The mission of the Arboretum is to conserve and restore Arboretum lands, advance restoration ecology, and foster the land ethic. As a land-based Center within the University of Wisconsin–Madison, the Arboretum gives high priority to land conservation and restoration. Our 75th anniversary year is a logical time to reflect, take stock, and summarize the status of Arboretum lands.

Outlying properties

The Arboretum administers 11 outlying properties that are noteworthy examples of natural ecosystems (Figure 1). Their total area is approximately 513 acres. They range in size from McKenna Pond (3.3 acres) to Finnerud Forest (147 acres, including the recently gifted 32-acre Annan parcel). The most distant is Finnerud Forest, which lies 215 miles north of the Arboretum, and the nearest is Raymond Road Prairie (Pasque Flower Hill), just 4 miles to the west of the core property.

The Arboretum has permanent stewardship responsibility for these lands, with the aim of preserving their native ecosystems and managing them for research and education. Eight of the properties are also designated State Natural Areas, which are overseen by the Ecosystem and Diversity Conservation Section of the Wisconsin Department of Natural Resources (DNR). The state’s interest is to ensure that high quality natural ecosystems are preserved.

The core property in Madison

The core property in Madison (Figure 2) differs from the outlying properties in that much of the 1200-acre site was historically disturbed by agriculture, and the lands were acquired primarily because they offered an opportunity to reconstruct natural communities.

The topography of the core property (Figure 3) dictates much of its environmental condition and its potential for restoration. The land slopes from southwest to northeast, with a maximum difference in elevation of 167 feet, with the highest elevations in the Grady Tract (1,011 ft) and lowest at the Gardner Marsh outlet (844 ft.).

Condition of core property lands

Historically, much of the precipitation that fell within the watershed would have infiltrated into the uplands. Today, however, most of those uplands are developed and ‘hardscaped,’ such that far more stormwater runoff flows into the Arboretum today than historically. Ten major inflow paths (Figure 4) carry an estimated 14 to 513 ac-ft per year each into the Arboretum’s lowlands, making historical wetlands wetter (e.g., Wingra Marsh, Gardner Marsh) and turning low-lying uplands into wetlands (e.g., central Curtis Prairie, Southeast Marsh, Lower Greene Prairie—all of which were historically cultivated farmlands).
The core property can be divided into four types of lands that are relevant to the Arboretum mission. These are **remnant ecosystems** (Noe Woods, Wingra Woods, Wingra Marsh, Gardner Marsh, eastern Curtis Prairie), **restorations** (Curtis Prairie, Greene Prairie, Grady Savanna, Gallistell Woods, Wingra Oak Savanna), **developed areas and human structures** (Longenecker Garden, Native Plant Garden, buildings, and stormwater facilities), and **‘other’** (Figure 5). These ‘other’ lands present opportunities for future restoration. Most are dominated by invasive alien plants, especially buckthorn (*Rhamnus cathartica, R. frangula*) and reed canary grass (*Phalaris arundinacea*).

**Restoration potential**

A soil survey map from 1939 (Figure 6) provides details that, together with stormwater inflows (Figure 4) can help establish the potential for restoring historical plant and animal communities.

A 1937 aerial photo (Figure 7) shows large areas of open (non-wooded) vegetation within the current Arboretum boundaries before the Arboretum became surrounded by residential and industrial land uses. The landscape both within and outside of the Arboretum boundaries contrasts sharply with recent imagery (Figure 8).

Additional changes to the Arboretum are the roads and trails (Figure 9), which make the lands accessible for research, education and public interpretation. Their effects on ecosystem fragmentation and habitat connectivity have not been quantified.

Obviously, the challenges of restoring the ‘other’ lands are greater today than they would have been in 1937, within a rural landscape, where large, hot fires were possible, when less runoff entered the Arboretum, and fewer people made use of the site. Changing climate is a further concern, with predictions that the future Wisconsin will be warmer in winter, have a longer growing season, and experience more storminess.

**Rethinking land care goals**

At age 75 years, the Arboretum needs to identify achievable restoration targets for its unrestored lands. Historical restorations focused on reducing invasive shrub cover in wooded areas. Sustaining these restorations is a continual task, requiring annual burning and weeding of invasive species.

Some historical restorations have fallen victim to environmental shifts. In Lower Greene Prairie, for example, a
Figure 2 (left). Arboretum plant communities.

Figure 3 (below). Topography, with highest elevations in pink and lowest in dark green.
Figure 4 (above). Ten significant inflows of urban stormwater. Orange arrows are scaled to indicate the volume of runoff estimated to flow in each. Yellow arrows show the main through-flow paths. Numbers are acre feet. One acre-foot = 46,560 cubic feet.

Figure 5 (right). Four types of lands. Remnants of native ecosystems total 35% of the 1200-acre core site; restoration areas 16%; developed areas 11% and ‘other’ lands 38%.
monotype of reed canary grass now covers 9 acres, overlapping some areas of historical prairie plantings, although the lowest areas might never have been planted (Figure 10). Reed canary grass has also formed a monotype where stormwater tends to accumulate within Curtis Prairie, just downstream from Curtis Pond.

Because stormwater inflows are a central cause of the reed canary grass invasion, it is essential to find ways to minimize stormwater impacts in Lower Greene Prairie and Curtis Prairie. Planning is underway to achieve those aims.

In Curtis Prairie, a native shrub, gray dogwood (*Cornus racemosa*), is increasing in area and cover, while displacing native prairie plantings. According to Ted Snyder’s 2002–3 survey, this shrub occupied 53% of the 1,011 square-meter plots distributed throughout the prairie. Matt McCaw’s study of the impacts of gray dogwood on prairie vegetation clearly shows reductions in herbaceous diversity and cover. Thus, the Botany 670 Class of 2008 developed an adaptive restoration approach to removing the shrub in order to replace native grasses and forbs.

Given the unknowns and difficulties imposed by today’s novel conditions and a future warmer climate, it might not be possible to restore either the ecosystem that once existed on any specific site or the historical assemblages of species that are native to the region. It might be necessary to aim to “keep all the parts” (as recommended by Aldo Leopold) somewhere in the Arboretum. Toward that aim, adaptive restoration approaches (Leaflet #4) are appropriate. Field experiments could test our ability to establish and sustain historical vs. novel assemblages of species. Natural, historically-present assemblages would be the first priority for testing.

Regardless of the Arboretum’s ability to restore naturally-occurring assemblages of species, the Arboretum should remain a site that facilitates efforts to achieve that goal. That is, its vision should be a place where innovative restoration research leads to global recognition.
Figure 7. The site of the Arboretum in 1937 with current property boundary superimposed in yellow (Orthorectified from scanned USDA aerial photo prints).

Figure 8. The Arboretum in 2008, with its current boundary superimposed in yellow (image source: USDA National Aerial Imagery Program).
Summary and recommendations

Outlying properties and the core Arboretum make up 1,713 acres of lands that vary in ecological condition. The 513 acres of remnant natural ecosystems that constitute the outlying properties are threatened by human encroachment, climate change, and invasive species.

The 1200-acre core property faces those same challenges as the outlying properties, plus the added constraints of long histories of agricultural and ongoing stormwater disturbances. All of these stressors make it difficult for managers to fulfill our mission of conservation and restoration.

Over a third of the land is yet to be restored, but current conditions differ substantially from historical conditions. Novel assemblages might be needed to vegetate novel environments.

Because stormwater inflows create opportunities for unwanted plant invasions, stormwater needs to be minimized and treated at the source—instead of accommodated within our finest and most long-standing restoration efforts. These are Greene and Curtis Prairies.

Restorations need continual maintenance to retain their intended qualities. More land-care personnel are needed to address both maintenance and conduct new restorations.

Figure 9. Soil types at the Arboretum mapped by the Natural Resources Conservation Service, with drainage classes interpreted by Kevin McSweeney and Mark Wegener, UW Arboretum.
Figure 10. Map of reed canary grass in Lower Green in Prairie in 2007. The monotype covers 9.8 acres, increased from 7.8 acres in 1998.