Impervious surface analysis of watersheds in Richland, Ross, Barry and Prairieville Townships

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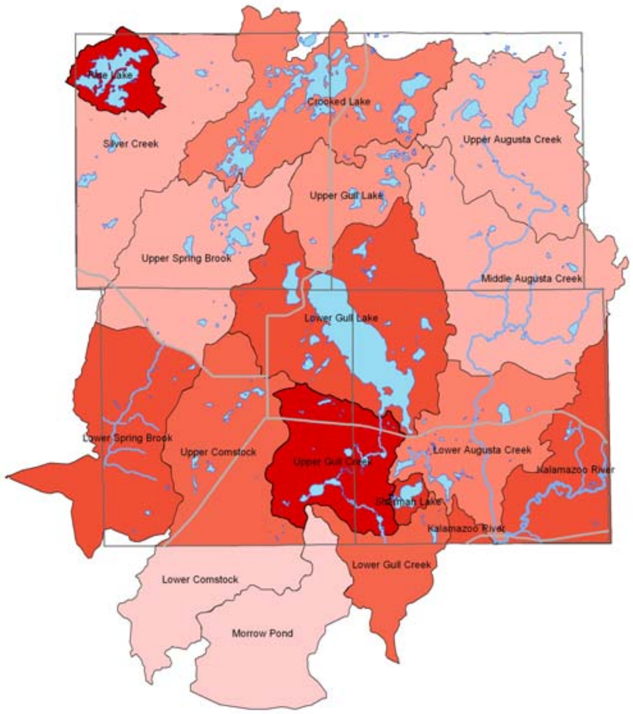

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Introduction

Limiting impervious surfaces in the four-township area is one of the key strategies to reduce the impact of development on lakes, streams and wetlands.

The following analysis provides an estimate of impervious surface area in four-township watersheds using the most recent land use data available (1994-1996). This information can be used to identify sub-watersheds at highest risk for water quality impairment caused by excessive storm water runoff.

This effort was completed as part of a USEPA non-point source pollution control grant awarded under Section 319 of the Federal Clean Water Act.

Methods

Computerized Geographic Information Systems (GIS) can be used to perform all kinds of analysis and has been used by the Four-Township Water Resources Council to help local officials and residents gain a better understanding of important natural resources.

During the late 1990s, the Western Michigan University Center for GIS Research developed maps showing land uses in the Kalamazoo River Basin, including the four-township area. Those data and watershed boundaries information developed by Dr. Dave Lusch at Michigan State University were used to estimate the area of impervious surface existing in 1994-1996, when the land use data was collected. Although the land use data is ten years old, it is the most recent available and still is current enough to be a useful tool.

The techniques used to perform this analysis were developed by staff at the Planning and Zoning Center, Inc. and Huron River Watershed Council (Wyckoff *et al*, 2003). Using this method, each land use polygon was assigned an imperviousness coefficient, which was then used to compute and estimate the impervious surface area. These coefficients were developed in southeast Michigan by measuring impervious surfaces on aerial photographs.

Each sub-watershed was categorized using a system developed by Center for Watershed Protection (Schueler, 1995). In this scheme, *sensitive streams* are those in watersheds with less than ten percent impervious surfaces; *impacted streams* occur in watersheds with 10 to 25 percent impervious surfaces; *non-supporting* streams are in watersheds with greater than 25 percent imperviousness. Although developed for stream systems, the concepts are applicable to lakes, too.

After impervious area was determined, a set of calculations estimated total imperviousness capacity and remaining impervious acres that the watersheds could sustain and still remain below 10 percent imperviousness.

Results and conclusions

All of the four-township watersheds were classified as *sensitive* and were below the 10 percent threshold where water quality impacts are likely (Figure 1). This indicates that, overall, imperviousness is not yet a major factor affecting overall stream and lake quality in the area. There are likely, though, specific sites adjacent to lakes and streams, where localized problems may occur.

Pine Lake, Sherman Lake and the Upper Gull Creek watersheds had the highest imperviousness percentage. Of particular concern are the Pine and Sherman Lake watersheds. Because of their small area and small amount of upland area relative to water and wetlands, they are particularly vulnerable to changes in impervious surfaces. A relatively small increase in impervious acres could impact water quality in those areas.

Remaining impervious surface capacity (Table 1, column I) is the average imperviousness that development should be limited to in the watershed to remain below the overall 10 percent threshold. Again, because of their small size and limited amount of remaining developable land, even development in the Pine Lake, Sherman Lake and Upper Gull Creek watersheds with relatively low imperviousness may negatively impact water quality. Development in these watersheds should be carefully designed to minimize impervious surfaces.

The next step in this analysis will be to perform the same analysis using potential future development using the township zoning maps. Using this technique, imperviousness can be estimated at *buildout*, as if all areas were developed to the maximum currently allowed under zoning regulations.

References

Schueler, T. 1995. Site Planning for Urban Stream Protection. Center for Watershed Protection, Ellicott City, Maryland.

Wyckoff, Mark, M. Manning, K. Olsson and E. Riggs. 2003. How much development is too much? A guidebook on using impervious surface and gravel road capacity analysis to manage growth in rural and suburban communities. Planning and Zoning Center and Huron River Watershed Council. http://www.hrwc.org/pdf/PAL_Guidebook.pdf.

Figure 1: Impervious surface area (percent) in four township watersheds, 1994-1996. Darker color indicates higher percentage of impervious surface.

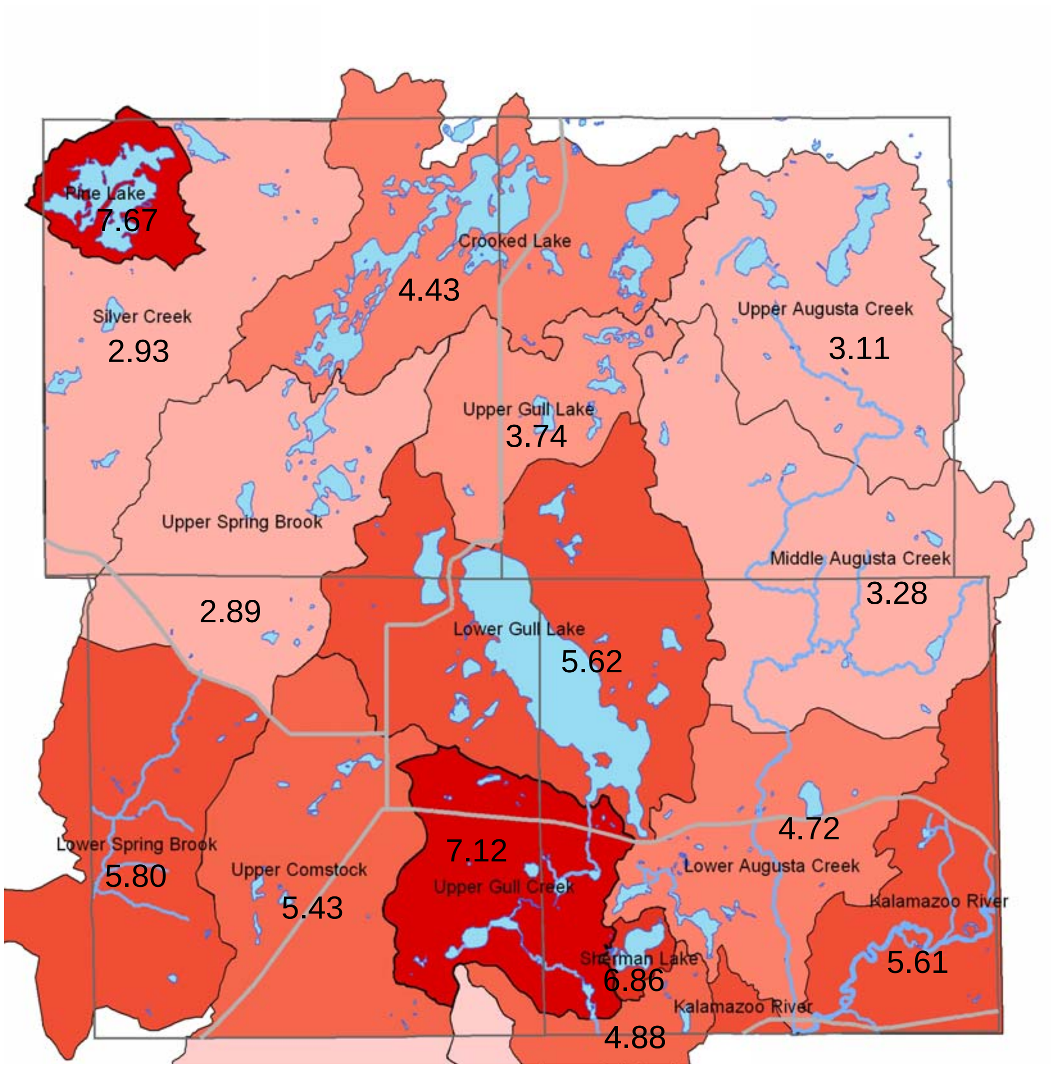

Table 1: Impervious surface capacity analysis
Sub-watersheds in the four-township area

A	B	C	D	E	F	G	H	I
Sub-watershed	**Current Impervious (percent)**	**Current impervious category**	**Total sub-watershed area (acres)**	**Buildable land remaining (acres)**	**Current impervious watershed area (acres)**	**Total impervious capacity (acres)**	**Additional impervious area sub-watershed can handle (acres)**	**Remaining Impervious surface capacity (percent)**
Upper Augusta Cr.	3.11	Sensitive	5,973.22	5,529.34	185.61	597.32	411.71	7.45
Middle Augusta Cr.	3.28	Sensitive	7,440.88	6,884.49	243.83	744.09	500.26	7.27
Lower Augusta	4.72	Sensitive	5,512.52	4,265.20	259.93	551.25	291.32	6.83
Upper Comstock	5.43	Sensitive	7,157.18	6,030.76	388.49	715.72	327.23	5.43
Crooked Lake	4.43	Sensitive	6,520.38	5,758.20	115.16	652.04	536.88	9.32
Upper Gull Creek	7.12	Sensitive	4,185.54	3,308.82	298.12	418.55	120.43	3.64
Lower Gull Creek	4.88	Sensitive	992.58	824.13	48.48	99.26	50.78	6.16
Upper Gull Lake	3.74	Sensitive	3,331.66	3,083.27	124.61	333.17	208.56	6.76
Lower Gull Lake	5.62	Sensitive	8,632.96	6,775.55	485.51	863.30	377.79	5.58
Kalamazoo River	5.61	Sensitive	3,777.05	2,992.37	211.82	377.71	165.89	5.54
Morrow Pond	2.54	Sensitive	299.87	290.27	7.63	29.99	22.36	7.70
Pine Lake	7.67	Sensitive	1,275.68	876.41	97.85	127.57	29.72	3.39
Sherman Lake	6.86	Sensitive	302.51	215.95	20.76	30.25	9.49	4.39
Silver Creek	2.93	Sensitive	7,101.16	6,661.51	208.19	710.12	501.93	7.53
Upper Spring Brook	2.89	Sensitive	7,298.91	6,880.31	211.23	729.89	518.66	7.54
Lower Spring Brook	5.80	Sensitive	4,947.52	3,751.87	287.07	494.75	207.68	5.54
Totals			**74,749.62**	**64,128.45**	**3,194.29**	**7,474.96**	**4,280.67**	

Column B – Estimated percent impervious surface in each watershed using imperviousness coefficients.
Column D – Total area of each watershed, excluding lakes and wetlands
Column E – Buildable acres computed by excluding areas currently in residential, commercial or industrial uses
Column F – Total impervious acres computed by multiplying watershed area by imperviousness percentage
Column G – Total impervious capacity computed by multiplying watershed area by maximum preferred impervious percentage (10 percent)
Column H - Additional impervious capacity computed by subtracting current impervious acres (column F) from total impervious capacity (column G)
Column I – Remaining impervious capacity computed by dividing additional impervious acres capacity (column H) by acres of buildable land remaining (column E)