Planning Community Gardens: Soils and Slopes at the University of Wisconsin-Eau Claire Priory, West Central Wisconsin

Matthew Brueske, Hannah Adams, Nik Anderson, Dakota Dorn, Miles Hegg, Zach Hilgendorf, Alyssa Krantz, Cody Kroening, Sean Morrison, Patrick Thompson & Garry Running,

University of Wisconsin Eau Claire
Department of Geography & Anthropology

Abstract

In 2011 the University of Wisconsin-Eau Claire Foundation purchased the 112 acre property south of town known as the Priory. Previous research indicate loess-derived soils are thin or absent on the ridge top and thin and poorly developed on adjacent slopes due to severe, EuroAmerican agriculture-induced erosion and are not suitable for community gardens. The purpose of our research is to determine if lower slope and valley settings are appropriate for community gardens, based on: public accessibility, access to sunlight, well water availability, and appropriate soil fertility. Two soil profiles in toeslope and two in valley positions were described using Natural Resource Conservation Service methods. The other criteria were assessed using ESRI ArcGIS software (hillshade and slope aspect tools) and LIDAR data. Soil profiles observed formed in sandy bedrock and glacial out-wash-derived alluvium (valley) and slopewash (toeslope) overlain by silt (redeposited loess eroded from above). Degree of development (A-Bt-Bw-C, valley; and A-Bw-C toeslope) and presence of buried soils in some toeslope positions suggest erosion has been episodic throughout the Holocene, but particularly since the advent of EuroAmerican agriculture since the 1850s. We recommend community gardens be established where soils in toeslope and valley settings are most suitable (fertile silty solums over sandy alluvium), the water table is near the surface, and on sunny south-facing slopes near existing access roads.

Introduction & Methods

The purpose of our investigation, as the 2014 Geography 350 class, is to determine suitable locations for community gardens on the Priory. The Priory is within Eau Claire County, in the town of Washington, approximately three miles south of the University of Wisconsin-Eau Claire campus (Figure 1 and Figure 2).

Methods

- Initial exploration of the Priory was done on foot observing soil forming factors
- Soil pits and soil profiles described using National Resource Conservation Service methods (Soil Survey Division Staff, 1993)
- ESRI Geographic Information Software analysis

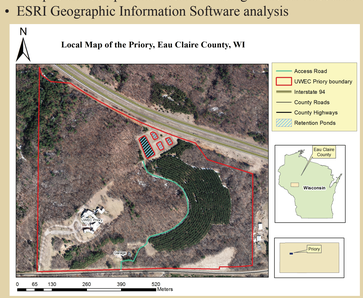

Figure 1. This map shows the Priory, located in northwestern quarter of Eau Claire County, Wisconsin.The Priory is bordered in the north by Interstate 94, by Priory Road in the south, and by private lots to the east and west.

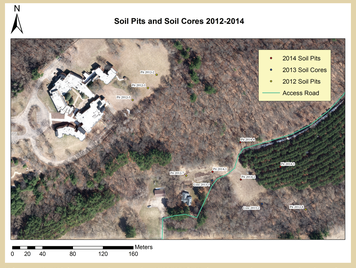

Figure 2. This map shows the UWEC Priory at a larger scale than in Figure 1 to show all of the soil pit locations, investigated in 2012, soil core locations from 2013, and soil pit locations from 2014.

Garden Suitability

A suitable community garden location is determined by physical traits of the environment as well as access by the public. Physical traits that enable successful gardening to occur are sunlight, slope aspect, public accessibility, and soil quality (Bradley, 1998).

Sunlight: *Low or no vegetation will allow for the maximum amount of sunlight to reach the garden*
Slope: *Slope steepness will limit possible community garden locations (Figure 3)*
Aspect: *Slope aspect will directly affect the amount of sunlight that is able to reach the garden*
Public Accessibility: *Easy access to people with a wide range of physical capabilities*
Soil Quality: *Rich in organic material to reduce the need of heavy fertilizer use*

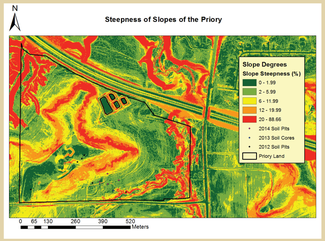

Figure 3. This map displays slope gradient in terms of percentage on the Priory. Pits 2014-1, 2, and 3 are located on slopes ranging from 2-6%, while Pit 2014-4 is located on 6-12% slopes. Many slopes adjacent to the ridge are too steep for gardens. Steep slopes lead to accelerated soil erosion.

Soil Forming Factors

Climate

The Priory is located within a Dfb climate; a humid continental, mild summer (based on the Köppen-Geiger climate classification system Goodes World Atlas, 2009). In Eau Claire the growing season is roughly from May to September. The probability of freeze/frost days in a yearly period, days at or below 0°C, is 46% or roughly 168 days (Wisconsin State Climatology Office, 2014).

Organisms

Much of the Priory is wooded. Commonly observed tree species found at the Priory are Jack Pine (Pinus banksiana), Boxelder (Acer negundo), Pin Oak (Quercus palustris), Aspen (Populus tremuloides), Silver Maple (Acer saccharinum), and Yellow Birch (Betula alleghaniensis).

Relief and Parent Material

Relief in the study area is controlled by a bedrock ridge sloping to the valley bottom. There are four main parent materials present in the study area: bedrock, loess (ridgetop), colluvium (slopes adjacent to ridge), and glaciofluvial sediments (valley bottoms) (Figure 4). Soils forming on the modern surface of the Priory landscape are silty-texture (loess or loess derived) or sandy texture (glaciofluvial) (Figure 5).

Time

Soils in the study area formed on a landscape that stabilized during post-glacial time (Schaetzl, Forman, and Attig, 2014). Soils in the valley are post-glacial and are characterized by thicker horizons, suggesting they have seen less erosion than soils on slope landscape positions (Tompsett et al., 2012). Soils near the Priory have experienced some disturbance in the form of Euro-American agricultural practices. However, there is evidence to support that soils near the Priory have also been affected by the distribution of loess (Tompsett, 2013; Schaetzl, Forman, and Attig, 2014). Loess is described as silt-sized sediment formed by the accumulation of windblown dust (Tompsett, 2013). Schaetzl, Forman, and Attig (2014) examine loess in bedrock uplands in the Chippewa River Basin, near the Priory.

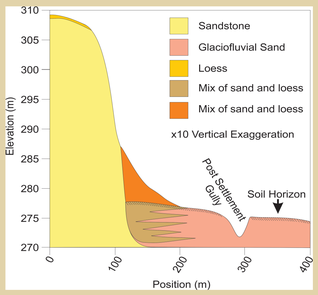

Figure 4. Bedrock in the study area is the Late Cambrian Mt. Simon Formation, a ridge forming sandstone. Sediments overlying the Mt. Simon-supported ridge include: late-Wisconsinan loess on the ridgetop, reworked loess mixed with older (late Pleistocene) reworked glacial outwash on adjacent slopes, reworked late-Wisconsinan loess and glacial outwash on lower slopes, and late-Wisconsinan glacial outwash in the valley. Valley aggradation and destabilization of ridgetops and slopes occurred simultaneously during the late-Wisconsinan. Slope stability and valley incision occurred during the Holocene until EuroAmerican agricultural practices lead to renewed slope destabilization, erosion, and redeposition of mixed colluvium along valley margins. In addition, gully formation on the valley floor occurred during the period of intense EuroAmerican agricultural landuse. Slopes have revegetated and stabilized since the 1960s when the study area was converted from farmland to a priory.

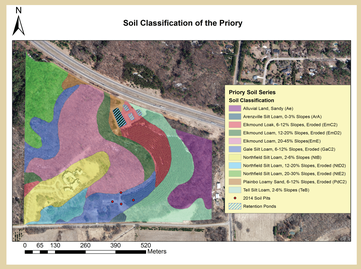

Figure 5. This figure shows the soil map unit present at the Priory (Thomas, D. D., P. D. Lindgren, G. N. Wing, 1977.). The 2014 soil pits are excavated in areas described as Gale, Arenzville, and Tell soil series.

Results

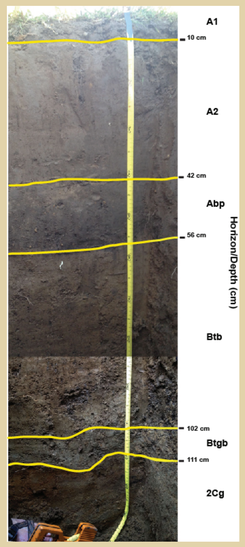

Figure 6. Photographs of soil profile 2014-1. Approximate horizon boundaries are shown by the yellow line. Horizon designations are on the right. This photo is a composite of two photos stitched at the 80 cm mark (Photograph by Travis Haas).

Table 1. Description of the soil profile exposed in soil pit 2014-1 (44.7645°N, 91.5092°W).

Horizon	Depth (cm)	Color	Texture	Structure, Consistence, Inclusions, Boundary
A1	0-10	10YR 3/3 Dark Brown	Silty Clay Loam	Weak, fine, granular; friable, non-sticky, non-plastic; roots: very fine, vertical, many; clasts: quartz arenite, equiaxial, medium pebbles, no orientation, few; clear smooth
A2	10-41	10YR 3/4 Dark Yellowish Brown	Clay Loam	Weak, very fine, sub-angular blocky; roots: very fine, vertical, common; clasts: quartz arenite, equiaxial, medium pebbles, no orientation, few; gradual smooth
Abp	41-56	10YR 3/2 Very Dark Grayish Brown	Silty Clay Loam	Moderate, fine, sub-angular blocky; roots: very fine, vertical, few; clasts: quartz arenite, equiaxial, fine pebbles, no orientation, few; abrupt smooth
Btb	56-102	10YR 4/4 Dark Yellowish Brown	Silty Clay	Moderate, very fine, sub-angular blocky; common, distinct clay film best expressed between 71 cm and 86 cm; firm, non-sticky, moderately plastic; roots: very fine, vertical, few; gradual smooth
Btgb	102-111	10YR 4/4 Dark Yellowish Brown Mottles: 5YR 4/6 Reddish Brown	Silty Clay	Moderate, very fine, sub-angular blocky; consistence not recorded; mottles: medium, distinct, blocky, common; abrupt smooth
2Cg	110+	7.5YR 4/6 Dark Brown	Sand	Single grain; loose

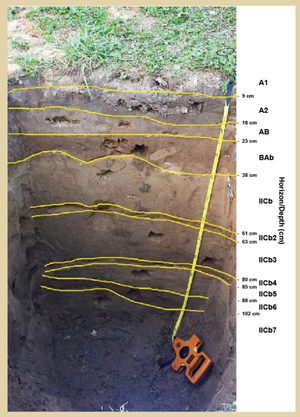

Figure 8. Photograph of soil profile 2014-2. Approximate horizon boundaries are shown by the yellow lines. Horizon designations are on the right (Photograph by Alyssa Krantz).

Table 2. Description of the soil profile exposed in soil pit 2014-2 (44°45'51.86"N, 91°30'31.12"W).

Horizon	Depth (cm)	Color	Texture	Structure, Consistence, Inclusions, Boundary
A1	0-9	10YR 3/3, Dark Brown	Silty Clay Loam	Strong, fine, platy; firm, non-sticky, non-plastic roots: fine, vertical, common; smooth abrupt
A2	9-18	10YR 3/2, Very Dark Grayish Brown	Sandy Clay Loam	Strong, medium, platy; firm, non-sticky non-plastic roots: fine, vertical, common; smooth abrupt
AB	18-23	10YR 4/4, Dark Yellowish Brown	Loamy Sand	Weak, course, platy; friable, non-sticky, non-plastic roots: very fine, vertical, few; smooth abrupt
BAb	23-38	10YR 5/4, Yellowish Brown	Sand	Weak medium, sub-angular blocky, very friable, slightly sticky; non-plastic; smooth abrupt
IICb	38-61	10YR 4/4, Dark Yellowish Brown	Sandy Loam	Weak, course, sub-angular to massive, friable, slightly sticky, non-plastic; smooth abrupt
IICb2	61-63	10YR 4/6, Dark Yellowish Brown	Loamy Sand	Weak, course, sub-angular blocky, friable, non-sticky, non-plastic; smooth abrupt
IICb3	63-80	10YR 4/4, Dark Yellowish Brown	Sandy Loam	Weak, course, sub-angular blocky, friable, non-sticky, non-plastic; smooth abrupt
IICb4	80-85	10YR 4/4, Dark Yellowish Brown	Sand	Weak, course, sub-angular blocky, friable, non-sticky, non-plastic; smooth abrupt
IICb5	85-88	10YR 4/4, Dark Yellowish Brown	Sand	Weak, course, sub-angular blocky, friable, non-sticky, non-plastic; smooth abrupt
IICb6	88-102	10YR 4/4, Dark Yellowish Brown	Sand	Weak, course, sub-angular blocky, friable, slightly sticky, non-plastic; broken abrupt
IICb7	102+	10YR 5/4, Yellowish Brown	Sand	Weak, course, sub-angular; friable, slightly sticky, non-plastic clasts: quartz arenite, medium pebbles, no orientation, few; smooth abrupt

Figure 9. This photograph shows typical vegetation surrounding Pit 2014-2 (Photograph taken by Alyssa Krantz).

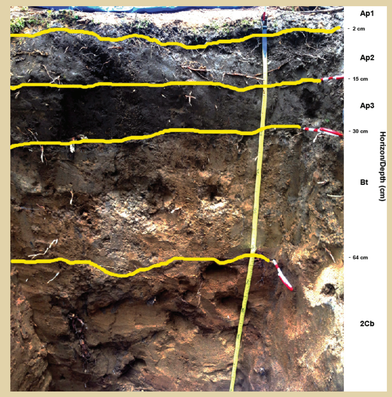

Figure 10. Photograph of soil profile 2014-3. Approximate horizon boundaries are shown by the yellow line. Horizon designations are on the right. This photo is a composite of two photos stitched at roughly 60 cm deep (Photograph by Matthew Brueske).

Table 3. Description of the soil profile exposed in soil pit 2014-3 (44.7646°N, 91.5080°W).

Horizon	Depth (cm)	Color	Texture	Structure, Consistence, Inclusions, Boundary
Ap1	0-2	10YR 3/2, Very Dark Grayish Brown	Silty Clay Loam	Moderate, fine, platy; very friable, non-sticky, moderately plastic. Roots: fine, vertical, common; abrupt smooth
Ap2	2-15	10YR 3/2, Very Dark Grayish Brown	Silty Clay Loam	Moderate, fine, platy; very friable, non-sticky, moderately plastic. Roots: medium, vertical, common; abrupt smooth
Ap3	15-30	10YR 3/2, Very Dark Grayish Brown	Silty Clay Loam	Moderate, fine, platy; very friable, non-sticky, moderately plastic. Roots: fine, vertical, few; abrupt smooth
Bt	30-64	10YR 4/4, Dark Yellowish Brown	Sandy Clay Loam	Moderate, coarse, fine sub-angular blocky; very firm, non-sticky, non-plastic; Roots: fine, vertical, few; clear smooth
2CB	64-140	10YR 5/6, Yellowish Brown	Loamy Sand	Weak, fine, granular; friable, slightly sticky, non-plastic; Roots: medium, vertical

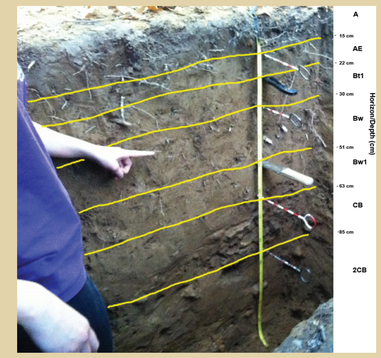

Figure 12. Photograph of soil profile 2014-4. Approximate horizon boundaries are shown by the yellow line. Horizon designations are on the right. (Photograph by Zach Hilgendorf).

Table 4. Description of the soil profile exposed in soil pit 2014-4 (44.7649°N, 91.5087°W).

Horizon	Depth (cm)	Color	Texture	Structure, Consistence, Inclusions, Boundary
A	0-15	10YR 4/2, Dark Grayish Brown	Sandy Clay Loam	Moderate, fine, sub-angular blocky; friable, non-sticky, moderately plastic roots: very fine to fine, vertical, many; clear smooth
AE	15-22	10YR 4/3, Brown	Sandy Clay Loam	Moderate, fine, sub-angular blocky; friable, non-sticky, moderately plastic roots: very fine to medium, vertical, common; clear smooth
Bt1	22-30	10YR 4/4, Dark Yellowish Brown	Sandy Clay Loam	Strong, fine to medium, sub-angular blocky; firm, non-sticky, very plastic, roots: fine, vertical, few; gradual smooth
Bw1	30-51	10YR 5/4, Yellowish Brown	Sandy Clay	Strong, medium, sub-angular blocky; firm, non-sticky, very plastic; roots: medium, horizontal, few; gradual smooth
Bw2	51-63	10YR 4/6, Dark Yellowish Brown	Sandy Clay Loam	Strong, very fine-fine, angular blocky; firm, non-sticky, very plastic; roots: fine to medium, no orientation, few; clear smooth
CB	63-85	10YR 4/4, Dark Yellowish Brown	Sand	Weak, fine to medium, sub-angular blocky; friable, non-sticky, non-plastic; clasts: quartz arenite, channers, sub-horizontal, many; clear smooth
2CB	85-130+	10YR 5/6, Yellowish Brown	Sand	Weak, fine to medium, sub-angular blocky to massive; very friable, non-sticky, non-plastic; clasts: quartz arenite, equiaxial, cobbles, no orientation, few

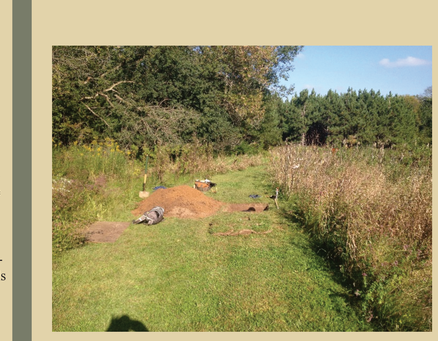

Figure 7. This photograph shows typical vegetation surrounding Pit 2014-1 (Photograph by Travis Haas).

Figure 11. This photograph shows typical vegetation surrounding Pit 2014-3 (Photograph taken by Matthew Brueske).

Figure 13. This photograph shows typical vegetation surrounding Pit 2014-4 (Photograph taken by Samantha Peterson).

Conclusion

We recommend the area surrounding soil profile 2014-1 for the community garden location because: We recommend starting small with a garden that can be irrigated with rainwater collected from the garage roof.
Slope- low slope/ reduced soil erosion parking
Aspect- south facing, sunny
Accesiblity- adjacent to trail access and parking
Soil Quality- well-developed A horizons, silt-loam texture holds water well, well-drained

Next steps to improve land use and restoration efforts must focus on the biota of the Priory. We suggest beginning an assessment of the pine plantation to determine if it can be removed. Future researchers could conduct a cost-benefit analysis of removing the plantation. If the cost and sales even out, or if money could be made by selling the timber, we think it is a good idea to sell the wood. Removal of the plantation will open that part of the Priory for a garden. A biological assessment of the plants and animals living at the Priory will also be beneficial. Biology students at the University of Wisconsin-Eau Claire could conduct the assessment as part of their course work, or as an undergraduate research project. Biologists could also conduct invasive species removal projects. Invasive buckthorn is ubiquitous at the Priory, particularly beneath mixed hard-

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