Expanding LREC Flora: Using GIS to identify upstream sources of plants established at Litzsinger Road Ecology Center.

Morgan Hooker

Litzsinger Road Ecology Center

Summer 2026

Introduction

The Deer Creek watershed is a subwatershed (Hydrologic Unit Code (HUC) 12) of the Prairie duPont Creek-Mississippi River (HUC 10) watershed. It has an area of ~95.8 km^2, includes 23 municipalities, and flows for ~17.3 kilometers from Creve Coeur to the River des Peres. The three major streams in the Deer Creek watershed are Deer Creek, Twomile Creek, and Black Creek (Missouri Department of Natural Resources, 2023). The Litzsinger Road Ecology Center (LREC) lies near the midpoint of Deer Creek, with ~30 km^2 of upstream area (Figure 2). This large area has likely been a source of many plants established at LREC, particularly species that utilize water as a dispersal mechanism. By using Geographic Information Systems (GIS), upstream natural areas were identified as ideal for surveying through land cover classification and suitability modeling.

Many factors drive the establishment and spread of plant species, including land use and cover, climatic variables, soil characteristics, biotic interactions, hydrology, and more. This study focuses on land cover, soil attributes, and hydrology as potential predictors of suitable habitat. The land use in Deer Creek watershed is predominantly developed land, approximately 99%, although the development levels vary. According to the Missouri Department of Natural Resources, most of the area is in low-intensity development, 56.9%, while high- and medium-intensity development is 6.4% and 9.1%, respectively. Developed open space, such as golf courses, parks, and large lawns, is around 27%, and the remaining 1% is made up of forest, wetland, and open water (Missouri Department of Natural Resources, 2023). Additionally, impervious surfaces make up a sizable portion of land cover within the Deer Creek watershed, totaling around 33% (Missouri Department of Natural Resources, 2023).

While much of Deer Creek watershed is now developed, prior to European settlement, about half of what is now the Saint Louis area, including Deer Creek watershed, was tallgrass prairie, which was home to prairie chickens, badgers, and bison. Eventually the land was converted to row crops, but before that the land had deep fertile soils that supported diverse communities of flora and fauna (Craft, 2017). Deer Creek watershed lies within the alluvial floodplain of the Mississippi and was subject to the repeated flooding and glaciation events that are a part of Missouri's geological history (Gregory, 2020). This allowed for the development of the loamy, loess- and alluvium-derived soils that are common in Missouri (USDA Web Soil Survey). Limestone is also especially common in this area (Gregory, 2020), which can influence soil characteristics, particularly by improving drainage and maintaining an alkaline to neutral pH (USDA Web Soil Survey).

The aim of this study is to identify upstream natural areas within the Deer Creek watershed that are suitable for three species of interest: Japanese stiltgrass (*Microstegium vimineum*), Chinese fountain grass (*Cenchrus purpurascens*), and rattlesnake root (*Nabalus crepidineus*). Once these areas were identified, presence/absence surveys were conducted for the species of interest as well as other native, invasive, and non-native species. The overall goal is to document the species composition of the areas upstream from LREC with the hopes of helping land managers be more prepared for the establishment and spread of problematic or rare species and inform restoration and management practices.

Methods

The GIS program ArcGIS Pro was used for all spatial analysis methods.

Watershed Delineation

A 2026 digital elevation map (DEM) with a spatial resolution of 1 ARC second, downloaded from USGS TNM Download, was used to delineate the Deer Creek Watershed. The DEM data layer was run through the Fill tool to minimize holes and peaks within the raster layer. The filled DEM was then put through the Flow Direction tool, and the output flow direction raster served as the input for the Flow Accumulation tool. The pour point of the watershed was found by placing a point feature at the raster cell with the highest flow accumulation using the Snap Pour Point tool (Figure 1). This point is also where the watershed empties into the River des Peres. The output layers from the Flow Direction, Flow Accumulation, and Snap Pour Point tools were used as the inputs for the Delineate Watershed tool. Once run, the tool produced a polygon feature layer of the Deer Creek watershed boundary (Figure 2).

Landcover Classification

Data layers from Landsat 8-9 Levels 1 and 2 were downloaded from the USGS Earth Explorer. Bands 2, 3, 4, 5, and 8 were used in the analysis. The individual band data layers were combined into one raster layer using the Composite Bands tool. This combined raster layer was used to calculate the Normalized Difference Vegetation Index (NDVI) using the NDVI raster function (Figure 3). Band 4 (Red) was used for the Visible Band ID ,and Band 5 (Near Infrared) was used for the Infrared Band ID. The output NDVI raster layer was then used in the unsupervised landcover classification analysis. Using the ISO Cluster Unsupervised Classification tool, ten landcover classes were identified. These classes were manually combined into five groups: pavement or water, residential, natural-residential, natural, and buildings, using the Reclassify tool (Figure 4). The classifications were visually cross-referenced with aerial imagery. Natural areas were manually identified and marked with a created feature layer (Figure 5).

Suitability Modeling

Suitability models were created for three species of interest, *M. vimineum*, *C. purpurascens*, and *N. crepidineus*, using the Suitability Modeler analysis tool (Ramirez, 2025). Three ranked raster layers, landcover class, soil characteristics, and stream distance, were used to create each suitability model. Each raster layer was ranked based on characteristics specific to each species. The ranking was based on a 1-5 system where 1 is least suitable, and 5 is most suitable. For the landcover class rasters, natural and natural-residential classes were ranked 5 and 4, respectively, for *C. purpurascens* and *N. crepidineus,* while natural-residential was also ranked 5 for *M. vimineum,* and the remaining three classes were ranked 1 (Figure 6). Soil characteristics varied for each species and were ranked accordingly (Table 1 and Figure 6). The stream distance raster was ranked the same for all three species, with cells within 50 meters ranked 5 and the rest ranked 1 (Figure 6). To create the final models, the rankings from each raster layer in each cell were added to create a range of 3-15. The final suitability raster layers for each species were exported from the tool (Figure 7, 8, 9).

Surveying

Survey areas were chosen based on level of suitability, amount of natural area, and accessibility. Known stream access points were obtained from the Cooperative Stream Investigation Project (Missouri Department of Natural Resources, 2025). Three sites were surveyed (Figure 10) using presence-absence surveys with the purpose of identifying and documenting species of interest, in addition to abundant or rare native, invasive, and non-native species.

Results

Landcover Classification

The majority of the land cover in the Deer Creek watershed was classified as natural-residential with 33.2 km^2 (34.6%), followed closely by residential with 31.4 km^2 (32.7%). Natural areas were 15.9 km^2, approximately 16.6% of the total area of Deer Creek watershed. The remaining areas were made up of pavement and water, and buildings, 13.0 and 2.6 km^2, respectively. Calculations were done in ArcGIS Pro in the WGS 1984 UTM Zone 15 coordinate system.

Suitability Modeling

The suitability models yielded varying distributions for each species. To compare the suitability ratings within and between each species, the ratings were separated into groups of four: high (12-15), medium (7,8,10,11), and low (3-6), with the suitability rating of 9 viewed as an average suitability or having a neutral suitability rating (Table 2). For *M. vimineum*, areas of high suitability accounted for 23.6 km^2 or 25.3% of the total area of Deer Creek watershed. Medium suitability areas accounted for the largest area, 48.3 km^2 (51.7%), while low suitability areas were the smallest, 17.6 km^2 (18.8%) (Figure 7). *C. purpurascens* had the most medium suitable area, 47.8 km^2 (51.2%), followed by low suitability, 21.2 km^2 (22.7%), and then high suitability areas, 19.2 km^2 (20.6%) (Figure 8). In comparison to the invasive species models, *N. crepidineus* had the smallest amount of high suitability areas, 17.4 (18.6%), Medium suitability areas also accounted for the largest area within the *N. crepidineus* model, 42.8 (45.8%), followed by low suitability with 21.3 km^2 (22.8%) (Figure 9). All three models yielded the most medium suitability areas, 34.6%, 50.0%, and 44.6% respectively, but *M. vimineum* had 34.1% more high suitability areas than low, while *C. purpurascens* and *N. crepidineus* had 10.4% and 22.4% more low suitability areas than high.

Surveying

Between the three survey areas, two of the species of interest were identified, *M. vimineum* and *C. purpurascens. N. crepidineus* was not identified at any of the surveyed areas despite two of the areas having medium to high suitability. *M. vimineum* was identified at two of the sites surveyed, sites 1 and 3. *C. purpurascens* was only identified at site 3. (Table 3, 4, and 5). No species of interest were identified at site 2. However, many invasive and non-native species currently present at LREC were found at all three sites. Native species in high abundance or matrix or conservative (Coefficient of Conservatism (C Value) of 4-10) species were also documented at each site. (Table 3).

M. vimineum was found on upper banks along the creek edge in both sites 1 and 3. These areas were open, heavily vegetated, and under full to medium sun. It was in patches scattered throughout areas of around 25-100 m^2. At site 1, the *M. vimineum* filled in the spaces between plants, including *Phyla lanceolata, Acalypha rhomboidea, Perilla frutescens, and Bidens frondosa* (Figure 11). At site 3, the *M. vimineum* was constrained by the goldenrod (*Solidago altissima* and *Solidago gigantea*) that mostly blanketed the clearing (Figure 12). There was a variety of associated plants observed at both sites, but *Leersia spp.* and *Fraxinus spp.* were present at both observations of *M. vimineum.*

C. purpurascens was found in a drainage area or feeder creek off the main stream surrounded by a powerline utility easement. The substrate was mostly riprap before gradually turning back into a shallow creek. The area was drained when the survey was conducted but likely fills during rains or seasonally. *C. purpurascens* was along the creek edge in full sun to medium shade (Figure 13). Six clumps were identified within an area of around 25 m^2. Associated species identified at site 3 include *Persicaria hydropyperoides, Humulus scandens, Asclepias syriaca, Symphyotrichum lanceolatum,* and *Leersia oryzoides*.

Discussion

The suitability models for the three species of interest were generally consistent with the characteristics of the species. *M. vimineum* and *C. purpurascens* are invasive species and often considered generalist species capable of establishing and spreading in a variety of conditions, particularly *M. vimineum* (National Oceanic and Atmospheric Administration, 2026; Plants for a Future, 2026). *N. crepidineus,* however, is a rare native species with a C Value of 9, that is sensitive to environmental conditions and changes (Wisconsin Department of Natural Resources, n.d.), and observable individuals are not common during most of the year (Yatskievych, 2006). The suitability model for *M. vimineum* showed the largest amount of highly suitable area, with the majority (57.4%) of Deer Creek watershed having neutral or better suitability. Also, *M. vimineum* was found at two of the three sites, further illustrating *M. vimineum's* ability to survive in a wider variety of conditions. Suitability for *C. purpurascens* was more even between low and high suitability, with the majority of the area being medium or neutral (56.7%). Since *C. purpurascens* was found at one of the survey sites, this also generally fits with the model's predictions. Finally, the majority of Deer Creek watershed had neutral or worse suitability for *N. crepidineus.* Given the low likelihood of its presence within the survey sites, its absence during field surveys is consistent with the model's predictions. However, the high to medium suitability areas for all three species were more concentrated around the streams. This can be partially attributed to the high suitability scores assigned to stream-adjacent areas, but it also stems from the strong tendency of all three species to establish and spread along riparian corridors. Soil attributes, such as moisture class, drainage, and taxonomy, together with water-mediated seed dispersal, likely contribute to this pattern. In addition to the high rankings for natural and natural-residential areas, these processes led to more of the highly suitable areas falling within the potential survey sites. It should be noted that with the constraints of the study, only three sites were able to be surveyed. Increasing the number of survey sites, particularly in areas with higher suitability, would likely increase the probability of detecting the target species.

The varying suitability between the survey sites had an effect on the presence or absence of the target species. While the survey sites were chosen for their high suitability, amount of natural cover, and accessibility, site 2 had lower suitability compared to sites 1 and 3. This is reflected in the presence of *M. vimineum* and *C. purpurascens* at sites 1 and 3 but not at site 2. It is important to consider that there are many other factors that have an effect on the distribution and establishment success of plant species that were not included in the suitability analysis due to time and computational constraints. This limitation will have likely affected the accuracy of the suitability maps and may explain why the species of interest were not found even in areas that were identified as highly suitable. Furthermore, although *N. crepidineus* was not identified during the surveys, it is not evident that the species is not present because the basal rosettes produced in the spring often die out during the summer, when the surveys were conducted, and only a small portion of plants flower each year (Yatskievych, 2006).

While the suitability models were created for specific species, many other invasive, non-native, and native species were documented during the surveys. (Table 3). There were significant populations of many of the invasive species established at LREC, most notably wintercreeper (*Euonymus fortunei*), honeysuckle (*Lonicera spp.*), beefsteak plant (*Perilla frutescens*), and sweet clover (*Melilotus alba* and *Melilotus officinalis*), which were present at all sites. This indicates that there will likely be consistent propagules of these species coming from upstream and feeding LREC populations long-term. However, the surveyed sites were not overrun by invasive and non-native species and supported relatively diverse communities of native species, some of which were conservative species (C value of 7 and 8). The communities at the survey sites were similar to LREC communities. Many of the abundant species present at the survey sites are also abundant at LREC, indicating that the LREC communities are likely reinforced by the upstream communities. Furthermore, the species with higher C values found at the survey sites, such as leafy pondweed (*Potamogeton foliosus*) and wild hydrangea (*Hydrangea arborescens*), which appeared to be naturally occurring, show that they have the potential to establish at LREC due to it having similar conditions and suitability as the surveyed sites. It should also be noted that not all species present were documented, so diversity metrics and direct comparisons are unlikely to yield accurate conclusions.

Conclusion

There are many native, invasive, and non-native species present upstream from LREC, and having an idea of the composition of these areas can highlight the potential positives and negatives of the incoming plant propagules. This can help direct management practices and inform decision-making going forward as to what species to prioritize for removal and what species to look out for. Additionally, despite the decline in ideal natural areas, the native species in Deer Creek watershed are adapting to the urban-driven changes and persisting even among the invasive species. This likely means that not only is LREC receiving invasive propagules, but it could also be supported by the upstream native communities, as it may be supporting the surrounding areas.

Furthermore, studies like this can be overlooked because heavily developed regions impose significant research limitations and introduce urban-driven stressors that complicate the study of local wildlife. Yet, studying ecosystems and ecological processes in urban contexts is becoming even more important as development increases and natural areas decline. These types of studies are important for documenting species composition to track changes over time, understand what species are more resilient to urban conditions and what species are struggling, and to help predict what future ecosystems might look like. Much of the suitability modeling in urban areas is based around identifying plants that are more resilient for use in urban settings. However, some studies have used suitability modeling to identify potential restoration sites within areas with high levels of development and urban land cover (White & Fennessy, 2005). As the conditions of the world change, ecology and restoration must adapt, and studying the ecological dynamics within urban areas is key.

Appendix

Data Sources

Source	Use	Link
USGS TNM Download	Digital Elevation Map - 2026 1 ARC second	https://apps.nationalmap.gov/downloader/
Web soil survey USDA	Soil shapefile and soil description, moisture class, taxonomy, drainage, and pH data	https://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx
USGS Earth Explorer	Landsat Data: Landsat 8-9, Level 1 and 2 - Bands 2-5 and 8	https://earthexplorer.usgs.gov/
Missouri Department of Natural Resources GIS	Stream layer - Rivers and Streams	https://gis-modnr.opendata.arcgis.com/maps/49695c22aa5d495a8dd38621e61d8981/explore?location=38.631063%2C-90.380683%2C13
Missouri Spatial Data Information Service	Watershed Boundaries	https://data-msdis.opendata.arcgis.com/datasets/5e7719fa1e4e4645af35f3296cb75589_0/explore?location=37.213276%2C-86.792129%2C4

Table 1. Rankings of soil units within Deer Creek Watershed based on soil attributes for each target species.

Map_unit_symbol	Map_unit_name	Soil_Class	Orders	Suborder	Great Group	Drainage_class	pH	Microstegium Ranking	Cenchrus Ranking	Nabalus Ranking
60001	Menfro silt loam, 5 to 9 percent slopes, eroded	Udic	Alfisols	Udalfs	Hapludalfs	Well drained	5.5	5	4	3
60003	Menfro silt loam, 9 to 14 percent slopes, eroded	Udic	Alfisols	Udalfs	Hapludalfs	Well drained	5.5	5	4	3
60005	Menfro silt loam, 20 to 45 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Well drained	5.5	5	4	3
60025	Urban land-Harvester complex, 2 to 9 percent slopes	NA	NA	NA	NA	NA	NA	1	1	1
60030	Winfield silt loam, 5 to 9 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	6.6	4	5	5
60031	Winfield silt loam, 9 to 14 percent slopes, eroded	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	5.6	4	4	3
60055	Winfield silt loam, 2 to 5 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	5.6	4	4	3
60089	Crider-Menfro silt loams, 14 to 30 percent slopes	Udic	Alfisols	Udalfs	Paleudalfs	Well drained	7	3	3	5
60090	Crider-Menfro silt loams, 5 to 14 percent slopes	Udic	Alfisols	Udalfs	Paleudalfs	Well drained	7	3	3	5
60136	Iva silt loam, 1 to 3 percent slopes	Aquic	Alfisols	Aqualfs	Endoaqual	Somewhat poorly drained	6.2	1	2	1
60138	Iva-Urban land complex, 1 to 3 percent slopes	Aquic	Alfisols	Aqualfs	Endoaqual	Somewhat poorly drained	6.2	1	2	1
60165	Menfro silt loam, 2 to 5 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	well drained	5.5	5	4	3
60171	Menfro silt loam, karst, 2 to 14 percent slopes, eroded	Udic	Alfisols	Udalfs	Hapludalfs	well drained	5.5	5	4	3
60190	Menfro-Urban land complex, 5 to 9 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	well drained	7.2	3	5	5
60191	Menfro-Urban land complex, 9 to 20 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	well drained	5.5	5	4	3
60222	Urban land-Harvester complex, 0 to 2 percent slopes	NA	NA	NA	NA	NA	NA	1	1	1
60223	Urban land-Harvester complex, 9 to 20 percent slopes	NA	NA	NA	NA	NA	NA	1	1	1
60224	Urban land-Harvester complex, karst, 2 to 9 percent slopes	Udic	NA	NA	NA	Moderately well drained	7	2	1	4
60225	Urban land-Harvester complex, karst, 9 to 20 percent slopes	Udic	NA	NA	NA	Moderately well drained	7	2	1	4
60250	Winfield-Urban land complex, 2 to 5 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	6.6	4	4	4
60251	Winfield-Urban land complex, 5 to 9 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	6.6	4	4	4
60252	Winfield-Urban land complex, 9 to 20 percent slopes	Udic	Alfisols	Udalfs	Hapludalfs	Moderately well drained	6.6	4	4	4
66024	Wilbur silt loam, 0 to 2 percent slopes, frequently flooded	Udic	Inceptisols	Udepts	Eutrudepts	Moderately well drained	6.5	4	3	4
68001	Fishpot-Urban land-Freeburg complex, 0 to 2 percent slopes, frequently flooded	Udic	Entisols	Orthents	Udorthents	Somewhat poorly drained	5.7	3	2	1
68015	Fishpot-Urban land-Freeburg complex, 0 to 3 percent slopes	Udic	Entisols	Orthents	Udorthents	Somewhat poorly drained	5.7	3	2	1
68025	Urban land-Fishpot complex, 0 to 3 percent slopes	NA	NA	NA	NA	NA	NA	1	1	1
99000	Pits, quarry	NA	NA	NA	NA	NA	NA	1	1	1
99001	Water	NA	NA	NA	NA	NA	NA	1	1	1
99023	Urban land, upland, 0 to 5 percent slopes	NA	NA	NA	NA	NA	NA	1	1	1

Table 2. Area (km^2), cumulative totals, and percentage of total area for the target species within each suitability rating group.

	M. vimineum	*C. purpurascens*	*N. crepidineus*
Suitability Rating	km^2	km^2	km^2
3	10.936861	11.394884	11.254776
4	1.38665	1.238687	0
5	0.584027	0.002599	3.890056
6	4.649027	8.607304	6.156405
7	19.481024	17.642745	19.318808
8	2.700659	4.000024	5.161142
9	3.864475	5.082757	11.943849
10	14.025998	17.92844	11.219845
11	12.106185	8.274743	7.053269
12	1.243131	3.073607	9.844741
13	5.791107	10.293897	1.703743
14	15.45687	5.480376	5.347755
15	1.153857	0.366278	0.491333
Total	93.379871	93.386341	93.385722
Sum - Low	17.556565	21.243474	21.301237
Sum - Medium	48.313866	47.845952	42.753064
Sum - High	23.644965	19.214158	17.387572
Percent - Low	18.8012307	22.74794555	22.80995054
Percent - Medium	51.7390584	51.23442196	45.781157
Percent - High	25.3212654	20.57491256	18.6190904
Percent - Neutral	4.13844543	5.442719937	12.78980206

Table 3. Identified species at survey site 1. Not a complete list of all species present.

Site 1 - Malcolm Terrace Park Access

Category	Common Name	Scientific Name	C Value
Native	Annual fleabane	Erigeron annuus	1
Native	Jumpseed	Persicaria virginiana	1
Native	Black-eyed Susan	Rudbeckia hirta	1
Native	White snakeroot	Ageratina altissima	2
Native	White avens	Geum canadense	2
Native	Pokeweed	Phytolacca americana	2
Native	White vervain	Verbena urticifolia	2
Native	Stickseed	Hackelia virginiana	3
Native	Spotted St. John's-wort	Hypericum punctatum	3
Native	Jewelweed	Impatiens capensis	3
Native	Indian tobacco	Lobelia inflata	3
Native	Virginia creeper	Parthenocissus quinquefolia	3
Native	Dotted smartweed	Persicaria punctata	3
Native	Frogfruit	Phyla lanceolata	3
Native	Sycamore	Platanus occidentalis	3
Native	Brown-eyed Susan	Rudbeckia triloba	3
Native	Figwort	Scrophularia marilandica	3
Native	Winter grape	Vitis cinerea	3
Native	Hog peanut	Amphicarpaea bracteata	4
Native	False nettle	Boehmeria cylindrica	4
Native	Meadow sedge	Carex granularis	4
Native	Black Walnut	Juglans nigra	4
Native	White grass	Leersia virginica	4
Native	Smartweed	Persicaria hydropyperoides	4
Native	American elm	Ulmus americana	4
Native	Sharpwing monkeyflower	Mimulus alatus	5
Native	Leafy pondweed	Potamogeton foliosus	6
Native	Wild hydrangea	Hydrangea arborescens	7
Native	Overcup oak	Quercus lyrata	8
Invasive/Introduced	Mimosa / Persian silk tree	Albizia julibrissin	*
Invasive/Introduced	Asiatic dayflower	Commelina communis	*
Invasive/Introduced	Wintercreeper	Euonymus fortunei	*
Invasive/Introduced	Creeping Charlie	Glechoma hederacea	*
Invasive/Introduced	Honeysuckle	Lonicera spp.	*
Invasive/Introduced	White sweet clover	Melilotus albus	*
Invasive/Introduced	Yellow sweetclover	Melilotus officinalis	*
Invasive/Introduced	Japanese stiltgrass	Microstegium vimineum	*
Invasive/Introduced	Beefsteak plant	Perilla frutescens	*
Invasive/Introduced	Mock strawberry	Potentilla indica	*
Invasive/Introduced	Multiflora rose	Rosa multiflora	*
Invasive/Introduced	Dandelion	Taraxacum officinale	*
Invasive/Introduced	Red clover	Trifolium pratense	*
Invasive/Introduced	Mullein	Verbascum thapsus	*

Table 4. Identified species at survey site 2. Not a complete list of all species present.

Site 2 - Denny Creek Access

Category	Common Name	Scientific Name	C Value
Native	Common evening primrose	Oenothera biennis	0
Native	Aunt Lucy	Ellisia nyctelea	1
Native	Annual fleabane	Erigeron annuus	1
Native	Black-eyed Susan	Rudbeckia hirta	1
Native	Frank's sedge	Carex frankii	2
Native	Squash	Cucurbita pepo	2
Native	Pokeweed	Phytolacca americana	2
Native	Elderberry	Sambucus canadensis	2
Native	False grape	Ampelopsis cordata	3
Native	Mistflower	Conoclinium coelestinum	3
Native	Jewelweed	Impatiens capensis	3
Native	Obi Wan Conobea	Leucospora multifida	3
Native	Indian tobacco	Lobelia inflata	3
Native	Creeping primrose willow	Ludwigia peploides	3
Native	Frogfruit	Phyla lanceolata	3
Native	Creek oats	Chasmanthium latifolium	4
Native	Duckweed	Lemna minor	4
Native	Moonseed	Menispermum canadense	4
Native	Switchgrass	Panicum virgatum	4
Native	Smartweed	Persicaria hydropyperoides	4
Native	Wild golden glow	Rudbeckia laciniata	4
Native	Carolina willow	Salix caroliniana	4
Native	Purple coneflower	Echinacea purpurea	5
Native	Virginia wild rye	Elymus virginicus	5
Native	Woolly rosemallow	Hibiscus lasiocarpos	5
Native	Sharpwing monkeyflower	Mimulus alatus	5
Native	Leafy pondweed	Potamogeton foliosus	6
Native	Goldenrod	Solidago spp.	
Invasive/Introduced	Tree of heaven	Ailanthus altissima	*
Invasive/Introduced	Mimosa / Persian silk tree	Albizia julibrissin	*
Invasive/Introduced	Chicory	Cichorium intybus	*
Invasive/Introduced	Asiatic dayflower	Commelina communis	*
Invasive/Introduced	Queen Anne's lace	Daucus carota	*
Invasive/Introduced	Wintercreeper	Euonymus fortunei	*
Invasive/Introduced	Rose of Sharon	Hibiscus syriacus	*
Invasive/Introduced	Korean bush clover	Kummerowia stipulacea	*
Invasive/Introduced	Japanese bush clover	Kummerowia striata	*
Invasive/Introduced	Bush clover	Lespedeza capitata	*
Invasive/Introduced	Honeysuckle	Lonicera spp.	*
Invasive/Introduced	White sweet clover	Melilotus albus	*
Invasive/Introduced	Yellow sweetclover	Melilotus officinalis	*
Invasive/Introduced	Beefsteak plant	Perilla frutescens	*
Invasive/Introduced	Multiflora rose	Rosa multiflora	*
Invasive/Introduced	Johnson grass	Sorghum halepense	*

Table 5. Identified species at survey site 3. Not a complete list of all species present.

Site 3 - Immediately Upstream from LREC

Category	Common name	Scientific Name	C Value
Native	Common ragweed	Ambrosia artemisiifolia	0
Native	Common milkweed	Asclepias syriaca	0
Native	Box elder	Acer negundo	1
Native	Jumpseed	Persicaria virginiana	1
Native	Tall goldenrod	Solidago altissima	1
Native	Green ash	Fraxinus pennsylvanica	2
Native	White vervain	Verbena urticifolia	2
Native	Rice cutgrass	Leersia oryzoides	3
Native	Hairy-flowered lens grass	Paspalum pubiflorum	3
Native	Dotted smartweed	Persicaria punctata	3
Native	Frogfruit	Phyla lanceolata	3
Native	Sycamore	Platanus occidentalis	3
Native	Late goldenrod	Solidago gigantea	3
Native	Panicled aster	Symphyotrichum lanceolatum	3
Native	White grass	Leersia virginica	4
Native	Smartweed	Persicaria hydropyperoides	4
Native	Wingstem	Verbesina alternifolia	4
Native	Buttonweed	Diodia virginiana	5
Native	Sharpwing monkeyflower	Mimulus alatus	5
Native	Early wild rye	Elymus macgregorii	6
Invasive/Introduced	Japanese beautyberry	Callicarpa dichotoma	*
Invasive/Introduced	Chinese fountain grass	Cenchrus purpurascens	*
Invasive/Introduced	Chicory	Cichorium intybus	*
Invasive/Introduced	Asiatic dayflower	Commelina communis	*
Invasive/Introduced	Creeping dayflower	Commelina diffusa	*
Invasive/Introduced	Bindweed	Convolvulus arvensis	*
Invasive/Introduced	Wintercreeper	Euonymus fortunei	*
Invasive/Introduced	Japanese hops	Humulus scandens	*
Invasive/Introduced	Bush clover	Lespedeza capitata	*
Invasive/Introduced	Tall fescue	Lolium arundinaceum	*
Invasive/Introduced	Honeysuckle	Lonicera spp.	*
Invasive/Introduced	White sweet clover	Melilotus albus	*
Invasive/Introduced	Yellow sweetclover	Melilotus officinalis	*
Invasive/Introduced	Japanese stiltgrass	Microstegium vimineum	*
Invasive/Introduced	Beefsteak plant	Perilla frutescens	*
Invasive/Introduced	Creeping yellow cress	Rorippa sylvestris	*
Invasive/Introduced	Johnson grass	Sorghum halepense	*

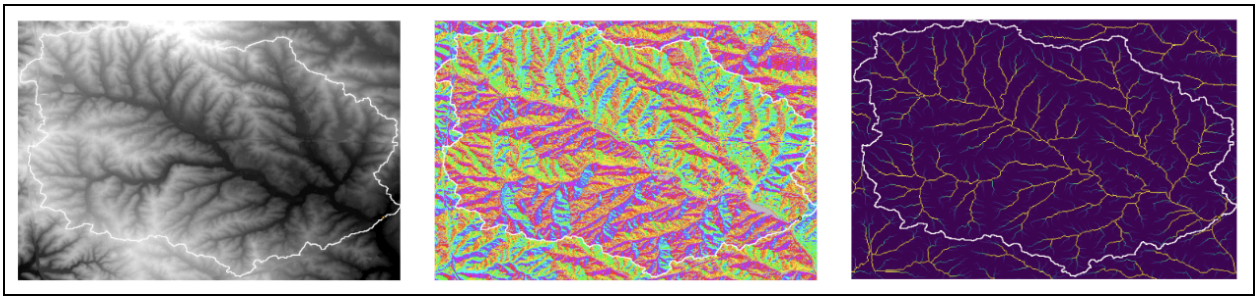

Figure 1. Watershed delineation processing raster layers. From left to right, filled DEM, flow direction, and flow accumulation with pour point and final watershed boundary overlaid.

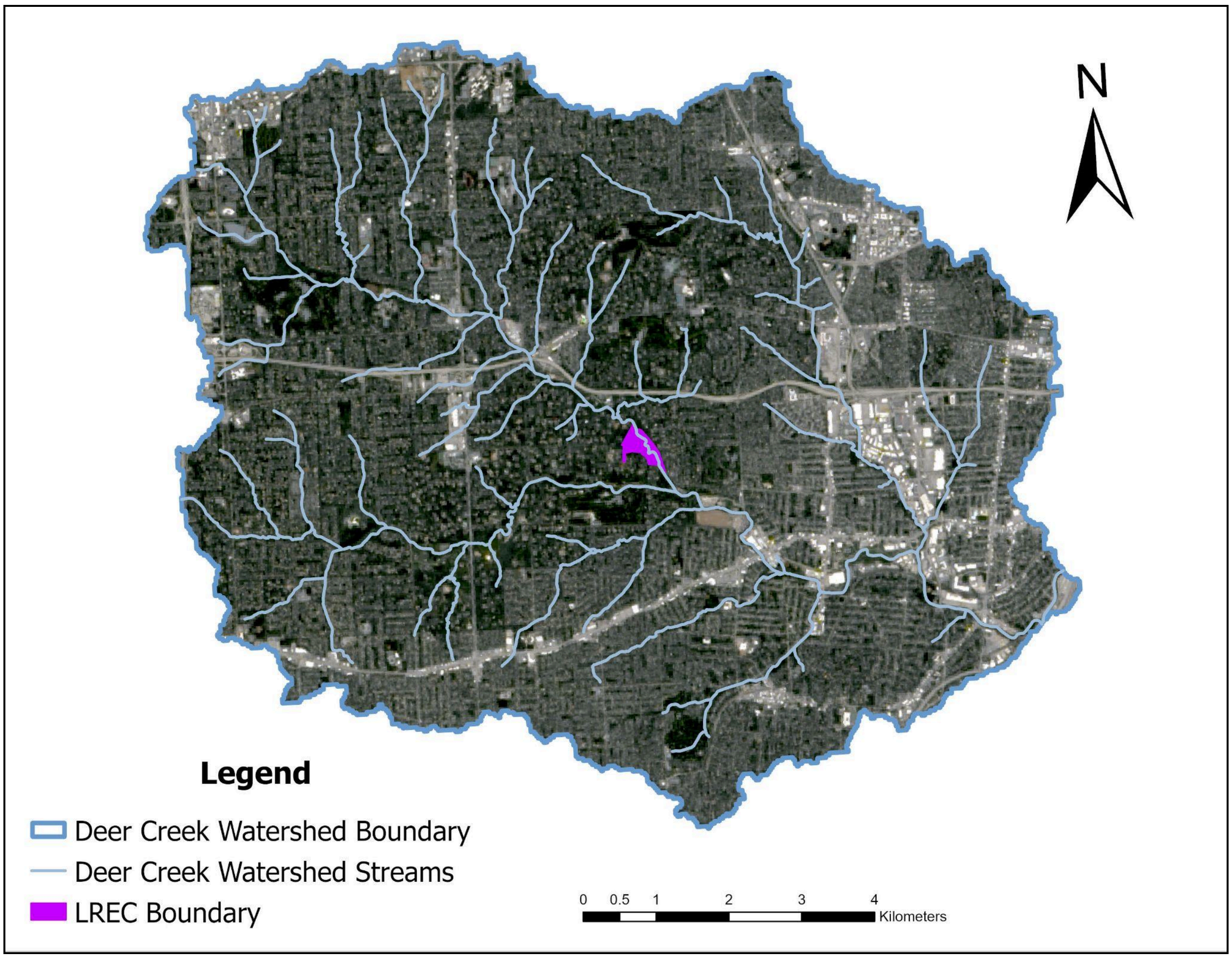

Figure 2. Deer Creek watershed with streams and Litzsinger Road Ecology Center boundary overlaid onto aerial imagery.

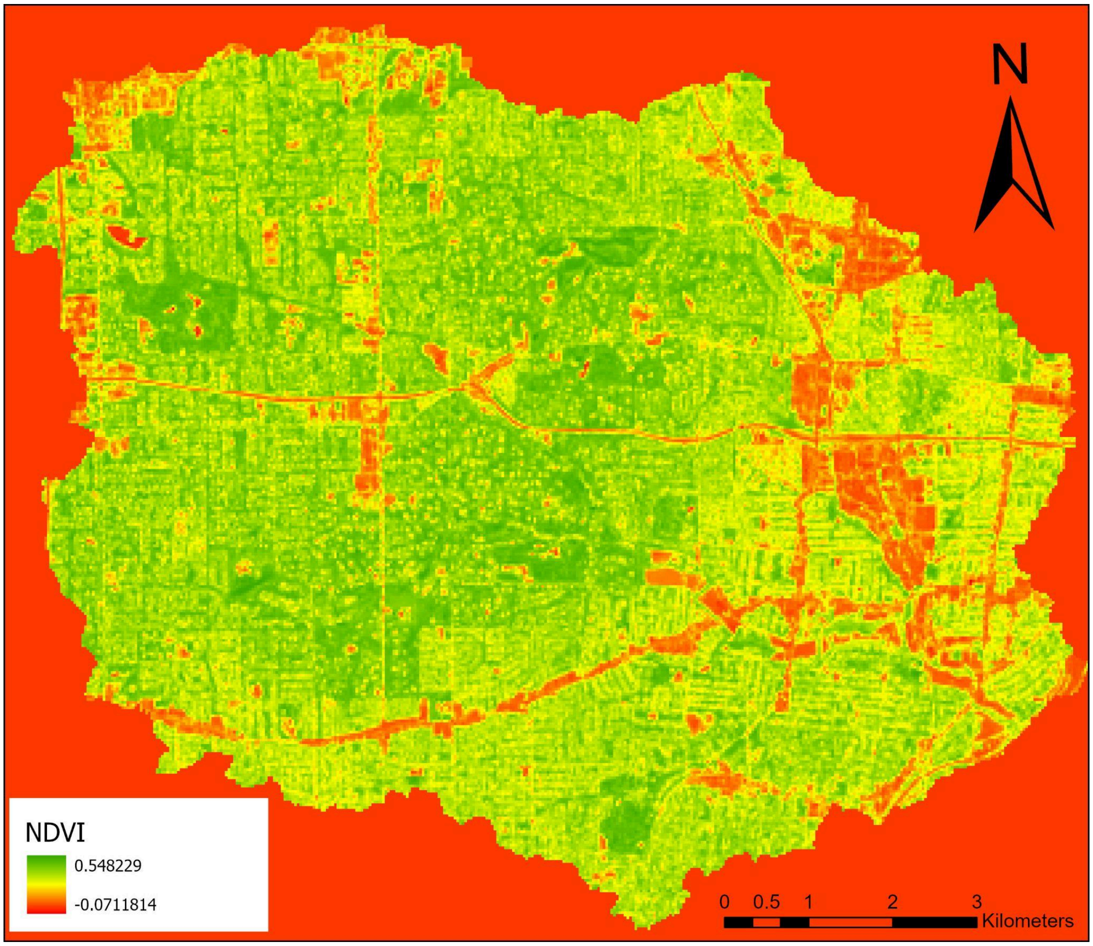

Figure 3. Deer Creek watershed with NDVI reflectance.

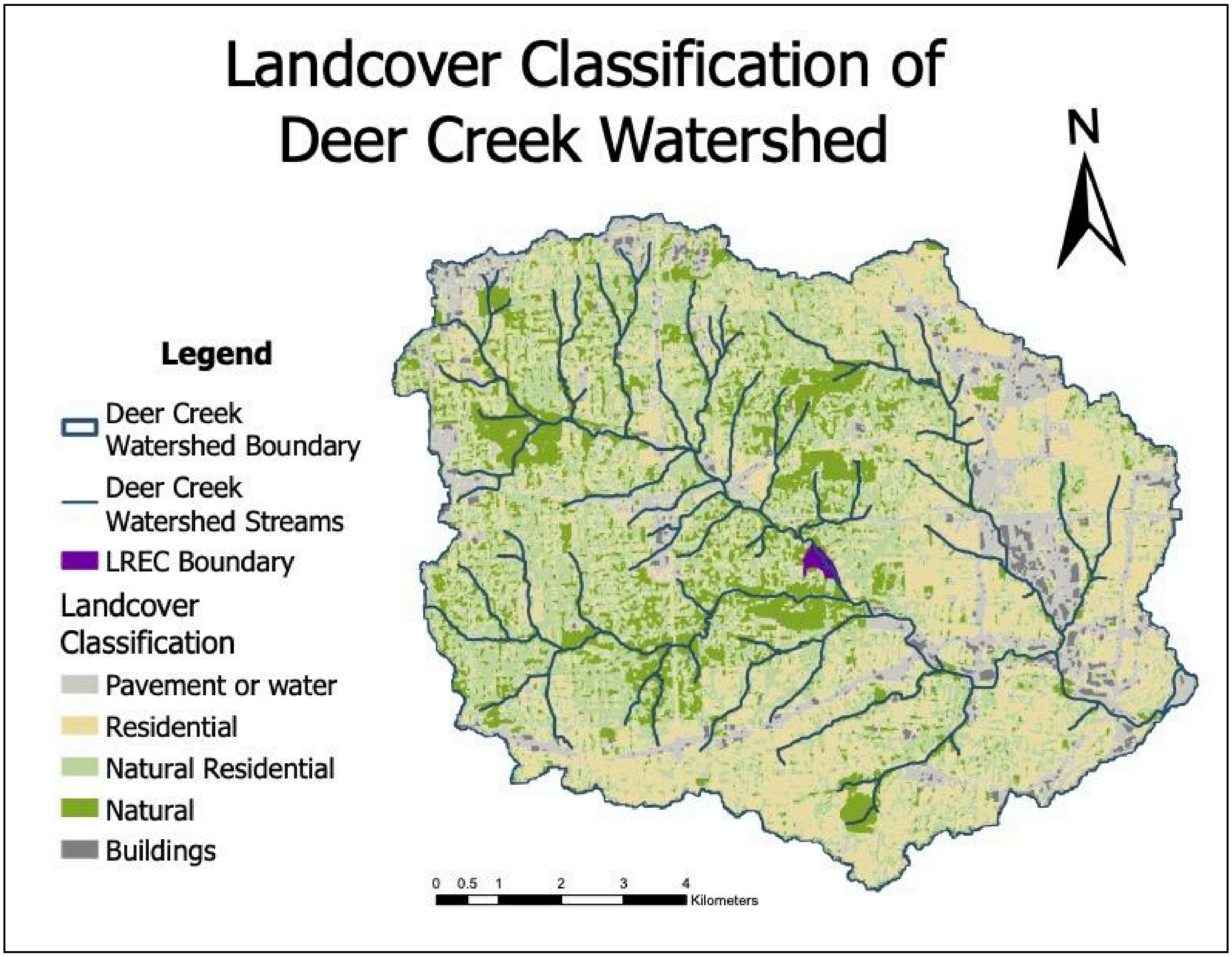

Figure 4. Unsupervised landcover classification of Deer Creek Watershed.

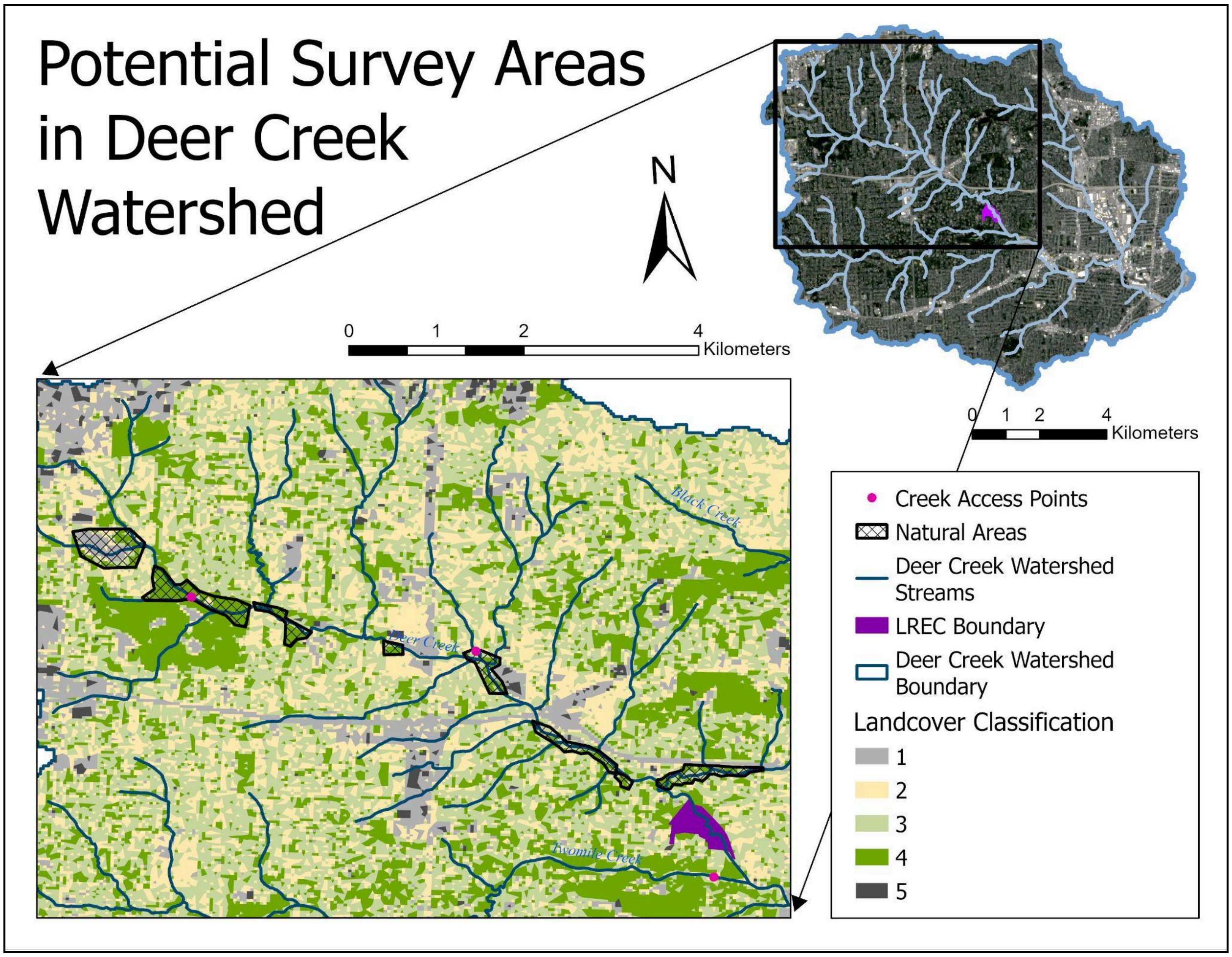

Figure 5. Natural areas upstream of Litzsinger Road Ecology Center identified as potential survey sites.

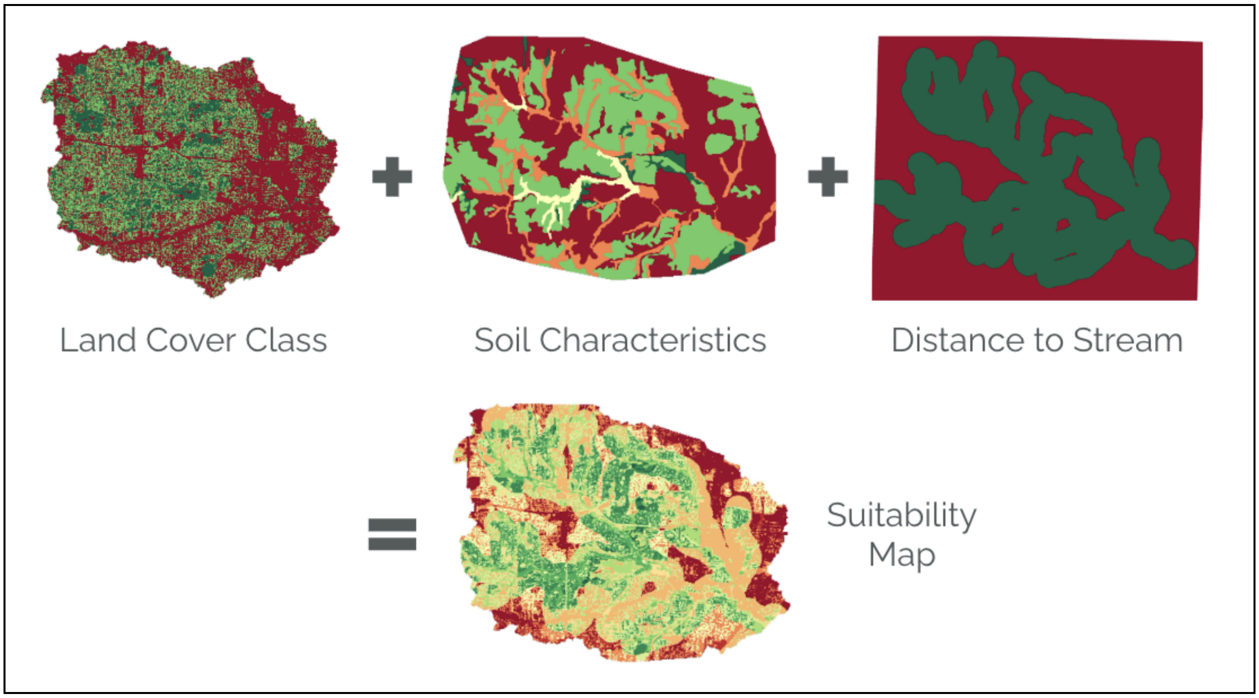

Figure 6. Examples of ranked raster layers used to create suitability models.

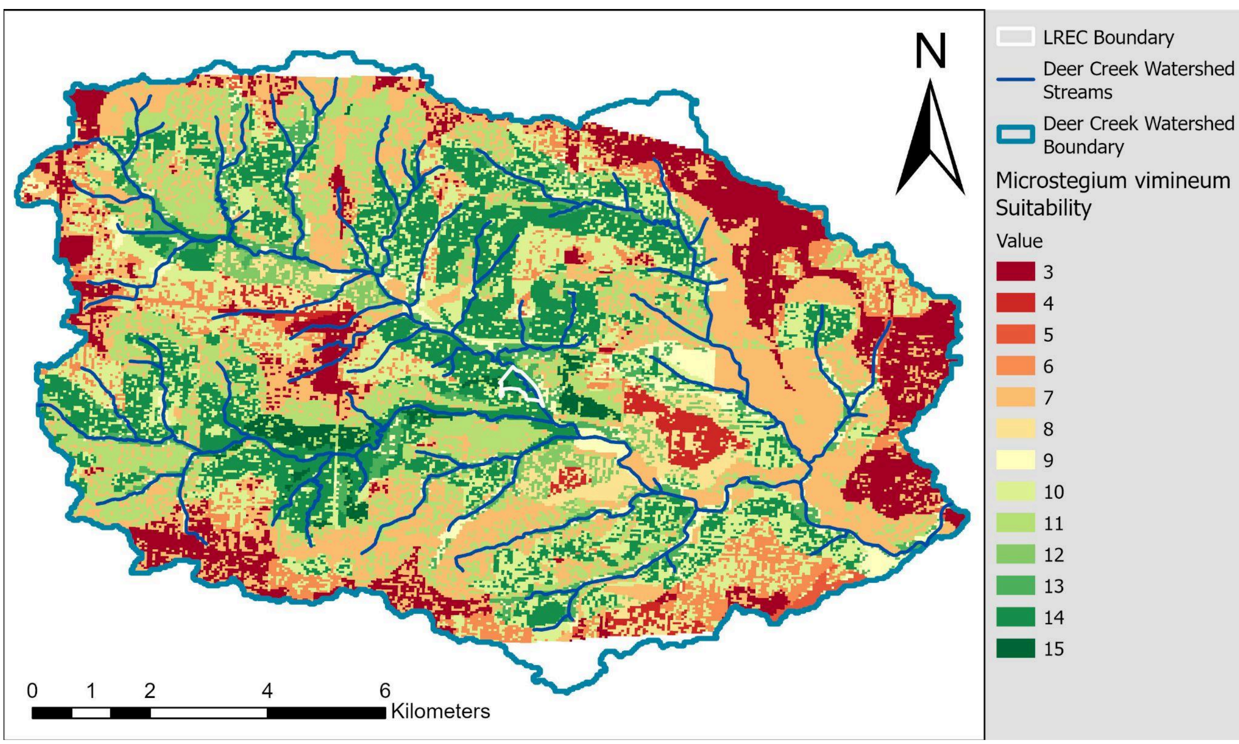

Figure 7. *Microstegium vimineum* suitability model of Deer Creek Watershed.

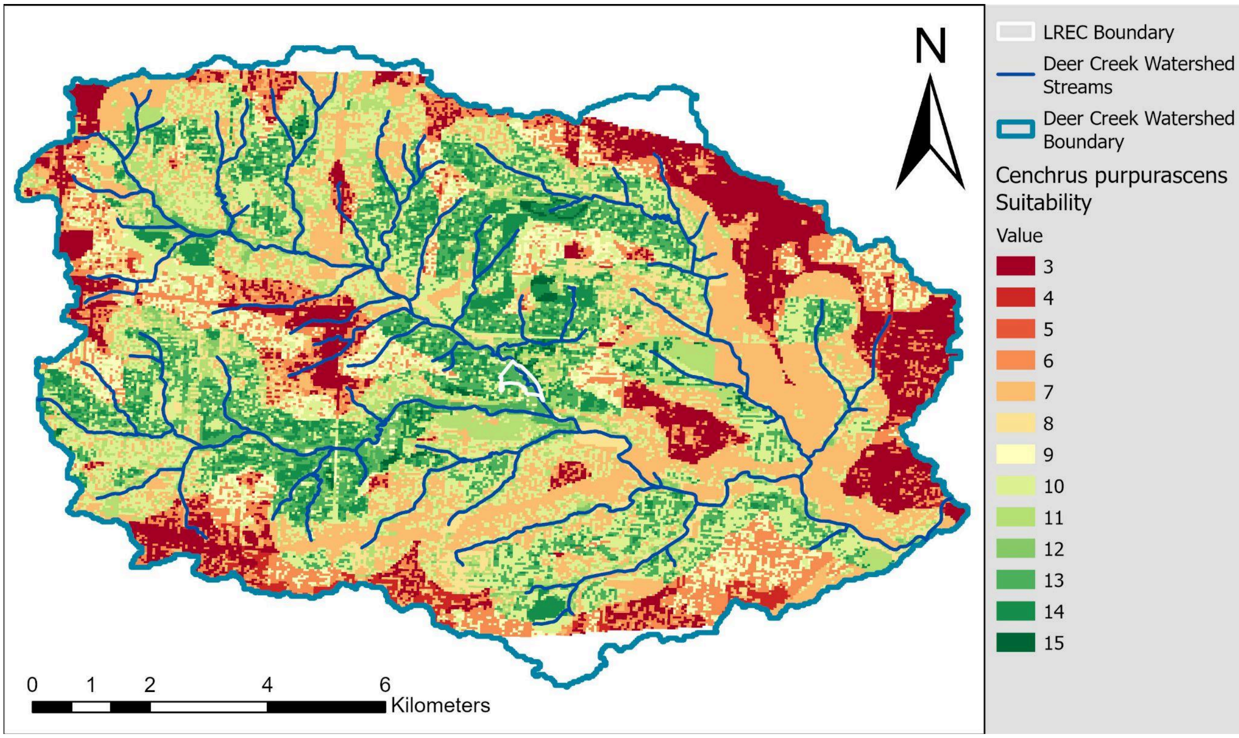

Figure 8. *Cenchrus purpurascens* suitability model of Deer Creek Watershed.

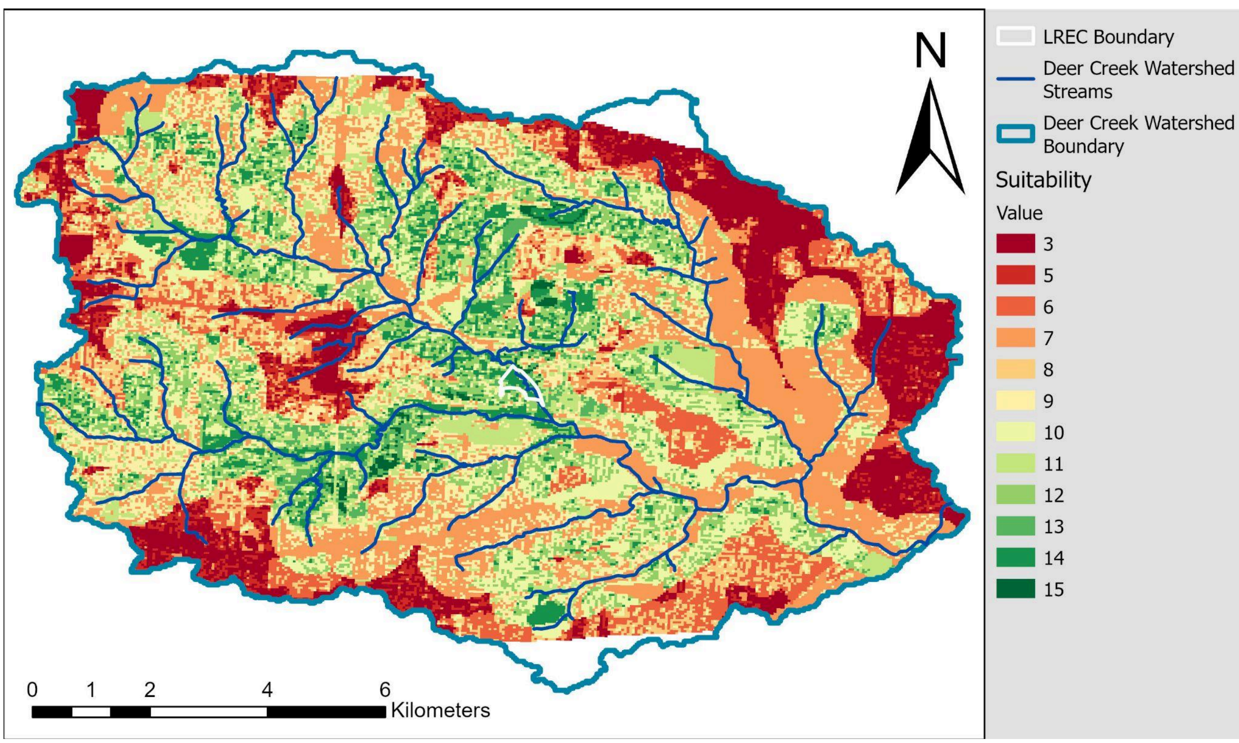

Figure 9. *Nabalus crepidineus* suitability model of Deer Creek Watershed.

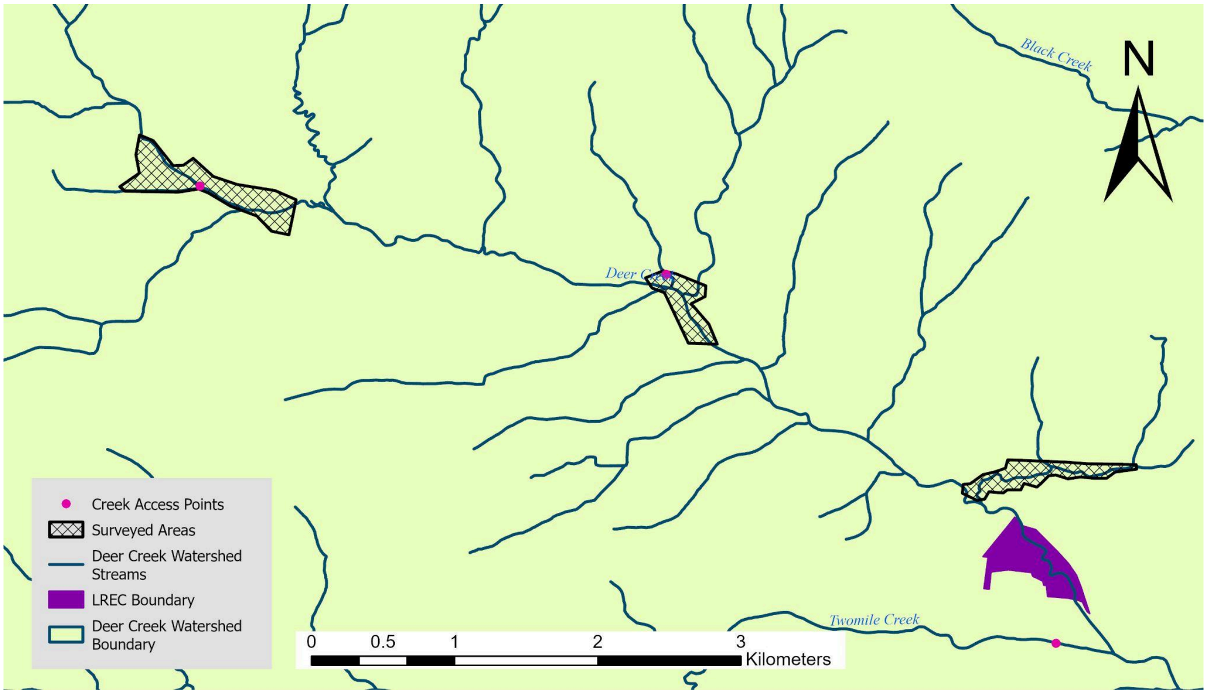

Figure 10. Surveyed Areas Upstream of Litsinger Road Ecology Center. From left to right, site 1, site 2, site 3.

Figure 11. *Microstegium vimineum* observed at site 1. *Microstegium vimineum* and associated plants (left) and area where it was found (right).

Figure 12. *Microstegium vimineum* observed at site 3. *Microstegium vimineum* and associated plants (left) and area where it was found (right).

Figure 13. *Cenchrus purpurascens* observed at site 3. *Cenchrus purpurascens* (left) and area where it was found (right).

References

Adelaide Plant Co. (2026). *Cenchrus purpurascens "Nafray" fountain grass.* https://adelaideplantco.com.au/products/cenchrus-purpurascens-nafray

Craft, P. (2017). *An American Original Landscape.* Missouri Department of Conservation. https://mdc.mo.gov/blogs/discover-nature-notes/american-original-landscape

Deer Creek Watershed Alliance. (n.d.). *Deer Creek watershed*. https://www.deercreekalliance.org/watershed

Ladd, D. and J.R. Thomas. (2015). Ecological checklist of the Missouri flora for Floristic Quality Assessment. *Phytoneuron* 2015-12: 1–274. ISSN 2153 733X. https://www.phytoneuron.net/2015Phytoneuron/12PhytoN-MissouriFlora.pdf

The Missouri Department of Natural Resources. (2025). Cooperative Stream Investigation Project Plan for Deer Creek Watershed. [Paper Copy]

The Missouri Department of Natural Resources. (2023). *Deer Creek Watershed Management Plan Summary.* https://dnr.mo.gov/document-search/deer-creek-watershed-management-plan-summary-pub3070/pub3070

NASA. (2025). *Spectral bands and Applications - NASA Science*. https://science.nasa.gov/mission/landsat/spectral-bands-and-applications/

National Oceanic and Atmospheric Administration and U.S. Geological Survey. (2026). *Species profile - Microstegium vimineum*. https://nas.er.usgs.gov/queries/GreatLakes/FactSheet.aspx?Species_ID=3585

National Parks Singapore. (2026). *Cenchrus purpurascens.* https://www.nparks.gov.sg/florafaunaweb/flora/3/3/3333

The Nature Conservancy and USDA. (n.d.). *SPECIES: Priorities for Micromanagement of Rare Plants and Alien Plants*. Western Kentucky University Green River Reserve. https://www.wku.edu/greenriver/grp-field-notes-4.pdf

North Carolina Extension. (n.d.). *Cenchrus alopecuroides.* https://plants.ces.ncsu.edu/plants/cenchrus-alopecuroides/

Plants for a Future. (2026). *Cenchrus Fountain Grass PFAF Plant Database.* https://pfaf.org/user/Plant.aspx?LatinName=Cenchrus.

Renzi, R. (2023). *Species Status Assessment*. New York Natural Heritage Program. https://www.nynhp.org/documents/255/nabalus-crepidineus-ssa-2025-draft.pdf

Ramirez, K. (2025). *Suitability Modeling for Quercus dumosa.* Huntington Botanical Gardens. https://esri-uc-2026-huntingtonbg.hub.arcgis.com/apps/1f01fe0e6c534ec69521473bfabb256e/explore

Gregory, H. (2020). *Geology of Missouri.* Washington University in Saint Louis. https://sites.wustl.edu/monh/geology-of-missouri/

White, D, and S. Fennessy. (2005). Modeling the suitability of wetland restoration potential at the watershed scale. *Ecological Engineering 24* (4), 359-377. https://doi.org/10.1016/j.ecoleng.2005.01.012.

Wisconsin Department of Natural Resources. (n.d.). *Nodding Rattlesnake-root (Prenanthes crepidinea).* https://apps.dnr.wi.gov/biodiversity/Home/detail/plants/8705

Yatskievych, G. (2006). *Steyermark's Flora of Missouri* (Vol. 2). Missouri Botanical Garden Press.