# appendix c

## scoring of major subwatersheds

# Scoring of Major Subwatersheds

## Introduction

The St. Joseph River Watershed was delineated using a 30-meter Digital Elevation Model into 217 subwatersheds. GIS-data, such as land cover, impaired water bodies and trout lakes and streams, are available for the subwatersheds. County level data, such as population, number of animal units and acres harvested, are available for the basin. These types of spatial data were used to score the subwatersheds for preservation priorities and to determine which subwatersheds were impacted (mitigation priorities). A nonpoint source model was also run for the subwatersheds to determine the expected loading of total suspended solids and total phosphorus contributed to Lake Michigan annually from each subwatershed.

## Mapping Major Subwatershed Units

A series of preservation scoring scenarios were developed for the 217 subwatersheds of the basin in order to identify those with large percentages of remaining forest and wetland land cover. Attachment 1 contains the detailed subwatershed scoring report. Because the St. Joseph River Watershed is quite large and objectives developed in the Watershed Management Plan will focus on large-scale implementation efforts, scores were determined for major subwatersheds. Each named surface water body flowing into the St. Joseph River was used as a major subwatershed unit. Subwatersheds within that unit were grouped and scores were averaged for those units. Subwatersheds along the main stem, delineated by overland flow to the river, were grouped into three units (upper, middle and lower). This initial grouping resulted in 32 watersheds. Six resulting watersheds, such as the Elkhart River, were quite large, while others, along the main stem, consisted of only one subwatershed each. Therefore, the large subwatersheds were divided into smaller units. (For example, the Coldwater River unit contained the Hog Creek Subwatersheds in the first iteration because the Hog Creek flows into the Coldwater River before the confluence with the St. Joseph River. The Hog Creek was then grouped as its own subwatershed, separate from the Coldwater/Sauk Subwatershed.) This resulted in 42 subwatersheds for the basin, shown in Figure 1.

## Scoring for Preservation and Mitigation

The detailed subwatershed scoring report describes four preservation scoring scenarios. Preservation Scenario 4 was chosen for the major subwatershed scoring and is based on the percent of wetland/open water land cover, the percent of forest land cover and trout lakes and streams (discounted by 1/3, as the presence of wetland and forest cover should indicate a watershed which provides trout habitat.) Table 1 lists the subwatersheds and their average preservation and mitigation scores. Trout Creek, Mill Creek, Upper Paw Paw River and Upper Dowagiac River scored the highest for preservation. (Trout Creek and Mill Creek consist of only 1 subwatershed each.) Baugo Creek, Lower Elkhart River and Little Elkhart River scored the lowest. Figure 2 illustrates these scores. Mitigation was scored by the percent urban land cover, percent agricultural land cover, presence of impaired waters [as identified by each state's 303(d) list], and county level statistics (2000 population, 1997 animal units and 1997 atrazine use). Pine Creek, Juday Creek and the Lower Elkhart River scored the highest for mitigation, while the Upper Fawn River and Upper Pigeon River scored lowest. Figure 3 illustrates these scores.

## Land Cover Analysis

The total percent imperviousness was also averaged for each subwatershed grouped into the larger drainage units. A watershed with greater than 10% imperviousness is considered impaired, while those with 5-10% are considered threatened. Imperviousness is calculated by multiplying an imperviousness factor for

each land use type by the area of that land use type. Those values are summed and divided by the total land area of the unit. One unit was considered impaired: the Lower Main Stem. Four were considered threatened: Lower Elkhart River, Hickory Creek, Yellow Creek and Juday Creek. Figure 4 illustrates these percentages.

Table 1 also lists the average percent wetland, forest, agriculture and urban land cover. Trout Creek, Portage River and Christiana Creek contained the greatest percentage of remaining wetlands, while Trout Creek, Mill Creek and the Upper Paw Paw River contained the greatest percentage of remaining forest cover.

Nonpoint Source Model

An empirical nonpoint source model using land cover and average annual rainfall was run to determine the annual loading of total suspended solids and total phosphorus from each subwatershed of the basin. The report is included in Attachment B. An average loading for each major subwatershed was calculated from the individual loads of each subwatershed in that unit. These values are also listed in Table 1. Trout Creek, the Lower Main Stem and Hickory Creek were determined to contribute the greatest sediment loading. Hickory Creek, Lower Main Stem and Yellow Creek were determined to contribute the greatest phosphorus loading. These data are due to the urban nature of these areas and the greater amount of rainfall at the western end of the St. Joseph River Watershed.

Discussion

This averaging scheme was used to characterize the watershed and identify critical areas at the large scale. It identifies regions where preservation should be recommended and regions largely impacted by development and agricultural uses. However, averaging the scores over a broad area tends to result in many units scoring in the middle range, as site specific characteristics are lost. It is evident in the fact that most of the highest and lowest scoring units are those composed of only one subwatershed (i.e., Hickory Creek, Trout Creek, Juday Creek). These single subwatersheds were not combined with other units because they directly flow into the St. Joseph River Watershed. (An exception was made for Soap and Sand Creeks in the headwater area because they are small, contiguous subwatersheds.)

The detailed scoring scenario in Attachment A largely illustrated subwatershed scores being clustered in geographic locations. However, a few isolated scores were noted in which the subwatershed score did not match those surrounding it. An example is Turkey Creek (of the Elkhart River Watershed) which scored high for preservation because 25% of its land cover is wetland. These fine details are not seen in the scoring of the major units, but is preserved in the Attachment A report. The scores in Table 1 can be used for broad watershed characterizations.

Table 1. Major Subwatershed Scores

| Name | Area (square meters) | Nonpoint Source Loading Model | | Percent Land Cover Type | | | | Score | | Percent Total Impervious Area |
|---|---|---|---|---|---|---|---|---|---|---|
| | | TSS (lb/acre) | TP (lb/acre) | Wetland | Forest | Agriculture | Urban | Preservation | Mitigation | |
| Lower Elkhart River | 27088.1 | 105.0 | 0.2372 | 2.1 | 8.1 | 77.5 | 9.1 | 1.10 | 13.98 | 6.19 |
| Middle Elkhart River | 31878.5 | 97.9 | 0.2074 | 5.5 | 6.4 | 81.7 | 4.9 | 1.33 | 12.60 | 3.06 |
| Turkey Creek Elkhart River | 41762.7 | 96.2 | 0.1903 | 6.3 | 6.3 | 84.8 | 1.8 | 1.42 | 12.89 | 1.31 |
| North Branch Elkhart River | 42355.7 | 87.0 | 0.1880 | 11.5 | 10.0 | 75.6 | 2.0 | 2.43 | 9.48 | 1.68 |
| South Branch Elkhart River | 29174.3 | 85.5 | 0.1727 | 9.4 | 12.1 | 77.6 | 0.7 | 2.38 | 9.28 | 0.45 |
| LIttle Elkhart River | 29733.6 | 97.0 | 0.1793 | 2.8 | 8.5 | 87.4 | 0.7 | 1.19 | 10.89 | 0.81 |
| Lower Pigeon River | 47158.6 | 89.6 | 0.1805 | 8.3 | 11.5 | 78.7 | 1.2 | 2.19 | 9.36 | 0.89 |
| Upper Pigeon River | 35784.5 | 88.1 | 0.1750 | 7.3 | 11.8 | 79.5 | 1.0 | 2.10 | 6.53 | 0.92 |
| Turkey Creek Pigeon River | 18696.4 | 87.0 | 0.1705 | 8.1 | 11.2 | 80.2 | 0.5 | 2.15 | 6.68 | 0.26 |
| Lower Fawn River | 22342.5 | 95.2 | 0.2040 | 6.2 | 11.8 | 76.0 | 3.9 | 2.04 | 10.38 | 3.41 |
| Upper Fawn River | 27206.5 | 82.5 | 0.1803 | 13.4 | 14.0 | 71.0 | 1.0 | 3.05 | 6.37 | 1.07 |
| Coldwater/Sauk Rivers | 48689.7 | 83.1 | 0.1740 | 8.2 | 17.1 | 71.8 | 2.3 | 2.80 | 9.21 | 1.27 |
| Hog Creek | 27946.1 | 82.4 | 0.1602 | 6.3 | 17.9 | 74.9 | 0.6 | 2.64 | 8.34 | 0.45 |
| Lower Dowagiac River | 28308.0 | 95.0 | 0.2002 | 9.1 | 21.3 | 67.4 | 1.6 | 3.62 | 9.16 | 1.11 |
| Upper Dowagiac River | 37300.2 | 88.8 | 0.1998 | 13.5 | 21.4 | 63.3 | 1.5 | 4.05 | 8.12 | 0.96 |
| Lower Paw Paw River | 46178.2 | 101.0 | 0.2409 | 9.2 | 21.8 | 61.2 | 6.0 | 3.60 | 7.15 | 3.89 |
| Upper Paw Paw River | 58990.1 | 85.7 | 0.1782 | 0.0 | 27.9 | 62.4 | 1.0 | 4.13 | 7.07 | 0.78 |
| Beebe Creek | 10851.8 | 74.5 | 0.1545 | 10.4 | 23.6 | 65.8 | 0.2 | 3.65 | 7.35 | 0.10 |
| Soap Creek, Sand Creek | 8762.8 | 80.0 | 0.1530 | 5.6 | 21.4 | 72.6 | 0.4 | 2.85 | 7.80 | 0.20 |
| Tekonsha Creek | 5625.0 | 77.0 | 0.1490 | 6.2 | 24.8 | 68.9 | 0.0 | 3.30 | 9.00 | 0.12 |
| Nottawa Creek | 45818.4 | 78.9 | 0.1601 | 9.3 | 22.7 | 67.6 | 0.2 | 3.49 | 9.11 | 0.19 |
| Little Portage Creek | 11432.4 | 91.5 | 0.1680 | 2.8 | 16.2 | 80.4 | 0.6 | 1.95 | 9.10 | 0.33 |
| Portage River | 50662.3 | 83.2 | 0.1891 | 14.4 | 16.3 | 66.9 | 2.1 | 3.42 | 8.79 | 1.01 |
| Swan Creek | 22462.4 | 85.0 | 0.1703 | 8.1 | 15.5 | 75.4 | 0.9 | 2.90 | 8.87 | 0.39 |
| Prairie River | 60721.6 | 84.7 | 0.1778 | 11.1 | 14.1 | 73.5 | 0.9 | 2.90 | 8.09 | 0.70 |
| Rocky River | 43481.8 | 85.1 | 0.1843 | 11.1 | 20.5 | 66.4 | 1.5 | 3.69 | 8.31 | 0.72 |
| Mill Creek | 11312.1 | 73.5 | 0.1615 | 12.9 | 30.3 | 56.6 | 0.2 | 5.30 | 7.85 | 0.10 |
| Trout Creek | 7928.0 | 124.0 | 0.1660 | 17.3 | 32.9 | 48.7 | 1.0 | 6.50 | 9.70 | 0.49 |
| Pine Creek | 7996.0 | 95.0 | 0.1830 | 3.3 | 12.3 | 81.9 | 1.9 | 1.60 | 14.30 | 1.01 |
| Baugo Creek | 19959.3 | 104.8 | 0.1928 | 1.8 | 5.7 | 90.5 | 1.2 | 0.80 | 12.73 | 1.11 |
| Peterbaugh Creek | 4261.0 | 97.0 | 0.2250 | 7.0 | 13.7 | 69.5 | 7.7 | 2.20 | 11.30 | 4.48 |
| Christiana Creek | 25681.6 | 84.6 | 0.2070 | 13.7 | 22.6 | 57.8 | 4.3 | 4.04 | 9.10 | 2.87 |
| Cobus Creek | 9151.0 | 95.0 | 0.2060 | 5.5 | 19.0 | 69.1 | 5.0 | 2.60 | 12.10 | 3.13 |
| Juday Creek | 9252.0 | 110.0 | 0.2680 | 0.7 | 12.8 | 69.0 | 14.5 | 1.40 | 13.40 | 8.38 |
| Brandywine Creek | 6134.0 | 95.0 | 0.2100 | 5.4 | 26.7 | 61.7 | 5.4 | 4.00 | 8.40 | 2.79 |
| McCoy Creek | 6063.0 | 106.0 | 0.2450 | 8.1 | 22.7 | 62.1 | 5.4 | 3.60 | 8.80 | 3.51 |
| Pipestone Creek | 12869.7 | 107.0 | 0.2025 | 3.9 | 20.1 | 74.9 | 1.1 | 3.35 | 7.90 | 0.51 |
| Yellow Creek | 13023.0 | 111.0 | 0.2850 | 3.6 | 22.0 | 58.2 | 14.6 | 4.00 | 7.40 | 7.01 |
| Hickory Creek | 13022.0 | 111.0 | 0.2850 | 3.6 | 22.0 | 58.2 | 14.6 | 4.00 | 7.40 | 7.01 |
| Middle Main Stem | 29351.7 | 91.0 | 0.1996 | 7.5 | 17.1 | 69.8 | 4.2 | 2.66 | 10.89 | 2.85 |
| Upper Main Stem | 52601.7 | 81.9 | 0.1804 | 9.6 | 18.7 | 67.6 | 3.4 | 3.08 | 8.89 | 2.01 |
| Lower Main Stem | 62466.6 | 116.0 | 0.3345 | 6.2 | 18.3 | 51.1 | 18.0 | 2.96 | 11.20 | 12.85 |

Figure 1. Major Subwatershed Units.

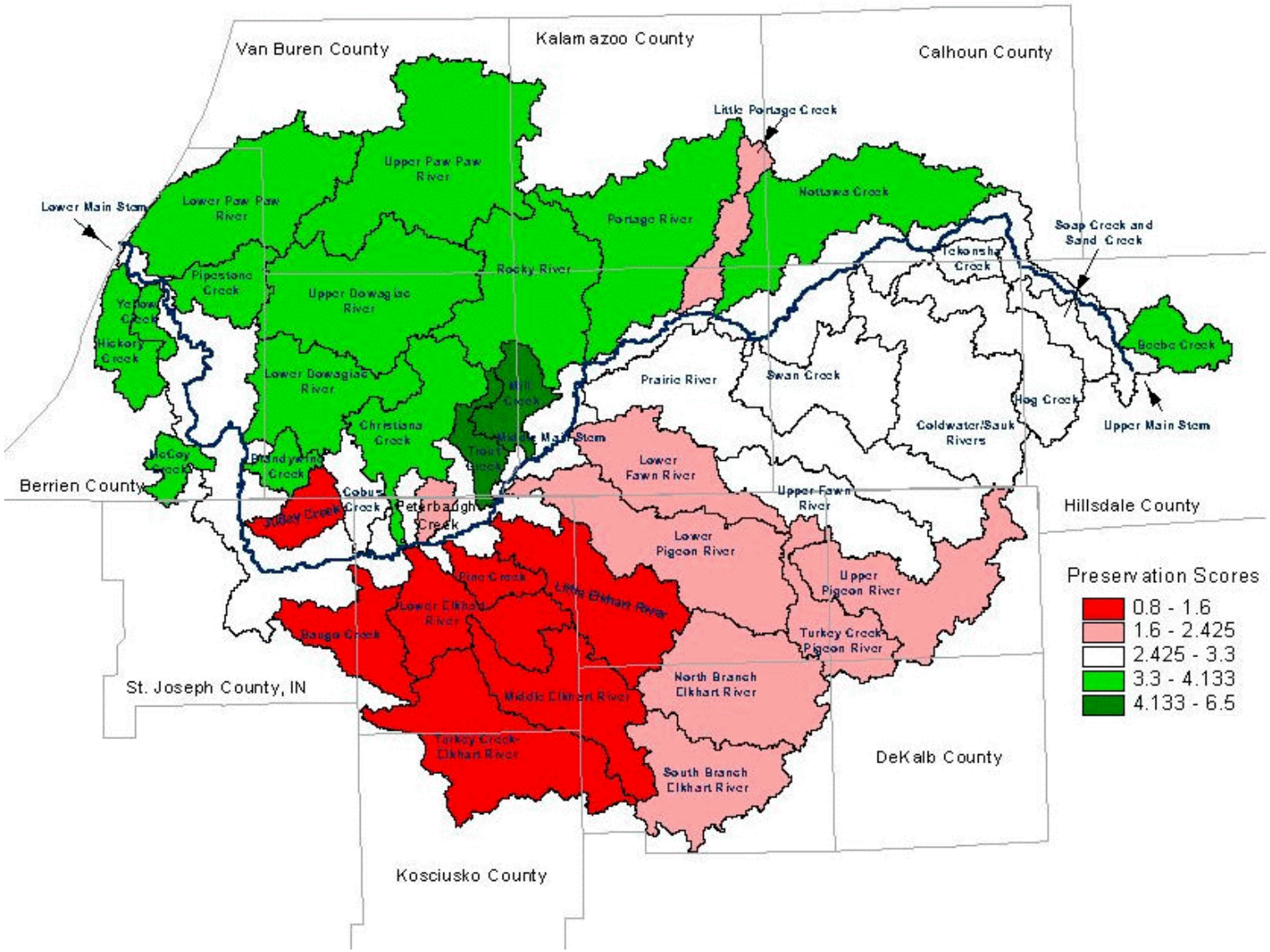


Figure 2. Major units scored for preservation.

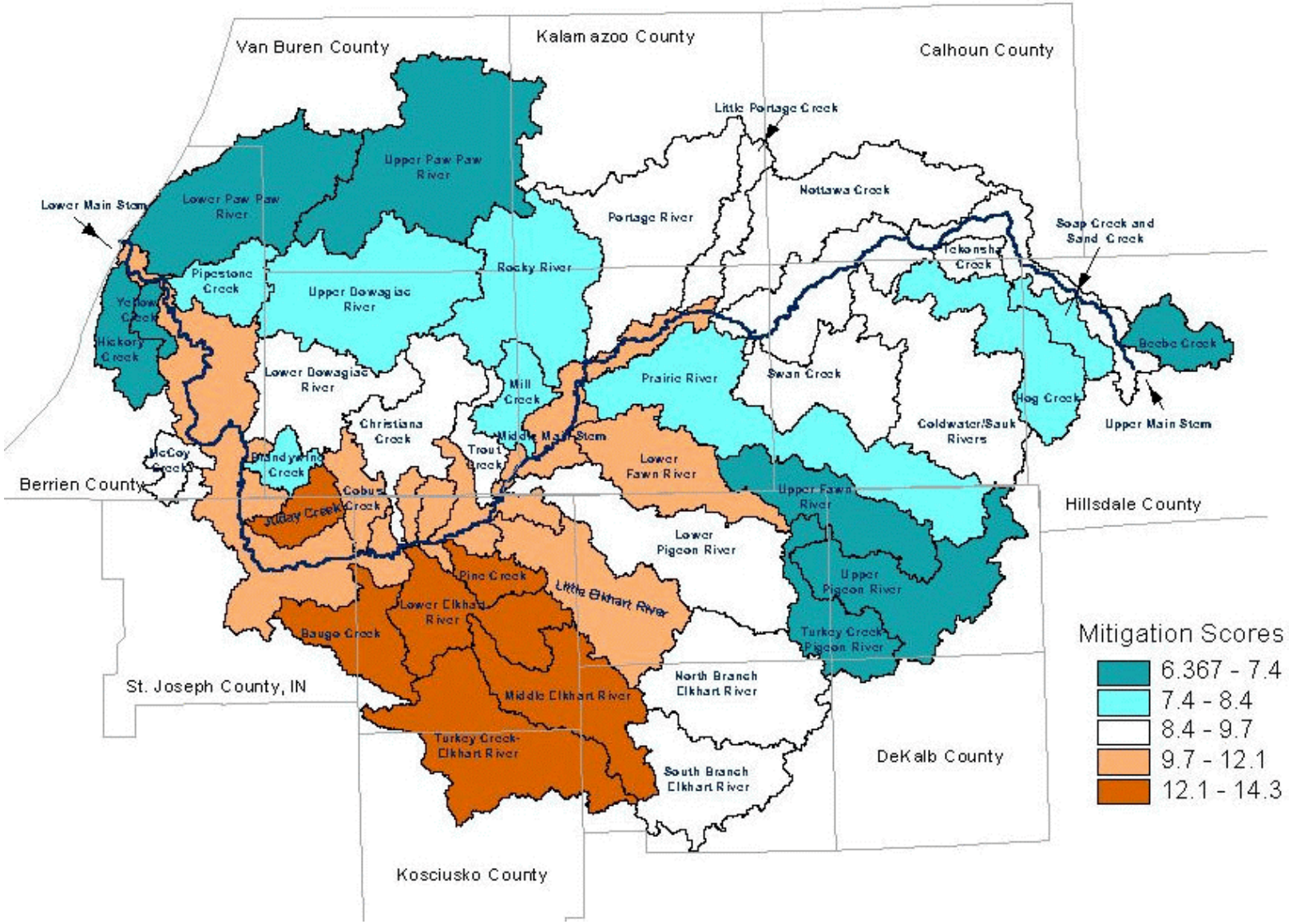


Figure 3. Major units scored for mitigation.

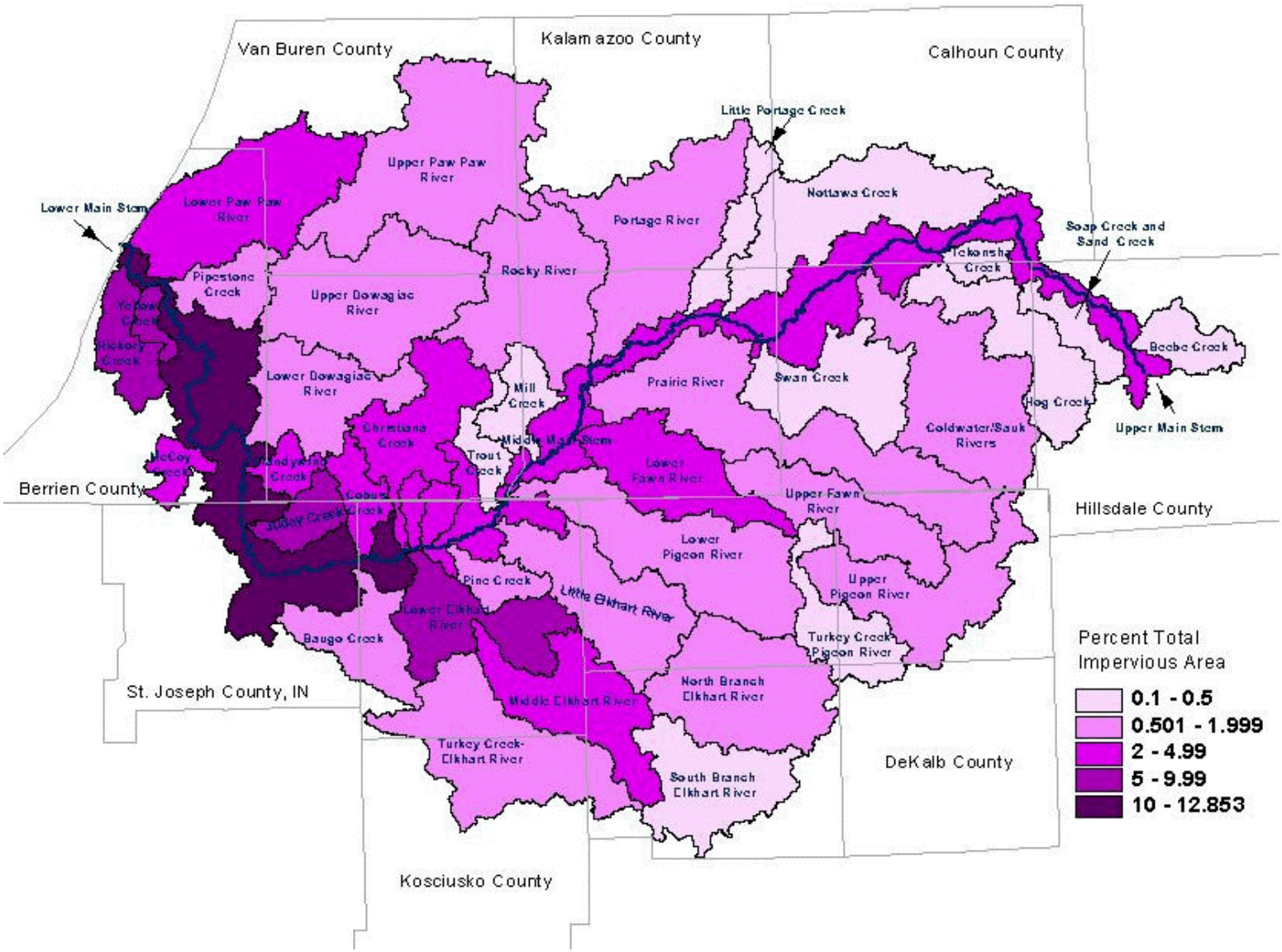


Figure 4. Total percent imperviousness for major units.