

An Assessment of Land Cover Change as an Effect of Renovation of Shelby Farms Park

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Intro

Shelby Farms Park is a 4,500 acre park located centrally in Memphis, Shelby County, Tennessee (figure 1). The Heart of the Park is the final project of the Shelby Farms Park Master Plan, developed by James Corner Field Operations, approved by Shelby Farms Park Conservancy in 2008. Construction on the project began in 2014, featuring an enlargement and ecological restoration of Patriot Lake and its watershed. Changes made to the lake, renamed Hyde Lake, include: enlargement of the lake, introduction of native wetland vegetation, increasing upland drainage, a new visitor's center, and a new restaurant, new footpaths, access roads, and parking lots, environmentally friendly overflow parking and more than 3,000 trees were planted.

Objectives:

- Perform iterative self-organizing cluster analysis of Landsat 8 images from September 2013 and October 2016
- Perform error analysis on isocluster classified images
- Assess changes in spatial distributions of classes

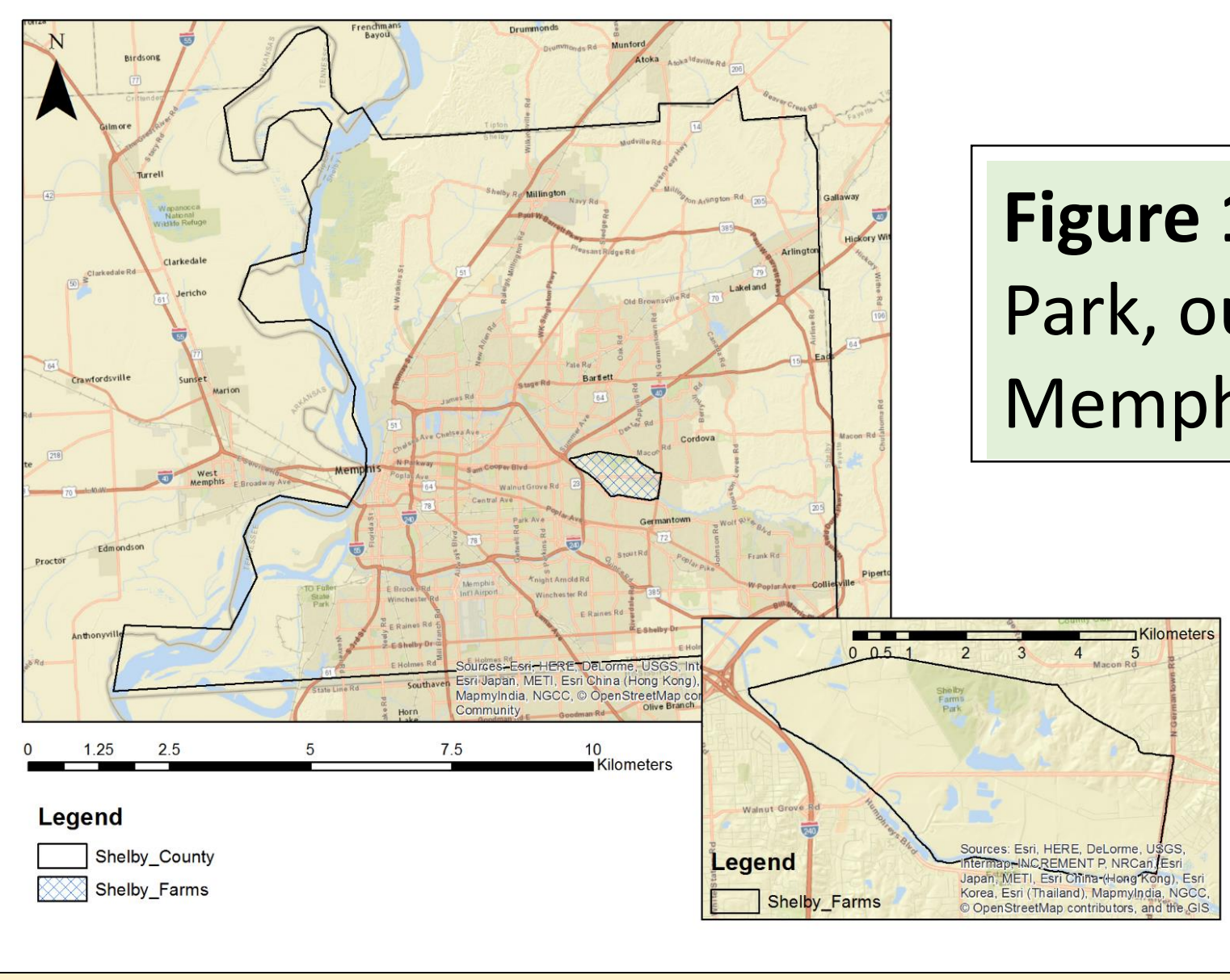
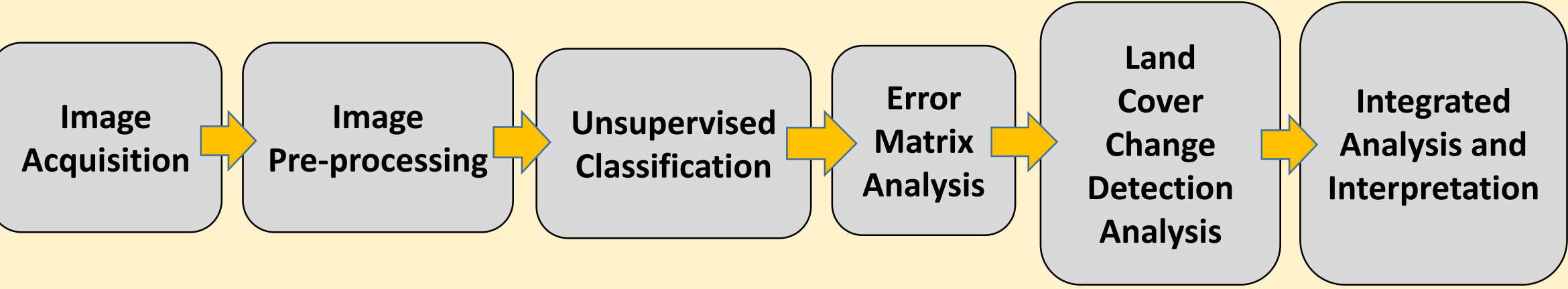


Figure 1. Shelby Farms Park, outlined in red, in Memphis, Tennessee.

Methods

To establish land cover changes in Shelby Farms Park resulting from the "Heart of the Park" renovation project, two Landsat 8 images (30 m spatial resolution) were acquired from the US Geological Survey's (USGS) Earth Explorer. Investigating land use change over time as a function of the project resulted in a comparison of two images, one from September of 2013 and one from October of 2016.

The general workflow is included below:



Initial Results of Land-Cover Classification

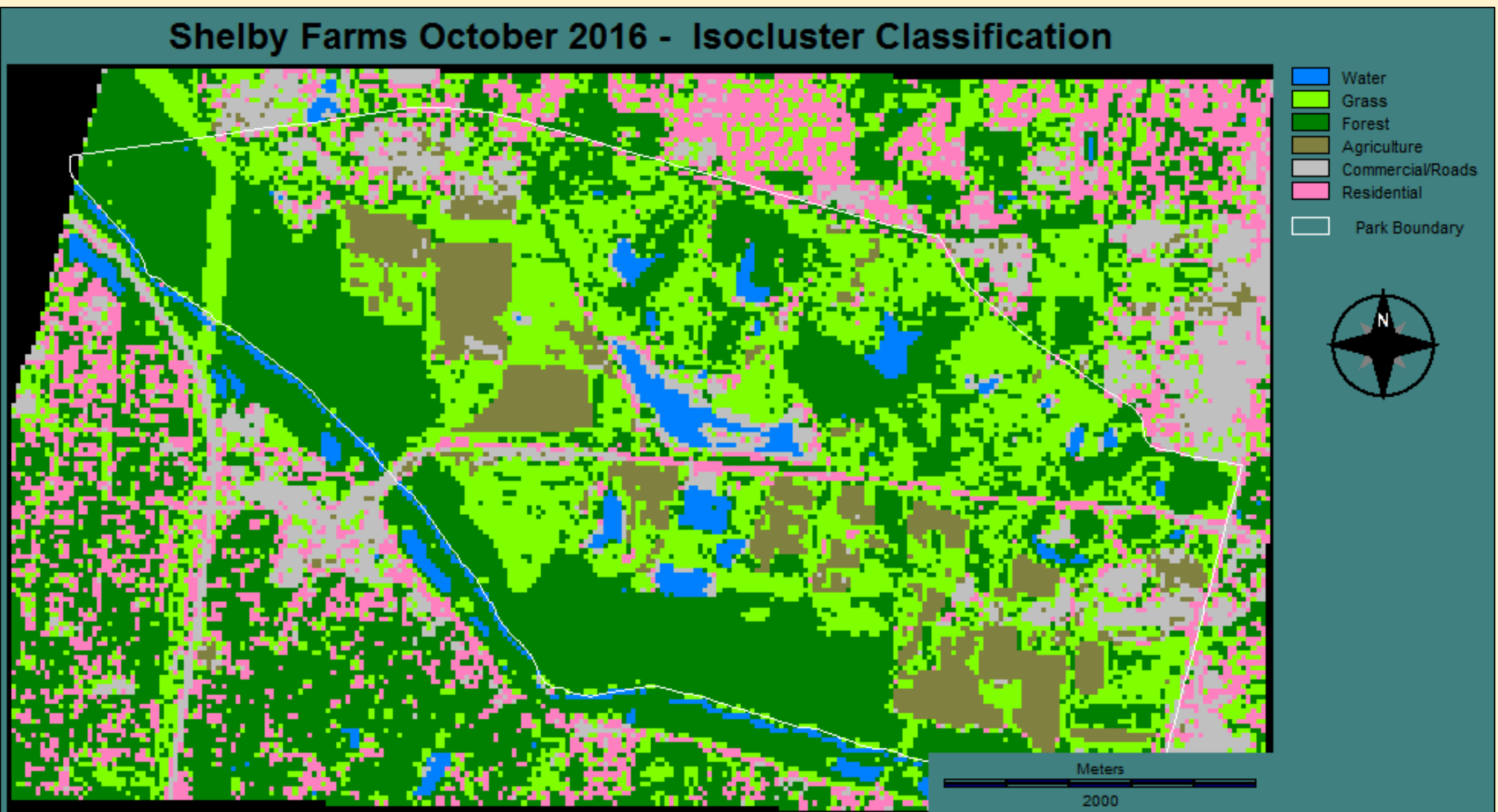


Figure 2. Isocluster Classification of October 2016 Landsat 8 Images.

	1	2	3	4	5	6	Total	ErrComm
1	5	0	0	0	0	1	6	0.17
2	0	23	1	1	0	1	26	0.12
3	0	2	27	0	0	3	32	0.16
4	0	2	0	3	0	0	5	0.4
5	0	0	0	0	12	2	14	0.14
6	0	0	0	1	12	12	13	0.08
Total	5	27	28	4	13	19	96	
ErrOmis	0	0.15	0.36	0.25	0.08	0.37		0.15

Table 1. Error Matrix using 100 point random sampling of 2016 classified image vs. photo-interpreted images from 2016 included.
Overall Kappa: 0.81

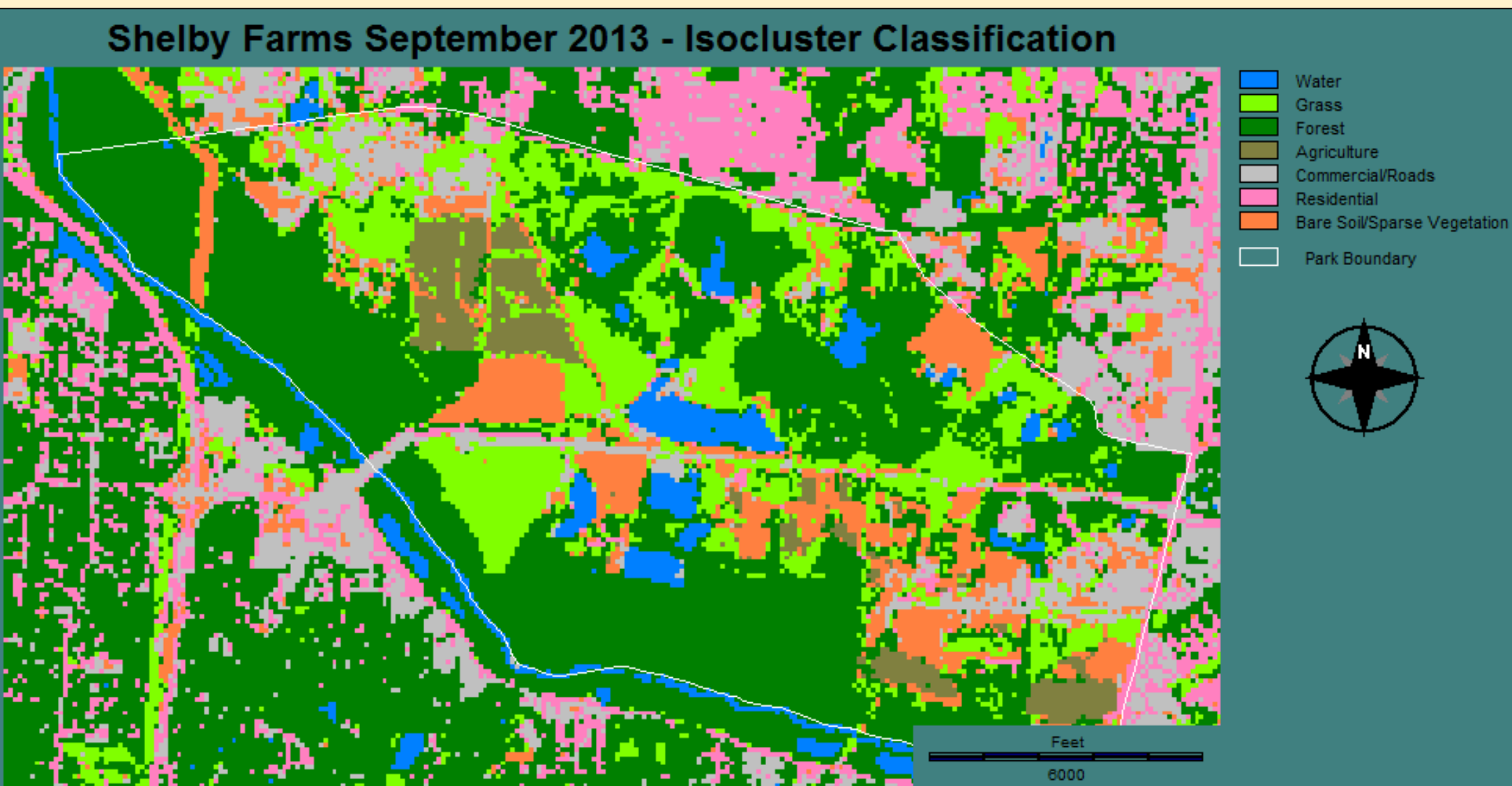


Figure 3. Isocluster Classification of September 2013 Landsat 8 Images.

	1	2	3	4	5	6	7	Total	ErrComm
1	2	0	1	0	0	0	0	3	0.33
2	0	12	1	0	0	1	1	15	0.2
3	2	1	39	0	1	8	0	51	0.24
4	0	2	0	5	0	0	0	5	0
5	0	0	0	0	8	2	2	12	0.33
6	0	0	0	0	2	7	1	10	0.3
7	0	1	0	0	0	0	3	4	0.25
Total	4	14	41	5	11	18	7	100	
ErrOmis	0.5	0.14	0.05	0	0.27	0.61	0.57		0.24

Table 2. Error Matrix using 100 point random sampling of 2013 classified image vs. photo-interpreted images from 2013 included.
Overall Kappa: 0.67

Change Assessment

Multi-temporal false color composite of Shelby Farms Park

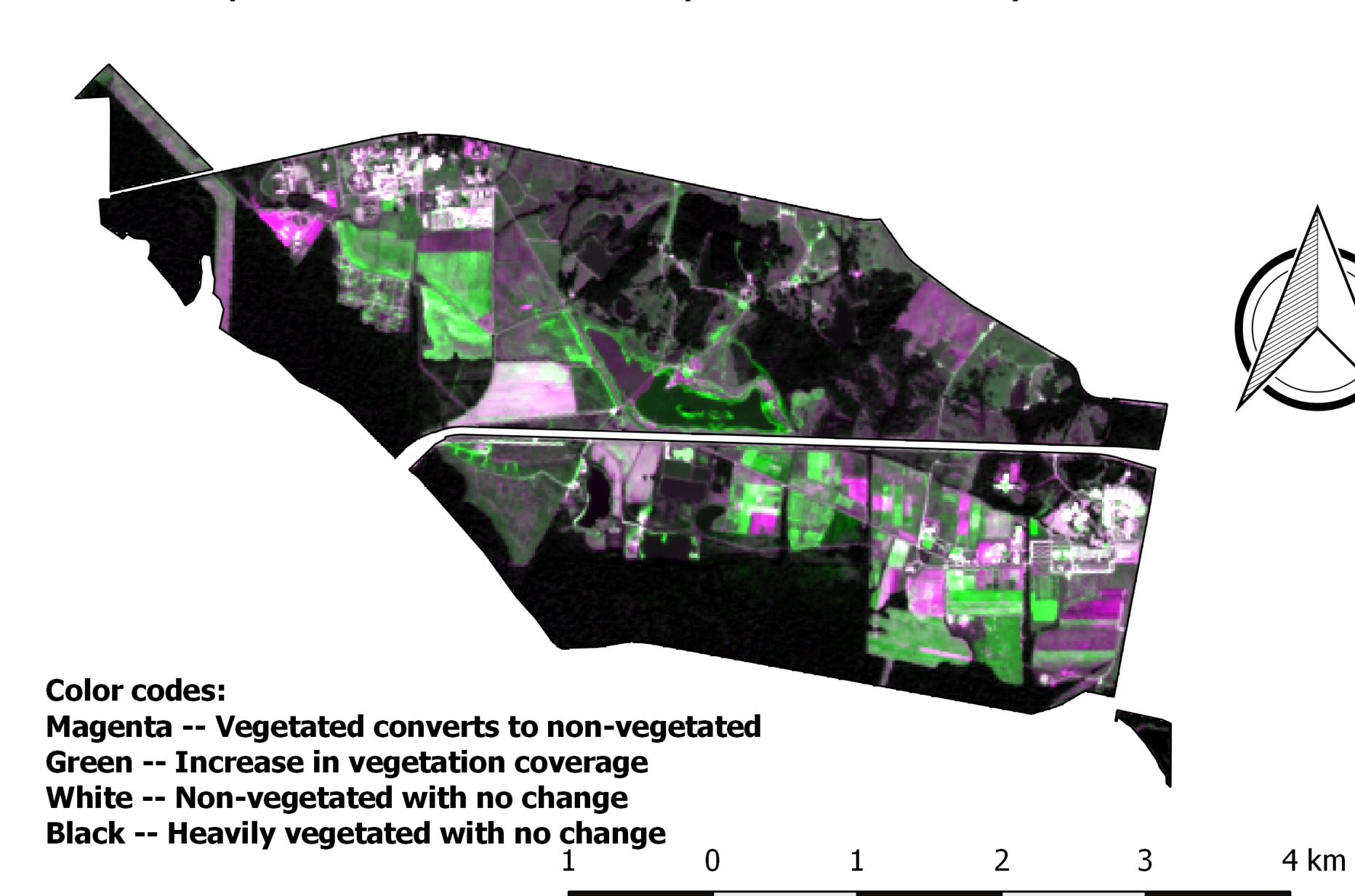


Figure 4. A multi-temporal false color composite delineating area of change

Greenness gain and loss at Shelby Farms after the renovation

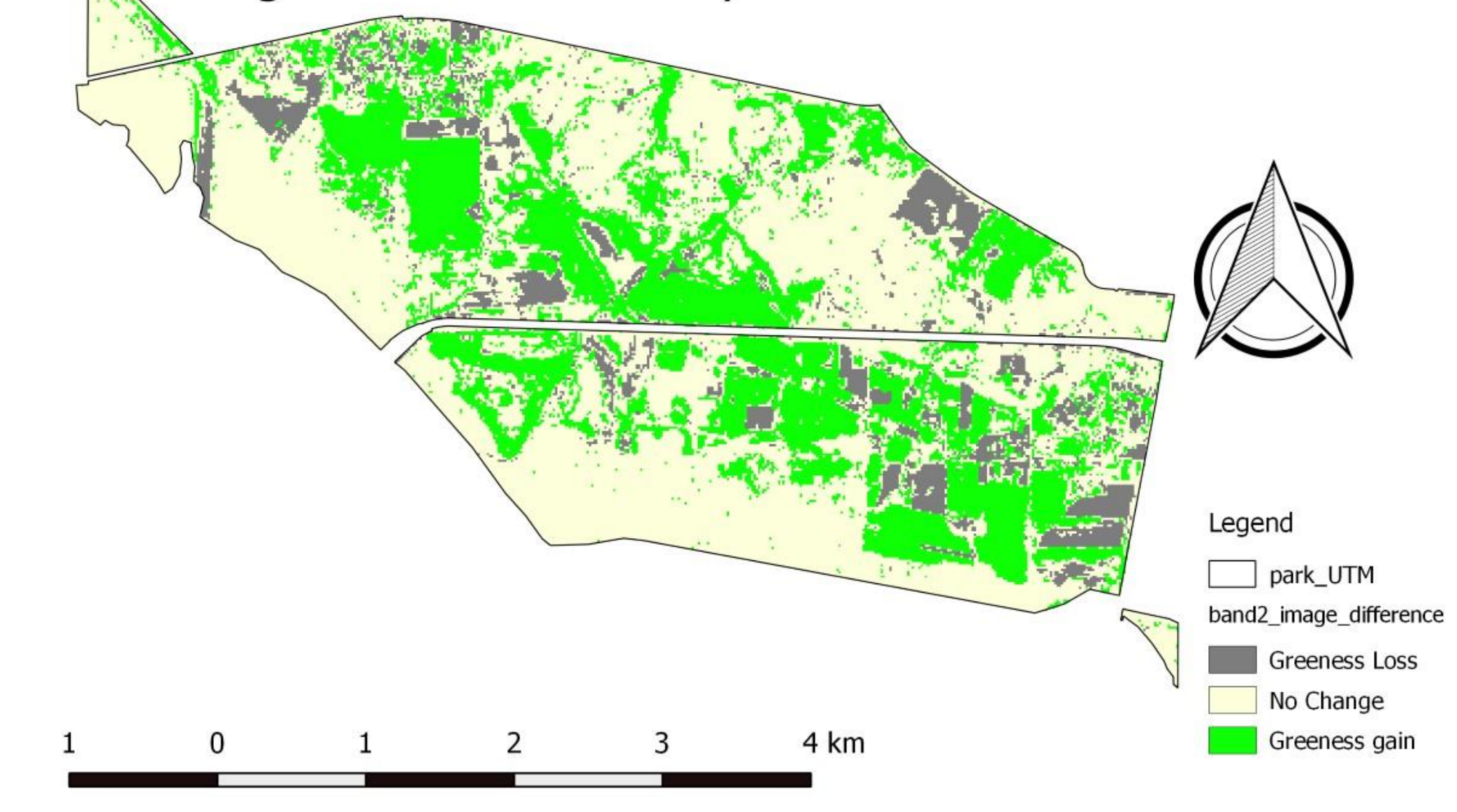


Figure 5. Image differencing highlighting area with gain or loss of greenness

Change Analysis

Landcover Changes		To					Sum
		water	forest	grassland	developed	undeveloped	
From	water	2859	733	32	207	34	3865
	forest	84	27197	569	2644	400	30894
	grassland	372	693	16784	4229	3741	25819
	developed	42	44	118	411	1095	1710
	undeveloped	14	164	4225	3389	8127	15919
Sum		3371	28831	21728	10880	13397	78207

Table 3. Pixel by pixel change analysis

Landcover type	Water	Forest	Grassland	Developed	Undeveloped	Sum
Unchanged in size (sq. km)	2.5731	24.477	15.1056	0.3699	7.3143	49.8402
Changed in size (sq. km)	0.9054	3.3273	8.1315	1.1691	7.0128	20.5461
Total size (sq. km)	3.4785	27.805	23.2371	1.539	14.3271	70.3863

Table 4. Changed area vs. unchanged area

Discussion and Conclusions

- Parallel-piped and Maximum Likelihood supervised classifications were outperformed by the isocluster unsupervised classification.
- Error matrix analysis of the isocluster classification found less than 26% and 15% for images of Set. 2013 and Oct. 2016, respectively. Furthermore, overall Kappa of classification for images of Sep. 2013 and Oct. 2016 determined as 0.67 and 0.81, respectively.
- Comparison of the Sep. 2013 and Oct. 2016 classifications found the most significant change was Undeveloped to Vegetated area.
- These changes were probably related to bare soils clearing for planting native grasses and wildflowers to restore and revitalize the ecosystems surrounding the newly expanded lake (as we expected from ecological enhancements plan [Shelby Farms Park Master Plan]).
- This study demonstrates that Landsat data and Isocluster classification provide an accurate way to quantify, map, and analyze land cover changes over time.

Resources

"Ecological Restoration." Ecological Restoration. N.p., n.d. Web. 28 Nov. 2016.
"Master Plan." Park Improvements. N.p., n.d. Web. 28 Nov. 2016.
Survey, USGS - U.S. Geological. "EarthExplorer." EarthExplorer. N.p., n.d. Web. 28 Nov. 2016.

Acknowledgments

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