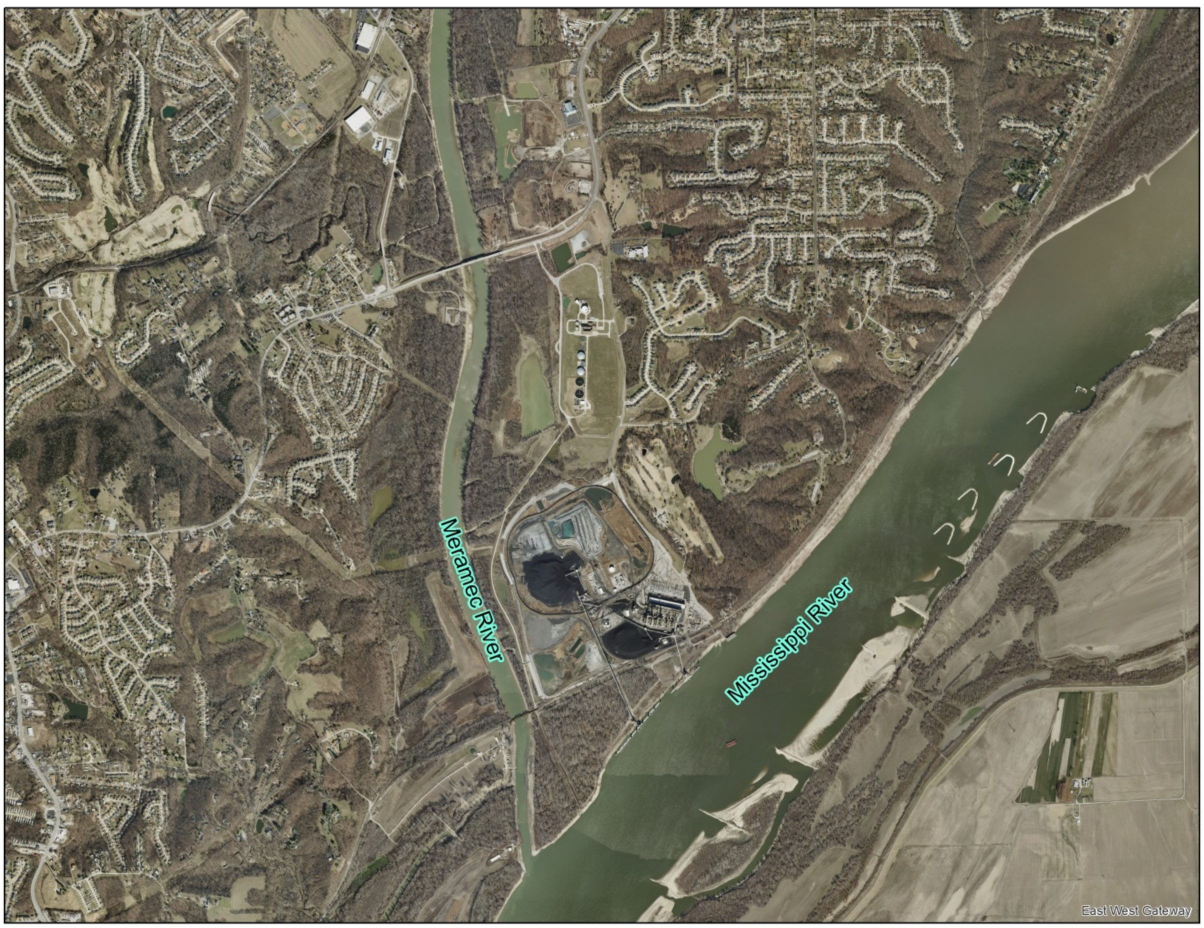
FY 2015 MoRAP / Ecological Approach to Infrastructure Development: Meramec River Floodplain and Upper Silver Creek Watershed Mapping & Importance Ranking

Final Report for FY2015

June 2015



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Missouri Resource Assessment Partnership Contact:
David Diamond
Missouri Resource Assessment Partnership
School of Natural Resources
University of Missouri
4200 New Haven Road
Columbia, MO 65201
diamondd@missouri.edu; 573/876-1862

East-West Gateway Contact:
Mary Grace Lewandowski
Director of Community Planning
East-West Gateway Council of Governments
One Memorial Drive, Suite 1600
St. Louis, MO 63102

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Summary

This document provides a summary of work done to map and rank wetlands for the Meramec River bottomland in Missouri and the Upper Silver Creek Watershed in Illinois. Both areas are within the St. Louis region. LiDAR elevation and vegetation height information and air photos were key data sets used for mapping. Other data sets, including satellite remote sensing land cover information, national agricultural statistics survey (NASS), national wetlands inventory (NWI), and soil survey geographic dataset (SSURGO) were also used. Water regime (flooding and wetness) assignments for both study areas were more tenuous than for the Missouri and Mississippi River bottomlands done earlier. This is because the levee and water control systems for these areas tend to be less well-developed versus the big river floodplains, so more areas that are not locally low-lying and occur over soils that are not poorly drained still flood seasonally or temporarily. Therefore, the land position and soil drainage regime variables that we used to define water regime were less certain in providing an index to water regime. More field-collected data would help address uncertainties. Nonetheless, we ranked contiguous semi-natural vegetation patches that included both wetland and upland vegetation, so any mistakes made in water regime calls were mitigated.

Together, wetland and upland natural and semi-natural vegetation made up more than half of the area of the Meramec River bottomlands, and in combination with water make up two-thirds of the area. The river passes through a more urbanized landscape along the lower reach and extends into rural parts of the St. Louis region upstream. Significant habitat for native biota occurs on these bottomlands, and the level of connectivity of semi-natural habitat serves as an important movement corridor for some species. The Upper Silver Creek study area was roughly 4.5 times as large as the Meramec River study area, but contained about the same area of existing wetlands. Wetland patches along Silver Creek within the Upper Silver Creek Watershed stand out as regionally significant, and form a nearly continuous, linear patch associated with the stream bottomland. Fairly large areas of cropland within the upper portions of the study area, and near streams, could be successfully restored to wetlands and would add to the regional significance of the existing wetlands.

Data produced for this project were delivered to the East-West Gateway Council of Governments in geodatabase form. A separate appendix (Appendix 1) to this document containing hard-copy figures of the most significant wetland patches (highest ranking) within the study areas was delivered. Finally, technical documents detailing step-by-step methods for each study region were delivered. Staff from MoRAP will remain available for further explanations of the data sets.

Introduction

The Missouri Resource Assessment Partnership has developed a number of data sets and maps for the East-West Gateway Council of Governments (EWG) and their partners over the past seven years (Table 1). Efforts have been directed toward support of the Ecological Approach to Infrastructure Development initiative.

Table 1. Summary of related data sets previously produced by MoRAP for the St. Louis region.

Data Set/Map	Description
Current Vegetation	used 30 m satellite data classification, digital soils, digital elevation models, & image objects from air photos generated at 6 m resolution to map and describe 60 vegetation types
Regional Ecological Significance	used Current Vegetation to form land cover patches & assign importance values to patches based on size, biological significance, and landscape context
Project-level Ecological Significance	used Current Vegetation to assign values to all patches of all 60 mapped vegetation types based on inherent significance of the mapped type, patch size, other biological factors, and landscape context
Fine-resolution Wetlands Mapping for Missouri & Mississippi bottomlands	used LiDAR-based elevation and vegetation height and digital soils to map extant wetlands; assigned values to wetland patches based on biological criteria and landscape context; restoration potential was assigned to current croplands based on biological potential & landscape context
Fine-resolution urban area mapping	used LiDAR-based elevation and object height, air photo classification, and image objects to provide fine-resolution maps of two pilot areas; in one pilot area, these results showed only half as much impervious cover versus the coarser Current Vegetation data described above

Fine-resolution wetland maps were created for the Missouri and Mississippi River bottomlands using LiDAR, air photos, digital soils maps, and other information (Figure 1).

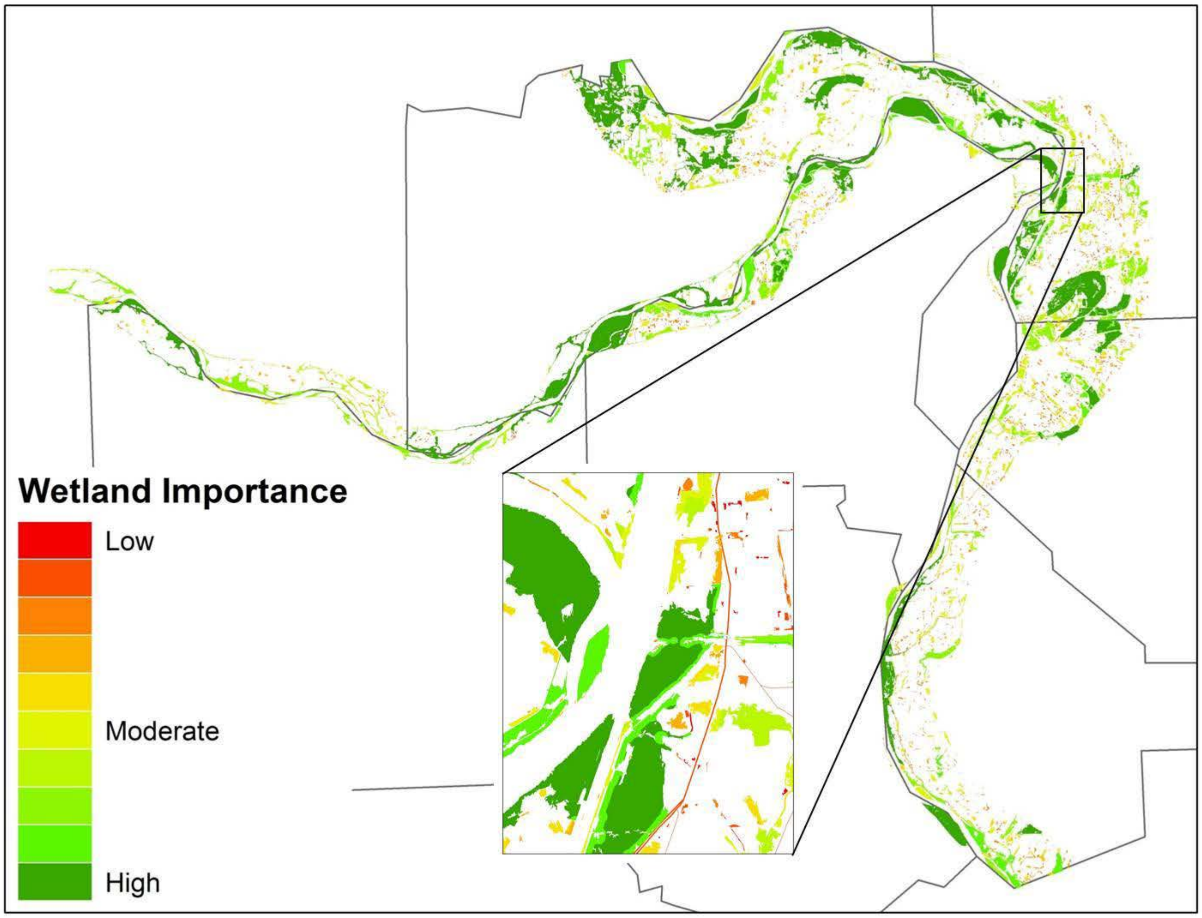

Figure 1. Fine-resolution wetland mapping and ranking for mitigation and restoration importance has previously been done for the Missouri and Mississippi River bottomlands.

Wetland mapping results for the Missouri and Mississippi River floodplains, and fine-resolution urban mapping results, stimulated partner interest in more fine-resolution mapping work. EWG therefore moved forward with fine-resolution wetland mapping for the Meramec River bottomland and the Upper Silver creek watershed (Figure 2).

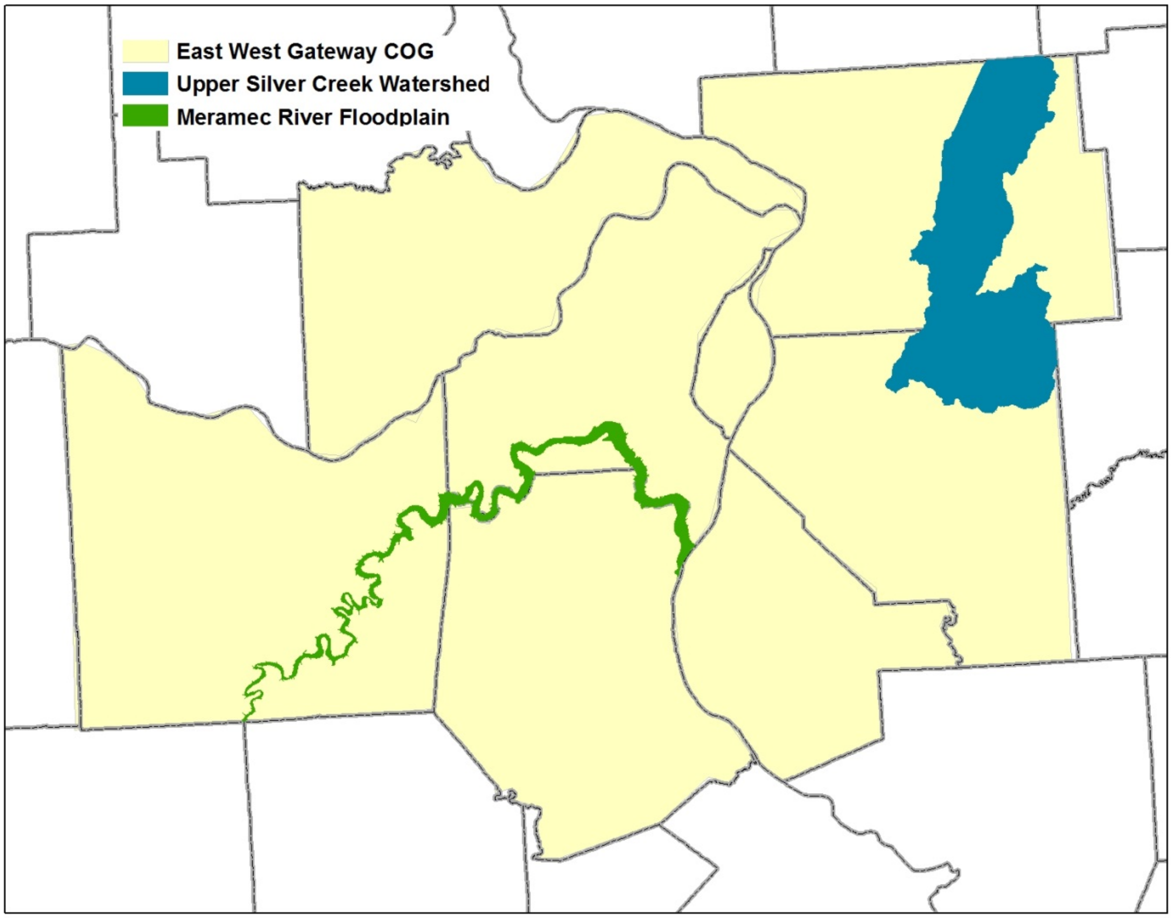

Figure 2. Location of the Meramec River bottomland and Upper Silver Creek watershed study areas.

Methods and Input Data

We used methods previously described in our June, 2012 report to map and rank wetlands. Separate documents that outline step-by-step technical procedures were also generated for both the Meramec and Upper Silver Creek study areas, and were delivered to EWG technical staff. The classification is based on Cowardin's Classification of Wetlands and Deep Water Habitats of the United States, available at http://www.fws.gov/wetlands/data/wetland-codes.html. Essentially, this classification is based on water regime and vegetation height and type, and is widely used as a standard by regulatory agencies such as the US Fish and Wildlife Service, the Environmental Protection Agency, and the Corps of Engineers in the USA (Figure 3).

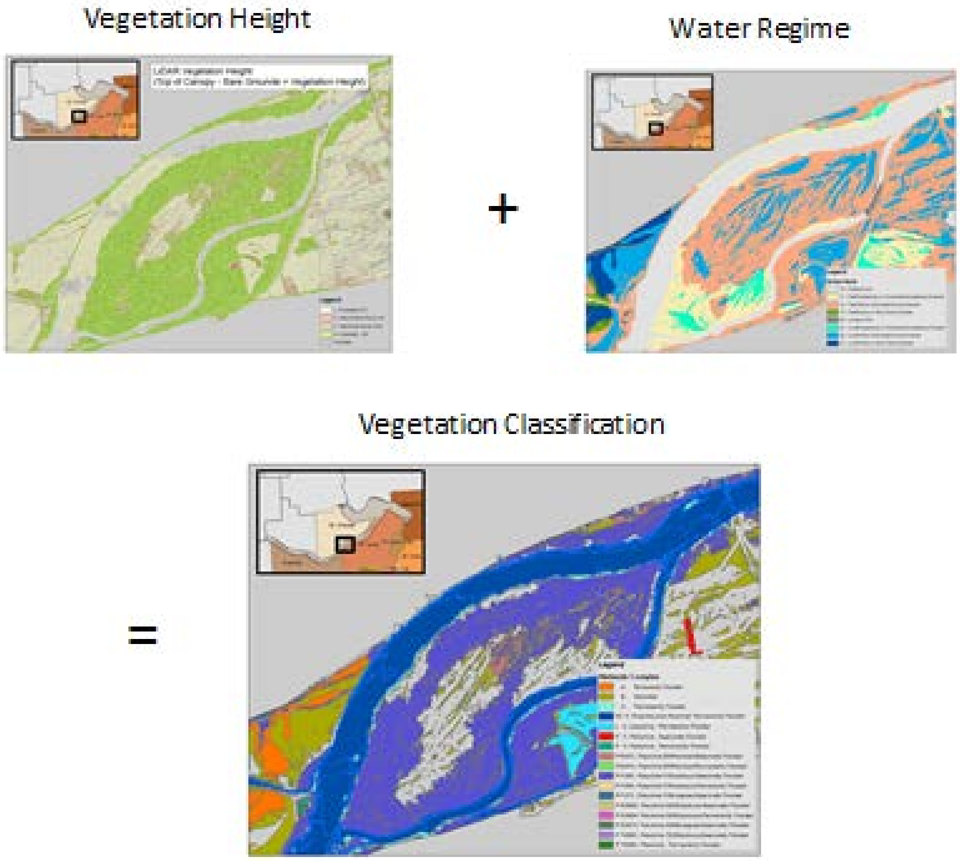

Figure 3. We used information on vegetation height and type, together with information on water regime, to classify wetlands at fine resolution. LiDAR data was key.

Briefly, we used the following steps to map wetlands:

- Use LiDAR-based elevation to define sinks based on elevation and water flow
- Use LiDAR-based height to define vegetation height and group as short shrub/scrub, tall shrub/scrub, tree, or herbaceous emergent
- Use air photos and satellite data in further define land cover type (e.g. separate cropland from herbaceous; deciduous from evergreen; buildings from trees)
- Use digital soils to provide information on drainage (substrate)
- Generate image objects (polygons) using air photo and LiDAR data, and use these as mapping units by attributing the objects with information on drainage and vegetation
- Hand-modify results by viewing image object-based classification over air photos (a time-consuming but very important step)

We used algorithms that considered patch size, diversity, and landscape context to assign ranks for wetland mitigation and restoration importance. The basic process and concepts were as follows:

1. Only extant wetlands were ranked for mitigation importance, and only cropland or barren land was ranked for restoration importance.
2. Wetland complexes (patches) were defined based on patches formed by aggregation of all wetlands and all non-wetland vegetation touching existing wetlands. Thus, uplands adjacent to wetlands were included in patches.
3. Mitigation ranks were based on wetland complex size, diversity, and landscape context (distance to public lands or urban lands).
4. Restoration ranks were based on water regime (essentially, a ‘do-ability’ index for restoring wetlands) and landscape context (distance to extant wetlands, public lands)

The ranking algorithm for wetland mitigation was:

Wetland Mitigation Importance Rank = Patch Size(1.5) + Patch Diversity + Distance to Public Lands + Distance to Urban Lands*

Patch size:
<5 hectares = 1
>=5 – 10 hectares = 2
>=10 – 25 hectares = 3
>=25 – 100 hectares = 4
>=100 – 500 hectares = 5
>=500 hectares = 6 (no complexes were this big in the Meramec study area)

Patch Diversity: number of different wetland and upland types within the patch, ranked from 1 `to 5 based on natural breaks
Distance to Public Land: ranked 1 to 4 with breaks at 1 m, 50 m, 100 m, and 150 m
Distance to Urban: ranked (-1) if within 100 m of urban and (-2) within 50 m

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The ranking algorithm for wetland restoration was:

Wetland Restoration Importance Rank = Water Regime + Distance to Public Lands + Distance to Urban Lands + Distance to Water + Distance to Extant Wetlands

Water Regime: “C” – Seasonally Flooded (score = 6); “A” Temporarily Flooded (score = 4)
Distance to Public Land: ranked 1 to 4 with breaks at 1 m, 50 m, 100 m, and 150 m
Distance to Urban Land: ranked (-1) if within 100 m of urban and (-2) within 50 m
Distance to Water: ranked 1 if within 50 m
Distance to Extant Wetland: ranked 3 if within 50 m, 2 if within 100 m; 1 if within 150 m

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Key Input Data Sets

The key input data types included LiDAR and air photos. Results generated from 30 m satellite-based land cover classification, the National Agricultural Statistics Survey (NASS), and the National Wetland Inventory data were also consulted. Digital county soil surveys from the National Resources Conservation Service (soil survey geographic database – SSURGO) were used for both study regions. All data were generated at 5 m spatial resolution.

For the Meramec River bottomlands, data sets included 2011 Jefferson and Franklin County LiDAR and 2012 St. Louis County LiDAR data. Leaf-off and leaf-on air photos from 2012 were used for this this study region. For the Upper Silver Creek Watershed study region, LiDAR available was from 2012 for Monroe and St. Clair Counties, and from 2014 for Madison County. Air photos for this region included 2012 leaf-on and leaf-off imagery from EWG.

Results: Meramec River Bottomland

Methods used, and especially incorporation of LiDAR, improved the accuracy of the wetland mapping over previous efforts both spatially and thematically (Figure 4).

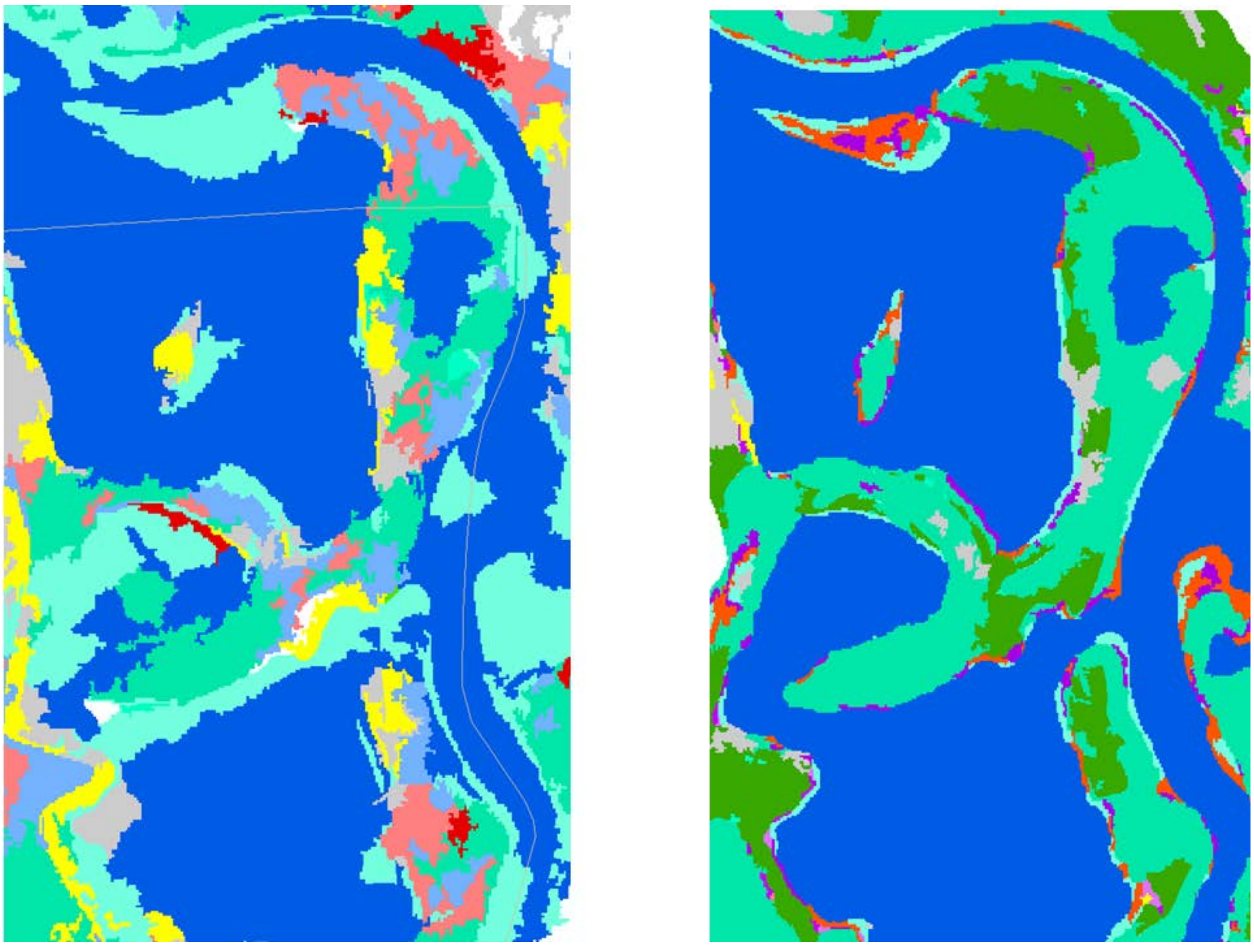

Figure 4. Use of LiDAR and finer resolution image objects improved the accuracy of mapping. A coarser-resolution (10 m) version of results from just downstream of Fenton is on the left and the improved 5 m resolution version is on the right.

The Meramec River bottomland study area circumscribed 15,922.9 hectares, of which 4,296.5 hectares (26.98%) was wetlands, and 2,509.1 hectares (12.38%) was water. Hence, nearly 40% of the study area was either water or wetland. Only 5.59% of the area was in high-intensity urban land cover. The Meramec Bottomland represents a significant semi-natural corridor within the St. Louis region**.**

Forested wetlands were by far the most abundant type of Palustrine wetland (all wetlands exclusive of lakes and rivers), and accounted for 81.48% of all wetlands in the region (Table 2). Emergent wetlands made up 10.65% of all wetlands, and tall and short scrub/shrub, which may be composed of short, successional trees or shrubs, together made up 7.87% of all wetlands.

Table 2. Palustrine wetlands (exclusive of lakes and rivers) within the Meramec River bottomland accounted for 26.98% of the area.

Wetland Type and Water Regime	Area (Hectares)	% of Palustrine Wetland
Emergent (EM; marsh <1 m)		
Permanently Flooded	2.5	0.06%
Seasonally Flooded	203.2	4.73%
Emergent Temporarily Flooded	252.0	5.87%
Subtotal	**457.6**	**10.65%**
Short Scrub Shrub (SSS; 1 to <3 m)		
Permanently Flooded	2.3	0.05%
Seasonally Flooded	122.0	2.84%
Temporarily Flooded	53.7	1.25%
Subtotal	**178.0**	**4.14%**
Tall Scrub Shrub (TSS; 3 to <6 m)		
Permanently Flooded	4.5	0.11%
Seasonally Flooded	119.5	2.78%
Temporarily Flooded	36.1	0.84%
Subtotal	**160.2**	**3.73%**
Forested (FO; > 6 m)		
Permanently Flooded	33.2	0.77%
Seasonally Flooded	3,084.4	71.79%
Temporarily Flooded	383.1	8.92%
Subtotal	**3,500.6**	**81.48%**
Total	**4,296.5**	**100.00%**

Wetland complexes were mostly ranked as moderately high to highly important (Figure 5). Ranks ranged from 1 (low) to 16 (high), and 76.70% of the area of all patches scored 12 or higher (Figure 6). Ranked patches, which include wetlands and upland vegetation touching wetlands (see Methods, above) made up 8,449.7 hectares, or about twice as much area as the wetlands themselves. This result contrasts with analyses of the Missouri and Mississippi bottomlands, where wetlands make up most of the non-crop vegetation. On the larger river bottomlands, levees (Missouri River) and a combination of levees and water control structures (Mississippi River) protect large cropland areas from frequent flooding. On the Meramec River bottomlands, semi-natural vegetation predominates and cropland is less common along many reaches. Forest and grassland we have identified as non-wetland tend to be well-watered, are often contiguous with mapped wetlands, and many are temporarily or seasonally flooded. Hence, our wetland estimates for the bottomland are quite conservative, and probably underestimate wetlands. The extent of the semi-natural patches highlights the significance of the Meramec bottomland as habitat for native biota and as a movement corridor.

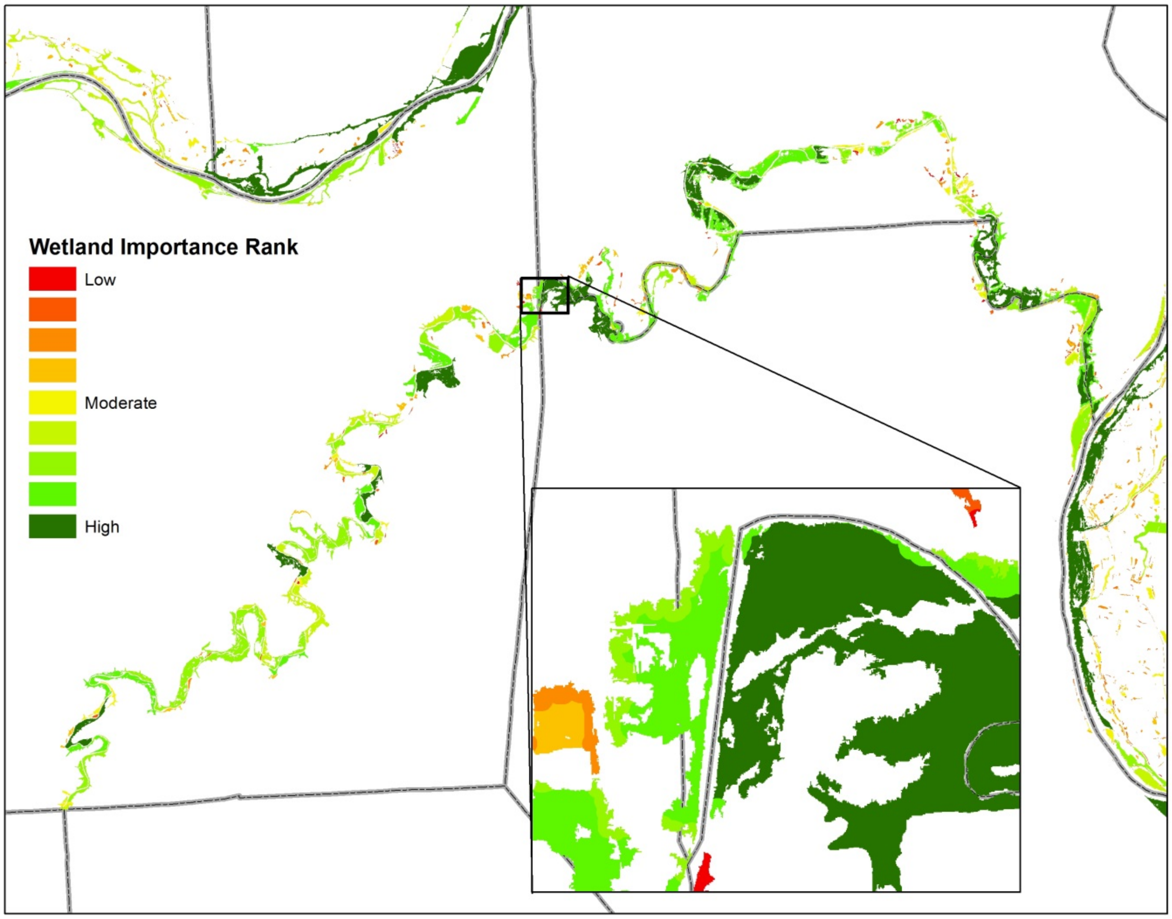

Figure 5. Relative importance of wetland complexes depicted in nine classes using natural breaks. Complexes were mostly of high to moderately high significance.

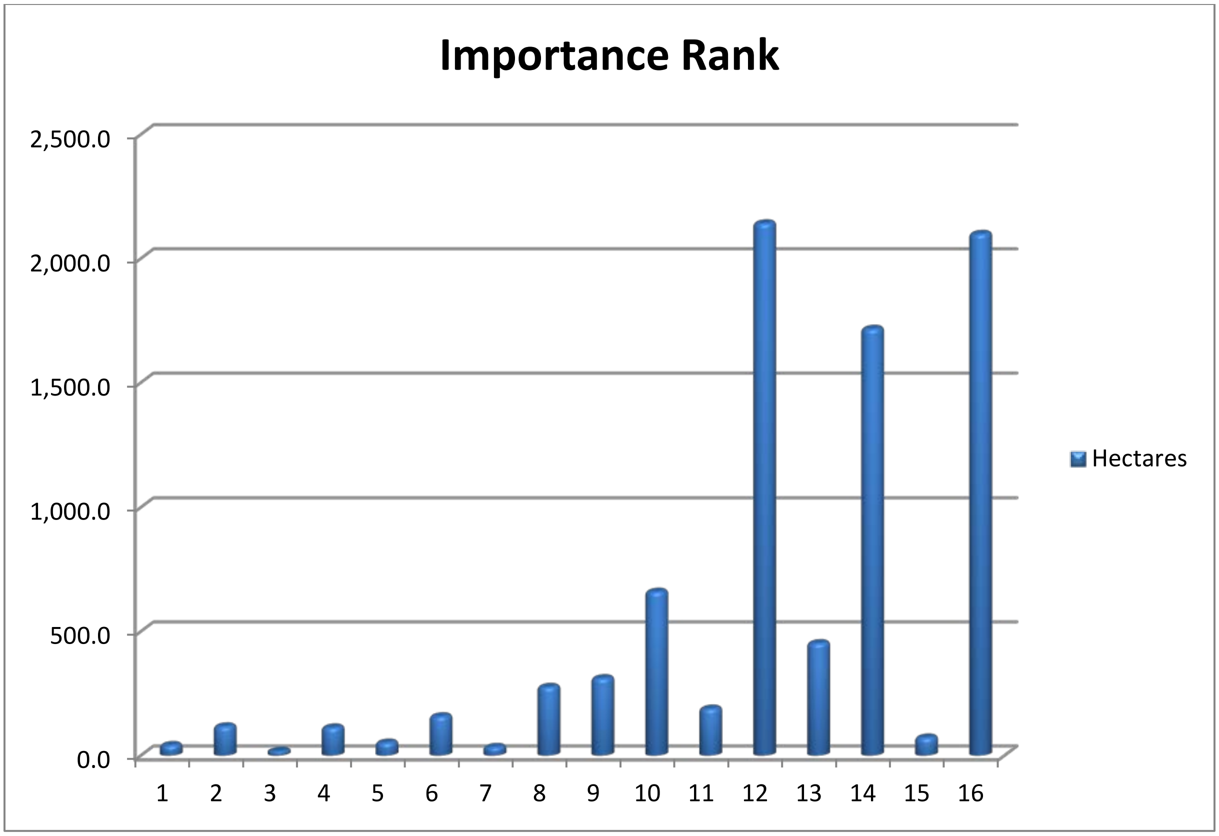

Figure 6. Most wetlands within the Meramec River bottomlands scored high for wetland importance.

Croplands and barren lands, a total of 2,402.6 hectares, were scored for restoration importance (Figure 7). Most of the croplands do not have a hydric water regime, and therefore cannot be "restored" to wetlands (Figure 8). Such areas do not rank high in terms of wetland restoration potential. However, areas contiguous with a wetland patch are valuable for restoration in an ecological sense, as they increase habitat patch size, which is important to many species.

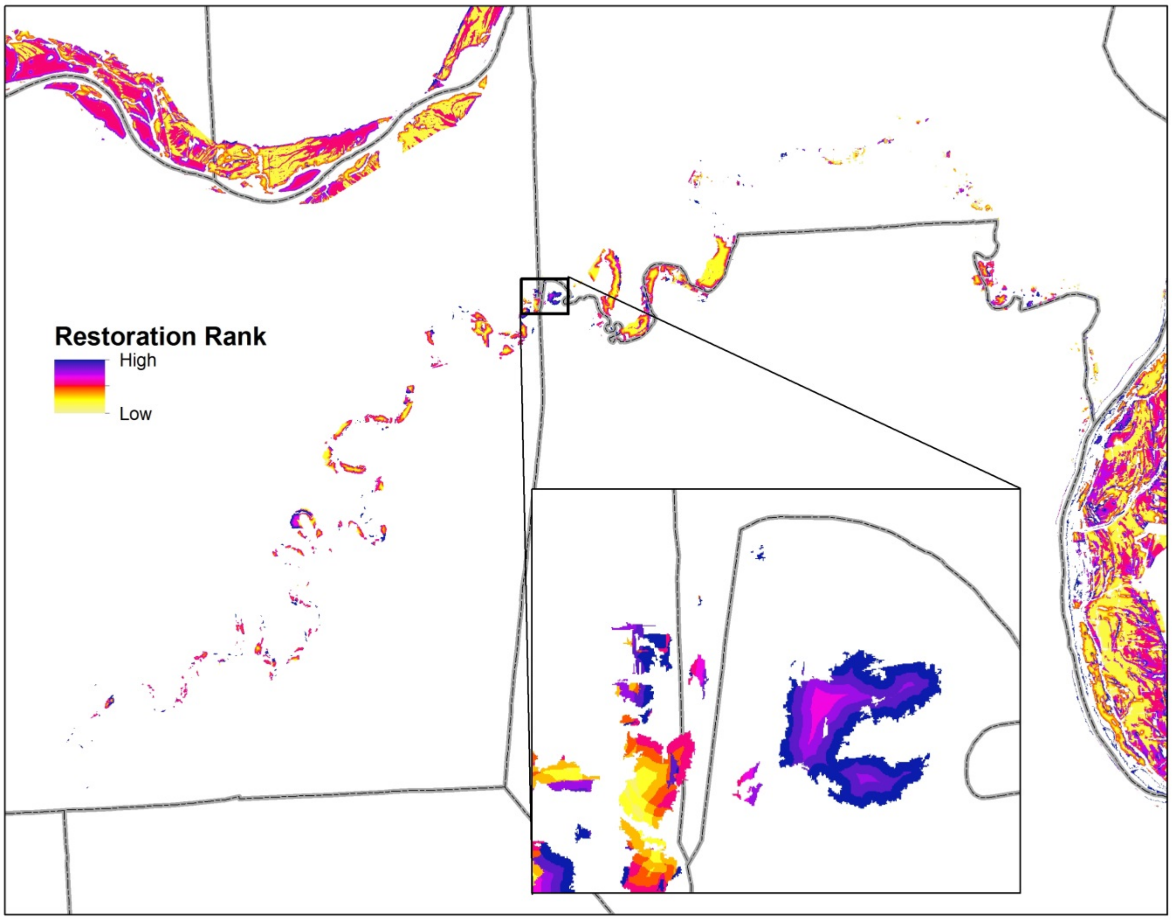

Figure 7. Wetland restoration ranks depicted on a color ramp. A total of 41.34% of the area had no or very low wetland restoration potential because most croplands do not have a hydric water regime.

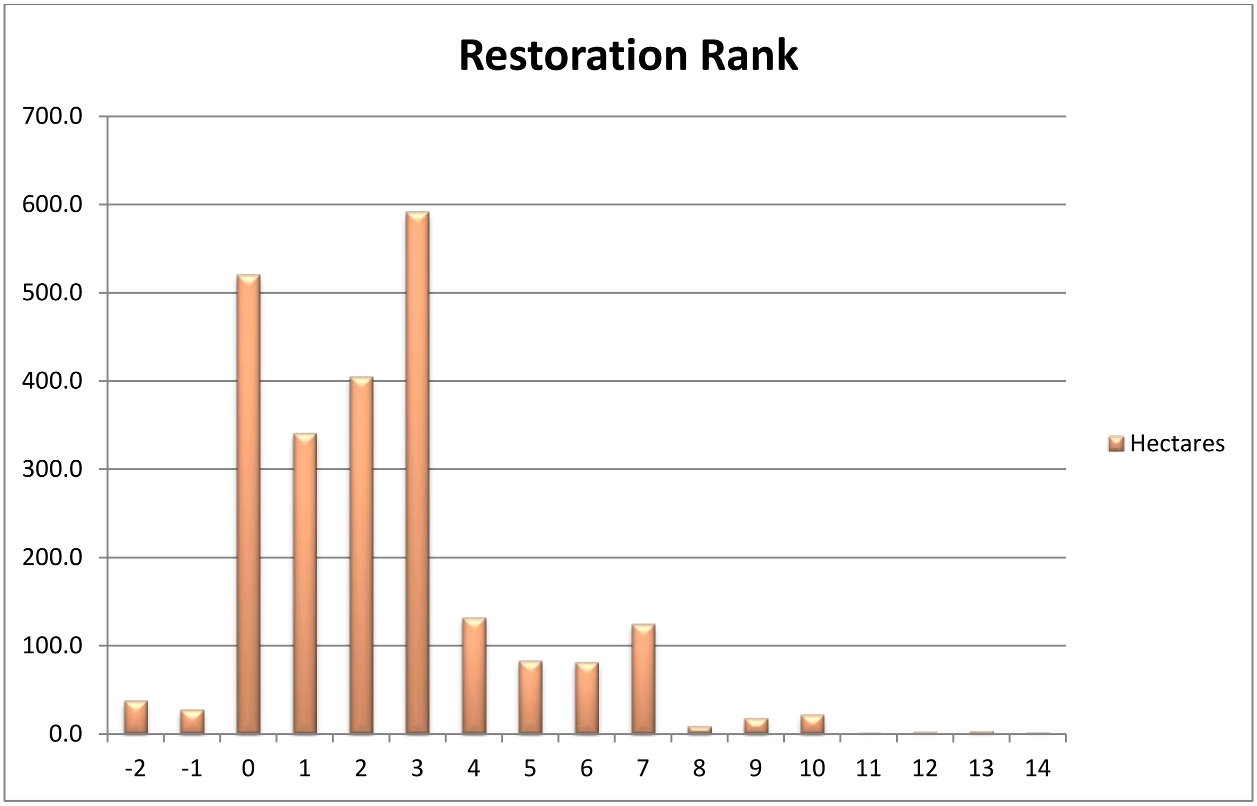

Figure 8. Most former croplands and barren lands in the Meramec River bottomlands cannot be restored to wetlands, because they are too dry or too well-drained.

Results: Upper Silver Creek Watershed

The Upper Silver Creek watershed study area covered 71,714.5 hectares, of which 4,593.4 hectares (6.40%) was Palustrine wetland, exclusive of lakes and rivers (Table 3). Forested wetlands accounted for 87.79% of all Palustrine wetlands.

Table 3. Palustrine wetlands (exclusive of lakes and rivers) accounted for 6.40% of the area of the Upper Silver Creek Watershed.

Wetland Type and Water Regime	Area (Hectares)	% of Palustrine Wetland
Emergent (EM; marsh <1 m)		
Seasonally Flooded	73.5	1.60%
Temporarily Flooded	123.0	2.68%
Subtotal	**196.6**	**4.28%**
Short Scrub Shrub (SSS; 1 to <3 m)		
Seasonally Flooded	59.6	1.30%
Temporarily Flooded	125.6	2.73%
Subtotal	**185.2**	**4.03%**
Tall Scrub Shrub (TSS; 3 to <6 m)		
Seasonally Flooded	64.3	1.40%
Temporarily Flooded	114.7	2.50%
Subtotal	**179.0**	**3.90%**
Forested (FO; > 6 m)		
Seasonally Flooded	2890.7	62.93%
Temporarily Flooded	1141.9	24.86%
Subtotal	**4,032.6**	**87.79%**
Total	**4,593.4**	**100.00%**

Wetland importance scores ranged from 0 to 18, and most of the existing wetlands in the Silver Creek watershed ranked high in terms of wetland importance (Figures 9, 10). A total of 51.57% of wetland complexes scored from 14 to 18. The presence of small areas of conservation lands in one large patch increased the score of that patch from 14 to 18, but all patches that scored between 14 and 18 should be viewed as having high importance. Most wetlands were associated with Upper Silver Creek and side drainages. Like in the Meramec bottomland, our wetland area estimates are quite conservative, and contiguous patches of semi-natural vegetation may be almost entirely wetland, even though the upland edges tend to be mapped as non-wetland.

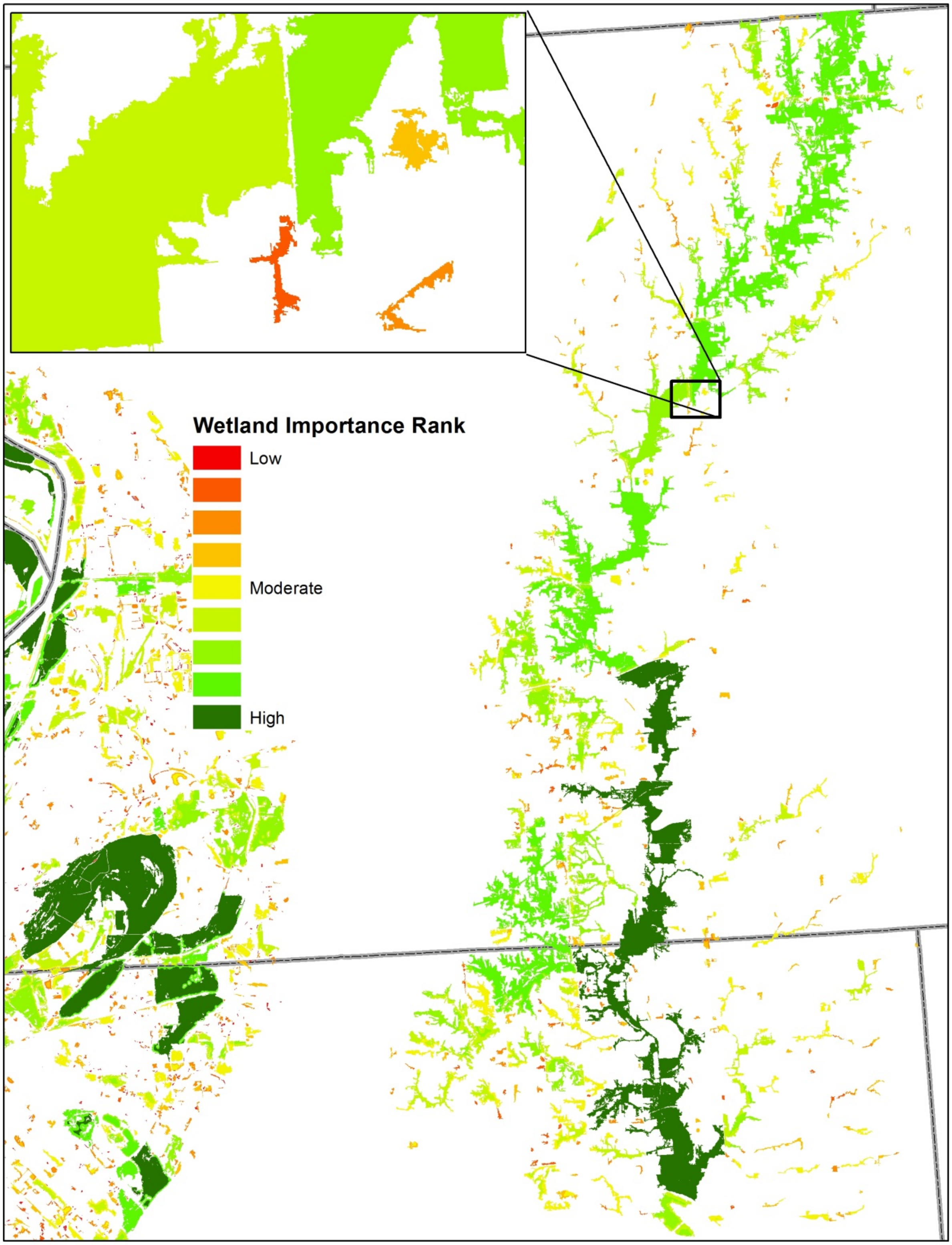

Figure 9. Most wetlands in the Upper Silver Creek watershed occur along the creek, and score high for wetland importance. Earlier results for the Mississippi River bottomland appear on the left.

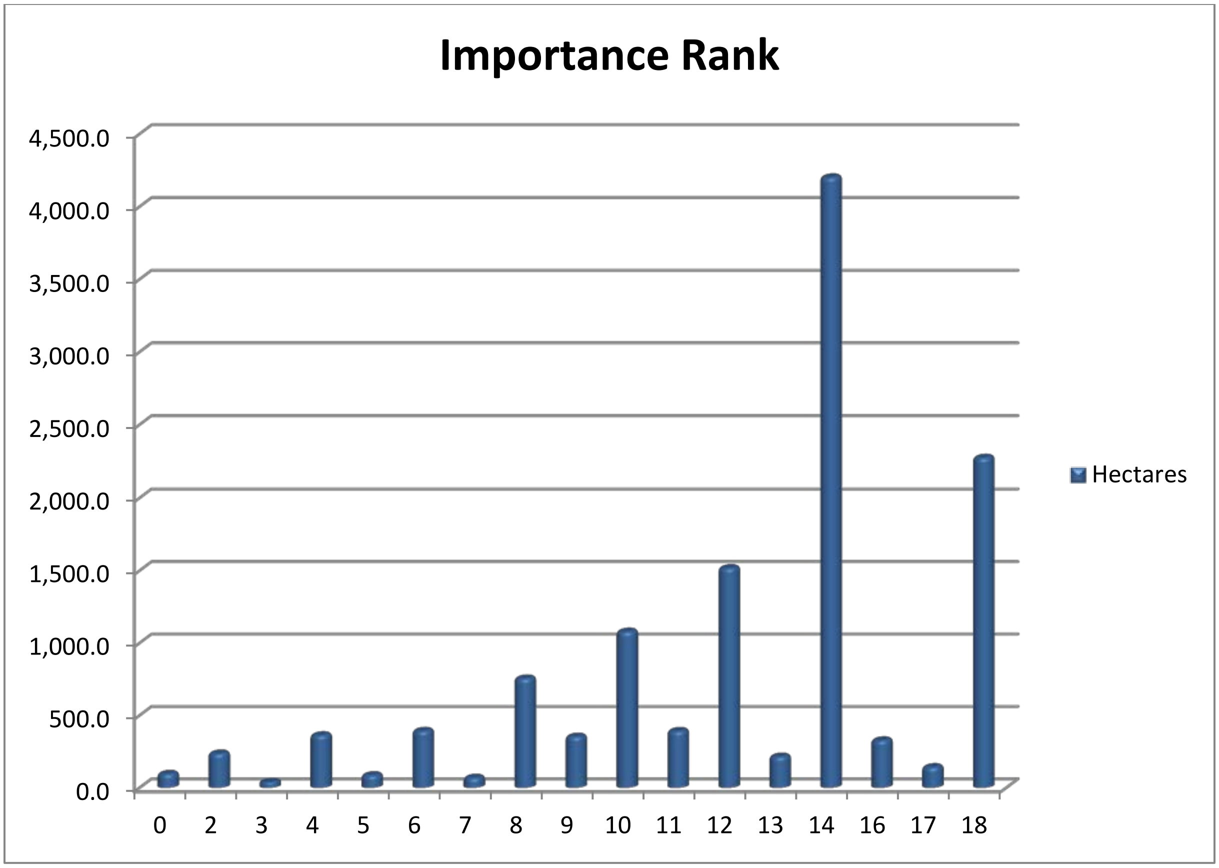

Figure 10. Most existing wetlands in the Upper Silver Creek watershed scored high for wetland importance.

Wetland restoration ranks were assigned to cropland and barren land, and scores ranged from -2 to 13. Almost 80% of this area scored 3 or lower for wetland restoration potential, mainly because these areas are too well-drained to support wetlands in the modern landscape (Figure 11, 12). However, significant areas of cropland and barren land within the watershed, 9,731.3 hectares, are poorly drained and would support wetland restoration (the purple color in Figure11). These areas are concentrated in the northern part of the study area, or near existing wetlands along the creek.

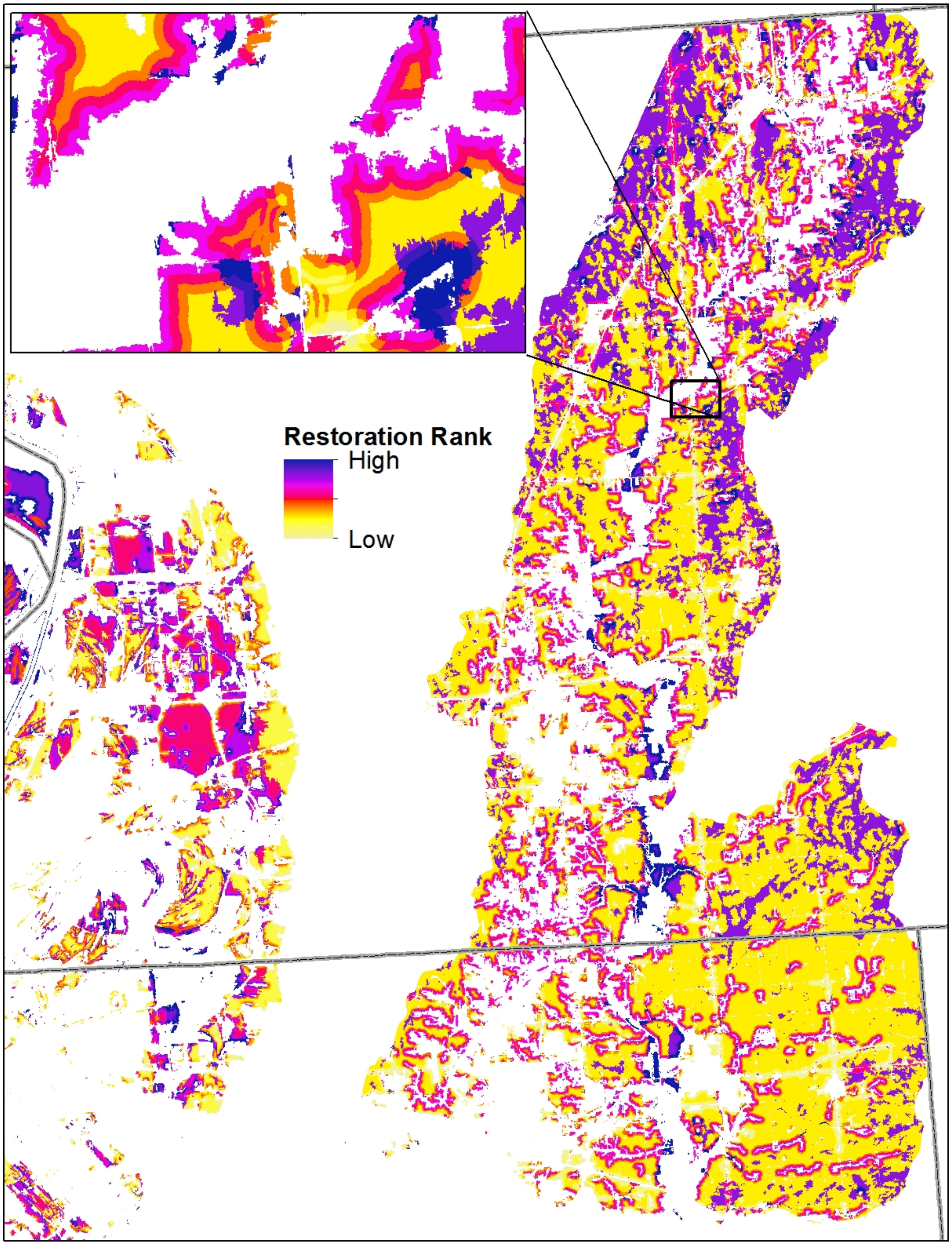

Figure 11. Areas most suitable for wetland restoration (purple to blue) are concentrated in the northern part of the Upper Silver Creek Watershed, or are near existing wetlands along the creek and tributaries. Results from earlier work on the Mississippi River bottomlands appear on the left.

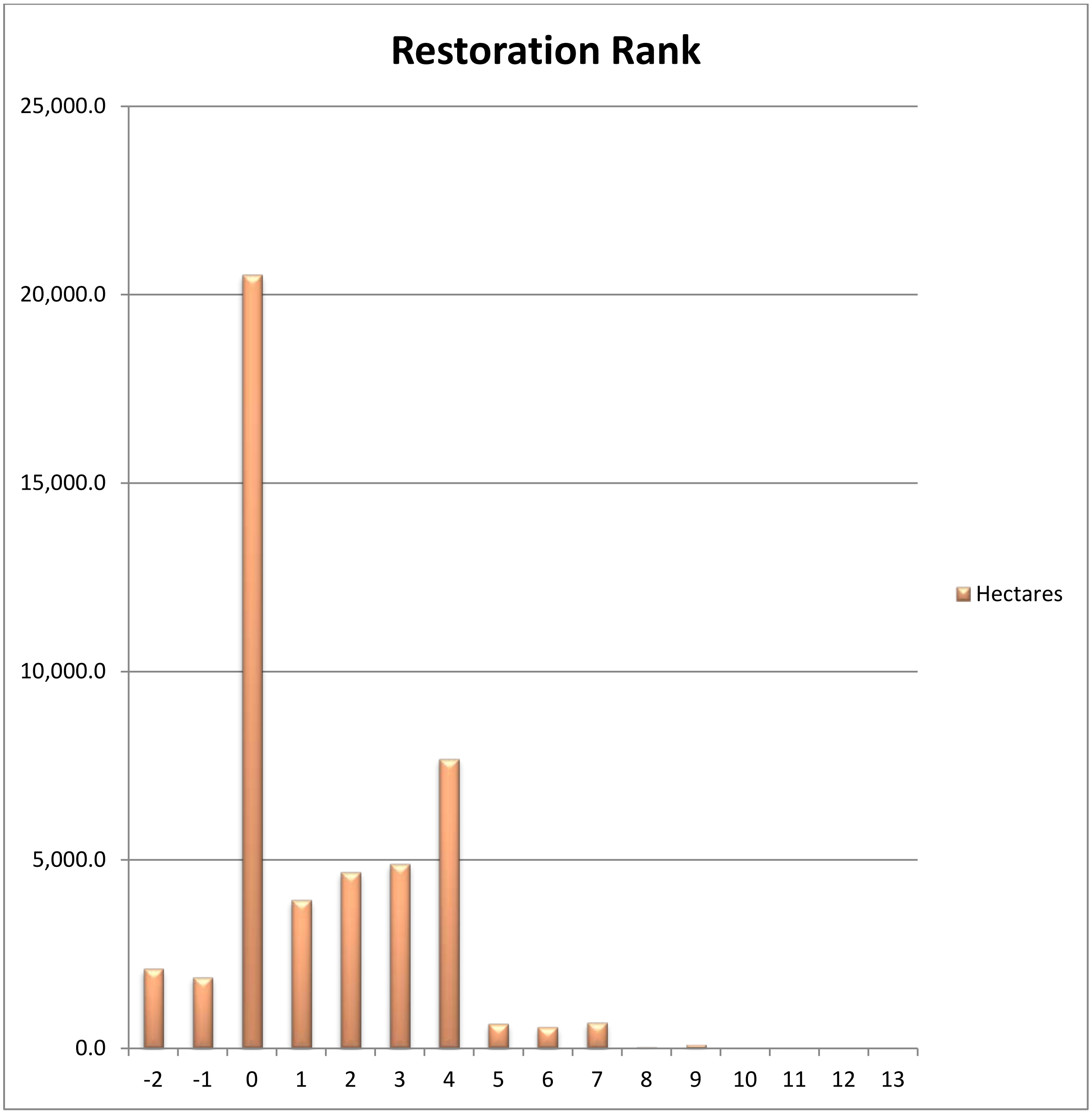

Figure 12. Most cropland and barren land within the Upper Silver Creek watershed do not score high for wetland restoration potential. However, 9,731.3 hectares score 4 or higher, and could be readily restored to wetland.