Wisconsin Department of Natural Resources
Elizabeth Nauertz	Science Support	1993–1998	Transferred to National Park Service, MN
Sue Lietz	Science Support	1990–2006	Continued in Institute for Applied Ecosystem Studies
Tina Baumann	Science Support	1996–2006	Transferred to Chequamegon-Nicolet National Forest
Silviculture in the Northern Lake States: 1989–1996			
Ecology and Silviculture of Northern Lake States Forests: 1997–2005			
(Studies continued as part of the Institute for Applied Ecosystem Studies: 2015–present)			
Edward Hansen (in Grand Rapids, MN)	Project Leader and Scientist	1989–1996 (lead)	Retired
John Zasada	Project Leader and Scientist	1997–2000 (lead)	Transferred to Grand Rapids, MN in 1997; retired in 2000
Terry Strong	Scientist	1989–2005	Retired
Daniel Netzer	Science Support	1989–1997	Moved to Genetic and Silvicultural Systems for Sustainable Intensive Forestry
Integrated Approaches to Wildlife and Fish Management: 1990–1996			
Ecology and Management of Riparian/Aquatic Ecosystems: 1997–2002			
Clayton Edwards	Scientist	1990–2002	
Richard Buech	Scientist	1997–2000	
Ecophysiological Processes of Northern Forest Ecosystems: 1991–1992			
Physiological Mechanisms of Growth and Multiple-Stress Responses in Northern Forest Species: 1992–**2006**			
Aspen FACE Experiment: 1998–2011			
Judson Isebrands (Fig. 70)	Project Leader and Scientist	1991–2002 (lead)	Retired
Mark Kubiske	Project Leader and Scientist	2002–2004 (lead) 2005–2006	Continued in Institute for Applied Ecosystem Studies
Neil Nelson	Project Leader and Scientist	2004–2006 (lead)	Continued in Institute for Applied Ecosystem Studies
Edmund Bauer	Science Support	1991–1997	Moved to Genetic and Silvicultural Systems for Sustainable Intensive Forestry
Richard Dickson (Fig. 71)	Scientist	1991–2000	Retired

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Ecophysiological Processes of Northern Forest Ecosystems: 1991–1992 **Physiological Mechanisms of Growth and Multiple-Stress Responses in Northern Forest Species:** 1992–**2006** **Aspen FACE Experiment: 1998–2011**			
Don Riemenschneider	Scientist	1991–1997	Moved to Genetic and Silvicultural Systems for Sustainable Intensive Forestry
Ronald Teclaw (Fig. 75)	Science Support	1991–2010	Retired
Patricia Tomlinson	Scientist	1991–1993	Moved to Genetic and Molecular Transformation Bases of Forest Trees Stress Tolerances
Gary Garton	Science Support	1991–1995	Retired
James Bushey	Science Support	1991–1996	Retired
Dave Tolsted	Science Support	1991–1996	Retired
Gary Bushacher	Science Support	1991–1995	Retired
John Zasada	Scientist	1993–1996	Moved to Ecology and Silviculture of Northern Lake States Forests
Paul Anderson	Scientist	1993–1994	Moved to Genetic and Molecular Transformation Bases of Forest Trees Stress Tolerances
Mark Coleman	Scientist	1992–2006	Transferred to Michigan Technological University, but still stationed at Rhinelander
William Mattson	Scientist	1998–2006	Continued in Institute for Applied Ecosystem Studies
Bruce Birr	Science Support	1998–2006	Continued in Institute for Applied Ecosystem Studies
Therese Hubacher	Science Support	2000–2001	Retired
Paula Marquardt	Science Support	2001–2006	Continued in Institute for Applied Ecosystem Studies
Anita Foss	Science Support	2001–2006	Continued in Institute for Applied Ecosystem Studies
JoAnne Lund	Science Support	1998–2006	Continued in Institute for Applied Ecosystem Studies
Ray Lange	Science Support	2000–2007	Continued in Institute for Applied Ecosystem Studies
Genetic and Silvicultural Systems for Sustainable Intensive Forestry: 1998–2006 **Phytotechnologies and Ecosystem Services: 1999–2006**			
Don Riemenschneider	Project Leader and Scientist	1998–2006 (lead)	Continued in Institute for Applied Ecosystem Studies
Ron Zalesny (Fig. 76)	Scientist	1998–2006	Continued in Institute for Applied Ecosystem Studies
Daniel Netzer	Science Support	1998–2006	Retired
Edmund Bauer	Science Support	1998–2000	Retired
Adam Wiese	Science Support	1998–2006	Continued in Institute for Applied Ecosystem Studies
Institute for Applied Ecosystem Studies: 2007–2023			
Neil Nelson	Project Leader and Scientist	2007–2009 (lead)	Retired
Eric Gustafson	Project Leader and Scientist	2007–2008 2009–2012 (lead) 2013–2023	
Deahn Donner	Project Leader, Scientist	2007–2011 2012–2023 (lead)	
Don Riemenschneider	Scientist	2007–2008	Retired
Brian Sturtevant	Scientist	2007–2023	
Ron Zalesny	Scientist	2007–2023	
Patrick Zollner	Scientist	2007–2014	Moved to Purdue University
Mark Kubiske	Scientist	2007–2019	Retired

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Table 2 (continued).—Timeline identifying the research projects and permanent or long-term Forest Service personnel at the Rhinelander field laboratory from 1956 to 2023

Institute for Applied Ecosystem Studies: 2007–2023			
John Probst	Scientist	2007–2010	Retired
William Mattson	Scientist	2007–2009	Retired
Paula Marquardt	Scientist and Science Support	2007–2020	Science support 2007–2013; Scientist 2013–2020
Joel Flory	Science Support	2018–2022	Transferred to Chequamegon-Nicolet National Forest
Brian Miranda	Science Support	2007–2023	
Sue Lietz	Science Support	2007–2017	Retired
Anita Foss	Science Support	2007–2012	Retired
JoAnne Lund	Science Support	2007–2013	
Bruce Birr	Science Support	2007–2016	Retired
Adam Wiese	Science Support	2007–2023	
Ray Lange	Science Support	2007–2018	Retired
Timothy Paul	Science Support	2020–2023	
Dustin Bronson	Scientist	2019–2023	
Rachel Toczydlowski	Scientist	2022–2023	
Ryan Vinhal	Science Support	2022–2023	
Kenneth Hayes	Science Support	2022–2023	
Jeffrey Suvada	Science Support	2022–2023	
Administrative Support and Facility Managers			
Harold "Hal" Luedtke (Fig. 77)	Facility Manager	1960–1966	
Eddie Stoltz	Administrative Support	1966–1973	
George Peyla	Administrative support	1971–1975	
Raymond Warren	Administrative support	1975–1986	
Kathy Heise	Administrative Support	1999–2017	Retired
MaryAnn Kipper	Administrative Support	1988–2010	Retired
Eddie Franson	Administrative Support	1986–1998	Retired
Paul Vuchetich	Administrative Support	2011–2016	Retired
Timothy Paul	Administrative Support	2016–2020	Moved to science support
Mike Moran	Facility Support	1969–1997	Retired
Rodney Eternicka	Facility Manager	1974–2006	
William Danfield	Facility Manager	1976–2020	Retired
Mary Berlin	Administrative Support	1987–1993	Retired
Jeremy Kasprak	Facility Manager	2021–2023	

Table 3.—Timeline documenting the name changes of the Rhinelander field station and the names of the Director's Representatives from 1957 to 2023

Northern Institute of Forest Genetics: 1957–1962 **Institute of Forest Genetics: 1963–1977**	
Hans Nienstaedt (Figs. 66, 69)	1957–1976
David Dawson (Figs. 51, 58)	1976–1977
Forestry Sciences Laboratory: 1978–2006	
David Dawson (Figs. 51, 58)	1978–1982
Edward Hansen	1982–1988
Judson Isebrands (Fig. 70)	1989–2002
Eric Gustafson	2002–2006
Institute for Applied Ecosystem Studies: 2007–2023	
Don Riemenschneider	2007–2009
Eric Gustafson	2009–2012
Deahn Donner	2012–2023

Figure 66.—Hans Nienstaedt grafting seedlings as part of the Genetics of Northern Forest Trees project. USDA Forest Service photo archives.

Figure 67.—Philip Larson with a C-14 treatment chamber at the Institute of Forest Genetics in 1966. USDA Forest Service photo archives.

Figure 68.—Joe Ginzl (left), forestry technician, and a student pollinating jack pine, circa 1969. USDA Forest Service photo archives.

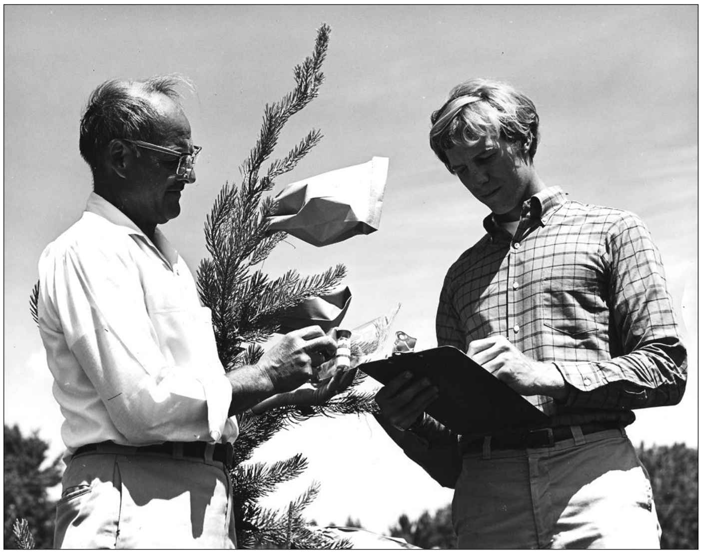

Figure 69.—Hans Nienstaedt (left) and Richard Jeffers examining jack pine for insect damage, circa 1969. USDA Forest Service photo archives.

Figure 70.—Gary Buschacher (left), lab technician, and Judson Isebrands, plant physiologist, examining plant material under a microscope, circa 1969. USDA Forest Service photo archives.

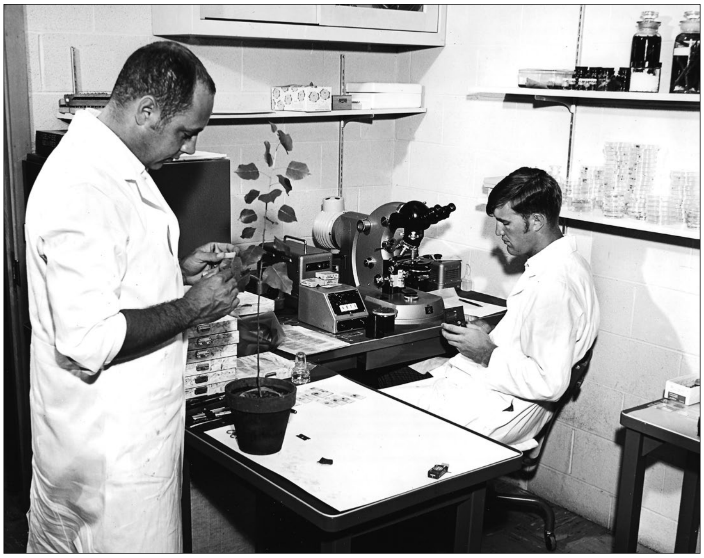

Figure 71.— Richard Dickson, a research plant physiologist who studied the biochemistry of northern red oaks as part of the Establishment and Early Growth of Northern Forest Species project, in 1993. Courtesy photograph by J.G. Isebrands.

Figure 72.—Jaroslav Zavitkovski, leader of the Intensively Cultured Plantations for Biomass and Energy Production project, in front of a planting of hybrid poplar in 1977. Courtesy photograph by J.G. Isebrands.

Figure 73.—Thomas Crow, who in 1987 became Project Leader of the first landscape ecology research program in the Forest Service. The program was headquartered at the Rhinelander field laboratory. Courtesy photograph from Thomas Crow.

Figure 74.—Richard Godman, who led silvicultural studies at the Argonne Experimental Forest from 1967 to 1985 while based at the Institute of Forest Genetics in Rhinelander. USDA Forest Service photo archives.

Figure 75.—Ronald "Ron" Teclaw, research biologist, using a scanning electron microscope as part of the Physiology and Raw Material Evaluation of Intensively Cultured Plantations project in 1980. At the time, the Rhinelander field laboratory had one of only twenty scanning electron microscopes in Wisconsin. Courtesy photograph by J.G. Isebrands.

Figure 76.—Ronald Zalesny, Jr., supervisory research plant geneticist, among selected poplar varieties in the Po River Valley, Italy, a region representing the most historic poplar production worldwide. Courtesy photograph by Rick Hall, Iowa State University.

Figure 77.—Harold "Hal" Luedtke, administrative assistant, collecting data on a white spruce seedling that was recently transplanted in the Hugo Sauer Nursery, circa 1962. USDA Forest Service photo archives.

Appendix 2

Map and Photographic Documentation of Extant Historic Buildings of the Hugo Sauer Nursery

In 1996, in compliance with federal statutes and regulations (e.g., 36 CFR 800, Protection of Historic and Cultural Properties), the Hugo Sauer Nursery property was formally evaluated to determine if it met National Register of Historic Places (NRHP) eligibility criteria. Photographic documentation of existing buildings and landscape elements was completed at that time. The Wisconsin State Historic Preservation Officer (WISHPO) concurred that the entire 79-acre property, including the original buildings, structures, objects, and cultural landscape elements, were part of an eligible historic district (Bruhy 2002, McKay 1996).

Figure 78.—Map of the Rhinelander/Hugo Sauer Nursery showing extant historic buildings and landscape features included in the photo documentation. The numbering scheme replicates the map numbers in the National Register of Historic Places Nomination Form (McKay 1996).

The USDA Forest Service has determined that future management goals are incompatible with maintaining the site's historic values. As part of the mitigation plan developed in consultation with WISHPO, an updated photographic documentation was completed in 2019 by consultants from the University of Wisconsin-Stevens Point. This appendix shows the results of the documentation. A map of the site illustrates the current locations of the existing structures and landscape elements (Fig. 78). The numbering system for buildings replicates the map numbers used in the National Register of Historic Places Nomination Form for consistency (McKay 1996). Each building/landscape feature includes photographs taken from different perspectives, along with a reference to specific pages in the nomination form that provide additional details such as sizes, siting, materials, and architectural features. Additional photographs of each structure and feature are on file at the Northern Research Station's Institute for Applied Ecosystem Studies in Rhinelander.

All photos in Appendix 2 were taken in 2019 by the authors as part of the Schmeeckle Reserve consultant contract, unless otherwise noted.

Map Area #4: Seed Extractory, built in 1933 (noncontributing)

The seed extractory (Figs. 79, 80), sized at 20 by 26 feet, was constructed in 1933 as a two-story building. Only the lower floor exists today and is used for storage. Due to these modifications, it is not a contributing structure. More details are included on pages 7–8 of the National Register of Historic Places Nomination Form (1996).

Figure 79.—Remaining lower floor of the Hugo Sauer Nursery seed extractory (map area #4) facing south, 2019.

Figure 80.—Remaining lower floor of the Hugo Sauer Nursery seed extractory (map area #4) facing southwest, 2019.

Map Area #5: Warehouse #1, built in 1932 (contributing)

The two-story warehouse #1 (Figs. 81, 82, 83), measuring 20 by 42 feet, was completed in 1932. It is currently used for storage and is a contributing structure. More details are included on pages 6–7 of the National Register of Historic Places Nomination Form (1996).

Figure 81.—Hugo Sauer Nursery warehouse #1 (map area #5) facing northeast, 1931. USDA Forest Service photo archives.

Figure 82.—Both stories of the Hugo Sauer Nursery warehouse #1 (map area #5) facing northeast, 2019.

Figure 83.—Top story of the Hugo Sauer Nursery warehouse #1 (map area #5) facing west, 2019.

Map Area #6: Seed Storage Shed, built in 1935 (contributing)

The seed storage shed (Figs. 84, 85, 86), sized at 18 by 22 feet, was constructed in 1935. It is currently used for storage and is a contributing structure. More details are included on pages 8–9 of the National Register of Historic Places Nomination Form (1996).

Figure 84.—Hugo Sauer Nursery seed storage shed (map area #6) facing northwest, 2019.

Figure 85.—Hugo Sauer Nursery seed storage shed (map area #6) facing west, showing the adjacent steps through the retaining wall, 2019.

Figure 86.—Hugo Sauer Nursery seed storage shed (map area #6) from the bottom of the retaining wall facing southeast, 2019.

Map Area #7: Cone Shed #2/Cold Storage/Packing Plant, built in 1936, expanded in 1958 (noncontributing)

The cone shed #2 two-story complex (Figs. 87, 88) was constructed in 1936, with a major addition erected in 1958. The original building measured 39.5 by 70 feet, and the addition increased the length to 110 feet. Most of the upper story was converted to offices. Due to these changes, it is not a contributing structure. More details are included on pages 9–11 of the National Register of Historic Places Nomination Form (1996).

Figure 87.—Hugo Sauer Nursery cone shed #2/cold storage/packing plant (map area #7) facing northwest, 2019.

Figure 88.—Hugo Sauer Nursery cone shed #2/cold storage/packing plant (map area #7) from the bottom of the retaining wall facing southeast, 2019.

Map Area #8: Pumphouse #1, built in 1931 (contributing)

The first pumphouse building (Figs. 89, 90, 91, 92, 93), sized at 12 by 20 feet, was constructed in 1931 on Langley Lake. It is currently abandoned, and the concrete foundation is deteriorating. It is a contributing structure. More details are included on page 12 of the National Register of Historic Places Nomination Form (1996).

Figure 89.—Hugo Sauer Nursery pumphouse #1 (map area #8) facing west, 1931. USDA Forest Service photo archives.

Figure 90.—Hugo Sauer Nursery pumphouse #1 (map area #8) facing west, 2019.

Figure 91.—Hugo Sauer Nursery pumphouse #1 (map area #8) facing northeast, 2019.

Figure 92.—Hugo Sauer Nursery pumphouse #1 (map area #8) facing southeast, 2019.

Figure 93.—Interior of the Hugo Sauer Nursery pumphouse #1 (map area #8) facing south, 2019. Note the deteriorating foundation.

Map Area #9: Field Warehouse/Warehouse #3, built in 1935 (noncontributing)

The field warehouse was built in 1935 in the middle of the nursery (Figs. 94, 95, 96). It is a one-and-a-half story building measuring 25 by 78 feet with an addition measuring 10 by 15 feet. Since the building has undergone considerable modification, it is not a contributing resource. It is currently used for storage. More details are included on pages 14–15 of the National Register of Historic Places Nomination Form (1996).

Figure 94.—Hugo Sauer Nursery field warehouse (map area #9) facing northwest, 2019.

Figure 95.—Hugo Sauer Nursery field warehouse (map area #9) facing northeast, 2019.

Figure 96.—Hugo Sauer Nursery field warehouse (map area #9) facing southwest, 2019.

Map Area #10: Oil House #2, moved to site in 1951 (noncontributing)

A 10-by-10-foot oil house (Fig. 97), located next to the field warehouse, may have been moved to the site by the Wisconsin Conservation Department in 1951. Since its construction date is unclear, it is not a contributing structure. More details are included on pages 13–14 of the National Register of Historic Places Nomination Form (1996).

Figure 97.—Hugo Sauer Nursery oil house #2 (map area #10) facing southwest, with the field warehouse (map area #9) behind, 2019.

Map Area #11: Implement Shed, built in 1936 (contributing)

Constructed in 1936, the implement shed (Figs. 98, 99, 100, 101), sized at 30 by 120 feet, was located near the Civilian Conservation Corps (CCC) side camp. It is currently used to store equipment and is a contributing structure. More details are included on page 17 of the National Register of Historic Places Nomination Form (1996).

Figure 98.—Hugo Sauer Nursery implement shed (map area #11) facing south, 2019.

Figure 99.—Hugo Sauer Nursery implement shed (map area #11) facing northeast, 2019.

Figure 100.—Hugo Sauer Nursery implement shed backside (map area #11) facing north, 2019.

Figure 101.—Interior of the Hugo Sauer Nursery implement shed (map area #11) facing southwest, 2019.

Map Area #12: Civilian Conservation Corps Side Camp, built by 1936 (noncontributing)

Several buildings for a Civilian Conservation Corps (CCC) side camp were erected by 1936 at the nursery, including a bunkhouse, shower house/washroom, mess hall, and kitchen. The only evidence left of the side camp is a concrete pad (marked by map location #12) where the smaller kitchen building stood into the 1960s (Figs. 102, 103). The pad is now used to store equipment. More details are included on page 57 and 84 of the National Register of Historic Places Nomination Form (1996).

Figure 102.—The beginning of the loop drive in 2019, facing south, where the Hugo Sauer Nursery Civilian Conservation Corps (CCC) side camp once stood. The fertilizer shed on the right (map area #13) was the location of the shower house/washroom that paralleled the driveway. To the south was a bunkhouse that also paralleled the driveway. The implement shed on the left (map area #11) is the only surviving structure from the CCC side camp era.

Figure 103.—The concrete slab at the south end of the loop drive in 2019 is where the Hugo Sauer Nursery Civilian Conservation Corps side camp kitchen building once stood (map area #12). A long mess hall oriented east-west stood in front of the kitchen.

Map Area #13: Fertilizer Shed, built in 1957 (noncontributing)

The fertilizer shed (Figs. 104, 105), measuring 20 by 30 feet, was constructed in 1957 at the original location of the CCC side camp shower house. Due to its construction date, it is not a contributing structure. More details are included on pages 16–17 of the National Register of Historic Places Nomination Form (1996).

Figure 104.—Hugo Sauer Nursery fertilizer shed (map area #13) facing northwest, 2019.

Figure 105.—Hugo Sauer Nursery fertilizer shed (map area #13) facing southwest, 2019.

Map Area #14: Pumphouse #2, built in 1935 (contributing)

The second pumphouse (Figs. 106, 107, 108, 109), sized at 12 by 20 feet, was constructed in 1935 to provide irrigation to the southern portion of the nursery. The diesel pumps have been replaced with an electric pump, and the pumphouse is still used to irrigate experimental plantings. It is a contributing structure. More details are included on pages 17–18 of the National Register of Historic Places Nomination Form (1996).

Figure 106.—Hugo Sauer Nursery pumphouse #2 (map area #14) facing northwest, 2019. The pipe on the ground to the left leads towards an inlet of Langley Lake where water was pumped from.

Figure 107.—Hugo Sauer Nursery pumphouse #2 (map area #14) facing southwest, 2019.

Figure 108.— Gabled roof and decorative features over the front door on the east side of the Hugo Sauer Nursery pumphouse #2 (map area #14), 2019.

Figure 109.—Interior of the Hugo Sauer Nursery pumphouse #2 (map area #14) facing north, 2019.

Map Area #15: Compost Pit #1, built in 1933 (contributing)

The first compost pit (Figs. 110, 111), located south of the field warehouse, was constructed in 1933 by G. Willard Jones, the first nurseryman. Measuring 49 by 13.5 feet with 6-foot walls, the open concrete structure was used to store a mix of peat, hardwood duff, and mineral fertilizers. It is a contributing structure. More details are included on page 16 of the National Register of Historic Places Nomination Form (1996).

Figure 110.—Hugo Sauer Nursery compost pit #1 (map area #15) on the left side of the road facing south, 2019.

Figure 111.—Hugo Sauer Nursery compost pit #1 (map area #15) facing southeast into the pit, 2019.

Map Area #16: Compost Pit #2, built in 1936 (contributing)

The second compost pit (Fig. 112), located just west of the field warehouse, was built in 1936. The concrete structure measures 60 feet by 16 feet, with 6-foot-high walls. It is a contributing structure. More details are included on page 15 of the National Register of Historic Places Nomination Form (1996).

Figure 112.—Hugo Sauer Nursery compost pit #2 (map area #16) facing northeast into the pit, 2019.

Map Area #17: Repair Shop/Warehouse #2, built in 1935 (contributing)

The Forest Service repair shop (Figs. 113, 114, 115, 116), measuring 32.25 by 70 feet, was constructed in 1935 to serve as an automotive repair shop and truck storage for the USDA Forest Service and nursery. It continues to serve this purpose today and is a contributing structure. Vandalism in 2019 resulted in the replacement of two of the glass paneled garage doors. More details are included on pages 4–6 of the National Register of Historic Places Nomination Form (1996).

Figure 113.—Hugo Sauer Nursery repair shop (map area #17) facing southeast, 2019.

Figure 114.—Hugo Sauer Nursery repair shop (map area #17) facing north, 2019.

Figure 115.—Hugo Sauer Nursery repair shop (map area #17) facing northwest 2019.

Figure 116.—Interior of the Hugo Sauer Nursery repair shop (map area #17) facing southeast, 2019.

Map Area #18: Oil House #1, built in 1936 (contributing)

Located east of the repair shop (map area #17), the 10-by-12-foot oil house (Figs. 117, 118) was constructed in 1936. It was originally used to store combustibles such as oils, paints, and gas. Today, it continues to be used for storage and is a contributing structure. More details are included on page 6 of the National Register of Historic Places Nomination Form (1996).

Figure 117.—Hugo Sauer Nursery oil house #1 (map area #18) facing northwest, 2019.

Figure 118.—Hugo Sauer Nursery oil house #1 (map area #18) facing southwest, 2019.

Map Area #19: Pumphouse #3, built in 1961 or 1962 (noncontributing)

The third pumphouse (Figs. 119, 120), measuring 8.4 by 8.4 feet, was constructed by the Forest Service in 1961 or 1962. Due to its construction date, it is not a contributing resource. More details are included on pages 11–12 of the National Register of Historic Places Nomination Form (1996).

Figure 119.—Hugo Sauer Nursery pumphouse #3 (map area #19) facing north, 2019.

Figure 120.—Hugo Sauer Nursery pumphouse #3 (map area #19) facing northwest, 2019.

Map Area #20: Hugo Sauer stone monument, erected in 1936 (contributing)

A monument dedicating the nursery to Hugo Sauer was unveiled on April 28, 1936, near the entrance. It consists of a bronze plaque attached to a 4.5-foot granite boulder (Figs. 121, 122). The monument still stands in its original location and is a contributing structure. More details are included on page 4 of the National Register of Historic Places Nomination Form (1996).

Figure 121.—Hugo Sauer Nursery stone monument (map area #20) facing south, 2019.

Figure 122.—Bronze plaque on the stone monument near the entrance of the Hugo Sauer Nursery (map area #20), 2019.

Irrigation System, installed 1931–1936 (contributing)

An overhead oscillating sprinkler system was constructed from 1931 to 1936 to water the nursery planting beds. This included 2,210 feet of underground galvanized pipe, 47 6-foot risers (Fig. 123), and portable overhead sprinkler pipes. Most of the underground portion of the system is intact and operational, along with many of the risers. This is a contributing resource. More details are included on pages 19–20 of the National Register of Historic Places Nomination Form (1996).

Figure 123.—Irrigation risers (left) along the edge of a nursery bed block at the Hugo Sauer Nursery, 2019. Most of the existing irrigation system is underground.

Nursery Landscape (contributing)

Specific landscape features necessary for nursery operation are also contributing resources for the National Register of Historic Places nomination. Features that are still observable on the Hugo Sauer Nursery site include planted cedar and spruce windbreaks (Fig. 124), a network of nursery roads to accommodate machinery (Fig. 125), recognizable planting blocks laid out along the east side of Langley Lake (for a water source), and a 400-foot-long concrete retaining wall, built in 1936 and 1937 (Figs. 126, 127), that provided equipment access to both the top floor and the bottom floor of warehouse #1 (map area #5), the seed extractory (map area #4), and cone shed #2/cold storage/packing plant (map area #7). More details are included on pages 20–22 of the National Register of Historic Places Nomination Form (1996).

Figure 124.—Gravel nursery road and dense cedar windbreaks between Hugo Sauer Nursery blocks C and D, 2019.

Figure 125.—Gravel road alongside Hugo Sauer Nursery block A, planted in hybrid poplar with a cedar windbreak behind, 2019.

Figure 126.—The start of the 400-foot-long concrete retaining wall behind warehouse #1 (map area #5), 2019.

Figure 127.—Segment of the 400-foot-long concrete retaining wall behind the seed storage shed (map area #6) and ending at cone shed #2/packing plant (map area #7), 2019.

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