# Appendix 1
# Local Land Use Analysis

**Historic Land Use**

The following history of land use in the Flint River Watershed was described by Joe Leonardi in 2001:

> Prior to European settlement vegetation consisted of open forests and savannas of black and white oak on the sandy loam moraines and beech-sugar maple forests with some white oak on the clay-rich soils (Albert 1994). Depressions supported alder and conifer swamps with white pine, white cedar, tamarack, black ash, and eastern hemlock. (Leonardi)
>
> When the first European explorers arrived in the Saginaw Valley, they found it populated by Chippewa and Ottawa Indians, with the Chippewas being more numerous (Ellis 1879). However, Chippewa history tells that when they came into the area the Sauks and Onottoways inhabited the valley.
>
> When early French fur traders moved into the Flint River Valley, they established an encampment at a natural river crossing used by Native Americans. The Indian name for this river was Pewonigowink meaning "river of fire stone" or river of flint. The crossing was located on the "southern bend" of the Flint River on the “Saginaw Trail” that ran between villages at the outlet of Lake St. Clair (Detroit) and encampments at the mouth of the Saginaw River. It was located very near the mouth of the Swartz Creek. This crossing became known as the “Grand Traverse” or great crossing place. A permanent trading post was established when Jacob Smith arrived in 1819 (Crowe 1945).
>
> The City of Flint grew up at the site of the “Grand Traverse” and European settlers concentrated along the banks of the Flint River, taking up farming, lumbering, and manufacturing. Permanent human settlement brought great change to the landscape as the land began to be altered for human benefit. Although Michigan was primarily an agricultural state before the Civil War, lumbering became the principal economic activity in the new state during the second half of the 19th century (Fitting 1975). Muskegon, Menominee, and Saginaw were lumbering centers and “lumbering altered much of the landscape, as all of the timber of the northern lower peninsula and much of the upper peninsula was removed between 1860 and 1910” (Fitting 1975). Truman Fox (1858) described the Flint River…Pine is found in abundance upon the banks of this stream… many rich bottomlands are also found along this river. The river also affords a number of excellent mill sites, and is already being applied to a variety of manufacturing purposes.” With a good supply of high quality lumber and a need to move supplies from town to lumbering camps, it is not surprising that Flint became a center for transportation producing horses, horse harnesses, horse drawn vehicles and ox carts. By 1900, Flint was building 150000 vehicles per year, both wagons and carts. As the pine forests were exhausted, Flint’s attention turned to other industries, and the transition to automobile manufacturing was natural (Crowe 1945). In 1903, Buick Motor Company began production of the Buick automobile. Under the business genius of Will Durant, formerly of Durant-Dort Carriage Company, Buick Motor Company convinced suppliers such as Champion Spark Plug Company, Weston-Mott (Axle) Company, and Fisher Body

Company to relocate in Flint. Flint became the birthplace of General Motors and the United Auto Workers (UAW) union. Even today, Flint is often referred to as Buick City and its prosperity centered on the manufacture of automobiles.

After World War II, prosperity fostered population increase and diversifying communities. Gasoline was inexpensive, new highways were built, and General Motors, the UAW, and Flint Flourished. Outlying communities of Lapeer, Davison and Grand Blanc experienced growth and were desirable locations to live and work. Advancements in the gasoline engine allowed for increased agriculture and farming dominated watershed land use.

Currently the Flint River Watershed is changing. A community, whose economic welfare traditionally was tied to the prosperity of General Motors, has had to seek economic stability through diversification. New businesses have become important and redevelopment of underused industrial properties to attract new business has been a challenge. More recently, the increased demand for new residential and small commercial development is replacing agriculture. (Kubic 2006)

**Current Land Uses**

The National Oceanic and Atmospheric Administration's (NOAA) Coastal Change Analysis Program (CCAP) 1995 and 2000 data sets were used to determine land cover in the Flint River South Branch watershed using the ESRI ArcView ATtILA extension. Area specific data was extracted using the boundaries for the South Branch watershed and its nine sub-watersheds. The 22-category CCAP land use classification was collapsed into the best approximation of the Anderson Level I classification system permitted by the ATtILA landscape characteristics function, making the final number of ATtILA generated fields smaller and easier to work with. The two data sets were subsequently exported to Microsoft Excel for post-processing re-calculating area, arranging fields, and calculating percentages. This final output can be seen in Table A1.1 and Table A1.2. Both tables present the same ATtILA data summary for 1995 and 2000 respectively. *Watershed* gives the name of the sub-watersheds in the South Branch. *Area* provides the area of each sub-watershed in acres. *%Watershed* is the percent of the South Branch watershed made up by each sub-watershed. *%Water and Water Area* give the percent and area of that land in the sub-watershed designated as open water. *%Natural* and *Natural Area* are both metrics that give the percent and total area of natural land cover in each sub-watershed. Conversely, *%Human* and *Human Area* are metrics that give the percent and total area of human influenced land cover in each sub-watershed. Table A1.3 shows differences between the 1995 and 2000 CCAP land cover dataset for each sub-watershed with the exception of *Area* and *%Watershed* since there is no change in these metrics. Table A1.3 shows less than 1% change between the two data sets. The small, negative, changes in *Percent Water* can probably be attributed to the filling of unregulated wetlands or wetland drying due to insufficient precipitation. The increase in *Percent Natural* land and corresponding decrease in *Percent Human* can be attributed to seral succession of agricultural fields. This is borne out by the decrease observed in the *Percent Ag* and *Ag Area* fields added to this table.

**Table A1.1**

| 2000 CCAP ATtILA Landscape Characteristics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Watershed** | **Acres** | **Percent Watershed** | **Percent Water** | **Water Area** | **Percent Natural** | **Natural Area** | **Percent Human** | **Human Area** |
| Flint River Main Branch | 11,395.3180 | 17.8 | 0.26 | 165.71 | 49.60 | 5569.9 | 50.40 | 5,659.7260 |
| Hunters Creek | 8,297.3430 | 12.96 | 0.19 | 122.55 | 59.40 | 4856.2 | 40.60 | 3,318.5760 |
| Mirror Creek | 3,880.4440 | 6.06 | 0.14 | 87.72 | 47.87 | 1815.6 | 52.13 | 1,977.0900 |
| Pine Creek | 8,479.7620 | 13.25 | 0.13 | 82.80 | 40.05 | 3362.8 | 59.95 | 5,034.1300 |
| Pine Creek Headwaters | 3,515.4370 | 5.49 | 0.06 | 37.85 | 61.68 | 2145.0 | 38.32 | 1,332.5900 |
| South Branch Headwaters | 18,300.2840 | 28.59 | 0.56 | 355.91 | 57.06 | 10238.8 | 42.94 | 7,705.5370 |
| Unknown Creek | 2,758.8260 | 4.31 | 0.06 | 37.16 | 62.77 | 1708.4 | 37.23 | 1,013.2310 |
| Whigville Creek | 4,703.0280 | 7.35 | 0.19 | 122.58 | 67.48 | 3090.8 | 32.52 | 1,489.6010 |
| Whigville Lakeshead | 2,674.0720 | 4.18 | 0.17 | 108.08 | 70.46 | 1808.1 | 29.54 | 757.9216 |
| Flint River Watershed | 64,004.5140 | 100.0 | 1.75 | 1120.37 | 55.02 | 34595.7 | 44.99 | 28,288.4000 |

**Table A1.2**

| 1995 CCAP ATtILA Landscape Characteristics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Watershed** | **Acres** | **Percent Watershed** | **Percent Water** | **Water Area** | **Percent Natural** | **Natural Area** | **Percent Human** | **Human Area** |
| Flint River Main Branch | 11,395.3180 | 17.80 | 0.27 | 172.8294 | 49.37 | 5540.10 | 50.63 | 5,682.4106 |
| Hunters Creek | 8,297.3430 | 12.96 | 0.2 | 125.6669 | 59.49 | 4861.60 | 40.51 | 3,310.1248 |
| Mirror Creek | 3,880.4440 | 6.06 | 0.15 | 95.5062 | 47.86 | 1811.40 | 52.14 | 1,973.5318 |
| Pine Creek | 8,479.7620 | 13.25 | 0.17 | 109.2649 | 39.86 | 3336.60 | 60.14 | 5,033.9073 |
| Pine Creek Headwaters | 3,515.4370 | 5.49 | 0.07 | 43.8535 | 61.71 | 2142.30 | 38.29 | 1,329.2540 |
| South Branch Headwaters | 18,300.2840 | 28.59 | 0.57 | 362.1384 | 56.85 | 10198.6 | 43.15 | 7,739.5629 |
| Unknown Creek | 2,758.8260 | 4.31 | 0.06 | 37.1579 | 62.77 | 1708.40 | 37.23 | 1,013.2309 |
| Whigville Creek | 4,703.0280 | 7.35 | 0.22 | 141.9322 | 67.53 | 3079.90 | 32.47 | 1,481.1497 |
| Whigville Lakeshead | 2,674.0720 | 4.18 | 0.18 | 113.1954 | 70.33 | 1801.20 | 29.67 | 759.7008 |
| Flint River Watershed | 64,004.5140 | 100.00 | 1.88 | 1,201.5447 | 54.90 | 34480.1 | 45.10 | 28,322.8728 |

**Table A1.3**

| CCAP Land Use Change (2000-1995) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Watershed** | **Percent Ag** | **Ag Area** | **Percent Water** | **Water Area** | **Percent Natural** | **Natural Area** | **Percent Human** | **Human Area** |
| Flint River Main Branch | -0.36 | -36.9175 | -0.01 | -7.1166 | 0.23 | 29.8 | -0.23 | -22.6846 |
| Hunters Creek | -0.72 | -57.6003 | -0.01 | -3.1135 | -0.09 | -5.4 | 0.09 | 8.4512 |
| Mirror Creek | -0.03 | 2.446343 | -0.01 | -7.7838 | 0.01 | 4.2 | -0.01 | 3.5582 |
| Pine Creek | -0.21 | -2.44634 | -0.04 | -26.4650 | 0.19 | 26.2 | -0.19 | 0.2227 |
| Pine Creek Headwaters | 0.03 | 3.335923 | -0.01 | -6.0047 | -0.03 | 2.7 | 0.03 | 3.3360 |
| South Branch Headwaters | -0.69 | -122.317 | -0.01 | -6.2271 | 0.20 | 40.2 | -0.20 | -34.0259 |
| Whigville Creek | 0.00 | 0 | 0.00 | 0.0000 | 0.00 | 0.0 | 0.00 | 0.0001 |
| Unknown Creek | 0.05 | 8.228609 | -0.03 | -19.3484 | -0.05 | 10.9 | 0.05 | 8.4514 |
| Whigville Lakeshead | -0.19 | -3.33592 | -0.01 | -5.1151 | 0.13 | 6.9 | -0.13 | -1.7792 |
| Flint River Watershed | -0.39 | -208.606 | -0.13 | -81.1741 | 0.11 | 115.6 | -0.11 | -34.4728 |

The categories of *Percent Natural* and *Percent Human* show the total percentages of natural and human land cover for each watershed. This distinction offers a quick but valuable insight into the land cover divisions of the sub-watersheds and their relationships within the South Branch. This data - from the 2000 CCAP dataset - has been graphed in figures A1.01 - A1.10. From this preliminary breakdown, two things are quickly evident. First, figures A1.01, A1.03, and A1.04 show that only three of the sub-watersheds in the South Branch have human land covers equal to or greater than 50%. The rest of the sub-watersheds all have natural land covers greater than 50%, and four have natural land covers greater than 60%. See figures A1.05, A1.07, A1.08, and A1.09.

The land cover figures also demonstrate the increase in human impact on a stream from its headwaters to its main stream. In figures A1.01 and A1.06, the Main Branch experiences a 7% drop in natural land cover from its headwaters to its main stream. In figures A1.08 and A1.09, Whigville Creek loses 3% of its natural land cover. However, it is in figures A1.04 and A1.05 that this relationship shows the starkest contrast. The Pine Creek watershed loses 22% of its natural land cover from its headwaters to its main channel. There is added significance to the loss of natural land cover from the upper to lower reaches of this watershed because the headwaters of Pine Creek provide the habitat for one of Southeast Michigan's few trout populations. The main channel can't support these trout due to the increase in human land cover and its associated thermal and sedimentation impacts on the river.

**Figure A1.01**

**South Branch Main Branch Watershed Use**

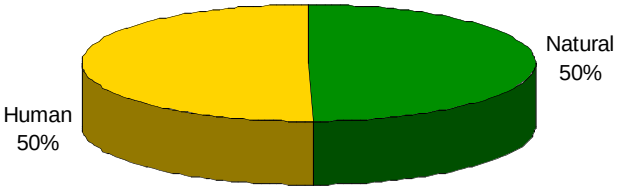



**Figure A1.02**

**Hunters Creek Watershed Use**

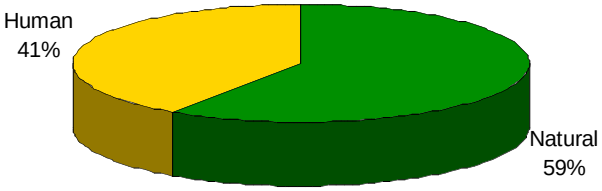



**Figure A1.03**

**Mirror Creek Watershed Use**

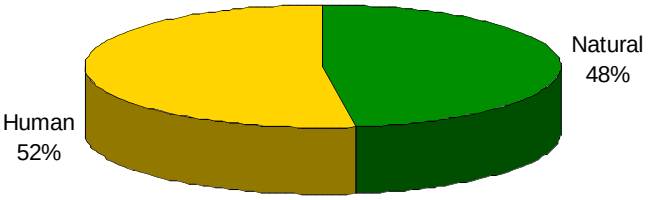



**Figure A1.04**

**Pine Creek Watershed Use**

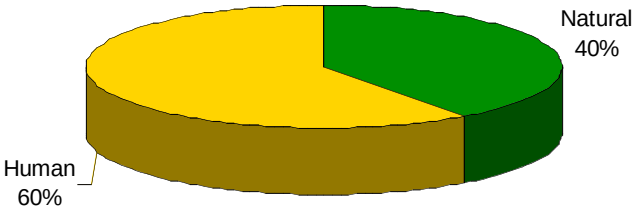



**Figure A1.05**

**Pine Creek Headwaters Watershed Use**

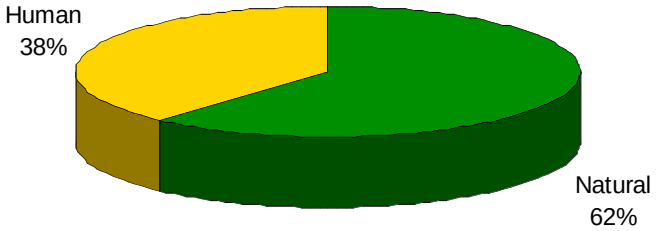



**Figure A1.06**

**South Branch Headwaters Watershed Use**

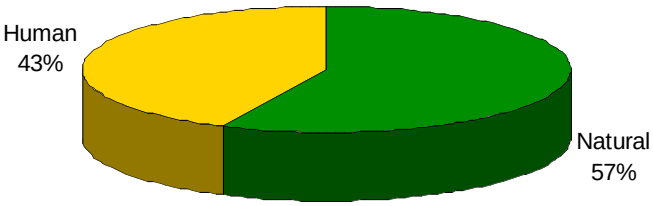


**Figure A1.07**

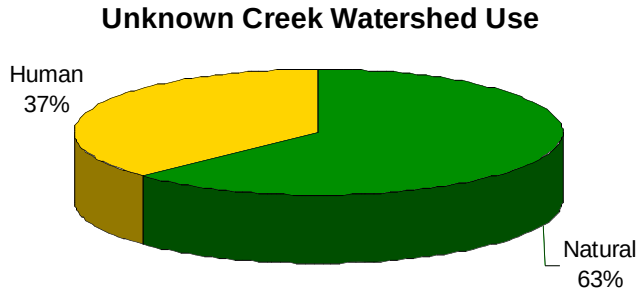



**Figure A1.08**

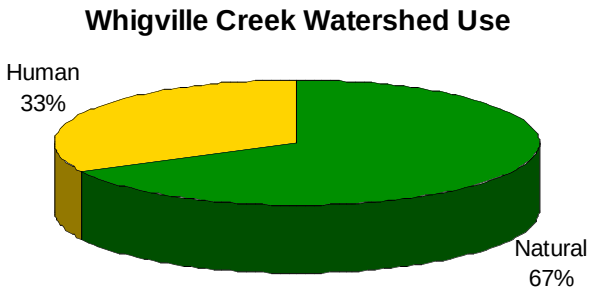



**Figure A1.09**

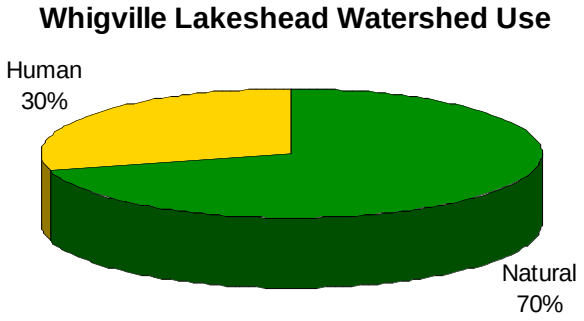
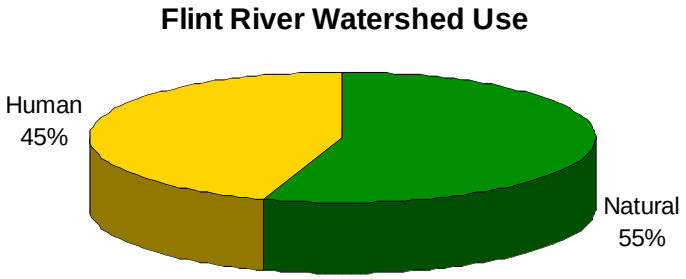



**Figure A1.10**



Figures 1.11 through 1.20 break the human and natural land cover groups down into more discrete classes. Human land cover is broken into crop, man made barren, and urban land covers while natural land cover is broken down into forest, wetland, natural grassland, and natural barren land covers. Barren land does not show up above 1% in any of the watersheds, and when it does, it is invariably man-made (see figures A1.12, A1.16, and A1.20). Urban land is also low, with the majority of human land cover in all sub-watersheds showing up as crop land. This meshes nicely with visual impressions of the South Branch made during field trips. With the exception of those areas immediately adjacent to urbanized areas such as the Village of Metamora or the City of Lapeer, the watershed is remarkably undeveloped with agriculture clearly making up the largest human use. Pine Creek is notable among all of the watersheds, however, for having the largest amount of cropland at 57% (see figure A1.14) while its upper reaches have 20% less (see figure A1.15). This shows the marked distinction in watershed habitat between the upper and lower reaches of this river and indicates why trout are not found in the main channel north of I-69.

**Figure A1.11**

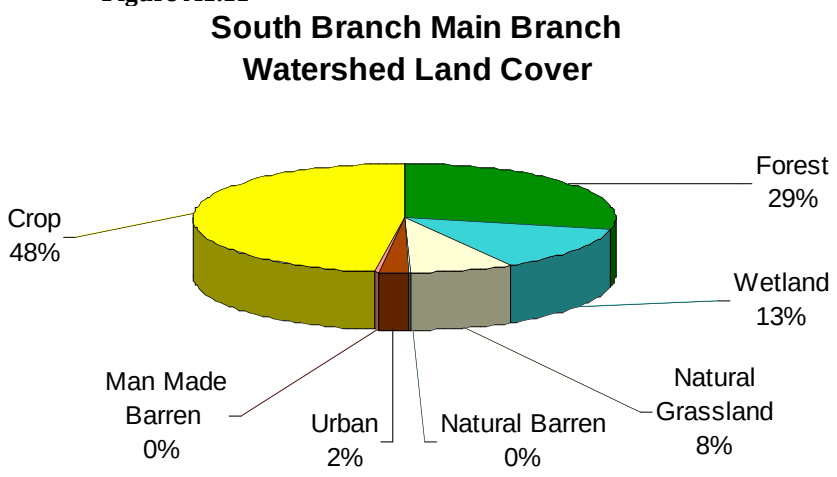


**Figure A1.12**

## Hunters Creek Watershed Land Cover

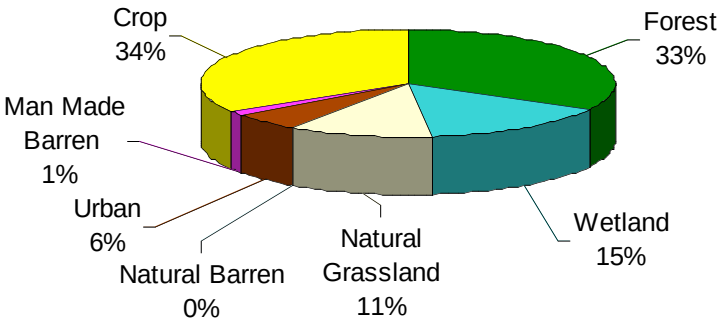



**Figure A1.13**

## Mirror Creek Watershed Land Cover

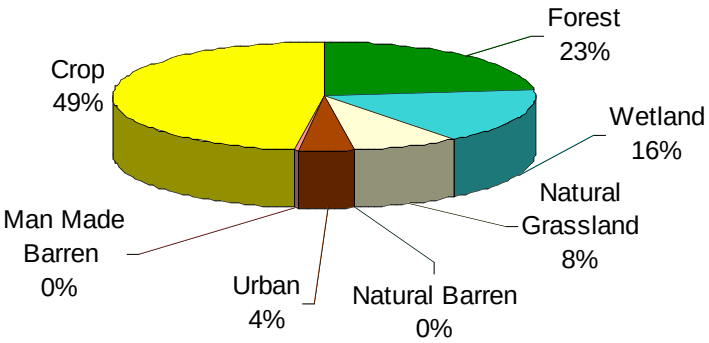



**Figure A1.14**

## Pine Creek Watershed Land Cover

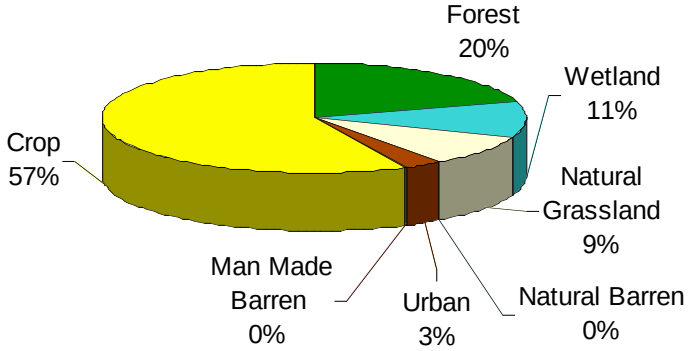



**Figure A1.15**

## Pine Creek Headwaters Watershed Land Cover

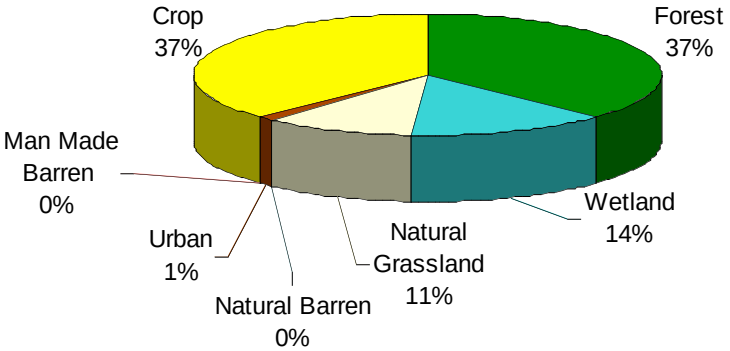


**Figure A1.16**

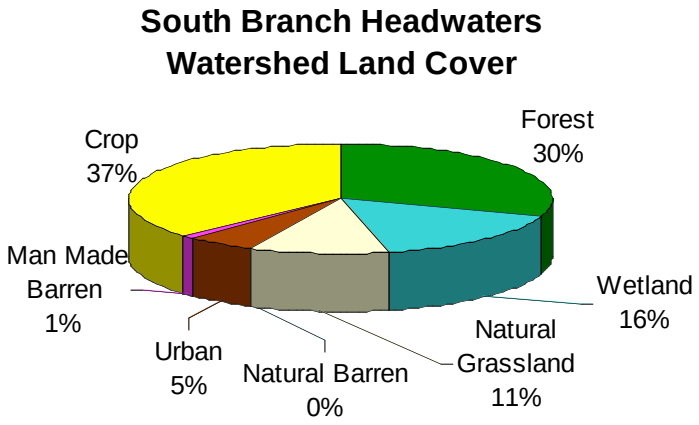



**Figure A1.17**

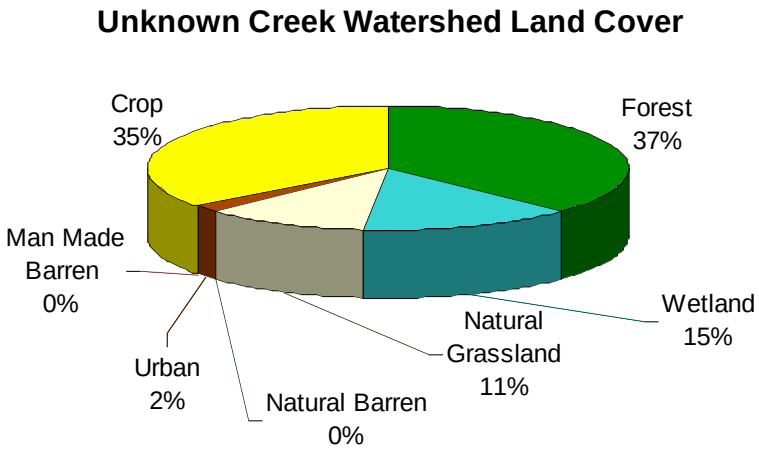



**Figure A1.18**

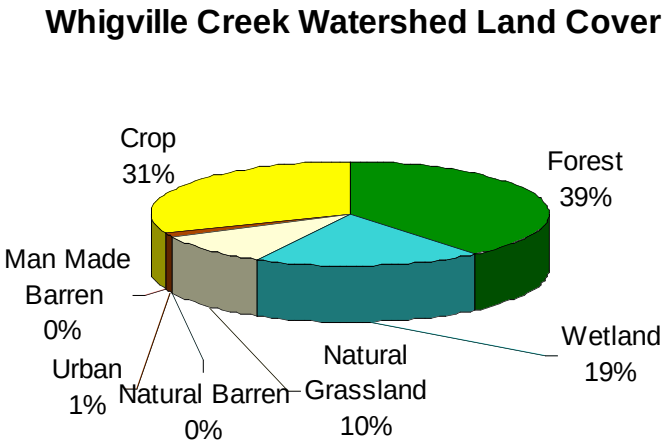
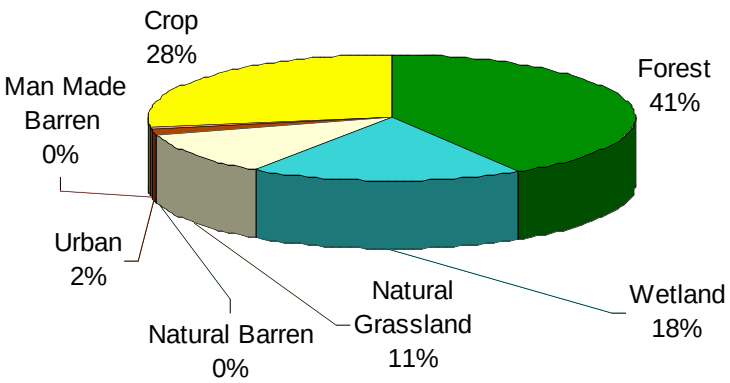



**Figure A1.19**



The land cover of a watershed is extremely important to the health of a river system. Increases in human land uses can intensify runoff to rivers, increase peak flows and lead to flooding problems, while simultaneously decreasing precipitation infiltration and contributing to low flows during dry periods. The riparian area adjacent to a river is extremely important to the health of a river and can have an immediate impact on the health of a river. If differences in riparian land cover are present, they may not show up in a landscape analysis of the entire watershed due to riparian lands making up a proportionally smaller part of the landscape.

ATtILA's riparian characteristics function is identical to its watershed-wide landscape analysis function discussed earlier, but on a narrower, user-defined buffer of the river. This riparian characteristics calculation was run using a 60 meter (197 foot) buffer. The desired buffer was 150 feet since that is the maximum width the NRCS considers when undertaking stream-bank stabilization projects, but the cell size of the 2000 CCAP data is 30 meter (98 feet) on a side. The 60 meter buffer is larger than desired, but it captures the desired range plus an extra 47 feet on each side of a river.

The results of the ATtILA riparian characteristics calculations on the 1995 and 2000 CCAP data can be seen in table 1.4 and 1.5. Table 1.6 is the difference table between 2000 and 1995. Field headings are the same as those in the landscape characteristics tables, all area metrics are in acres, and the last record in each table contains the calculation for the South Branch watershed. The relationship between natural and human land cover is graphed in figures A1.20-A1.28. These graphs show that the 60 meter riparian corridor analyzed in the sub-watersheds has less human and more natural land cover than their counterparts in figures A1.01-A1.10. This is an encouraging sign that the riparian corridor is in better condition than the rest of the watershed. The next group of graphs, figures A1.29-A1.37, presents the breakdown of all land covers for each sub-watershed. By comparing these figures to the land cover graphs of the sub-watersheds (figures A1.11-A1.19) similar trends can be seen in each set. They both show an increase in human land uses from the upper to lower watersheds of a stream, and the major human land use is cropland. Also, a large increase in wetlands can be seen in the riparian corridor. This increase is not unusual; the natural locations of wetlands are the topographic depressions near rivers and ponds. Most sub-watersheds show a corresponding drop in the percentage of cropland in the riparian corridor, which also would be expected given the technical difficulties and expense of draining the wetlands directly adjacent to open water. Pine Creek is an exception to this trend, showing only a 4% decrease in cropland in the riparian corridor. This is especially notable given that this watershed has the highest percentage of cropland. The fact that it also has the highest amount in the riparian corridor of any stream is a probable factor in the absence of trout from the main stream section. The proximity of agricultural land to the river can cause many problems for a stream, as mentioned earlier. This data matches well with the DEQ Thermal Habitat Classification map shown in figure A1.38, which shows the increasing temperature of Pine Creek from its headwaters to its confluence with the Main Branch of the Flint River.

**Table A1.4**

| *1995 CCAP ATtILA Riparian Characteristics - 60 meter buffer* | | | | | |
|---|---|---|---|---|---|
| *Watershed* | *Acres* | *Percent Natural* | *Natural Area* | *Percent Human* | *Human Area* |
| South Branch Headwaters | 18,300.3568 | 76.05 | 2,209.4928 | 23.95 | 695.8735 |
| Unknown Creek | 2,758.8367 | 74.86 | 460.3573 | 25.14 | 154.5644 |
| Whigville Creek | 4,703.0466 | 82.85 | 673.6340 | 17.15 | 139.4416 |
| Whigville Lakeshead | 2,674.0830 | 78.08 | 446.1241 | 21.92 | 125.2083 |
| Pine Creek Headwaters | 3,515.4511 | 78.59 | 324.9189 | 21.41 | 88.5131 |
| Flint River Main Branch | 11,395.3635 | 72.24 | 1,480.9273 | 27.76 | 569.1084 |
| Hunters Creek | 8,297.3758 | 77.37 | 1,210.2727 | 22.63 | 354.0526 |
| Mirror Creek | 3,880.4600 | 70.01 | 480.1505 | 29.99 | 205.7152 |
| Pine Creek | 8,479.7957 | 44.86 | 625.8191 | 55.14 | 769.2638 |
| Flint River South Branch | 64,004.7693 | 71.86 | 7,939.9407 | 28.14 | 3,109.3023 |

**Table A1.5**

| *2000 CCAP ATtILA Riparian Characteristics - 60 meter buffer* | | | | | |
|---|---|---|---|---|---|
| *Watershed* | *Acres* | *Percent Natural* | *Natural Area* | *Percent Human* | *Human Area* |
| Flint River Main Branch | 11,395.3636 | 72.26 | 1,483.1512 | 27.74 | 569.3308 |
| Hunters Creek | 8,297.3758 | 77.33 | 1,210.2727 | 22.67 | 354.7198 |
| Mirror Creek | 3,880.4600 | 70.10 | 481.2624 | 29.90 | 205.2704 |
| Pine Creek | 8,479.7957 | 45.13 | 630.0446 | 54.87 | 765.9278 |
| Pine Creek Headwaters | 3,515.4511 | 78.38 | 323.3621 | 21.62 | 89.1803 |
| South Branch Headwaters | 18,300.3569 | 76.04 | 2,209.0480 | 23.96 | 696.0959 |
| Unknown Creek | 2,758.8368 | 74.86 | 460.3573 | 25.14 | 154.5644 |
| Whigville Creek | 4,703.0467 | 82.85 | 673.6340 | 17.15 | 139.4416 |
| Whigville Lakeshead | 2,674.0830 | 78.40 | 448.7928 | 21.60 | 123.6515 |
| Flint River South Branch | 64,004.7695 | 71.90 | 7,948.1693 | 28.10 | 3,105.7440 |

**Table A1.6**

| *CCAP Riparian Characteristics Change (200-1995)* | | | | | |
|---|---|---|---|---|---|
| *Watershed* | *Acres* | *Percent Natural* | *Natural Area* | *Percent Human* | *Human Area* |
| South Branch Headwaters | 0.0001 | -3.79 | -0.4448 | 3.79 | 0.2224 |
| Unknown Creek | 0.0000 | 2.47 | 0.0000 | -2.47 | 0.0000 |
| Whigville Creek | 0.0000 | -12.75 | 0.0000 | 12.75 | 0.0000 |
| Whigville Lakeshead | 0.0000 | -32.95 | 2.6687 | 32.95 | -1.5568 |
| Pine Creek Headwaters | 0.0000 | -0.21 | -1.5568 | 0.21 | 0.6672 |
| Flint River Main Branch | 0.0001 | 3.80 | 2.2239 | -3.80 | 0.2224 |
| Hunters Creek | 0.0000 | -2.50 | 0.0000 | 2.50 | 0.6672 |
| Mirror Creek | 0.0000 | 12.84 | 1.1120 | -12.84 | -0.4448 |
| Pine Creek | 0.0000 | 33.54 | 4.2255 | -33.54 | -3.3359 |
| Flint River South Branch | 0.0003 | 0.04 | 8.2286 | -0.04 | -3.5583 |

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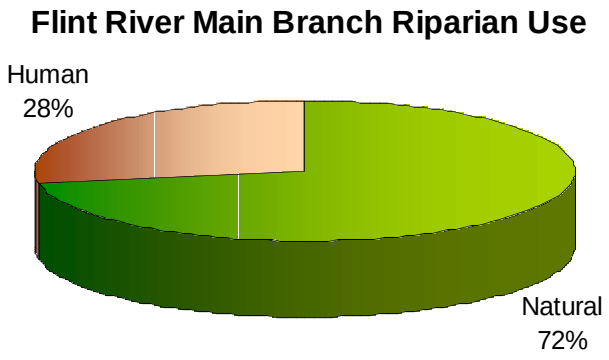


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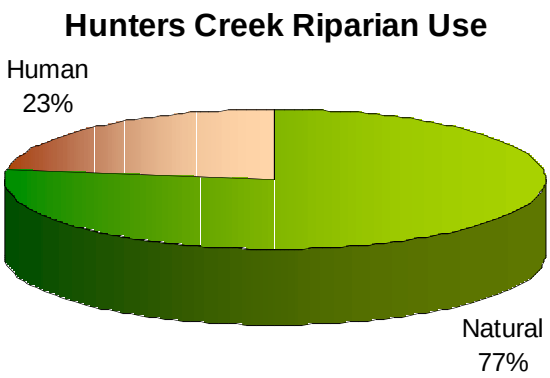


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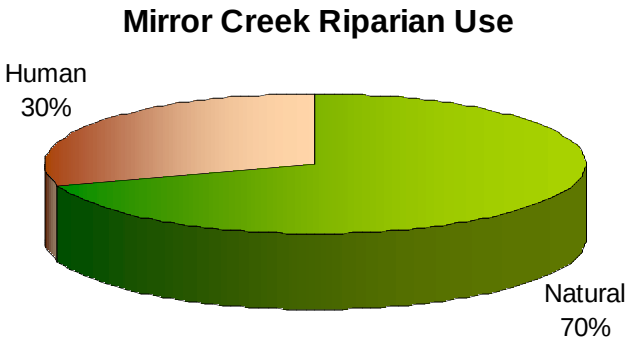


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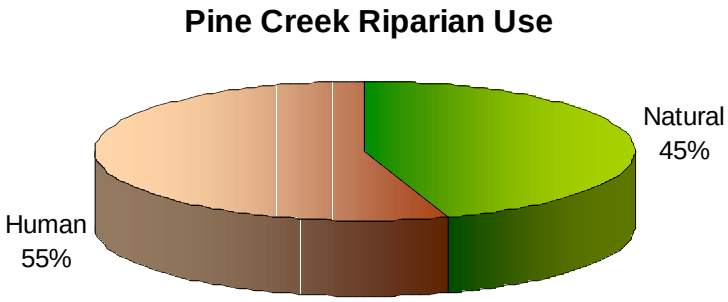


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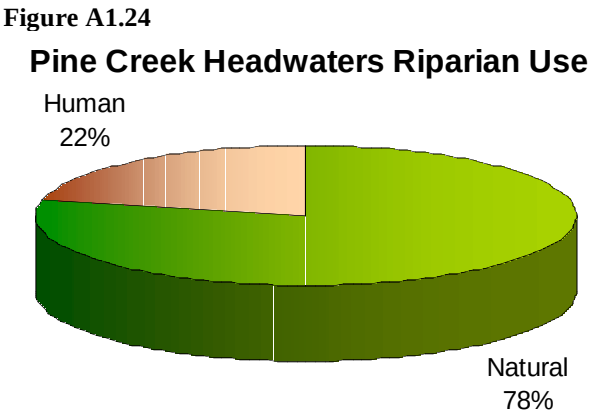


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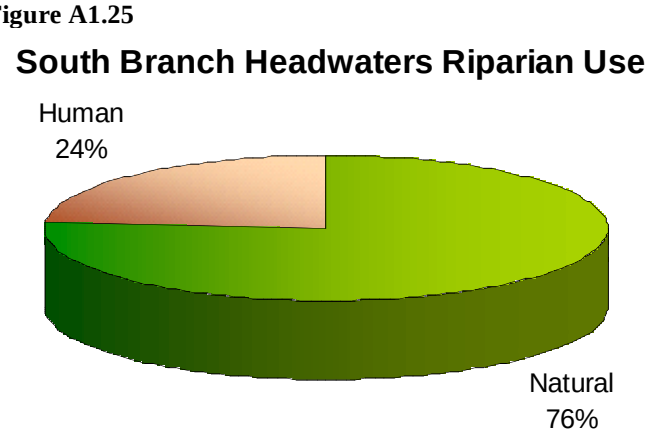

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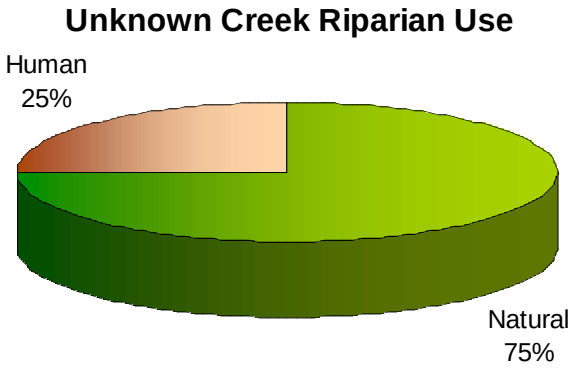


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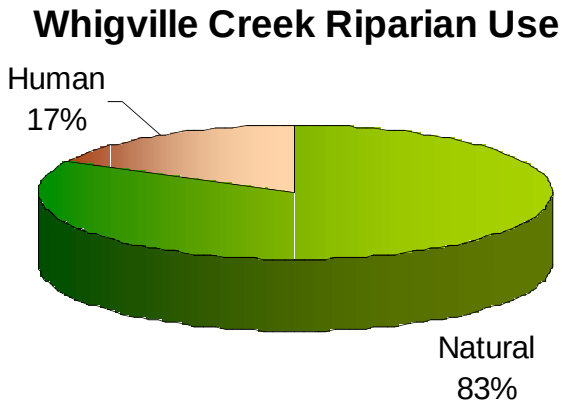


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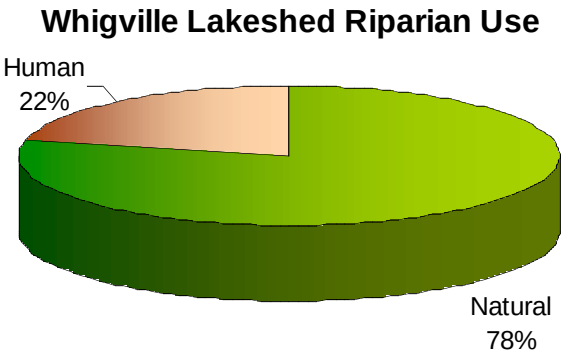


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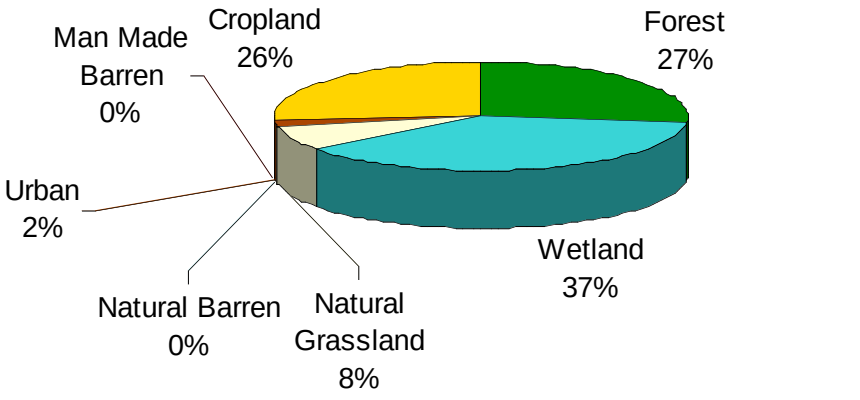

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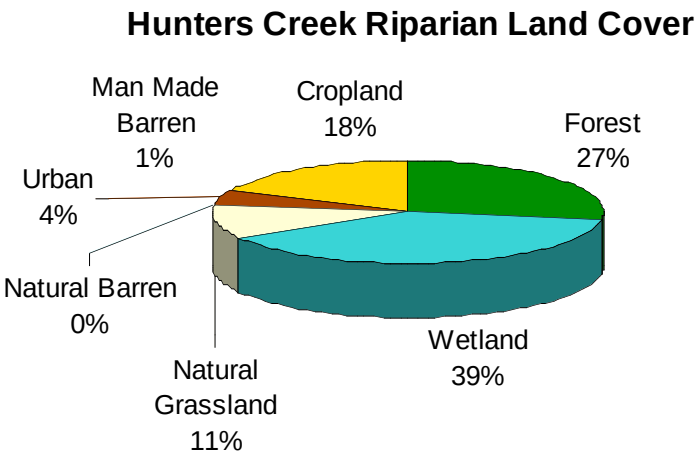


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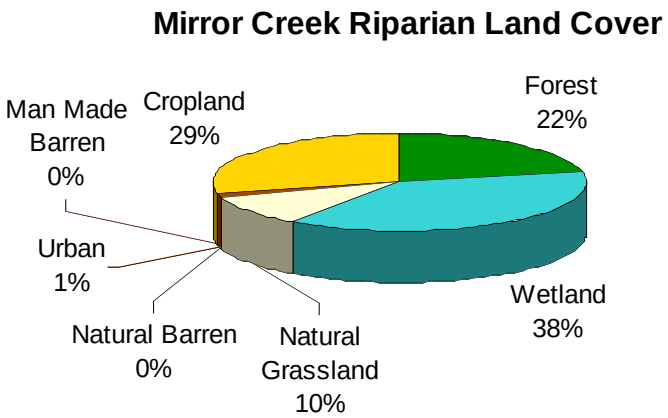


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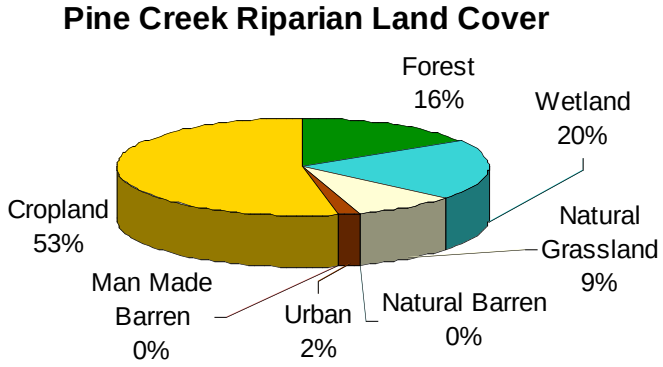


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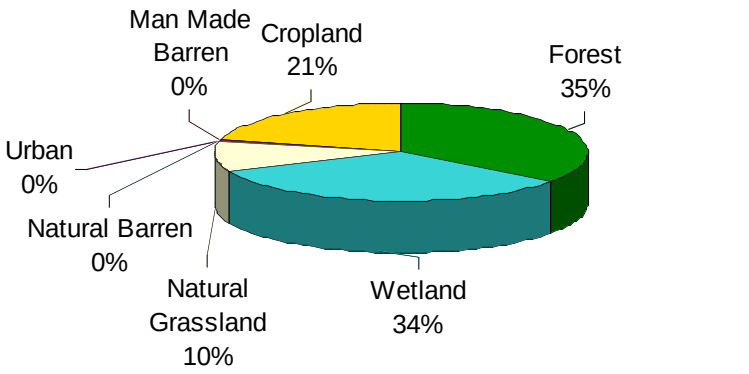

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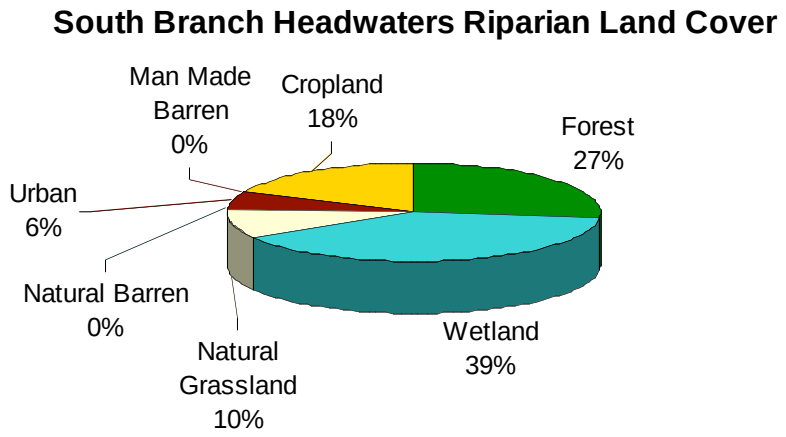


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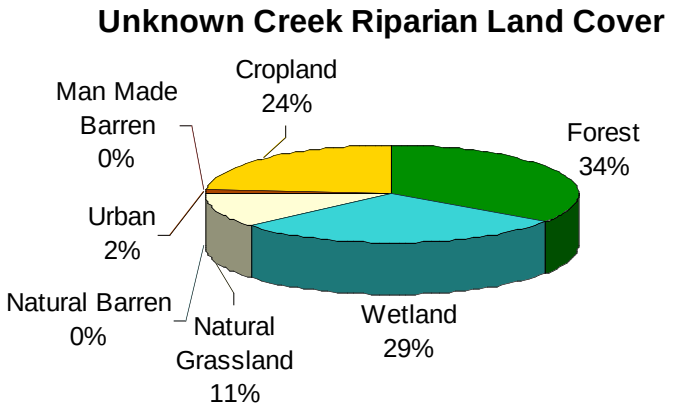


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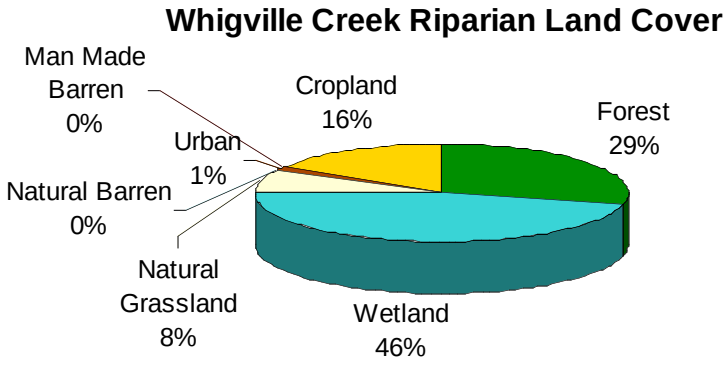


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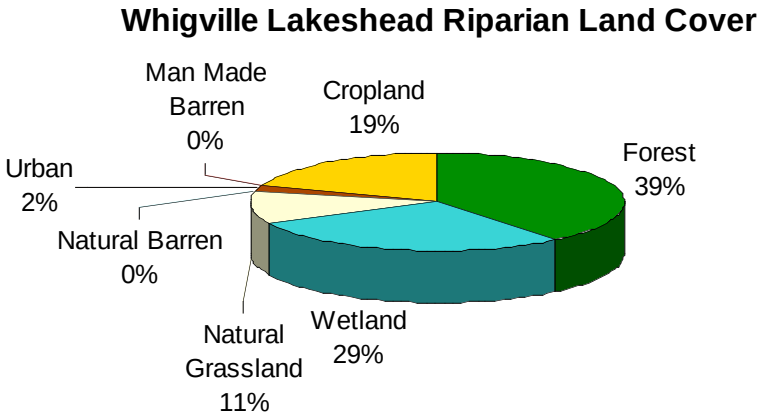

## Land Cover, Growth Trends and Population Density

Our observations revealed that the South Branch watershed has managed to avoid many of the negative water quality impacts that have been associated with rapid urban expansion in the southeast Michigan region (Figures A1.37 & A1.38). The largely rural area has maintained relatively stable land uses over the past decade but continues to face threats from urban expansion (Wiley 2006). However, the existing land covers have had some impacts on the water quality. Our observations revealed the most significant impacts are from agricultural land uses in the lower portion of the watershed. Based upon our experience we assert the largest future threat to the watershed is urban expansion from the southern portions of the watershed and along the M-24 corridor.

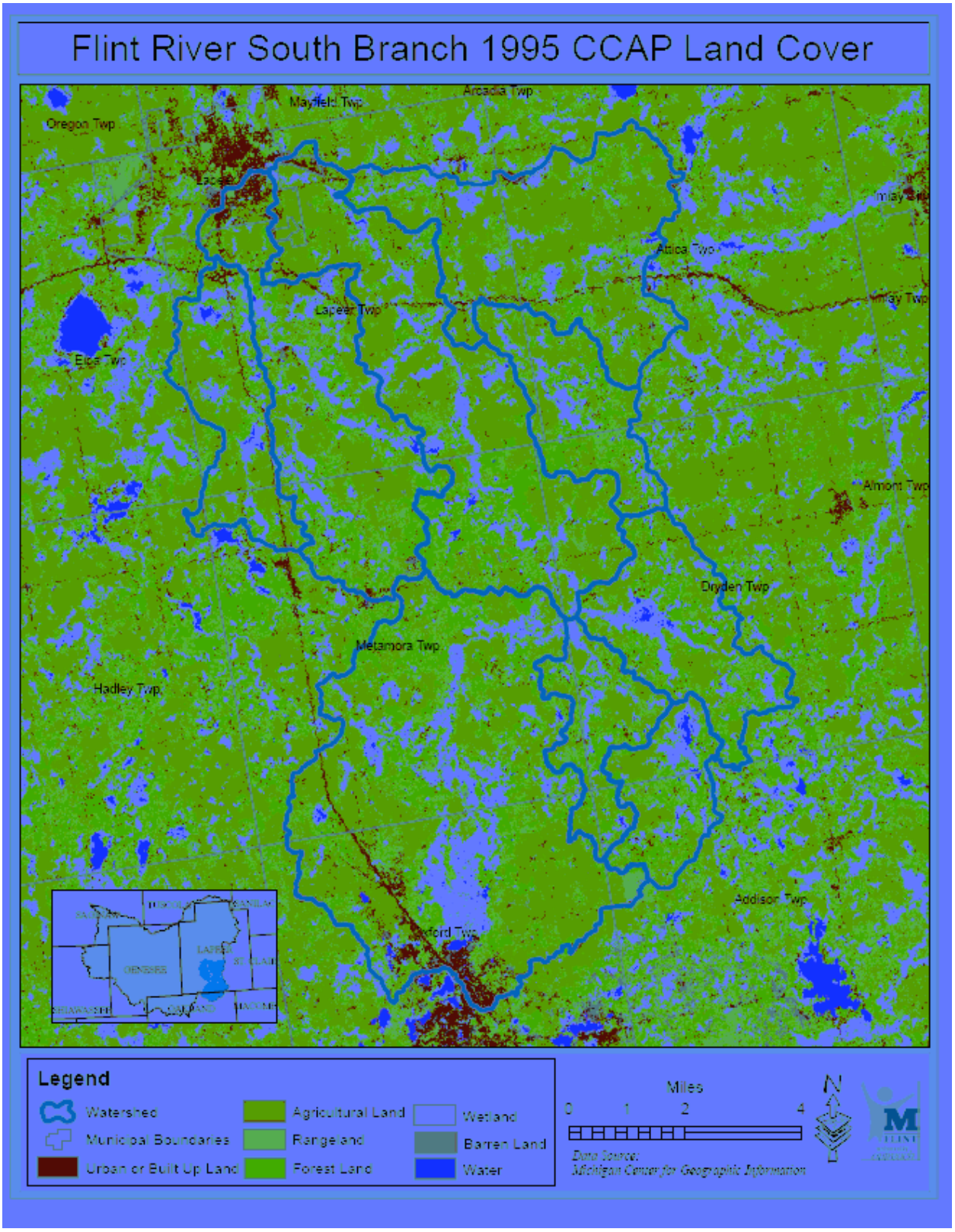


**Figure A1.37 1995 Land Cover in South Branch Watershed**

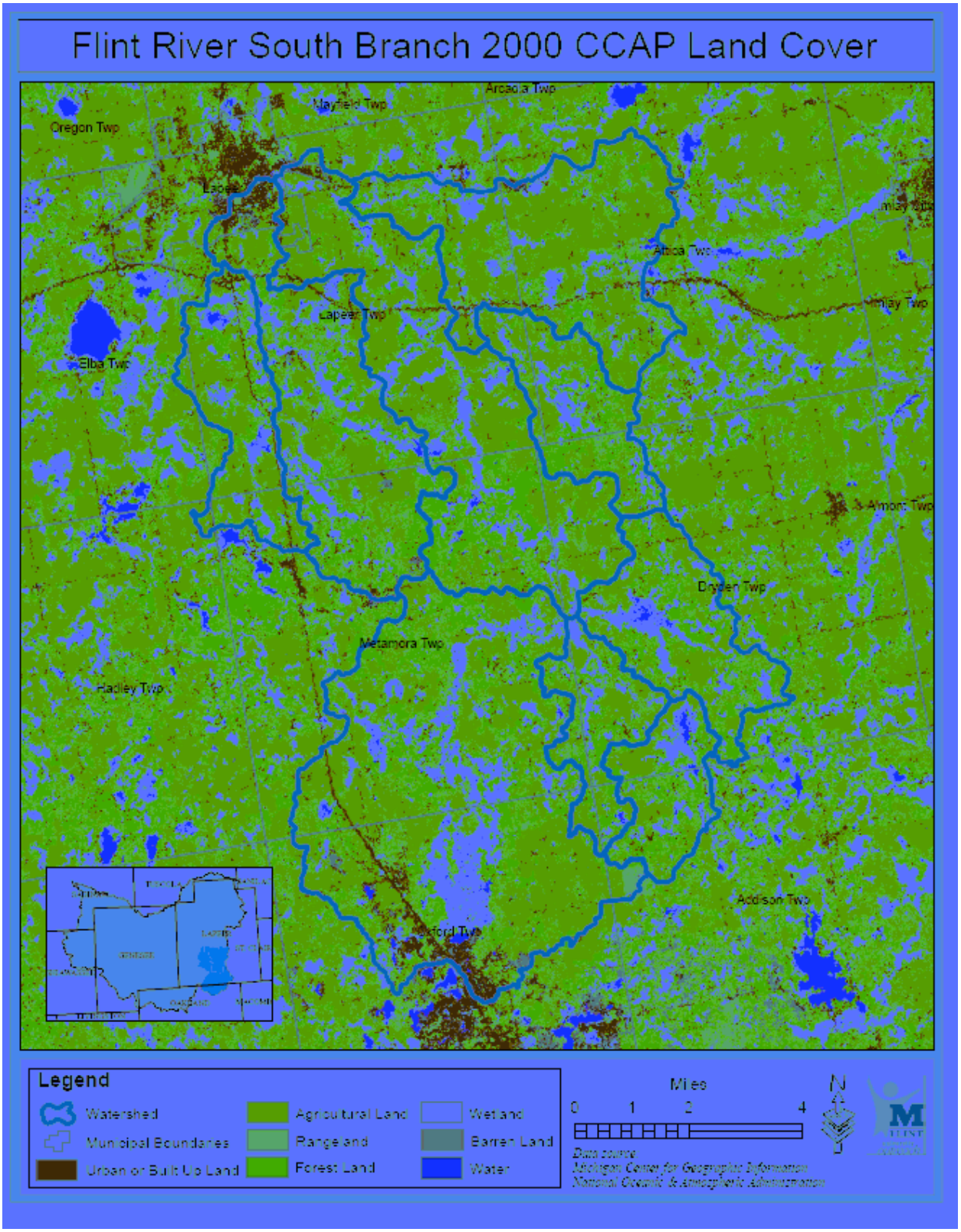


**Figure A1.38 2000 Land Cover in South Branch Watershed**

**Agricultural Land Cover**

- Agricultural land dominates the sub-watersheds of the SBW. This land use makes up approximately 50% of the land area within the watershed. The Pine Creek sub-watershed contains the highest percentage of agricultural land use at 57%. This is followed by Mirror Creek (49%), Flint River Main Branch (48%), Pine Creek Headwaters (37%), South Branch Headwaters (37%), Unnamed (35%), Whigville Creek (31%) and Whigville Lake (28%) respectively. The high percentage of agricultural land uses in the Pine Creek and Mirror Creek Watersheds are also coupled with the two lowest percentages of forested land uses in the watershed. Pine Creek's forest lands account for approximately 20% of the sub-watershed, and Mirror Creek's forested land is 22%.

- Key Point:
  The combination of high percentages of agricultural lands and reduced forest lands in the Pine Creek and Mirror Creek Watersheds are negatively impacting water quality.
  The land use combined with the drainage and ditching practices in the area appear to be increasing sediment delivery and hydrologic perturbations resulting in reduced water quality in these portions of the watershed. Figure A1.38 exemplifies these conditions. Specific recommendations for mitigating these impacts are presented in the implementation portion of the watershed plan including education, buffer strips and reforestation activities.

Figure A1.39: Pine Creek flowing through agricultural land (note lack of buffer on left bank)

**Urban Land Uses**
Urban land uses within the SBW land use has remained relatively stable from 1995 to 2000 with little to no significant increases in urban land use. The highest percentage of urban land uses are located within the Hunters Creek (6%), South Branch Headwaters (5%) and Mirror Creek (4%). These relatively higher percentages are associated with the Oxford urban center and the M-24 corridor.

- Key Point:

Continued increases in urban lands use poses a significant threat to future water quality within the SBW and are a major focus of the BMPs and education activities of this plans implementation section.

**Riparian Corridor**
The total amount of a particular land use impacts water quality in a watershed. Similarly, the location of that land use class will influence its impact on the health of the watershed. Research has shown that riparian lands, areas directly adjacent to the creek, are important in regulating flow, trapping sediment and providing critical habitat. These riparian areas often extend beyond the boundaries of the floodplain and act as a transition between aquatic and terrestrial environments (Forman and Wilson, 1995). As part of the land use analysis of the South Branch Watershed, the planning team analyzed the land use within a 150 foot buffer from the center of a river or stream. The results of that analysis are located in Appendix 1. The analysis points to Pine Creek having the most significantly impacted riparian corridor with 53% of the riparian corridor in agricultural land covers. This is almost double that of Mirror Creek, which has 29%.

- Key Point:

The riparian corridor of Pine Creek and Mirror Creek, and to a lesser extent Hunter's Creek, are negatively impacting water quality through the introduction of agricultural sediments and increased solar radiation. Significant effort should be placed in management of the riparian corridor in order to restore the impacted and threatened cold water fishery and protect other designated uses in the Pine Creek Watershed. In addition, efforts should be taken in the remainder of the watershed to protect the existing riparian corridors.

**Appendix 2. Local Policy and Ordinances**

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- **Water and Sewer Planning**
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## Introduction

It is commonly understood by watershed planners that "Communities find that their development codes and standards give developers little or no incentives to conserve natural areas and, in some cases, actually work against watershed protection" (frc&h, 2005). In order to address this reality the South Branch Watershed planning team conducted an analysis of the community's natural assets and the policies that impact them. This process involved identifying the land vital for maintaining high water quality, evaluating current policies, and offering recommendations on implementation steps necessary for resource protection that complement community goals (frc&h, 2005).

The identification of lands vital for resource protection was done done in this watershed plan and in the Greenlinks Potential Conservation Areas Assessment (see figure CD). The South Branch Flint River Watershed Management Plan elevates the relationship between land use and water quality by identifying specific changes in policy that will work to protect water quality within the watershed. The following policy review examines existing community goals, ordinances, development guidelines, and construction codes that impact water quality. The review also offers specific recommendations about policies that communities may want to adopt to protect water quality. Provided with this appendix is a CD that contains information about specific ordinances, natural features and other planning tools available to communities.

In Michigan land use and water quality decisions are made at the local level. Each unit of government plays a critical role in protecting natural resources. The following evaluation focuses on the role that county and township governments have on the water quality of the South Branch Watershed.

### The Role of Township Government

Township governments in the state of Michigan utilize several mechanisms to protect the health, safety and welfare of their community's residents. These include:

- Master Plan and Future Land Use Map – establishes community goals and vision for the future of the Local Township or city. These documents serve as a guide for development of zoning ordinances
- Zoning Ordinances – provide rules to guide development in the local government that preserve the health, safety and welfare of residents.
- Development Guidelines and Construction Code – outline required procedures when altering land for development

### Role of county government in protecting natural resources

County Governments also play a significant role in protecting the water resources of a community in a variety of ways. These specifically include:

- Soil Erosion & Sediment Control – regulated under Part 91 of the Natural Resources and Environmental Protection Act (1994 PA 451), the counties of Lapeer and Oakland administer soil erosion and sediment control permits for the respective communities of the South Branch. Permits are required for any activities that disturb more than an acre of land or that are within 500 feet of water in both counties.

- Drain Code – several water bodies in the South Branch watershed are regulated under the Michigan Drain Code of 1956 and administered by the Lapeer and Oakland County offices of the Drain Commissioner. The Drain Code gives authority to the Drain Commissions to construct, operate and maintain a system of county and inter-county storm drains.
- Road Commission – has jurisdiction over numerous roads in the watershed. The Road Commission is able to protect water quality by using Best Management Practices for road construction and stormwater runoff.

Overview of findings

Preserving the rich water resources of the South Branch requires watershed based land use decisions that protect natural resources. The communities of the South Branch have established goals that vary from protecting their beloved rural horse country and working farmlands, retaining small-town village character, to protecting unique natural features (woodlands, wetlands, scenic vistas). Alongside these goals are the realities of development pressure and the need to address infrastructure and service demands while maintaining the high quality of life enjoyed by residents of the South Branch watershed.

Several gaps have been identified between community goals and ordinances
CAERs recommendations are based on two levels:

1. What changes in local ordinances and codes are needed to meet current community goals (master plan, future land use plan)
2. What changes in local policy are needed to maintain the quality of life and clean water in the South Branch Watershed

## Methods

Review Framework

Several documents and public input guided CAER in developing the methods for the ordinance review. CAER followed the methods of the Fishbeck, Thompson, Carr & Huber, Inc. for the Gun River Watershed Plan in looking at three layers of policy that regulate land use. These documents are: community master plans, local zoning ordinances, and construction regulations. A matrix developed by the Oakland County Planning and Economic Development, Environmental Stewardship Services titled "Oakland County Community Planning Inventory for Natural and Water Resource Protection" was used to compare the policies of the seven South Branch communities.

- **Addison Township** Contains portions of the Whigville Lakeshed, Unknown Creek and the South Branch Headwaters sub-watersheds.
- **Attica Township** Contains portions of the Pine Creek and Pine Creek Headwaters subwatersheds.
- **City of Lapeer** Contains the lower portions of the Hunters Creek and Flint River Main Branch sub-watersheds.
- **Dryden Township** Contains all of the Whigville Creek sub-watershed, and portions of the Pine Creek Headwaters, Flint River Main Branch, Unknown Creek, and the Whigville Lakeshed sub-watersheds.
- **Lapeer Township** Contains portions of the Mirror Creek, Hunters Creek, Flint River Main Branch, Pine Creek and Pine Creek Headwaters sub-watersheds.
- **Metamora Township** Contains portions of Hunter Creek, Flint River Main Branch, South Branch Headwaters, and Unknow Creek sub-watersheds.
- **Oxford Township** Contains the upper portions of the South Branch Headwaters

At the watershed scale, CAER looked at natural areas and processes occurring in the watershed and their role in protecting and preserving water quality. Potential Conservation Areas were identified by Michigan Natural Features Inventory for Oakland and Lapeer Counties.

**Results & Recommendations**

Utilizing the framework developed by Oakland County Planning and Economic Development, Environmental Stewardship Services, CAER focused on eight topics relating to water quality and quality of life when reviewing local policy. Each topic is described below followed by each community's policy relating to that topic. These topics are:

1. **Green Infrastructure**
2. **Trails**
3. **Ecosystem Health and Wildlife**
4. **Wetland and Woodland Preservation**
5. **Stormwater Management**
6. **Water and Sewer Planning**
7. **Land Development**
8. **Funding and Outreach**

This analysis outlines where communities rank in water and natural resource protection and what steps they can take to improve and maintain their way of life and natural assets.

1. Green Infrastructure

Green infrastructure is best described as a "interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife" (Benedict & McMahon, 2006). Communities in the South Branch watershed benefit from having several characteristics of green infrastructure including clean water, good fishing and abundant wildlife.

Input from the residents of the watershed indicated further that the ideal community in five years would maintain open space, create greenways, preserve existing greenbelts, have parks, develop natural corridors, control development to protect the watershed, and stop building in areas that would affect water quality. The 25 year community vision includes: inventory all natural areas for protection, coordinated effort to protect natural resources, canoeing and fishing access to promote coldwater trout stream, and a nature and recreation corridor across all of Lapeer County. All of these community aspects are achievable through successful green infrastructure planning and implementation.

Communities were assessed by asking several questions about local policy in regards to natural areas and open space, Michigan Natural Features Inventory, and Greenway Corridors.

Two existing efforts are underway that provide local communities with access to natural resource information and tools to incorporate green infrastructure planning into local policy. Oakland County Planning and Economic Development, Environmental Stewardship Services provides communities with services including green infrastructure visioning. The Greenlinks (green infrastructure) program covers Lapeer, Genesee and Shiawassee Counties and is administered through CAER. CAER is able to provide local conservation organizations and governments with natural resource information and capacity building support.

A watershed approach to land use planning dictates looking at larger networks of streams, rivers, lakes, natural areas, and green space to protect water quality. It is strongly recommended that each community of the South Branch incorporate natural resource information available through Greenlinks and Oakland County into local policy. The integrated approach of implementing green-infrastructure allows for development and economic growth while preserving the natural assets that make the South Branch a great place to live.

It should also be noted that several communities that provide open space development options to developers have created a complicated process (more so than for traditional developments) for site plan approval. By utilizing natural resource information available and allowing for more flexibility in site plan review, developers may be more apt to pursue non-traditional development options.

*EXISTING GREEN INFRASTRUCTURE POLICY*

**Addison Township** has incorporated goals and objectives on the conservation of natural resources in its master plan. The township recognizes that maintaining areas is "essential to maintaining the Township's unique heritage and character" (Bowman, 2002). In support of these goals, Addison Township has adopted zoning ordinances that require 25 foot natural feature setbacks in all districts. The township also provides density bonuses to developers that preserve 50% of their site as open space.

**Attica Township** allows cluster development to preserve open space, working lands and natural features. Density bonuses are given to sites where 50% of total area is preserved in perpetuity.

**City of Lapeer** has adopted an ordinance that allows lot areas to be reduced by 20% if 3 acres or more are preserved as open space. Cluster development is permitted when recreation is permitted on said open space.

**Dryden Township** recognizes the importance of natural areas in maintaining ecologic health and socio-economic status in the township. They have adopted goals that encourage long term stewardship and management of preserved natural areas and advocate working with conservation partners (ex. Land conservancy). Dryden Township has yet to adopt adequate policy in support of these goals but does allow cluster development when 50% of PUD developments are dedicated to open space. This incentive applies only to parcels of 40 acres or more.

**Lapeer Township** has stated goals and objectives tied to natural features and open space. Township zoning ordinances allow 10% density increases for sites that preserve 80% of existing trees and 100% of wetlands; 50% of the total site must be preserved as open space.

**Lapeer County** has incorporated natural areas identified by the Michigan Department of Natural Resources (MDNR) and the MNFI into their comprehensive plan, and states ensuring their protection by complying with State and Federal guidelines. Lapeer County has no regulatory authority at this time in regards to natural resource protection.

**Metamora Township** permits cluster development when 30-40% of site is preserved in open space. The open space must contain the site's most significant natural and cultural features. Sites that preserve 50% as open space are given density bonuses.

**Oxford Township** has included in the master plan goals, objectives and strategies that recognize the importance of a green infrastructure network. They have incorporated MNFI natural areas provided by Oakland County, an Open Space and Greenway Plan, have identified funding strategies, and developed a Greenways Implementation Matrix. Their zoning ordinances encourage open space development through their Open Space Option and PUD for new developments.

*GREEN INFRASTRUCTURE RECOMMENDATIONS*

Recommendations for all the communities are bulleted followed by community-specific recommendations.

- Require or encourage the linking of natural areas with adjacent natural areas or open space in site planning
- Discourage the fragmentation of natural areas and greenway corridors in site planning
- Encourage TDR or PDR programs to shift development from ecologically sensitive areas to higher density growth areas

<u>Oxford Township</u>

- Recognize the importance of long-term stewardship and management of preserved natural areas and greenway corridors

<u>Townships of Addison, Attica, Dryden, Lapeer and Metamora; City of Lapeer; Lapeer County</u>

- Include a map that identifies the location of natural areas and other ecologically sensitive features to promote preservation of natural systems while allowing development that complies with the natural capacity of the land
- Provide a green infrastructure vision for creating a linked network of key natural areas and connecting greenways
- Recognize the importance of long-term stewardship and management of preserved natural areas and greenway corridors
- Have a regulatory mechanism in place that requires or encourages the linking of natural areas with adjacent natural areas or open space in site planning
- Provide a green infrastructure map to guide the placement of open space during the site planning process for new developments
- Provide incentives to developers and landowners to conserve natural areas and greenway corridors

*Tools*

1. *Resource Protection Overlay District, see examples from Hillsdale County and Macomb County (Attached)*

2. *Michigan Natural Features Inventory courtesy of Greenlinks for Lapeer County and Oakland County Environmental Stewardship Services (Attached)*

3. *Greenlinks Vision for Lapeer, Genesee, and Shiawassee Counties (Attached)*

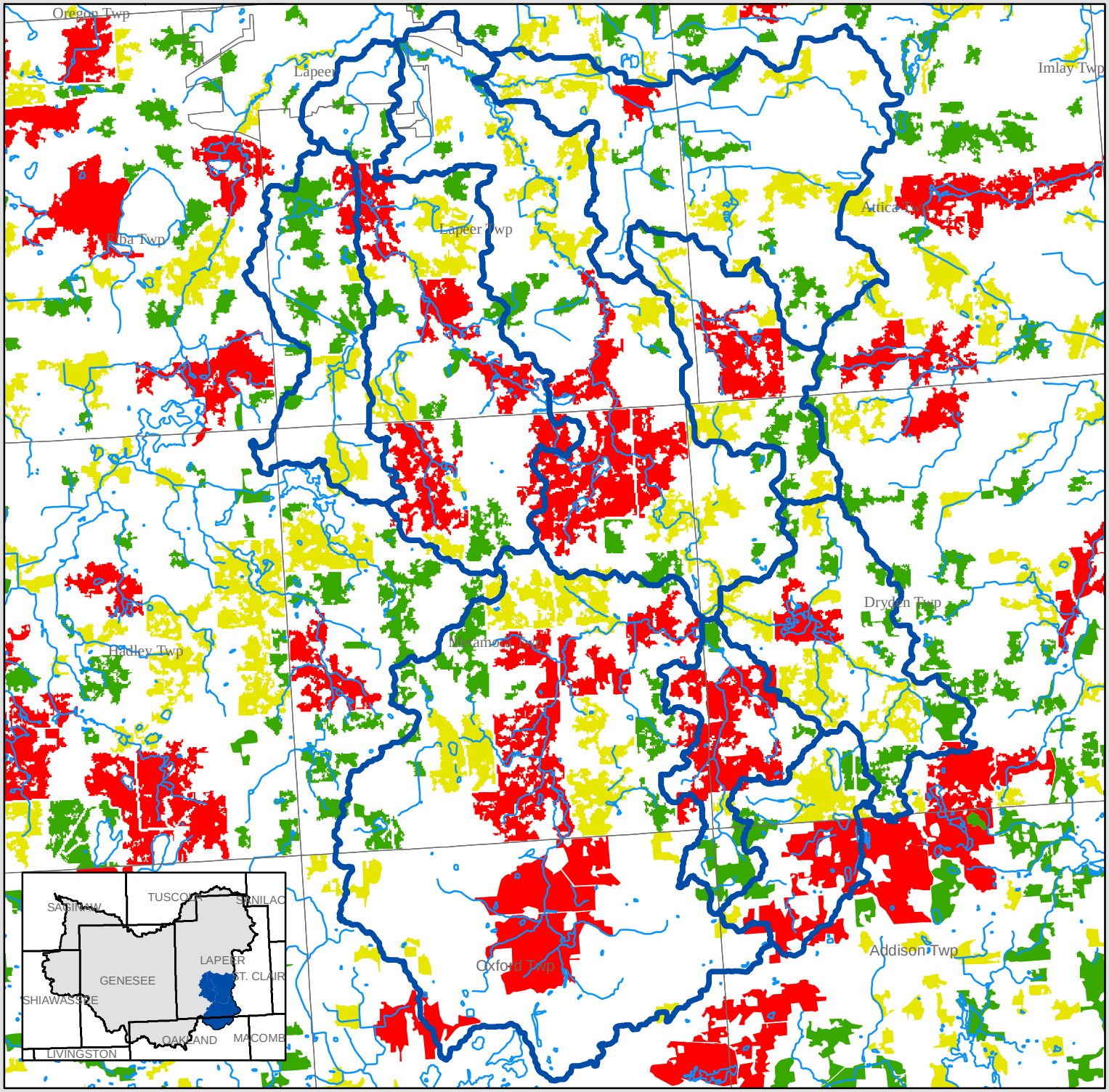
*Online Resources*

**Oakland County Planning and Economic Development, Environmental Stewardship Services (for Addison and Oxford Townships)**
http://www.oakgov.com/peds/program_service/es_prgm/green_infras/gi_project.html

**Greenlinks (for Lapeer City, Attica, Dryden, Lapeer, and Metamora Townships)**
http://www.flintriver.org/greenlinks/

**Green Infrastructure (the Conservation Fund)**
http://www.greeninfrastructure.net/

# South Branch Potential Conservation Areas




## Legend

**Potential Conservation Areas**

- Priority One
- Priority Two
- Priority Three

- Water
- Watershed
- Municipal Boundary

Field inventories should be conducted on identified PCAs. This fieldwork would provide much needed additional site-specific data that should be considered when developing in and around such areas.

Miles

0 1 2 4

Data Source:
-Michigan Geographic Library
-Oakland County Planning

2. Trails & Recreation

Trails come in many forms and serve multiple benefits. Trails on land or water serve as a connector between communities and natural areas providing vital corridors for wildlife health and social interaction. Trails have been shown to increase economic value of homes, spur economic activity, and preserve open space, and link wildlife and natural areas. Trails may also serve to provide education to community residents about water quality, ecosystems, etc through the use of signage. The lack of public access to the South Branch prohibits development of a water trail where education activities could occur to increase river stewardship. The existing Polly Ann Trail runs through the eastern part of the watershed and is perceived as a community asset by local governments and residents. To date, 14 miles of the Polly Ann trail exist in Oakland County and 20 miles in Lapeer.

With the exception of Lapeer County and Dryden and Oxford townships, the remaining communities of the South Branch do not have any policy relating to trails or greenways. Development of trails linking communities of the South Branch will only benefit its residents and enhance their quality of life. Communities of the South Branch may also consider a water trail for locals to enjoy and appreciate the nature of the area. Trails are a great opportunity to educate citizens about the natural world, historic features, cultural assets, etc.

Public input also supports trails and recreation. Some of the comments mentioned at the input session included: develop trails, keep developing our trail, fishing access to river, more public access to river in Lapeer County, family outdoor outings, and a county that is easy to move around by bike and public transit.

*TRAILS & RECREATION FINDINGS*

**Dryden Township** identifies the need for a township recreation plan and promotes the continued use and maintenance of the Polly Ann Trail in their master plan. They have also identified a potential rail-trail through the township.

**Lapeer County** recognizes the benefits of a county wide trail system and has set a long term goal to develop a Recreational Plan. Lapeer County would serve as the coordinating entity for trail development.

**Oxford Township** has included trails in the Transportation section of their master plan and has developed a Parks and Recreation Plan for improving non-motorized transportation in their community.

*TRAILS & RECREATION RECOMMENDATIONS*
Recommendations for specific communities are below.

Townships of Attica, Addison, Lapeer and Metamora; City of Lapeer

- Include goals, objectives, and policies that recognize the health, fitness, non-motorized transportation, economic, and recreational benefits of developing and maintaining a community trail system
- Outline a proactive approach to identifying and prioritizing the development of key trail connections and linkages
- Coordinate community trail planning with adjacent community, County, and regional green infrastructure planning
- Provide a map of the community's green infrastructure vision to guide the placement of trails during the development planning process
- Promote and/ or require long-term stewardship and management of designated trailways systems
- Have a mechanism for assessing and addressing trail maintenace needs
- Require or encourage trail infrastructure to include educational sinage that informs community members of ecological, cultural, and/ or historical landmarks located along the trail

Dryden Township, Oxford Township, and Lapeer County

- Require or encourage developers to incorporate connections to the existing linked trails network where applicable
- Require or encourage all trail development to respect the natural characterisitcs of the land and its capacity to support recreational use

*Tools*

1. *See green-infrastructure tools*
2. *Park and Recreation Plan*

*Online Resources*

**Polly Ann Trail**
http://www.pollyanntrailway.org/

**Oakland County Parks & Recreation**
http://www.oakgov.com/parksrec/program_service/trails_intro.html

**Lapeer County Parks**
http://www.lapeercountyparks.org/

**Michigan Trails & Greenways Alliance**
http://www.michigantrails.org/

3. Ecosystem Health & Wildlife

As land use impacts water quality, communities were assessed on their understanding on the importance of ecosystems and the role they play in protecting the health, safety and welfare of residents. Specific topics covered in this area include: habitat protection, identification of high priority natural areas, natural capacity of land for development, and importance of native vegetation.

Lapeer County, and Dryden, Addison and Oxford Townships have policies that support ecosystem health and wildlife. The remaining communities of the South Branch have no policy addressing ecosystem health (habitat protection, native vegetation, invasive species management). Though a few communities have goals for protecting ecosystem health, ordinances or regulations are weak or absent. A simple first step is to incorporate existing natural resource information into local policy available from Oakland County and CAER. Practices that protect and improve ecosystem health mimic those for establishing a healthy green infrastructure.

Likewise, public input supports the protection of ecosystem health and wildlife based on the following comments from the visioning session:

- Develop natural corridors
- More trout streams
- Control development to protect the watershed

*FINDINGS OF ECOSYSTEM HEALTH AND WILDLIFE POLICY*

**Addison Township** includes goals and objectives in their master plan stating not to develop lakes that would result in environmental degradation, maintain and promote corridors for wildlife habitat, protect declining habitat and manage habitat for wildlife, promote land uses which preserve wildlife habitat and review site plans for compliance. Addison Township includes Development Guidelines in their master plan that site the natural capacity of land for development and native vegetation.

**Dryden Township** includes an Open Space Concept into their Land Use Plan, objectives to preserve existing nature sanctuaries and surrounding natural areas and cites soil limitations and natural features.

**Lapeer County** recognizes the importance of having a healthy ecosystem to have healthy residents and includes a map of natural areas identified by the MDNR and MNFI.

**Oxford Township** includes a comprehensive strategy for maintaining ecosystem health in their master plan. Their master plan outlines goals, objectives and strategies for maintaining ecosystems, identifies priority conservation areas, funding strategies, and a land suitability analysis. The township also promotes habitat protection during site development.

*ECOSYSTEM HEALTH AND WILDLIFE RECOMMENDATIONS*

Recommendations for all the communities are bulleted followed by community-specific recommendations.

- Recognize the importance of native vegetation in protecting vital air, land, and water resource quality.
- Provide model development principles that can be applied to site designs to reduce the impact of development on a site's natural resources or ecosystem functions
- Require and encourage the retention of native vegetation during site development
- Prevent the spread of soils containing invasive species during site development
- Outline a proactive approach for long-term invasive species monitoring and eradication throughout the community
- Adopt and enforce an ordinance that prohibits the use of invasive plants and encourages the use of native plants in all landscaping
- Require or encourage the relocation of at-risk plants and animals to suitable habitat prior to site development
- Advocate public education regarding the negative impacts invasive species have on native ecosystems
- Include goals, objectives and policies to address removal and management of invasive species on public and private lands

<u>Attica Township, City of Lapeer, Lapeer Township, Metamora Township</u>

- Recognize the interdependence of natural resources and the critical role functioning ecosystems play in protecting the health, safety, and welfare of residents
- Include a map of MNFI or other natural features inventory that recognizes these areas as critical for ecosystem health
- Include goals, policies, and objectives for preserving/ and or restoring ecosytems
- Outline a proactive approach to protecting high-priority natural areas and/ or high-quality wildlife habitat areas
- Recognize the natural capacity and limitation of land to support development
- Include goals, objectives, and policies that promote the retention and restoration of native vegetation
- Require developers to obtain an opinion from the MDEQ regarding the occurrences of threatened or endangered plant or animal species on a property prior to construction.
- Promote habitat protection and/ or enhancement as part of site development.
- Prevent the spread of soils containing invasive species during site development

*Tools*

1. *Priority Conservation Areas identified by Michigan Natural Features Inventory (under green infrastructure section)*
2. *Native Vegetation Ordinance and Guidelines (Attached)*
3. *Sensitive Areas Protection (Attached)*

*Online Resources*

**Oakland Land Conservancy**
http://www.oaklandlandconservancy.org/

**Flint River Watershed Coalition**
http://www.flintriver.org/

4. Wetland & Woodland Preservation

Wetlands and woodlands serve key functions in maintaining water quality by providing groundwater recharge, and filtering out pollutants. Wetland and woodland preservation further complements community goals to minimize flooding, maintain scenic vistas, and preserve rural character. Policies were evaluated based on woodland and wetland preservation practices, management of riparian (stream side) land, and floodplain management.

Attica Township and the City of Lapeer do not have policies relating to woodland and wetland preservation. Ideal policies would prohibit development within 50 feet or more from natural features. Management of stream corridors and riparian lands are especially important for maintaining water quality. With the exception of Addison Township, communities are further recommended to protect wetlands less than 5 acres, particularly those that provide high groundwater recharge (see Wetland Functionality Assessment, Appendix 4).

The public input received from CAER indicates that residents desire no wetland loss, want to protect water quality and the watershed by restricting development, and want sustainable privately owned forests.

*EXISTING WETLAND AND WOODLAND PRESERVATION POLICY*

**Addison Township** includes goals, objectives and development guidelines that support wetland and woodland preservation in their master plan. These include preserving wetlands regardless of size, maps of existing wetlands and woodlands, limiting lakeshore and stream bank development to recreation, limiting development in upland areas that would disturb wetland hydrology, and maximizing stream side buffers. In support of these goals, Addison Township has adopted ordinances that establish a 25 foot natural feature setbacks in all districts, protects wetlands of 2 acres or larger, and provides a fragile water course map for preservation.

**Dryden Township** includes a map of existing wetlands and woodlands and objectives to establish floodplain protection in its master plan. The township currently has no ordinances or regulations that protect wetlands and woodlands.

**Lapeer Township** recognizes the importance of wetland and woodlands in protecting the health, safety and welfare of its residents but provides no clear goals or objectives in support of protection. A wetlands map and woodlands map are provided in the master plan but no regulations exist to protect existing resources.

**Metamora Township** has a zoning ordinance restricting development in floodplains. Development must be 30 feet above 100 year flood plain or 30 feet from waters edge where 100 year flood level hasn't been established.

**Oxford Township** includes a map of existing woodland, wetland and tree rows and an Open Space & Greenway Plan in its master plan. In support of this, they have required 25 foot natural feature setback in all districts through zoning regulations.

*WETLAND AND WOODLAND PRESERVATION RECOMMENDATIONS*

Recommendations for all the communities are bulleted followed by community-specific recommendations.

- Protect wetland in an ecosystem context by protecting adjacent buffers, uplands and transitional areas.
- Discourage upland activities that have a negative impact on the natural hydrology of wetlands or streams
- Restore degraded buffer zones with native vegetation
- Include goals, policies, and objectives that discourage the channelization, rerouting, or any other topographical disturbance to a stream corridor to accommodate site development
- Include a 'Functionality Clause' within the wetland ordinance requiring a hydrological assessment of the property (preferably by a hydrological engineer) prior to development to ensure that the proposed development will not alter or disturb the natural hydrology of wetlands found on site or any existing hydrological connections to other water features within the watershed.
- Provide developers and community residents with a list of desirable, native riparian plant species to use in buffer restoration initiatives
- Replace trees that are removed during site development with comparable (native) species

<u>Addison Township</u>

- Adopt a woodland protection ordinance that includes special provisions for landmark trees and prohibits clearcutting of trees on development sites
- Coordinate riparian buffer regulations that are applied to community streams and rivers with regulations protecting county drains
- Restrict clearing and construction within the floodplain

<u>Attica Township, City of Lapeer, Dryden Township, Lapeer Township, Metamora Township</u>

- Inventory and map wetland, woodland, and riparian buffer resources within the community (except Dryden and Lapeer Townships)
- Include goals, policies, and objectives that advocate maximizing the width of riparian and wetland buffers
- Include goals and objectives to identify and preserve key riparian corridors that link the community's open spaces and natural areas
- Describe desirable and undesirable uses of floodplains and buffer zones (except Dryden Township)
- Include goals, policies, and objectives to prohibit or discourage construction with the 100-year floodplain (except Metamora Township)
- Adopt a natural feature setback ordinance to preserve wetland and riparian buffers, and floodplains (Recommended setback width of >50 ft)
- Adopt a wetland ordinance that protects wetlands below state protection criteria (< 5 acres in size)
- Adopt a woodland protection ordinance that includes special provisions for landmark trees and prohibits clear cutting of trees on development sites

- Coordinate riparian buffer regulations that are applied to community streams and rivers with regulations protecting county drains
- Provide developers with a Water Resources Overlay District designed to protect wetlands, woodlands, stream corridors and floodplain and related buffers
- Require the retention or restoration of naturally vegetated buffers along drainage corridors, wetlands, and floodplain boundaries
- Restrict clearing and construction within the floodplain

Oxford Township

- Include goals, policies, and objectives that advocate maximizing the width of riparian and wetland buffers
- Include goals, policies, and objectives to prohibit or discourage construction with the 100-year floodplain
- Adopt a wetland ordinance that protects wetlands below state protection criteria (< 5 acres in size)
- Adopt a woodland protection ordinance that includes special provisions for landmark trees and prohibits clear cutting of trees on development sites
- Coordinate riparian buffer regulations that are applied to community streams and rivers with regulations protecting county drains
- Provide developers with a Water Resources Overlay District designed to protect wetlands, woodlands, stream corridors and floodplain and related buffers

*Tools*

1. *Woodlands Protection and Preservation Ordinance – example from Green Oak Township, Livingston County (attached)*
2. *Sample DEQ Wetland Ordinance (attached)*
3. *Natural Feature Setback Ordinance – example from Ann Arbor Township, Washtenaw County (attached)*
4. *Wetland Functionality Map (Appendix 4)*

5. Stormwater Management

Due to the effects stormwater has on water quality (see Watershed Description of SWFRWMP); community policies were reviewed for effective stormwater management. Review of stormwater management policy includes regulating quality and quantity of flow, impervious surface reduction, use of porous pavement and vegetated swales, preserving natural pathways, and erosion and sediment control. Stormwater management is an issue that should be addressed by local communities in partnership with their respective Drain Commission and Road Commission. Stormwater management should be focused on areas that are developing, particularly the M-24 corridor. Together, comprehensive actions varied from education to best management practices are necessary for the South Branch to remain fishable, swimmable, and drinkable. Public input also indicates that development should be restricted in areas that would harm water quality.

**Soil erosion and sedimentation** is regulated by Oakland County Drain Commission in Oxford and Addison Townships, and by Lapeer County Drain Commission in the remaining communities of the South Branch. Both drain offices require a permit is obtained for any activities occurring within 500 feet of water or when an acre or more of land is to be disturbed. The Oakland County Drain Commission provides new homeowners with a brochure on "New Homeowner's Guide to Soil Erosion Control". As a result, local communities do not enforce soil and sediment permits, but may regulate the removal of topsoil and require landscaping immediately after project completion.

*EXISTING STORMWATER MANAGEMENT POLICY*

**Addison Township** addresses stormwater management in its master plan by minimizing stormwater runoff through proper land use locations and development practices, preserving natural infiltration and drainage pathways, and discouraging development in areas of significant slope. Regulations supporting some of these policy goals are part of the site plan review process. Shared parking is allowed when business hours are not in conflict. Township landscaping regulations require landscaping is completed within 6 months of project completion.

**City of Lapeer** has no stated goals on stormwater management but does require soil erosion control measures to be in place 15 days after final grading, prohibits the removal of topsoil except where buildings, roads, and parking lots will go, and allows shared parking when business hours are not in conflict.

**Dryden Township** requires landscaping be in place 180 days after project completion.

**Lapeer County** has set a goal to educate local units of government about stormwater management and recommends local zoning ordinances require developers to provide appropriate stormwater management.

**Lapeer Township** requires a development impact statement show that the proposed development will not cause soil erosion or sedimentation problems.

**Oxford Township** identifies impervious surface reduction as an important community goal and allows for reduced road and sidewalk widths in Planned Unit Developments. Natural features and drainage may also be preserved when developers utilize the Open Space Option.

*STORMWATER MANAGEMENT RECOMMENDATIONS*

Recommendations for all communities are below followed by community specific recommendations.

- Include goals, policies, and objectives that advocate the use of porous pavement and naturally vegetated swales to enhance infiltration and slow runoff velocity
- Outline goals or objectives to protect the value and function of wetlands that have been incorporated into the stormwater management system
- Outline a goal or policy to incorporate innovative stormwater management BMP's or low-impact design techniques where feasible
- Encourage site design plans to include effective criteria for stormwater BMPs.
- Require performance standards for stormwater management (e.g. maintain pre-development runoff rates or volumes, pollutant removal standards, etc.).
- Require maintenance and monitoring agreements for all stormwater management systems or other BMPs
- Promote the use of porous pavement in site development guidelines
- Encourage developers to protect steep slopes and cuts and to stabilize disturbed areas within 2 weeks (except City of Lapeer)

<u>Attica, City of Lapeer, Dryden, Lapeer, Metamora, Oxford</u>

- Identify the management of stormwater quality and quantity as an important community goal or policy relating to the the protection of health, safety, and welfare of your community's residents
- Include goals, policies, and objectives that advocate preserving natural drainage pathways and existing vegetation to the greatest extent possible
- Include goals, policies, and objectives that recognize the importance of controlling erosion and sedimentation as they relate to water and habitat quality, and to the health, safety, and welfare of the community
- Discourage discharge of untreated stormwater and effluent into natural water bodies (wetland, stream, river, lake) or sensitive terrestrial areas
- Provide developers with guidelines to make drainage systems and retention ponds visually attrative while enhancing the system's functionality (for example, avoiding traditional turf grass, use native species and contoured ponds)
- Encourage the developer to use native vegetation swales, buffers, and infiltration areas to manage stormwater
- Have a mechanism in place to responding to public complaints regarding construction site erosion control

<u>Attica, City of Lapeer, Dryden, Lapeer, Metamora</u>

- Identify impervious surface minimization and preservation of natural infiltration to the greatest extent possible as important community goals
- Encourage the developer to design sidewalks, roads, and driveways to minimize impervious surfaces
- Encourage developers to preserve natural contours, vegetation, and drainage patterns by incorporate the existing landform into development designs, and keeping grading and site preparation to a minimum (except City of Lapeer)

*Tools*

*1. Stormwater Management / Impervious Surface Mitigation Sample Ordinance (attached)*

*2. Steep Slope Development Standards – example from Hillsdale County (attached)*

*3. Off Street Parking Regulations – example from Ann Arbor Township, Washtenaw County (attached)*

*4. Oakland County Drain Commissioner, New Homeowner's Guide to Soil Erosion Control (attached)*

*Online Resources*

**Stormwater Manager's Resource Center**
**http://www.stormwatercenter.net/**

**National Stormwater Center**
**http://www.npdes.com/**

**Center for Watershed Protection**
**http://www.cwp.org/**

**DEQ – Soil Erosion and Sedimentation Control**
**http://www.michigan.gov/deq/0,1607,7-135-3311_4113---,00.html**

**Oakland County Drain Office, Soil Erosion Control Permits**
**http://www.oakgov.com/drain/permit_license/erosion_apps.html**

6. Water & Sewer Planning

Communities that plan for water and sewer service are taking a proactive approach in how and where their community develops. Setting service boundaries, assessing land suitability for septic and implementing wellhead and groundwater protection ensures that vital water resources and public health will be protected as the community grows.

The public input received on this topic included: intergovernmental cooperation on sewers and drainage, demand clean drinking water, paying a more realistic price for fresh water, keep out Detroit and Flint city water, and sensible sewer system for our townships' area.

The SBWMP provides several resources to guide planning at the regional and site scale. Included are maps of geology and soils (Maps ??) to give general guidelines where areas of high infiltration and runoff are located and a septic suitability map (Map?). Site investigation is still required to determine the capacity of soils for stormwater retention and detention. The Wetland Functionality Assessment provides detail at the site scale for incorporating wetlands into stormwater management schemes. Further analysis is needed to determine groundwater recharge areas in the South Branch to guide local development.

*WATER AND SEWER POLICY FINDINGS*

**Addison Township** has no intention of providing its residents with sanitary sewer services. The master plan encourages residential development to avoid areas of soils with poor suitability for septic and protect sensitive groundwater recharge areas. Maps are included, based on soils, detailing which areas are suitable for septic disposal and where fragile watercourses are located. Local regulations require septic be 100' from waters edge and require a 25' vegetated setback from the high water line.

**Attica Township** states in the master plan that wastewater treatment is important but has no regulations or schedule for implementation.

**City of Lapeer** provides sewer and water services to its residents.

**Dryden Township** relies solely on groundwater for water supply and refers to the wetlands and woodlands map as areas of groundwater recharge. Sewer expansion is only permitted near the village of Dryden. A map is consulted during site plan review outlining soils with severe limitations for septic tanks. The township has no regulations in support of their stated goals.

**Lapeer County** summarized the surface water resources in the county and summarized the studies initiated by the communities of the county in the comprehensive plan. There are no county owned or operated wastewater or water districts at this time.

**Lapeer Township** identifies the need for sewer and water planning, provides a map of service boundaries and areas suitable for septic systems in their master plan.

**Metamora Township** currently has no sanitary sewer but may offer it along the M-24 corridor in the future. The township has included a septic suitability map in their master plan.

**Oxford Township** established a sewer service district with the Oakland County Drain Commission in 1997. The master plan includes a Land Capability Analysis for development based on soils and goals for identifying need infrastructure.

*WATER AND SEWER POLICY RECOMMENDATIONS*

Recommendations for all communities are below followed by community specific recommendations.

- Identify and map the groundwater recharge area(s) that contributes to your community's groundwater supply. Advocate eliminating potential sources of pollution and retaining as much permeable surface as possible in identified recharge area(s).
- Require septic systems to be located atleast 100 feet from wetlands, streams, lakes, or other water features
- Encourage developers to address preserving the balance and integrity of the hydrogeological system in site development plans.
- Prohibit the connection of downspouts to the stormwater system
- Require regular maintenance and inspection of septic systems
- Outline an approach for identifying and correcting failing septic systems
- Advocate that the majority of the surface in groundwater recharge areas remains open space, or is limited to low density development.
- Discourage or prohibit land grading in groundwater recharge areas to maintain the water-holding characteristics of the land
- Require site development plans to include an assessment of, and preventative measures for, potential sources of contamination to the recharge area during the construction process
- Outline an approach for identifying, mapping, and eliminating illicit discharges to the drainage system
- Outline proper application and storage proceedures to prevent sand and salt from entering the stormwater system

<u>Attica Township</u>

- Identify groundwater as a natural resource important to the health, safety, and welfare of community residents, and outline the importance of groundwater recharge to maintaining the integrity of aquatic resources such as streams and wetlands
- Advocate the use of maps and discussion relating to current and planned wastewater infrastructure and soil cabability in land use, zoning, and site plan decisions
- Identify the sanitary sewer infrastructure needed (location and capacity of service ) based on projected population growth, and outline a construction, maintenance, and replacement schedule for future and current sewer infrastructure
- Identify areas within the community that are suitable and unsuitable for septic systems, and include a map and discussion of soils and their capabilities for handling septic systems

<u>Dryden Township</u>

- Outline goals, policies, and objectives that address wastewater planning and relate adequate wastewater treatment to the protection of the health, safety, and welfare of residents

- Advocate the use of maps and discussion relating to current and planned wastewater infrastructure and soil cabability in land use, zoning, and site plan decisions

Lapeer Township

- Identify groundwater as a natural resource important to the health, safety, and welfare of community residents, and outline the importance of groundwater recharge to maintaining the integrity of aquatic resources such as streams and wetlands
- Advocate the use of maps and discussion relating to current and planned wastewater infrastructure and soil cabability in land use, zoning, and site plan decisions

Metamora Township

- Identify groundwater as a natural resource important to the health, safety, and welfare of community residents, and outline the importance of groundwater recharge to maintaining the integrity of aquatic resources such as streams and wetlands
- Advocate the use of maps and discussion relating to current and planned wastewater infrastructure and soil cabability in land use, zoning, and site plan decisions

Oxford Township

- Identify groundwater as a natural resource important to the health, safety, and welfare of community residents, and outline the importance of groundwater recharge to maintaining the integrity of aquatic resources such as streams and wetlands

*Water and Sewer Planning Tools*

*1. Groundwater Protection, by Planning & Zoning Center, Inc. from Filling in the Gaps by DEQ*

*2. Septic Suitability Map*

*3. Point of Sale Septic Program (Shiawassee County Health Department)*

*4. Wetland Functionality Assessment (see Appendix 4)*

7. Land Development

Local and county ordinances are consulted during the site plan approval process. This part of the review assessed the criteria developers must meet and provide as part of the site plan approval process. Communities were compared on the development review process they use, and the principles they advocate during site plan and development approval. Special notice was given to communities that advocate for principles that support green infrastructure, trails, ecosystem health and wildlife needs, wetland and woodland preservation, and stormwater management.

The communities of the South Branch can take a proactive approach in protecting water quality by streamlining the site plan review process and incorporating a comprehensive checklist for use by developers and review boards and commissions. All communities have required information to be included with site plans but it is unclear how this information encourages developers to preserve natural features, natural drainage, and protect water quality.

Public input also supported the following:

- Planned "green" development
- Better public transport coverage
- A trend toward smaller rather than larger homes
- Limited private road development
- Smart Growth to preserve the landscape
- No additional gravel mining
- Slow land division
- Control growth / slow development
- Land capability base planning

*LAND DEVELOPMENT POLICY FINDINGS*

**Addison Township's** criteria for site plan approval include preserving natural landscape by minimizing tree and soil removal and by topographic modifications. Drainage design shall recognize natural drainage patterns if practical.

**Attica Township** has standards for site plan approval. A Community Impact Statement (CIS) is required for intensive development projects and special land uses. The CIS must include impacts to community facilities and services, economy, environment, noise and traffic.

**Dryden Township** has standards for site plan approval.

**The City of Lapeer** has developed a Development Review Procedures Handbook to familiarize developers with the process and requirements for rezoning and master plan amendment, special conditional use permit, zoning variances, site plan review, subdivision and condominium review, and permits and inspections.

**Lapeer Township** requires a Development Impact Statement be submitted along for site plan approval. The intention is to provide the township with anticipated impacts to public infrastructure, adjacent properties, and the environment.

**Metamora Township** has standards for site plan approval. A Community Impact Statement (CIS) is required for intensive development projects and special land uses. The CIS must include impacts to community facilities and services, economy, environment, noise and traffic.

**Oxford Township** has standards for site plan approval. An Impact Assessment is required for developments that meet one of the following criteria: more than 100 residential units, square footage of non-residential building exceeds 100,000, anticipated vehicle traffic exceeds 1,000 trips per day, or hazardous material will be generated, stored or disposed of on-site.

*LAND DEVELOPMENT POLICY RECOMMENDATIONS*
Recommendations for all communities of the South Branch are below.

- Encourage developers to preserve natural features to the fullest extent possible
- Require a pre-application meeting or site analysis before engineered drawings are submitted
- Require site plan proposals to include a map of all natural features such as surface water, floodplains, wetlands, woodlands, steep slopes, and natural drainage pattern
- Strongly encourage or require developers to incorporate green development design into site plans
- Encourage developers to minimize impervious surface by using minimum widths for streets, ROWs, sidewalks, driveways, parking spaces and cul-de-sacs, and efficient street layouts and parking ratios
- Require a portion of all parking facilities to be dediated to enhancing filtration (plant vegetation within the parking area, provide pervious spillover areas using porous pavement, and use islands as detention areas)
- Relax side yard setbacks and narrow frontages to reduce total road length, driveway length, and overall site imperviousness
- Offer developers incentives to meet regulatory restrictions (density compensation, buffer averaging, transferable development rights, etc.)
- Provide developers with incentives and flexibility in the form of density compensation, buffer averaging, property tax reduction, stormwater credits, to conserve (unregulated) areas of environmental value

*Tools*

*1. Example of Environmentally Sensitive Future Land Use Plan, Filling in the Gaps*

*2. Integrating Water and Natural Resource Protection into the Planning Process: Guidelines for Site Plan Review, Oakland County Planning Website*

*3. Lot Averaging, example from Hillsdale County*

*4. Growing Greener, Putting Conservation into Local Codes*

8. Funding and Outreach

A strategy for accomplishing community goals traditionally consists of a Capital Improvement Plan, assessing funding options, and providing outreach and education on community goals. The evaluation of funding and outreach strategies is focused on environmental goals and objectives of individual communities. Communities that do not have strong policies for water and natural resource protection were not evaluated.

Funding and outreach strategies for water and natural resource protection are varied and available at multiple scales. It is recommended that all communities prioritize what projects are important and assess potential funding options.

*FUNDING AND OUTREACH POLICY FINDINGS*

**Addison Township** recommends a PDR or TDR program and/or working with a land conservancy to achieve goals of the master plan. Specific goal are not tied to specific funding strategies.

**Attica Township** lists several options for funding in the Implementation section of thei r master plan. The master plan does not tie specific goals and actions to specific funding options but does describe state and federal grants as well as TDR and PDR programs as options for achieving township goals.

**Dryden Township** includes in its master plan to promote the activities of local, state and national land conservancies as a strategy to protect natural resources without using tax dollars.

**City of Lapeer** has adopted a Tax Increment Financing (TIF) ordinance to spur economic growth which may conserve open space by encouraging infill development near the city center.

**Lapeer County** administers a Purchase of Development Rights (PDR) program for the county. The PDR program is focused on preserving farmland but may be used to conserve other natural features and open space.

**Lapeer Township** has included an Implementation section in their master plan that outlines several strategies to fund conservation of natural resources and open space. These strategies include partnering with local land conservancies, conservation easements, and bonds.

**Metamora Township** lists several options for funding in the Implementation section of their master plan. The master plan does not tie specific goals and actions to specific funding options but does describe state and federal grants as well as TDR and PDR programs as options for achieving township goals.

**Oxford Township** has included a prioritized list of conservation projects in the township and options for funding in their master plan.

*FUNDING AND OUTREACH POLICY RECOMMENDATIONS*

- Include guidance on how future infrastructure, repairs, and maintenance of the community's sanitary sewer system will be financed
- Outline goals, policies, and objectives for educating residents about the health, safety, and economic benefits associated with conserving the community's natural resources
- Use community millages as a funding mechanism for environmental, ecological, or conservation-related projects
- Apply for the M-DNR's Natural Resources Trust Fund Grant to fund the protection of natural resources and open space, and/ or purchase lands for outdoor recreation
- Produce and distribute educational materials discussing the health, safety, and economic benefits of preserving the community's natural resources
- Produce and distribute educational materials for residents that describe household/ residential conservation practices (for example, limiting water use outside their homes, such as on lawns and gardens, capturing storm runoff through features such as rain barrels or rain gardens, preserving riparian buffers, using native plants in landscaping, proper car-washing and waste-disposal practices etc.)
- Provide a mechanism for educating the community's commercial and industrial business owners/ managers about natural resource conservation practices (stormwater management, use of native vegetation, etc.)
- Support signage in local parks, natural areas, riparian corridors and/ or watershed boundaries to educate residents about natural features and their role in protecting vital air, land, and water resources

<u>City of Lapeer, Addison, Attica, Metamora, Dryden and Lapeer Townships</u>

- Outline a prioritized list of conservation projects/ areas to receive funding in the Master Plan Implementation Schedule
- Include a line item in the Capital Improvement Plan for funding community trails or greenways
- Include a line item in the Capital Improvement Plan for funding the community's natural area/ green infrastructure program
- Advocate the use of donation/ tax incentives, conservation easements, millages, bond referendums, and/ or utility fees to fund the conservation and management of natural areas, open space, and water resources within the community
- Identify environmental education and outreach as an important community goal or policy
- Advocate coordinating environmental education efforts with other organizations, such as local watershed councils, land conservancies, or the county

*Tools and Resources*

*1. Fish and Wildlife Service Grants available to local governments*
*http://www.fws.gov/grants/local.html*

*2. Michigan Natural Resources Trust Fund*
*http://www.michigan.gov/dnr/0,1607,7-153-10366_37984_37985-124961--,00.html*

*3. Oakland Land Conservancy*
*http://www.oaklandlandconservancy.org/*

*4. Flint River Watershed Coalition*
*http://www.flintriver.org*

*5. Field Guide to Transfer of Development Rights*
*http://www.realtor.org/libweb.nsf/pages/fg804*

*6. More on Transfer of Development Rights*
*http://www.beyondtakingsandgivings.com/tdr.htm*

# Appendix 3
# Hydrology and Impervious Surface Analysis

**Introduction to Hydrology**

Streams receive water in two general ways including overland flow (runoff) from the earth's surface and from base flow (infiltration that seeps directly into the stream channel). Land use changes in a watershed redistribute the amount of water that is delivered to the stream by these two processes. In most cases human interactions tend to increase the amount of water entering the stream from direct runoff while reducing the water available for base flow. This change in the hydrology (how much and how fast water moves through a watershed) is measured by two variables: the coefficient of runoff (amount) and the concentration time (speed). Landscape changes including land clearing, deforestation and the introduction of impervious surfaces increase the coefficient of runoff. Concentration time is shortened by activities such as installing ditches, constructing storm sewers and removing wetlands. (Figure A3.1) is a graphic representation of how natural and urban river systems react to rainfall events. This figure contains two hydrographs representing hypothetical urban and natural streams. Time is plotted along the horizontal axis while the amount of water (discharge) is plotted along the vertical axis. A review of this figure demonstrates drastic differences between natural and urbanized watersheds. Most important to notice are the increases in peak flow and reduction of base flow associated with the urban watershed.

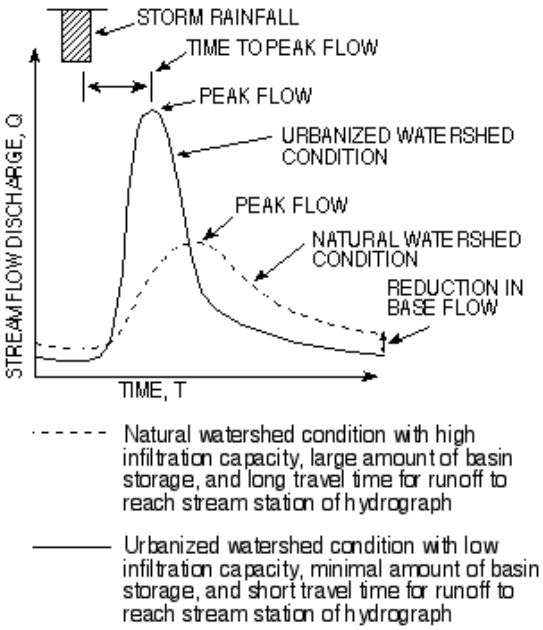



**Figure A3.1. Hypothetical urban and natural hydrographs**

The increases of runoff and concentration times (time it takes rainwater to reach the stream channel) associated with land use changes and channel alterations results in significant impacts on water quality. Changes in these two variables directly impact the aquatic habitats of the stream system. In addition they affect the magnitude and frequency of flooding events, increase erosion and the delivery of non-point source pollutants to the stream. The reduction in base flow negatively impacts the stream by reducing the water available for human and animal uses.

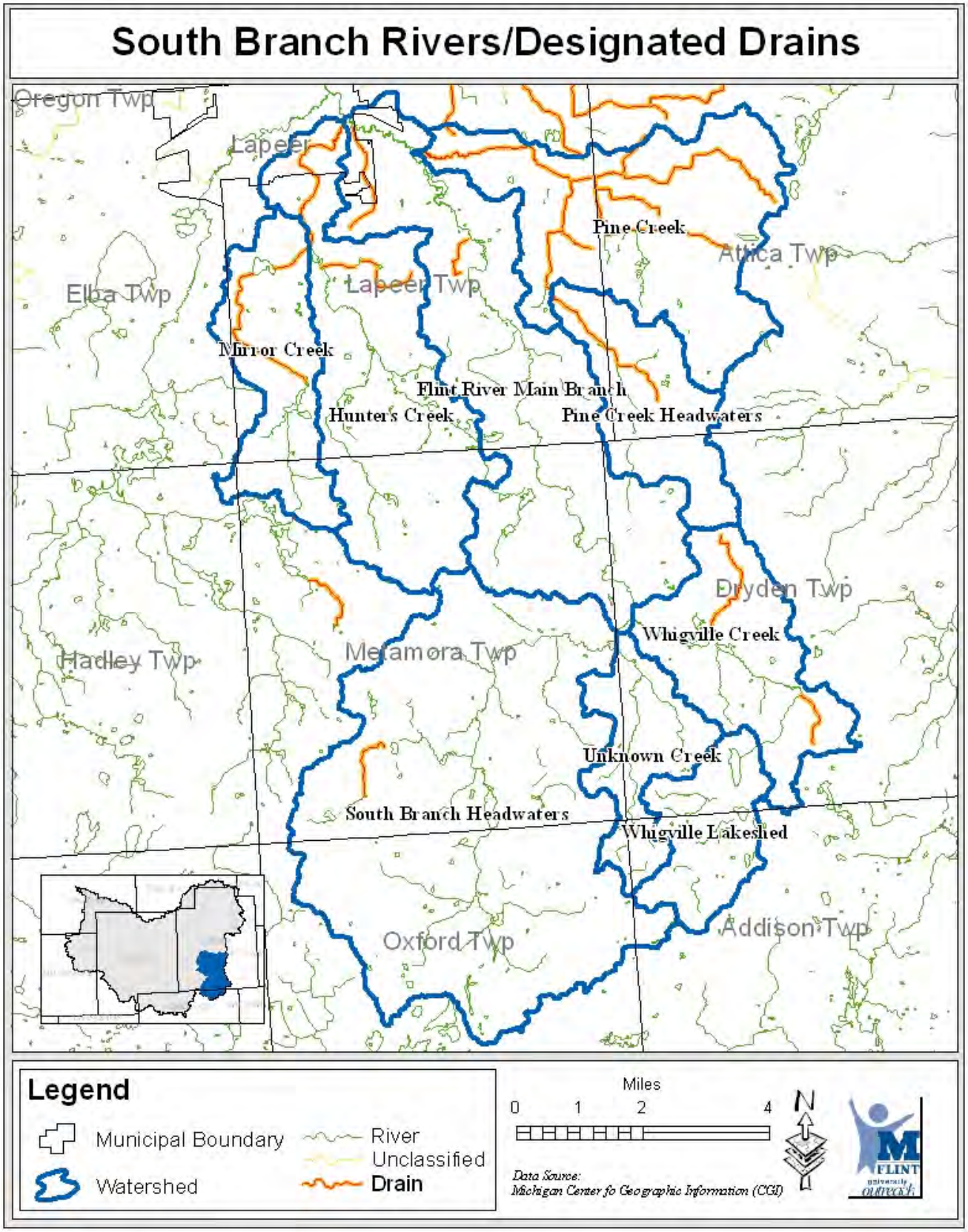
**Hydrologic analysis methods**

The planning team conducted several activities in an effort to characterize the hydrology of the South Branch Watershed. The basis for the analysis is the interpretation of hydrologic cues. Hydrologic cues are physical indicators within a watershed that offer information about the hydrologic condition of the watershed. For this analysis the cues consist of observations for extensive stream bank erosion, channel form (instability), high water mark and land use (impervious cover analysis).

**Channel form & stream bank erosion**

Significant portions of the South Branch watershed's stream channels are identified as designated drains (A3.2). However a majority of the watershed exhibits natural channel forms and stable stream banks. Field observation of stream bank erosion in the watershed was almost nonexistent with the exception of a few isolated locations within the watershed where erosion appears to be a result of local scale hydrologic factors. Most areas where these factors were noted, the channel exhibited forms that suggested the channel was adjusting and recovering naturally. These locations were infrequent and did not attract the attention of the planning team as a critical threat to designated uses. Table A.3.3 identifies the condition of the stream channels at the road/stream crossings inventoried. Included below are two photographs of the representative section of each sub watershed.

**Figure A3.2 South Branch Rivers**



## Designated Drains

**Table A3.3 Stream Channel Condition**

| | Upstream | | | Downstream | | |
|---|---|---|---|---|---|---|
| **River Morphology** | **%Natural** | **%Recovering** | **%Maintained** | **%Natural** | **%Recovering** | **%Maintained** |
| Channel | 64 | 11 | 16 | 63 | 13 | 14 |

## High Water Marks

The high water mark of a stream is defined as the elevation of water in the stream channel during a flood event. Streams with stable hydrology tend to have low fluctuations between normal water mark and flood water mark. Large differences between the current water level and high watermarks are indicators of hydrologic instability. As Table A3.4 shows, most sub-watersheds have a high water mark of less than 1 foot, followed by 1-3 feet.

**Table A3.4**

| | Highest Water Mark | | | | |
|---|---|---|---|---|---|
| **Watershed** | **?** | **<1** | **1-3** | **3-5** | **Total** |
| Hunters Creek | 0 | 4 | 5 | 1 | 10 |
| Main Branch | 2 | 6 | 4 | 0 | 12 |
| Mirror Creek | 0 | 3 | 1 | 0 | 4 |
| Pine Creek | 3 | 7 | 1 | 0 | 11 |
| Pine Creek Headwaters | 0 | 1 | 2 | 0 | 3 |
| South Branch Headwaters | 3 | 4 | 2 | 1 | 10 |
| Unknown Creek | 1 | 2 | 1 | 0 | 4 |
| Whigville Creek | 2 | 5 | 0 | 0 | 7 |
| Whigville Creek Headwaters | 2 | 1 | 0 | 0 | 3 |
| Total | 13 | 33 | 16 | 2 | 64 |

## Land use and hydrology

Land use within a watershed is a major determining factor of the hydrologic stability of the watershed. Changes in the natural land cover can have tremendous effects upon the hydrologic functioning of the river system. One major change that takes place in the alteration of natural land covers is an increase in impervious surfaces (the area covered by rooftops, streets, parking facilities, and other hard surfaces). The physical, chemical, and biological integrity of a given stream system has been shown to be strongly correlated to the amount of impervious cover in the sub-basin or watershed (Schueler, 1994). Even small increases in impervious surface will change stream morphology and degrade aquatic habitat. The amount of impervious cover in a watershed can be used as

an indicator to predict how severe differences are in the character of urban and natural watersheds.

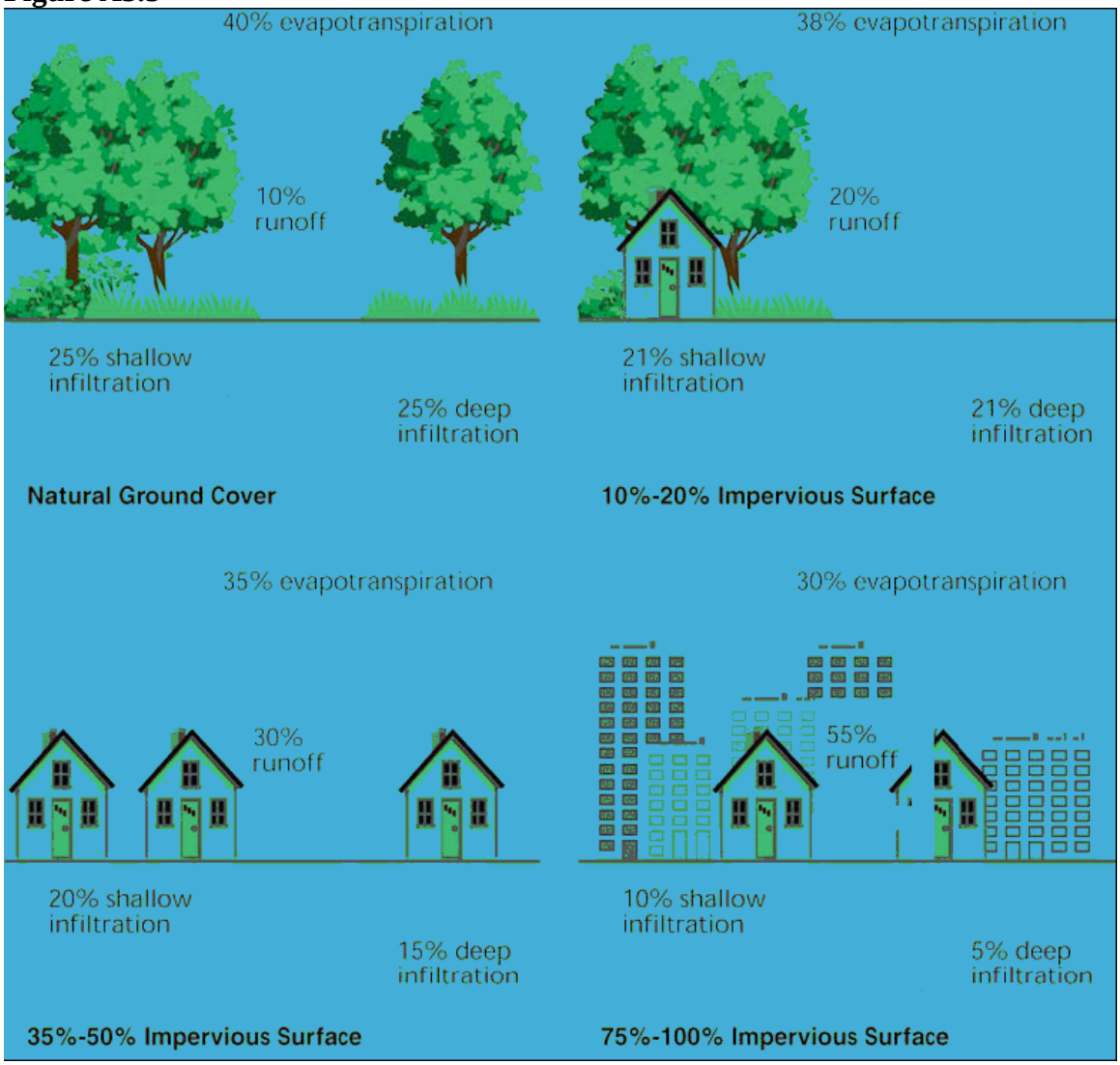
Analysis of stream systems across the country indicates there are thresholds at which watershed imperviousness results in degradation of water quality and physical stream processes. Research indicates that zones of stream quality exist, most noticeably beginning around 10 percent impervious cover, with a second threshold appearing at around 25-30 percent impervious cover. These thresholds are powerfully modeled in The Impervious Cover Model, classifying streams into three categories, sensitive, impacted, and non-supporting. Watersheds with less than 10 percent imperviousness appear to exhibit natural chemical, physical, and biological integrity. Between 10 and 25 percent imperviousness river systems show signs of degradation. Beyond 25 percent imperviousness, the damage to physical, chemical, and biological integrity may be irreversible. However it is important to understand the Impervious Cover Model, predicting quality of streams based on impervious cover change, is not without its limitations. (Schueler, 1994).

Impervious Surface Assessment

Impervious land cover consists of any surface that prevents the free movement of precipitation into soil pore spaces and then into interflow or a groundwater aquifer. It instead prevents infiltration and promotes storm water runoff into nearby wetlands or river networks. While certain clay soils, rocky outcroppings, and land with steep slopes can have these same effects and exist naturally, human created impervious land cover is more common in southeast Michigan and of greater concern. Man-made impervious surfaces can be anything from paved roads and parking lots, to the roofs of buildings and hard-packed soil.

Analysis of changes in impervious cover in the watershed over time will help evaluate the success of watershed planning efforts in the South Branch. The amount of impervious surface in a watershed is directly related to water quality. As impervious land cover increases, infiltration to groundwater and plant evapotranspiration are decreased while storm water runoff to storm drains, and subsequently to river systems, is increased (Figure A3.5). The results of this increased input to rivers includes increased risk of flooding, widely fluctuating stream levels, increased sedimentation of the stream bed, and increased erosion of the stream bank. Impervious cover in the South Branch must remain below 10% for water quality to remain in its current condition (CWP, 2005?).

**Figure A3.5**




**Effects of Urbanization on Runoff**
**Source: FISRWG**

Assessment Methods

Impervious surface reduction can be regulated through local policy and assessed by using simple GIS modeling. The National Oceanic Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) provides national land cover and change information based on satellite imagery for coastal regions of the U.S. One objective of C-CAP is to provide baseline for which coastal changes can be assessed over time. Data sets for the state of Michigan are available for 1995 and 2000. The C-CAP data can also be used to assess impervious cover through the use of the Impervious Surface Analysis Tool (ISAT), developed by NOAA Coastal Services Center and the University of Connecticut Non-point Education for Municipal Officials (NEMO) Program for coastal

and natural resource managers. The ISAT is used to calculate the percentage of impervious surface area of user-selected geographic areas (e.g., watersheds, municipalities, subdivisions).

ArcGIS is software developed by Environmental Solutions for Resource Integration (ESRI) for aerial and satellite imagery interpretation, and spatial data management. CCAP data can be manipulated using a combination of ArcGIS and an extension available from NOAA. ISAT can then be added to ArcGIS as an extension in order to analyze the land cover data for a desired geographic area to determine the runoff for that area. The CCAP and ISAT extension and help files are available for download from NOAAs website. Users must have access to ArcGIS or ArcView software to perform the analysis.

Impervious surface data for the South Branch and its sub-watersheds were developed through the combined use of ESRI's ArcView and ArcInfo software with NOAA's C-CAP data and ISAT in a two-step process. The ISAT applies impervious surface coefficients to the CCAP land cover data within a user defined boundary to determine the amount of impervious surface in that area. The 1995 and 2000 C-CAP data were analyzed using the sub-watersheds of the South Branch as boundaries and low (rural) coefficient defined by the extension. ISAT gives the user the choice of three predefined impervious surface coefficients: high, medium, and low, which correspond to urban, suburban, and rural land use. Since the majority land use identified for all watersheds was land that would fall into the rural category, the lowest coefficient was used. As can be seen in Figure A3.6 and Table A3.7, the results of the extension show that all watersheds have less than 10 percent impervious land cover.

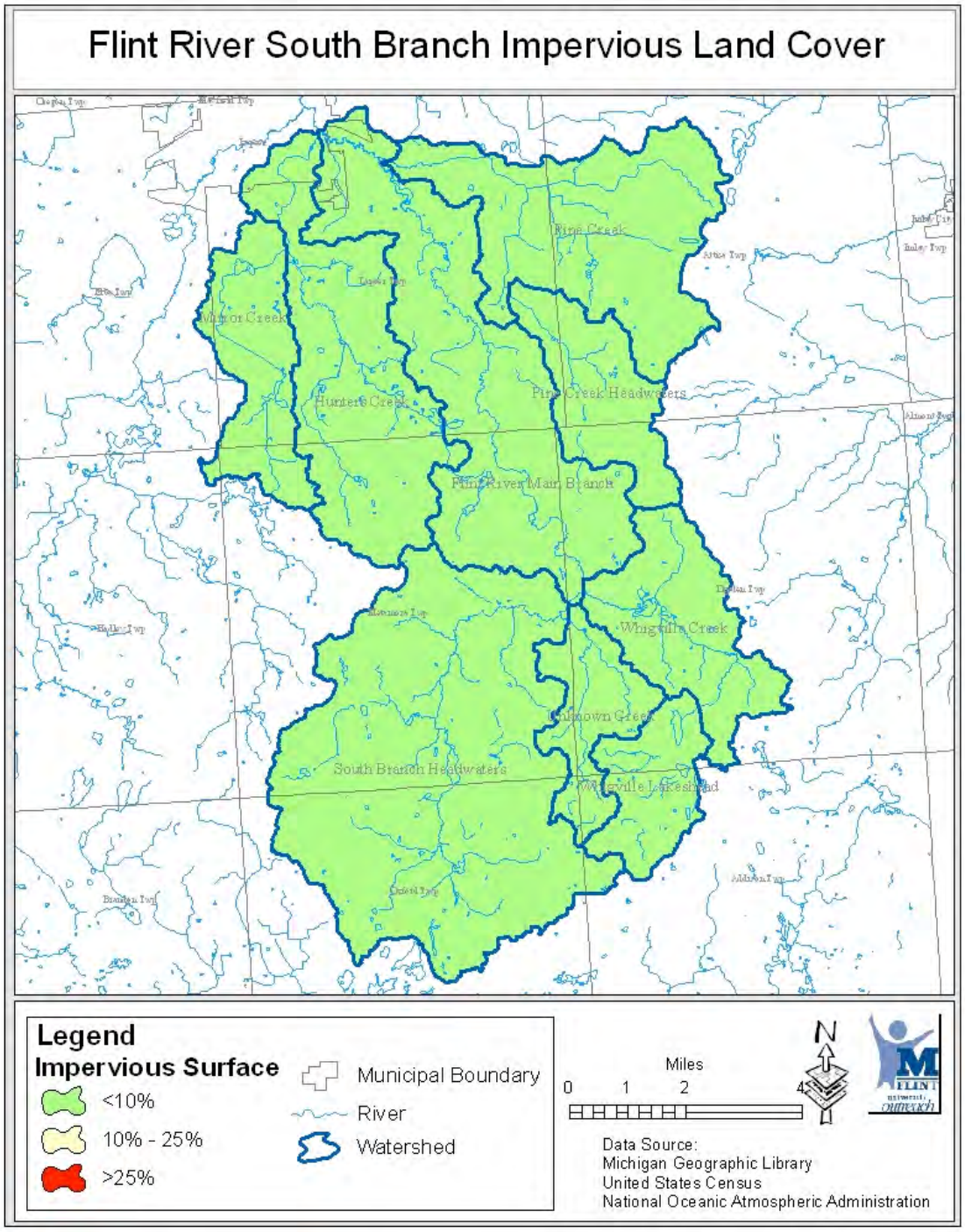



**Figure A3.6 Flint River South Branch Impervious Land Cover**

Table A3.7 Percent Impervious Land Cover

| Watershed | %Impervious Surface |
|---|---|
| Flint River Main Branch | 4 |
| Hunters Creek | 4 |
| Mirror Creek | 4 |
| Pine Creek | 4 |
| Pine Creek Headwaters | 3 |
| South Branch Headwaters | 4 |
| Unknown Creek | 3 |
| Whigville Creek | 3 |
| Whigville Lakeshead | 3 |

**Future Research**

As previously mentioned, changes in impervious land cover will have to be monitored in order to evaluate the success of watershed planning efforts in the South Branch. The available census data may be used as they have been here, but they will fail to pick up on changes at the local level unless population densities approach those of the City of Lapeer. There is a need, therefore, for the development of land cover data and impervious surface coefficients on the municipality level to adequately capture changes in impervious cover over time. Also it is anticipated that the 2005 CCAP data will soon be available, at which time it should be evaluated using ISAT to look for more recent changes in impervious land cover.

**Ponds and Lakes**

The stable hydrology of the South Branch Watershed is contributed to by the stable land use and the undulating landscape. The abundance of lakes and ponds in the watershed aid in the regulation of stream flow and is critical to maintaining high water quality in the South Branch. In addition to identifying rivers and streams, ponds and lakes also were inventoried as part of the Wetland Functionality Assessment (Appendix 4). Ponds and lakes were identified in each sub-watershed by origin and classified by flow path.

Origin is defined as:

Natural – naturally occurring lake or pond due to historic glacial activity
Dammed – lake or pond occurs as a result of a dammed stream or river
Excavated – lake or pond has been created by removal of soil and vegetation

Flow path is defined as:

Isolated – surface water does not enter pond or lake via a channel
Outflow – surface water flows out of lake or pond
Inflow – surface water flows into lake or pond
Through flow – surface water flows through lake or pond (ex. Impoundment)

Table A3.9 lists ponds and lakes in the South Branch watershed.

**Table A3.9**

| South Branch Headwaters Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Isolated | 1 |
| Lake | Natural | Outflow | 1 |
| Lake | Other Dammed | Isolated | 1 |
| Pond | Natural | Isolated | 27 |
| Pond | Natural | Outflow | 2 |
| Pond | Natural | Throughflow | 3 |
| Pond | Excavated | Isolated | 68 |
| Pond | Excavated | Outflow | 2 |
| Pond | Excavated | Throughflow | 7 |
| Pond | | Isolated | 4 |
| Pond | | Outflow | 1 |

| Unknown Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Pond | Natural | | 1 |
| Pond | Natural | Isolated | 4 |
| Pond | Natural | Outflow | 1 |
| Pond | Natural | Throughflow | 2 |
| Pond | Excavated | Isolated | 9 |
| Pond | Excavated | Outflow | 1 |
| Pond | Excavated | Throughflow | 5 |
| Pond | | Isolated | 2 |

| Hunters Creek Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Throughflow | 1 |
| Pond | Natural | Inflow | 2 |
| Pond | Natural | Isolated | 30 |
| Pond | Natural | Outflow | 4 |
| Pond | Natural | Throughflow | 5 |
| Pond | Excavated | | 1 |
| Pond | Excavated | Isolated | 33 |
| Pond | Excavated | Outflow | 2 |
| Pond | Excavated | Throughflow | 4 |
| Pond | | Isolated | 4 |

| Main Branch Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Outflow | 1 |
| Lake | Other Dammed | Throughflow | 2 |
| Pond | Natural | Isolated | 25 |
| Pond | Natural | Outflow | 2 |
| Pond | Natural | Throughflow | 5 |
| Pond | Dammed/impounded | | 1 |
| Pond | Dammed/impounded | Throughflow | 1 |
| Pond | Excavated | Isolated | 44 |
| Pond | Excavated | Outflow | 1 |
| Pond | | Isolated | 5 |

| Mirror Creek Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Throughflow | 1 |
| Lake | Other Dammed | Throughflow | 1 |
| Pond | Natural | Isolated | 6 |
| Pond | Natural | Outflow | 1 |
| Pond | Excavated | Isolated | 12 |
| Pond | Excavated | Outflow | 1 |
| Pond | Excavated | Throughflow | 1 |
| Pond | | Isolated | 4 |

| Pine Creek Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Dammed River Valley | Isolated | 1 |
| Pond | Natural | Isolated | 23 |
| Pond | Natural | Outflow | 1 |
| Pond | Natural | Throughflow | 3 |
| Pond | Excavated | | 2 |
| Pond | Excavated | Isolated | 36 |
| Pond | Excavated | Outflow | 3 |
| Pond | Excavated | Throughflow | 2 |
| Pond | | Isolated | 17 |

| Pine Creek Headwaters Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Pond | Natural | Isolated | 16 |
| Pond | Natural | Outflow | 1 |
| Pond | Natural | Throughflow | 3 |
| Pond | Excavated | Isolated | 20 |
| Pond | Excavated | Outflow | 1 |
| Pond | Excavated | Throughflow | 1 |
| Pond | | Isolated | 1 |

| Whigville Creek Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Throughflow | 1 |
| Pond | Natural | Isolated | 19 |
| Pond | Natural | Throughflow | 2 |
| Pond | Excavated | Isolated | 35 |
| Pond | Excavated | Outflow | 3 |
| Pond | Excavated | Throughflow | 1 |
| | | Isolated | 2 |

| Whigville Headwaters Watershed Ponds/Lakes | | | |
|---|---|---|---|
| **Waterbody** | **Origin** | **Flow Path** | **Count** |
| Lake | Natural | Throughflow | 1 |
| Pond | Natural | Isolated | 6 |
| Pond | Natural | Outflow | 2 |
| Pond | Natural | Throughflow | 1 |
| Pond | Dammed/impounded | Isolated | 2 |
| Pond | Dammed/impounded | Throughflow | 1 |
| Pond | Excavated | Isolated | 8 |
| Pond | Excavated | Outflow | 1 |

**Summary of the Hydrology of the South Branch Watershed**

The hydrology of the South Branch Watershed appears to be relatively stable. The low percentages of urban land uses and historic stable land use has protected the watershed's hydrology from significant degradation. The watershed is most hydrologically stable in the headwater reaches including the South Branch Headwaters, Unnamed, Whigville Creek, Pine Creek Headwaters and Flint River Main Branch. The hydrology of these areas is regulated by significant groundwater inflow (Figure A3.10). The high ground water inflow is a direct result of the high percentage of permeable soils (hydrologic soil groups A and B) and the undulating landscape of this region of the watershed (Figure A3.11). The lower section of the watershed including Mirror Creek, Hunters Creek and Pine Creek exhibit less stable hydrology due to significant draining and ditching practices and higher percentages of agricultural land.

- Key Point:
  The stable hydrology of the upper reaches of the South Branch Watershed should be a priority for preservation. Preserving this hydrology can be done through the combination of private land preservation, natural feature setback and increases in the use of storm water management techniques that encourage infiltration. Communities may want to adopt local ordinances that require construction sites to not increase offsite runoff beyond pre-development states.

- Key Point:
  The hydrology of the Pine Creek Watershed and Mirror Creek are impacting and/or threatening designated uses. Efforts should be made to mitigate historic alterations to the hydrology. This can be achieved through a combination of BMPs that include wetland restoration, alternative drain and ditch design, and improvements in riparian corridor management.

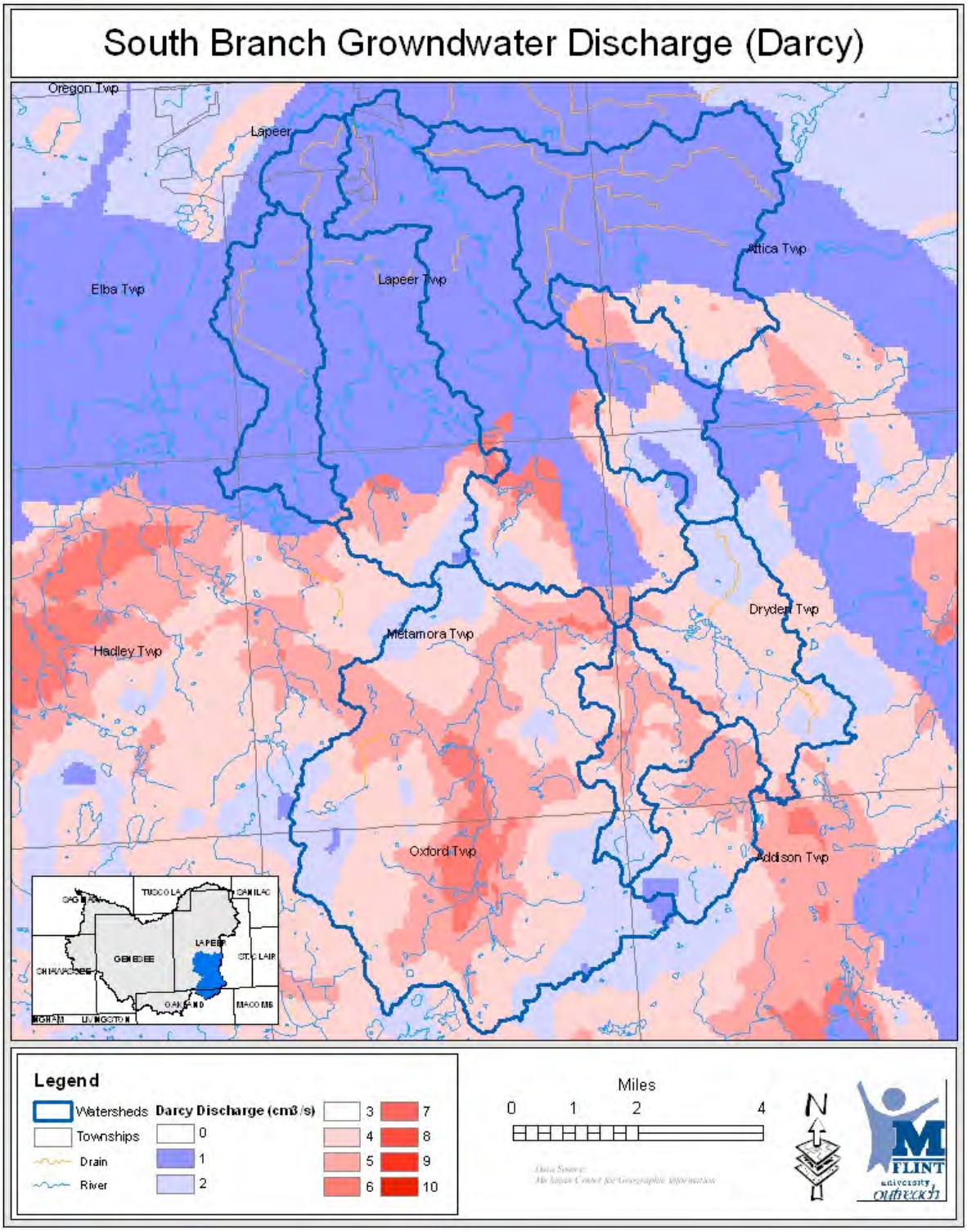



**Figure A3.10 Ground Water Inflow to South Branch Watershed**

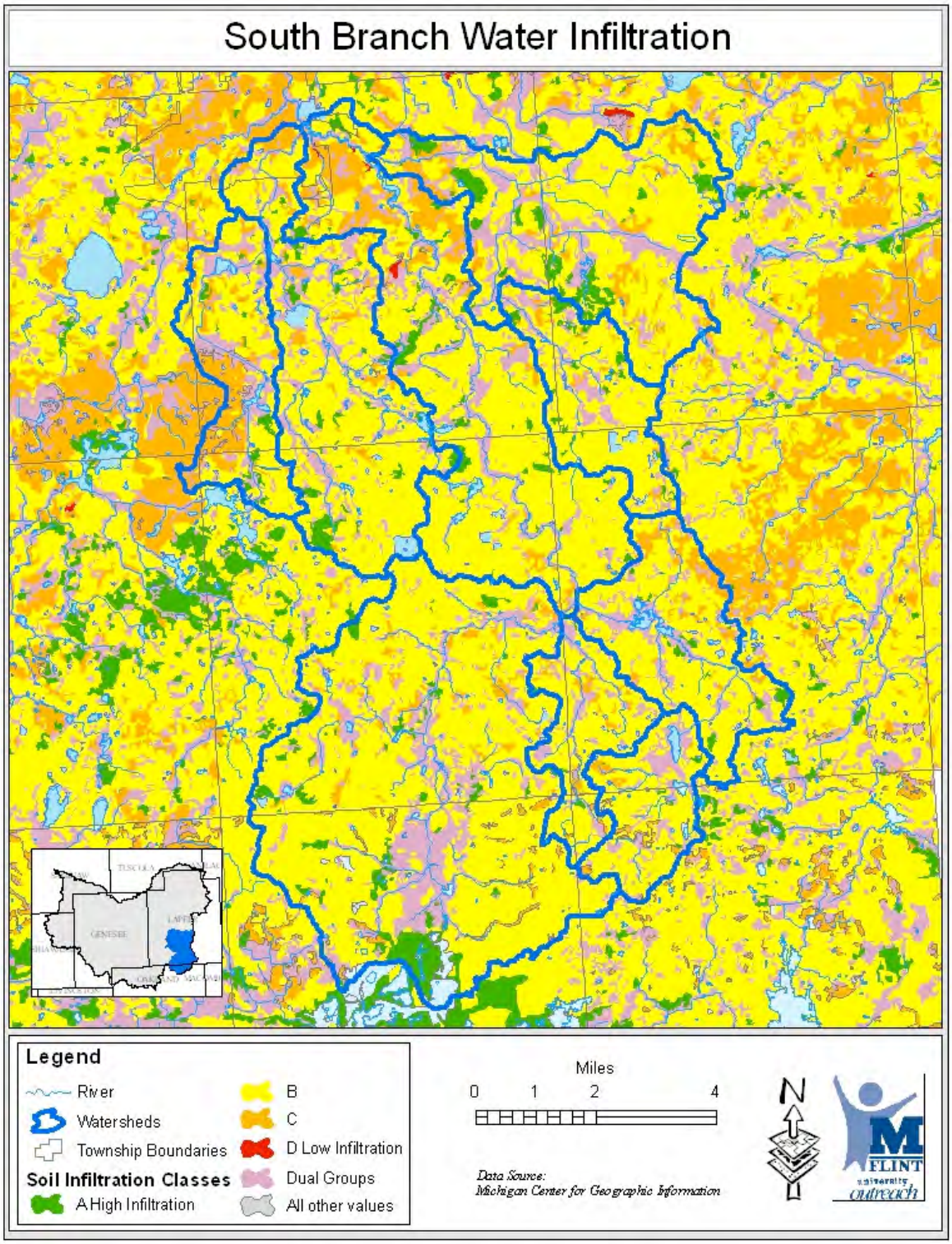



**Figure A3.11 Water Infiltration Based on Hydrologic Soil Units**