V. Defining the River Corridor

The River Corridor Model

A major part of this study focuses on the corridors of the major rivers of Allegheny County. This includes the Allegheny, Monongahela, Youghiogheny and Ohio rivers. These four rivers, all part of the greater Ohio river watershed, are the major hydrological elements of the county's geography. While the watershed section of the study looks at the entire hydrological network of the county, the river corridor analysis zooms in to examine only the sections of the county with a direct spatial relationship with the major rivers. The analysis attempts to measure the ecological functionality of the major river corridors using a combination of field data and GIS analysis of existing mapping.

Our study adopts the landscape ecology model of river corridors put forth by Richard Forman in Land Mosaics. The river corridor concept focuses on the entire landscape corridor through which the river flows. It is about the landscape in relation to the river. In a river corridor study, the "emphasis is on the vegetation corridor, its components, functioning and dynamics" (Forman 208). For a major 5th – 10th order river, the corridor includes the entire river valley as shown in Figure V.1. The section shows five types of habitat which form linear bands following the river.

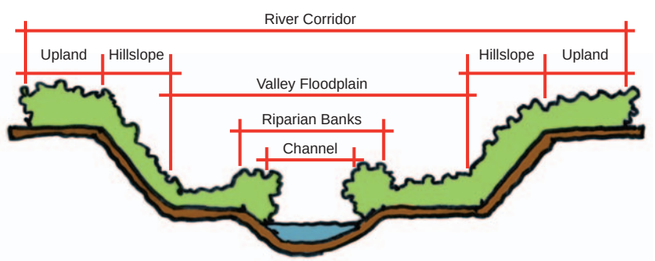


Figure V.1 The river corridor concept shown in section with the major landscape zones indicated. (Jonathan Kline-3R2N)

These include the river channel, riparian banks, valley floodplain, valley hillslopes and forested uplands. Forman's diagram from Land Mosaics is reproduced at right (Figure V.2.) It represents the river corridor from small seep at the top to large river at the bottom. The area of the corridor grows larger and more complex with the size of the river. Seen in three dimensions, the model corresponds to the entire valley form of the river (Figure V.3).

River Corridor Functionality

The zones included in the river corridor are based upon their individual and integrated ecological functions. The importance and functions of the different zones are shown in Figure V.2 & V.3. These aspect of river corridor functionality defined by Forman in Land Mosaics are the basis for our river corridor analysis. We have taken the optimum model and compared it to the available Allegheny County river corridor data. For large 5th to 10th order rivers, Forman proposes four major components for optimum ecological functionality: (Forman 241-252)

A. Continuous bands of vegetation along river banks.
B. Presence of woodlands on hill slopes.
C. Continuous bands of upland interior woodlands above hill slopes.
D. Patches of interior native floodplain vegetation extending from river edge to hillslope base alternating with patches of ecologically compatible land uses.

River bank vegetation provides habitat and movement corridors for semi-aquatic vertebrates, and shade and logs for river fish species. Wooded hillslopes act as habitat and reduce erosion and sedimentation of the river. Continuous upland interior woodland bands provide habitat and movement corridors for upland animal communities. Most significantly for the river, the floodplain vegetation minimizes flooding through friction and sponge effects, traps sediment during seasonal flooding, provides organic material for fish and other river organisms, and provides habitat for riparian species. The optimum condition is a continuous valley of native floodplain vegetation. An ecologically functional compromise is to divide floodplain vegetation into a "ladder" of large patches alternating with other land uses (Forman 249, 250).

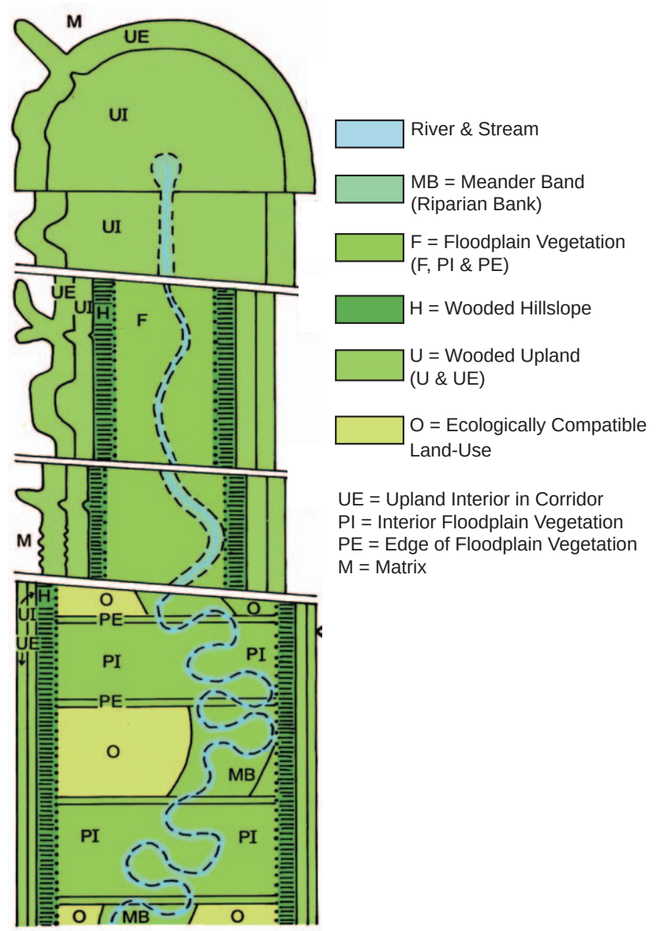
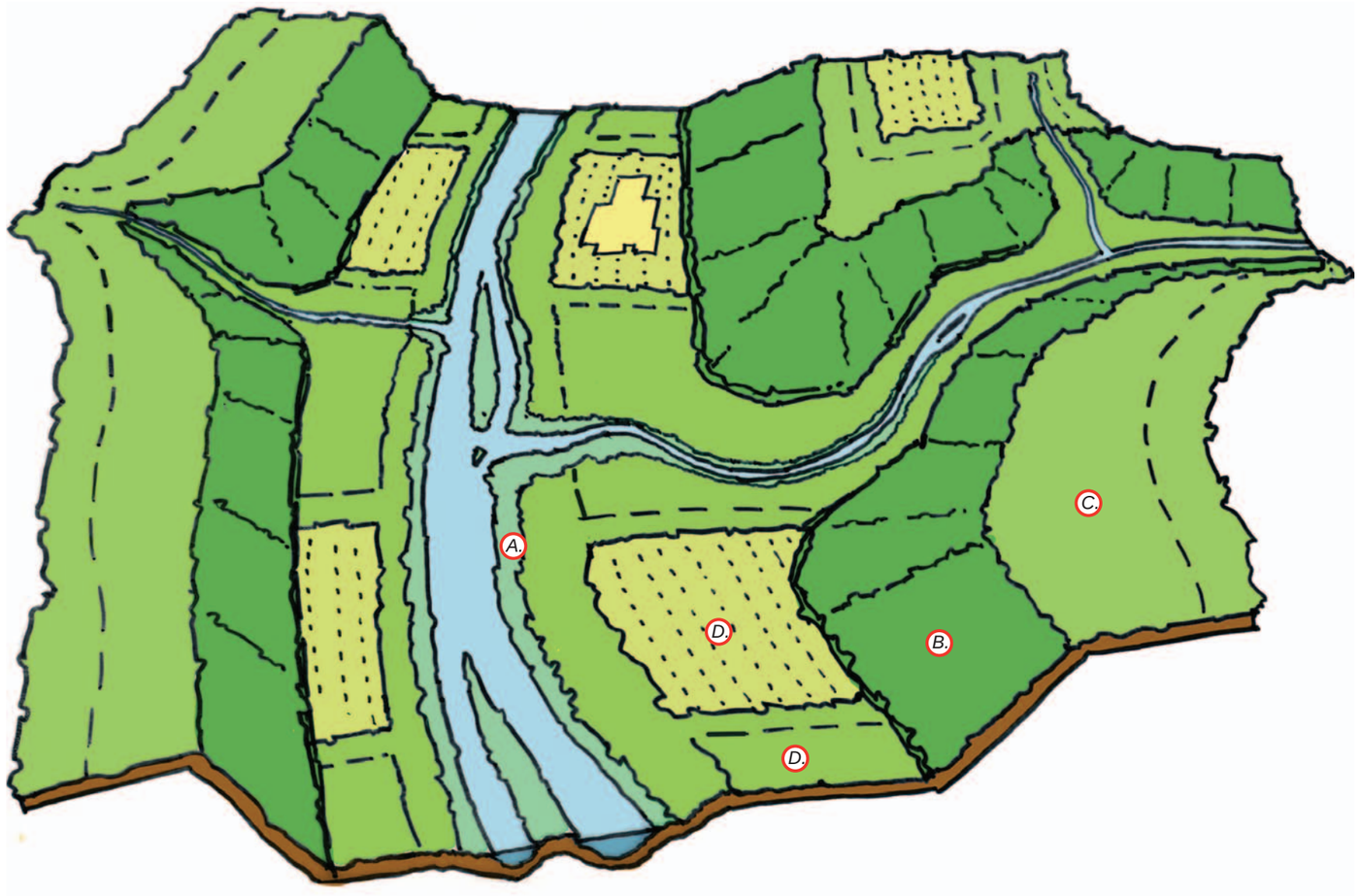


Figure V.2 "The minimum width of stream and river corridors based on ecological criteria. Five basic situations in a river system are identified, progressing from seepage to river. The key variables determining minimum corridor width ate listed under each." (Reproduced from Richard Forman - Land Mosaics Color Coding by 3R2N)



River & Stream
Riparian Bank
Floodplain Vegetation
Wooded Hillslope
Wooded Upland
Ecologically Compatible Land-Use
Urban Settlement

Zones of a Functional River Corridor
A. Continuous bands of vegetation along river banks.
B. Presence of woodlands on hillslopes.
C. Continuous bands of upland interior woodlands above hillslopes.
D. Patches of interior native floodplain vegetation extending from river edge to hillslope base alternating with patches of ecologically compatible land uses.

Figure V.3 A three-dimensional interpretation of the Forman river corridor model. (Jonathan Kline-3R2N, after Forman)

Defining the River Corridors of Allegheny County

For our GIS mapping study, we used the river corridor model to define a study area for the river corridors of Allegheny County. Two different analyses were combined to create this area. The first method attempted to capture the physical river valley form based upon topography; the second method adds streams small enough that they were not considered as individual sub-watersheds.

Map 5.1 River Valley Viewshed

A three-dimensional digital elevation model of the landscape was used to perform a GIS viewshed analysis from a series of points along the rivers. The map shows all areas of the landscape visible from a series of quarter mile points situated twenty-five feet above the pool elevation. To create a first draft of the river corridor, a line was drawn following the outlying visible points on the landscape, which tend to be beyond the edge of the hillslopes of the valley.

Map 5.2 First Order Drainage to the Rivers

The second component used to define the river corridor is the area of first order drainage to the river from the sub-watershed map. Along the major rivers there are numerous small first order streams which flow directly into the river. There are also large areas where streams have been lost to urban development.

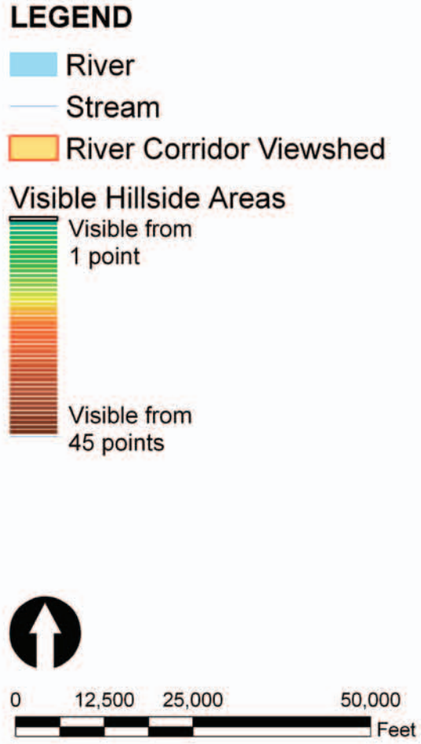
Map 5.3 River Corridor Study Area

The final river corridor study area added these two analyses together for the area shown in yellow. The study area captures the major landscape zones identified in the river corridor model, including the river and natural floodplain valley, the valley hillsides and the uplands along the river corridor. At major streams, it also captures the beginning of the stream valley and riparian floodplain where stream meets river. Because the valley viewshed analysis was not performed for the Youghiogheney an approximation based upon the topography was made for this area.

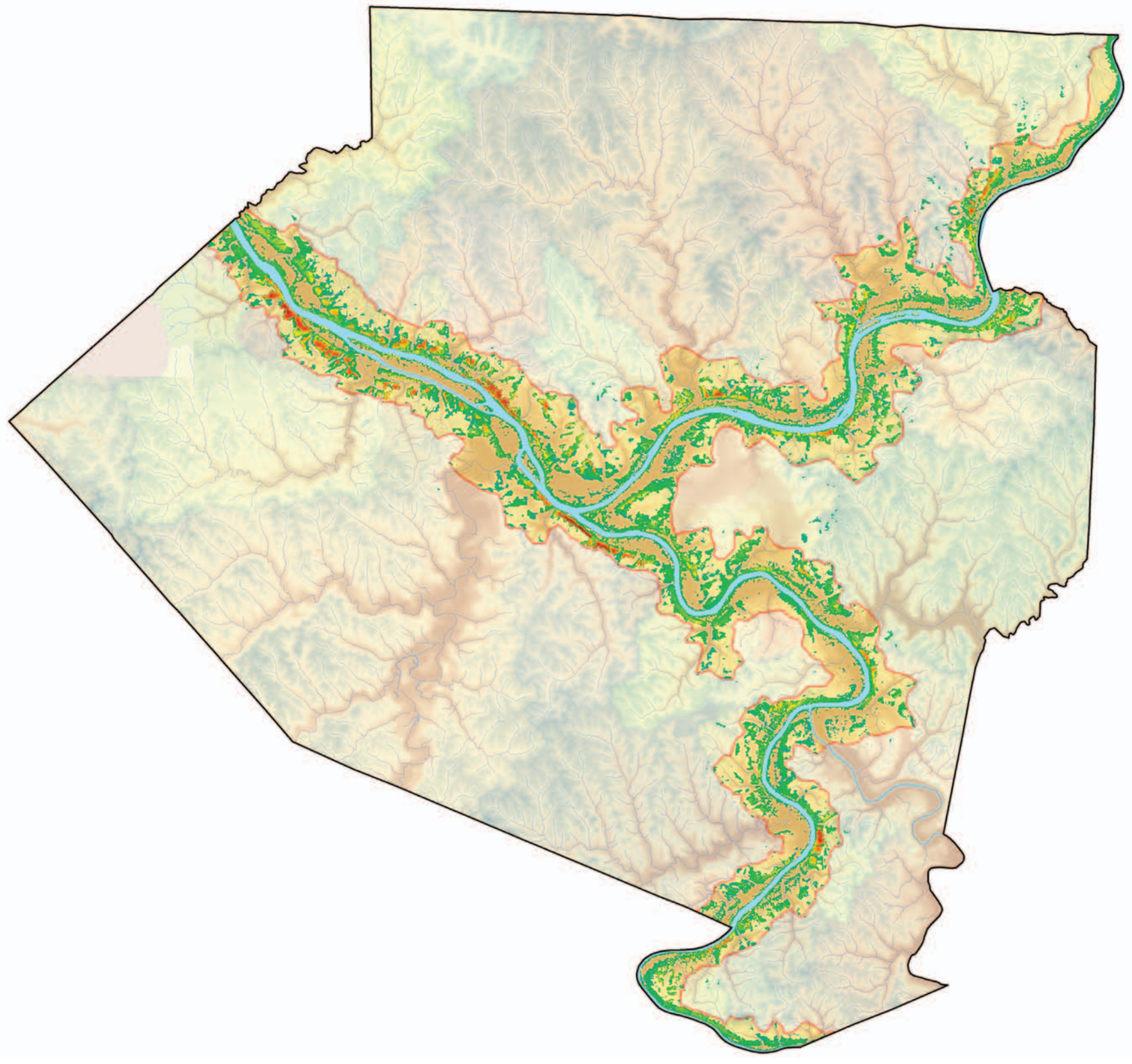
5.1 RIVER VALLEY VIEWSHED

The river valley viewshed was determined by a series of quarter mile points along the centerline of the river at 25 feet above the pool elevation. The color ramp indicates the number of points from which an area is visible. The bright red areas were visible from up to 45 points and the dark green from only a single point.

Based upon this point analysis a viewshed area was created shown in yellow. The outer edge of the viewshed area follows the furthest visible points from the river, which in turn reflects the top of the hills of the river valley corridor. At major sub-watershed creek mouths, flood plain areas are also included.



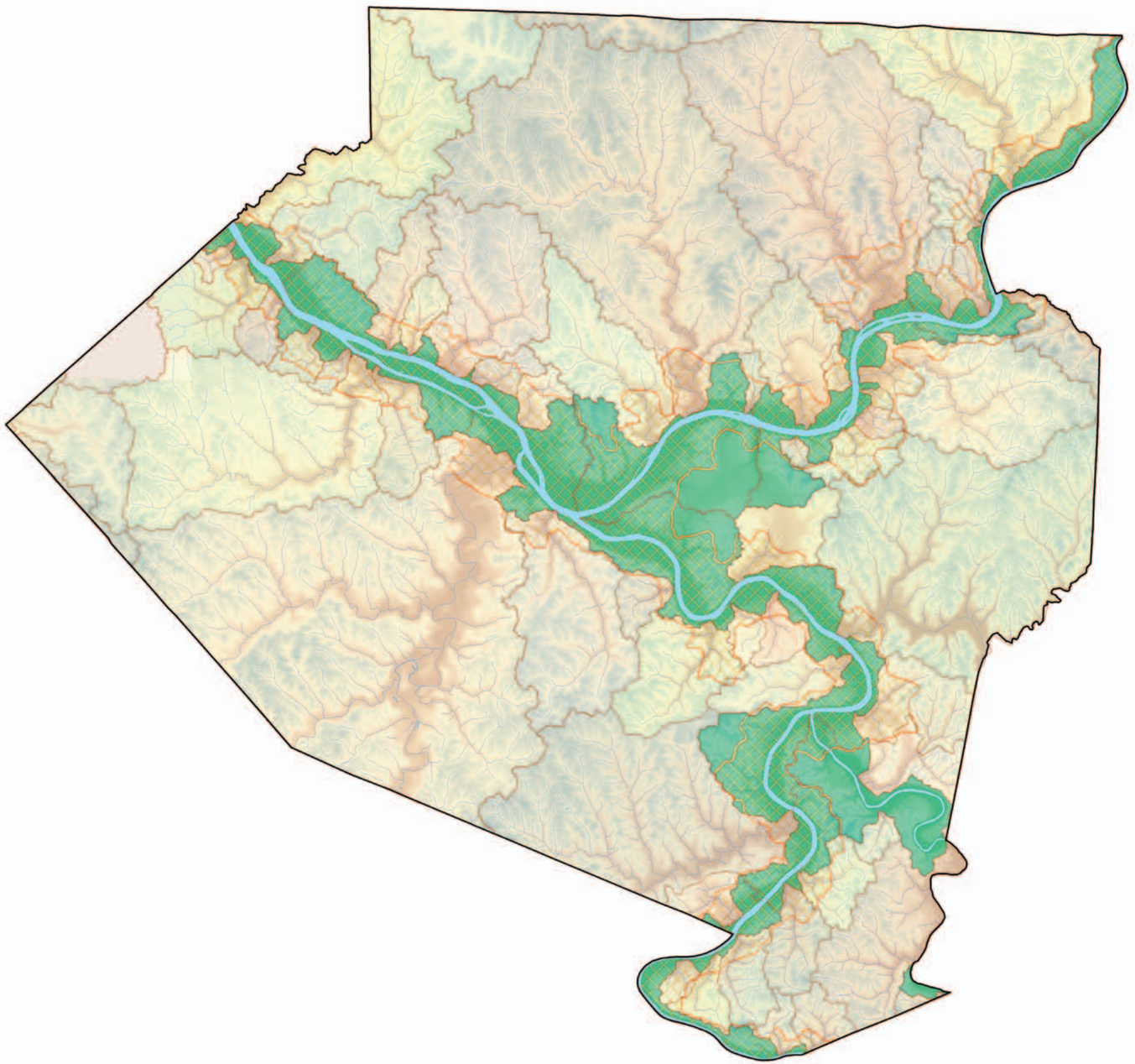
Author: Jonathan Kline



5.2 FIRST ORDER DRAINAGE TO THE RIVERS

The sub-watershed map of the county shows all of the drainage areas of more complex higher order streams as separate watersheds. However, along the rivers, small 1st order streams draining directly into the rivers are included in the immediate watershed area of the major rivers. This area also includes large areas of the City of Pittsburgh where streams have been culverted or integrated into the storm sewer system. This zone is shown in turquoise.

The river valley viewshed and the first order drainage area of the river cover slightly different areas. For our river corridor study, we have summed these two areas to define a single river corridor zone.



LEGEND

- River
- Stream
- Watershed Boundary
- River Corridor Viewshed
- First Order Drainage to the Rivers

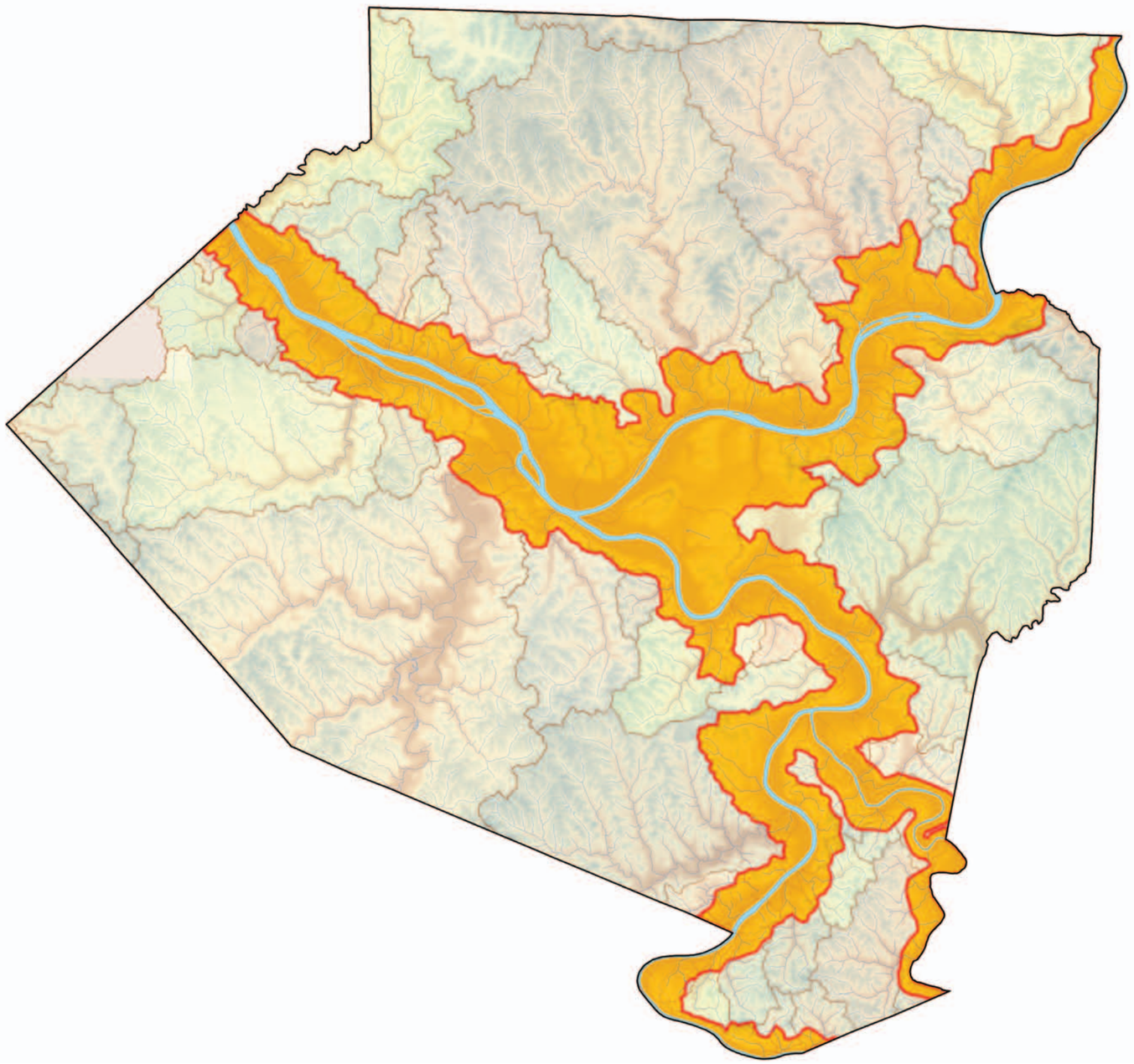
0 12,500 25,000 50,000 Feet

Author: Jonathan Kline

5.3 RIVER CORRIDOR STUDY AREA

The combination of the valley viewshed and the first order drainage to the rivers yields our river corridor study area. This area was then used for further analysis. It captures the physical river valley floor, the hillsides and tops of the hills and some upland areas. It also captures the mouths and initial stream valleys of all streams draining into the rivers.

Methodological Note: Because the construction of the first order drainage pattern polygon along the Youghiogheny river differed from that of the other rivers and did not accurately reflect the Forman river corridor, a new Youghiogheny river corridor was drawn to match the model.



LEGEND

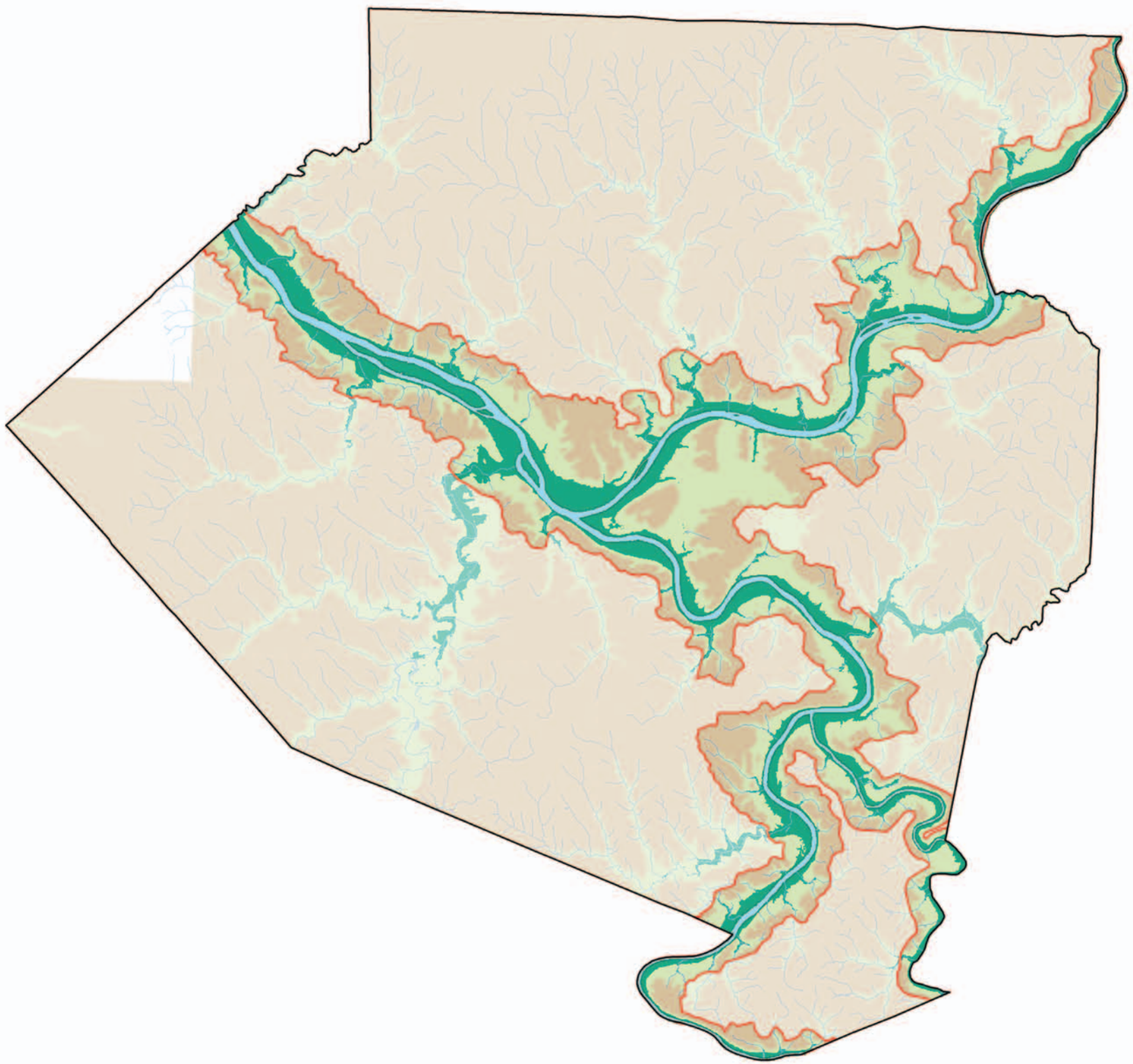
- River
- Stream
- Watershed Boundary
- River Corridor Study Area

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline

5.4 RIVER CORRIDOR LANDSCAPE ZONES

The combination of the valley viewshed and the first order drainage to the rivers yields our river corridor study area. This area was then used for further analysis. It captures the physical river valley floor, the hillsides and tops of the hills and some upland areas. It also captures the mouths and initial stream valleys of all streams draining into the rivers.



LEGEND

- River
- Stream
- River Corridor Study Area

River Corridor Zones

- Natural Valley Floor
- Hillsides
- Uplands

0 12,500 25,000 50,000 Feet

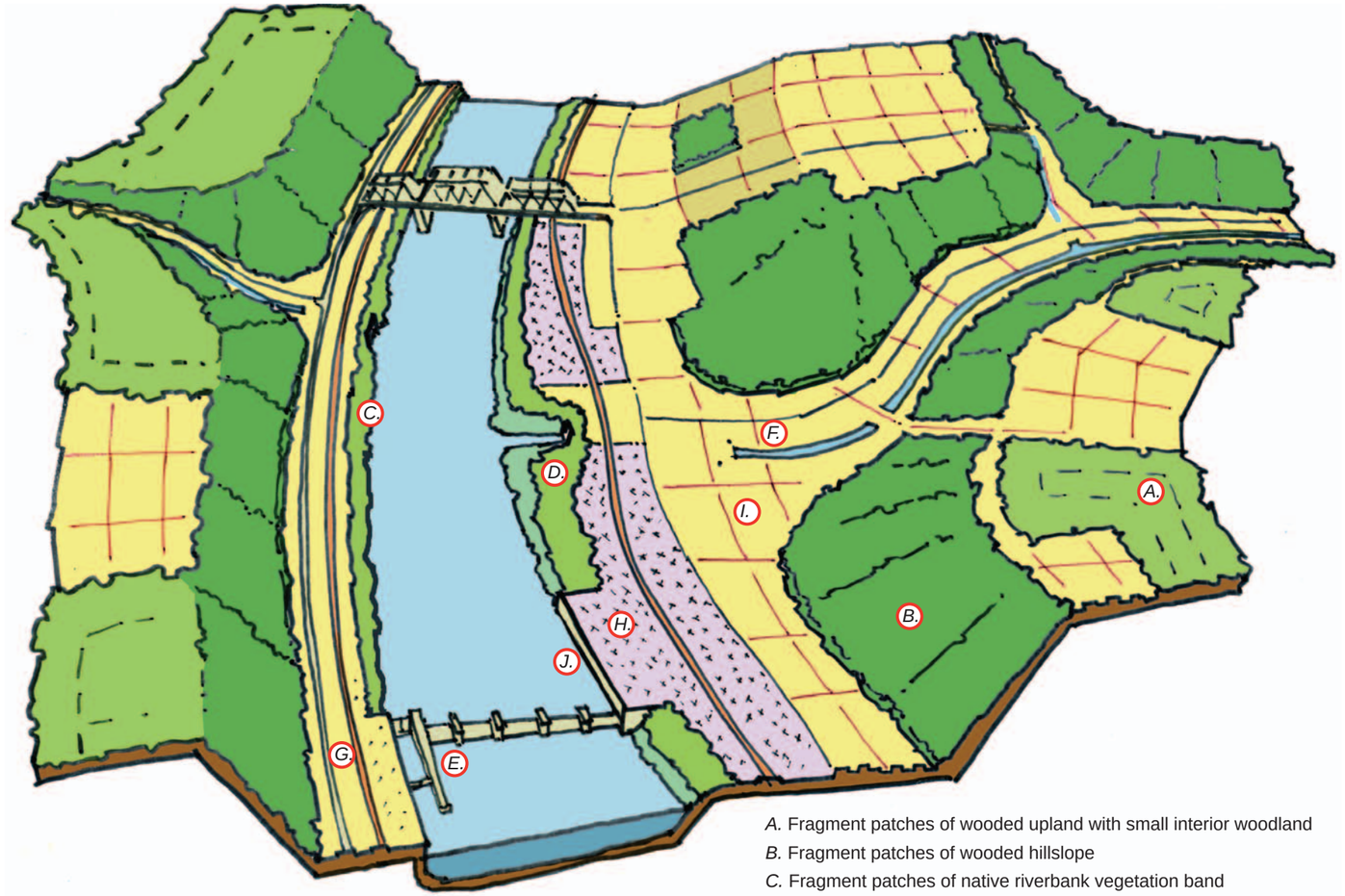
Author: Jonathan Kline

Map 5.4 River Corridor Landscape Zones

The major landscape zones of the river corridor can be seen in Map 5.4. The river meanders through the natural valley floor which historically acted as the riparian floodplain. Throughout the county, the major rivers have created an alternating pattern of wide floodplains on inside curves and narrow floodplains on outside curves. Hillsides also tend to follow this alternating pattern between extremely steep slopes and gentle slopes, corresponding to the outside curve and inside curve of the river respectively. Throughout the county, the continuous valley form is punctuated by major and minor smaller perpendicular stream valleys linking to the sub-watersheds of the county. At times, these valleys cut deep into the landscape, such as at Chartiers, Peters and Turtle Creeks, creating large areas of riparian floodplain adjacent to the river.

The Post Industrial Reality of the Rivers of Allegheny County

As shown in Figure V.4, the river valleys of twenty-first century Allegheny County are a long way from Forman's optimal river corridor model. Two centuries of human settlement and industrial development have transformed the natural state of the river corridors. Parts of the corridors do have major areas of remnant ecological value. Large upland interior woodland patches do exist, although they are dissected by roads and fragmented by other land-uses, particularly around the confluence of the rivers. Large patches of hillslope woodland remain but they are also dissected by numerous small road corridors and fragmented by other land uses. River bank vegetation is fragmented into patches of native vegetation, introduced vegetation and built infrastructure. However, the natural floodplains of the valley floor are a different story. First of all, the original hydrological pattern of the river has been fundamentally altered by a series of locks and dams creating relatively fixed level river pools. Over time floodplains have been filled and raised to create plateaus above the artificially controlled flood levels. Continuous roads and railroads line almost every river edge in the county. Patches of floodplain vegetation do exist, but they are far and few between and almost always are bisected by a road and/or railroad. In large part, the original floodplain has been given over to human settlement and industrial activity. Along the floodplains, human uses tend to alternate between dense compact towns with large industrial or former industrial river edges and transportation corridors consisting of multiple roads and railroads.



The River Corridors of Allegheny County

- River & Stream
- Riparian Bank
- Floodplain Vegetation
- Wooded Hillslope
- Wooded Upland
- Urban Settlement
- Industrial Brown Field

A. Fragment patches of wooded upland with small interior woodland
B. Fragment patches of wooded hillslope
C. Fragment patches of native riverbank vegetation band
D. Fragment patches of native floodplain vegetation
E. Lock and Dam system controlling river elevation and flow
F. Partially culverted sub-watershed streams
G. Continuous roads and railroads parallel to river
H. Patches of contaminated industrial brownfield
I. Patches of dense urban human settlement
J. Man-made embankments & walls

Figure V.4 The river corridor of Allegheny County in its post-industrial state today. (Jonathan Kline-3R2N)

Figure V.5 The Monongahela River Corridor from the air (Photo 3R2N)

The reality of Allegheny County is radically different from the optimum model. Very few ideal conditions exist in the county. Transformation of land-use over time has dramatically reduced the presence of woodlands and native riparian vegetation in the river corridors. Forman defines five spatial processes of land transformation for landscape ecology. These include perforation, dissection, shrinkage, attrition and fragmentation (Forman 407). Each of these processes changes the ecological functionality of an area in a variety of ways over time. All of these processes have affected the woodlands of the river corridors. Over time, woodland patches have been dissected by roads and other narrow corridors, perforated by clearings and house lots, shrunk by the introduction of other land uses, fragmented through human settlement patterns, and have disappeared altogether through attrition. The result of two hundred years of rapid human settlement and land transformation has resulted in the highly fragmented woodlands found today. The largest patch in the corridor is only 1130 acres while some patches are only a fraction of an acre. Human land uses such as houses, roads or industry border a great many of the individual forest patches in the corridor. Visual analysis of Map 6.1 reveals that no parts of the corridors have the desired bank and upland continuity for more than a few miles along the corridor.

Finding Remnant Value in a Post-Industrial Setting

A casual comparison of the physical reality with the ecologically optimum model might lead to the conclusion that the river corridors of the county are degraded to the point of having no value. The aerial photograph in Figure V.5 is drastically different from our model in Figure V.6. However, taking a restoration ecology approach, our study argues for the measurement of remnant value, looking for areas of opportunity for preservation, conservation and potential restoration. To do this, a variety of analyses are performed to identify aspects of ecological value that relate to the model.

Two major data sets for the county were used to identify areas of value in the river corridors. The first is the woodland patch GIS mapping for Allegheny County created from orthophotometric satellite imagery in 1996. The second is riverbank botany and geology point data sets collected by 3 Rivers 2nd Nature between 1999 and 2004. Analysis of the woodland patch data rates groups of patches for ecological value relative to one another. Analysis of the riverbank point data rates riverbank edges for preservation and restoration potential. These two ratings give us a partial picture of ecological value within the river corridors and allow us to identify areas for further analysis and field study.

Figure V.7 shows an overview of the strategies used to measure aspects of ecological value. The first set of strategies was based upon spatial analysis of the woodland patches. The scale of this analysis starts with the individual patch. Our first step was to look for spatially proximate groups of patches that could be considered as groups. Woodland patches which are dissected by narrow non-road corridors but are otherwise in close proximity to one another (within 100 ft.) were grouped. These patch groups were then considered together and were measured relative to one another in order to identify the areas of greatest significance. The groups were tested for overall size and for presence and size of valuable interior woodlands. Each group was then measured for internal fragmentation between the patches of the group. A test was also performed which looked at restoring group fragmentation and dissection to get a spatial sense of the restoration potential of a patch group. All of these tests attempted to establish the size and continuity of the river corridor woodlands. In most cases, the large groups are found primarily on the hillslopes and uplands

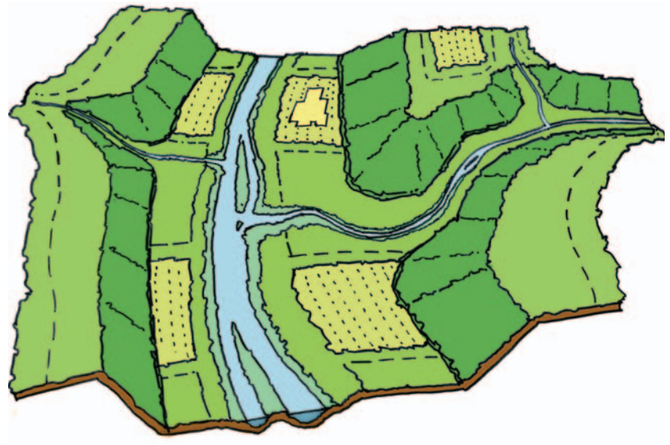


Figure V.6 A three-dimensional interpretation of the Forman river corridor model. (Jonathan Kline-3R2N, After Forman)

of the corridor. Thus the patch grouping, size, interior woodlands and degree of fragmentation are methods of testing for conditions B (presence of woodlands on hillslopes) and C (continuous bands of upland interior woodlands above hillslopes) of the Forman model. Because of the relative absence of floodplain woodlands on the valley floor and the human intervention in the hydrological flow of the rivers, woodland groups are tested for remnant connections to the altered hydrological floodplain patterns. Patch groups that have a relationship to the 100 year floodplain are taken as having remnant value in meeting criteria D (patches of interior native floodplain vegetation extending from river edge to hill slope base alternating with patches of ecologically compatible land uses.) The Section IV maps document the methods and results of the woodland patch study.

The second set of strategies utilized botany and geology field data collected by 3 Rivers 2nd Nature to measure riverbank vegetation. This data allowed for a much more in-depth measurement of perennial floodplains, riparian species presence, botany continuity, and preservation and restoration potential. Thus criteria A (Continuous bands of vegetation along river banks) is tested for in Section VII using the field data for river bank botany and geology.

Ultimately the different analyses of the data related to the Forman model as follows:

A. Continuous bands of vegetation along river banks
Test riverbank field data for:
1. Preservation potential
2. Restoration potential

B. Presence of woodlands on hillslopes and
C. Continuous bands of upland interior woodlands above hillslopes
Test woodland mapping for:
1. Patch group size
2. Patch group interior presence & size
3. Patch group percent fragmentation

D. Patches of interior native floodplain vegetation extending from river edge to hill slope base alternating with patches of ecologically compatible land uses.
Test woodland mapping for:
1. Patch group connection to the 100 year floodplain

For the woodland patch data, the group values under B, C and D were combined to rate the woodland patch groups relative to one another. Thus, while the measurements taken are based upon an ideal conditions presented in the Forman model, the actual rating is based upon existing fragmented woodlands measured relative to one another. This approach was taken because we are trying to measure areas of remnant value in a post-industrial setting. In addition, a series of other tests were performed on the woodland patch groups to look at restoration potential and to establish comparison values for the 100 year floodplain.

For the river banks, a series of measures were combined to create two ratings measuring riverbank vegetation. The first establishes a relative rating for preservation areas. The second establishes a relative rating for restoration potential.

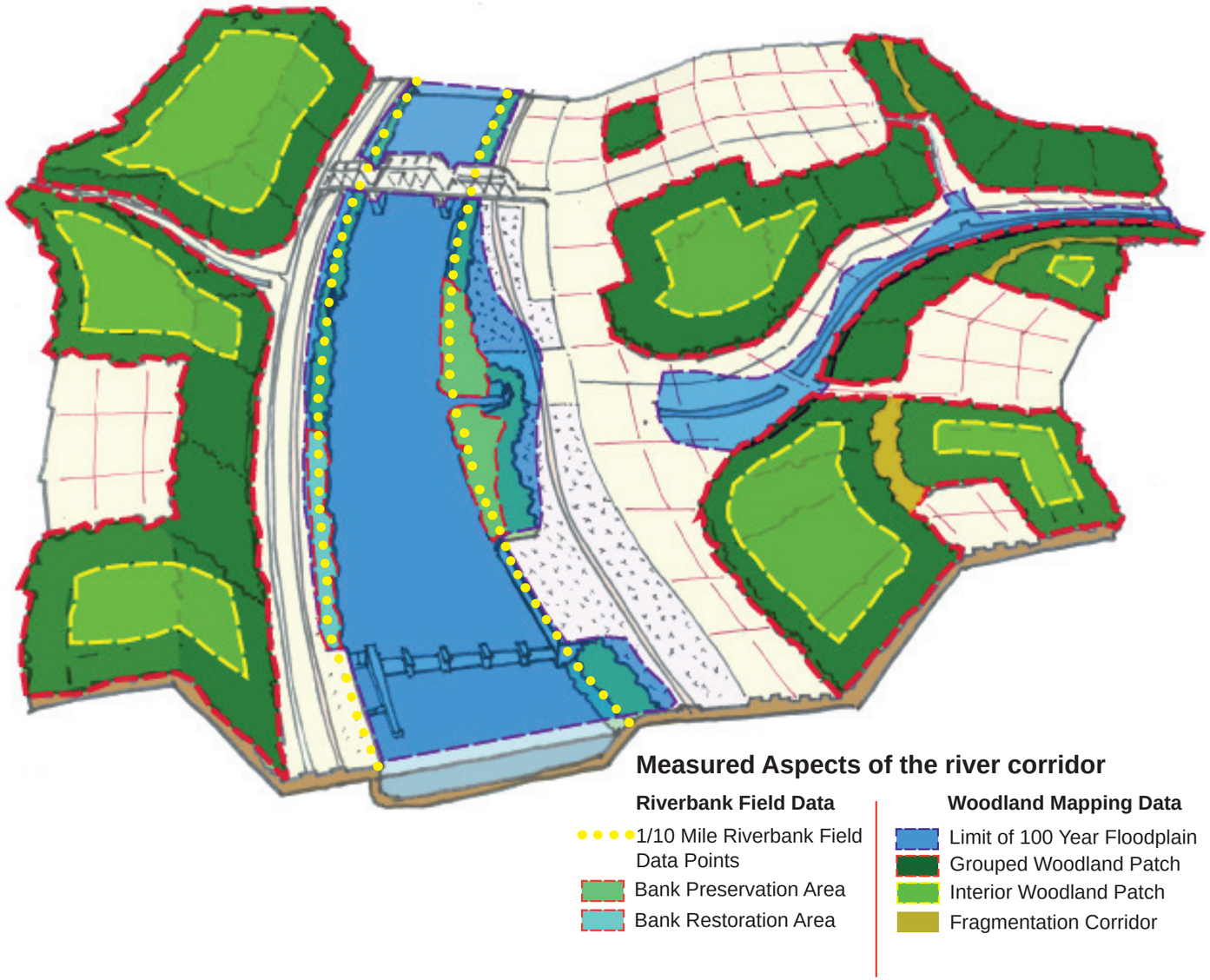
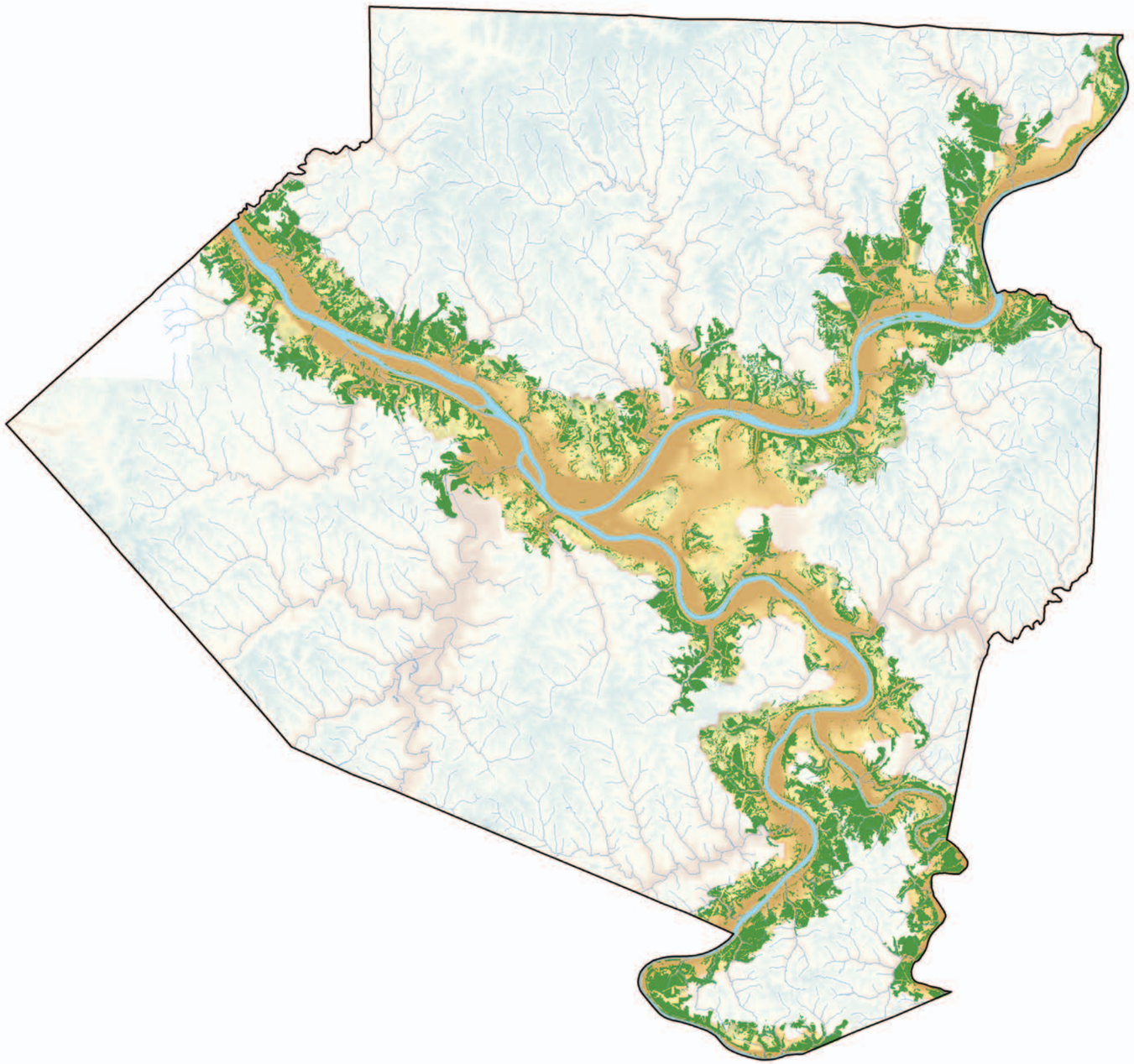


Figure V.7 Measured aspects of the river corridor including bank data and woodland patches used to find remnant value.

6.1 WOODLANDS TOUCHING THE RIVER CORRIDOR STUDY AREA

The river corridor woodlands include any forest patches which touch the river corridor study area. This captures river bank, valley flood plain, stream mouth, river valley hillside, and hill top upland forest patches.



LEGEND

- River
- Streams
- River Corridor Woodlands
- River Corridor Study Area

0 12,000 24,000 48,000

Feet

Author: Jonathan Kline

VI. Measuring the Woodlands

Woodland Patch Mapping

As stated earlier, the primary focus of a landscape ecology corridor analysis is on the vegetated areas in relation to the river itself. This section focuses on the woodlands found primarily on the hillsides and uplands of the corridor since these areas contain the largest patches, although river bank and floodplain woodlands are included in all analyses as well. The unit of measurement for this analysis is the woodland patch. Forman defines a patch as "a wide relatively homogeneous area that differs from its surroundings" (Forman 43). The analysis that follows is based upon spatial and geometric analysis of woodland coverage mapping. The data used in this analysis is from Allegheny County. In 1992, Allegheny County mapped the woodland areas in their jurisdiction to the detailed scale of 1:2400, based upon planimetric aerial photography. This data does not provide information related to species composition or potential habitat quality. It does provide an opportunity to take a comprehensive look at the size, shape and location of woodland patches in Allegheny County.

The GIS shapefile of individual woodland patches is a very detailed and highly fragmented representation of the tree coverage in the county. Visual comparison between the coverage and the source photography revealed that areas of contiguous tree coverage were massed into woodland patch polygons while scattered tree coverage, street trees, and other highly fragmented vegetation were eliminated. It is also apparent that road, trail, power line and, occasionally, stream corridors were carefully represented as breaks in the woodland patches even though at times the tree canopy appeared to span the corridor. Visual spot checks between the aerial photography and the woodland patch shapefile generally confirmed the accuracy of the mapping although some patches representing open fields were found to be miscoded as woodlands. In all apparent cases these coding errors were corrected by 3R2N.

Figure VI.1 Despite its history of ecological degradation and intense urban development, Allegheny County does contain amazingly intact patches of native woodlands. (Photo 3R2N)

It must be emphasized that the patch analysis is based strictly on aerial photometric mapping. No field data is included in the data set and the time and scope of the project did not allow for any field data collection in the actual woodland patches. Therefore, no information is available about the botany characteristics, presence and diversity of species or general habitat quality of the woodland patches in the river corridor. The patch evaluation is strictly a landscape-scale spatial analysis using measurements of patch size, shape, number and proximity.

Map 6.1 Woodlands Touching The River Corridor Study Area

The first step in the analysis is to capture all of the woodland patches in the county that touch the river corridor zone defined in section five. Any patch that is contained within or touches the boundary of the zone is included in Map 6.1. This methodology is designed to capture any woodland patches that fall into the zones defined in Forman's river corridor: bank, floodplain, hillside and upland edge. It is also designed to capture any woodland patch that has a direct relationship with the river corridor zone, while the majority of the patch itself may lie on the periphery of the zone. In many cases these outlying patches are found on the hillsides of stream valleys perpendicular to the main river corridor. As seen in Map 6.1, the river corridor has a great diversity of patch sizes and shapes. There is also a great deal of patch fragmentation given the urban characteristics of the county.

Parts of the corridor, particularly around the confluence of the major rivers, are completely devoid of large woodland patches. Notable is the near total absence of large woodland patches on the valley floors. While some small linear patches line the immediate banks of the rivers, the natural valley floodplains have been given over to primarily human settlement and industrial use over time. This pattern of human communities following the river is visible in Map 1.4 and is tied to historical use of the river as a transportation corridor. The majority of the large intact woodland patches tend to be on the hillsides, related stream valleys or upland edges. This again is tied to historical patterns of human use and settlement. Given the steepness of many of the valley hillsides, settlement patterns were limited to easily build-able areas except in areas of very high density where a combination of factors led to steep hillside development.

Grouping the Woodland Patches

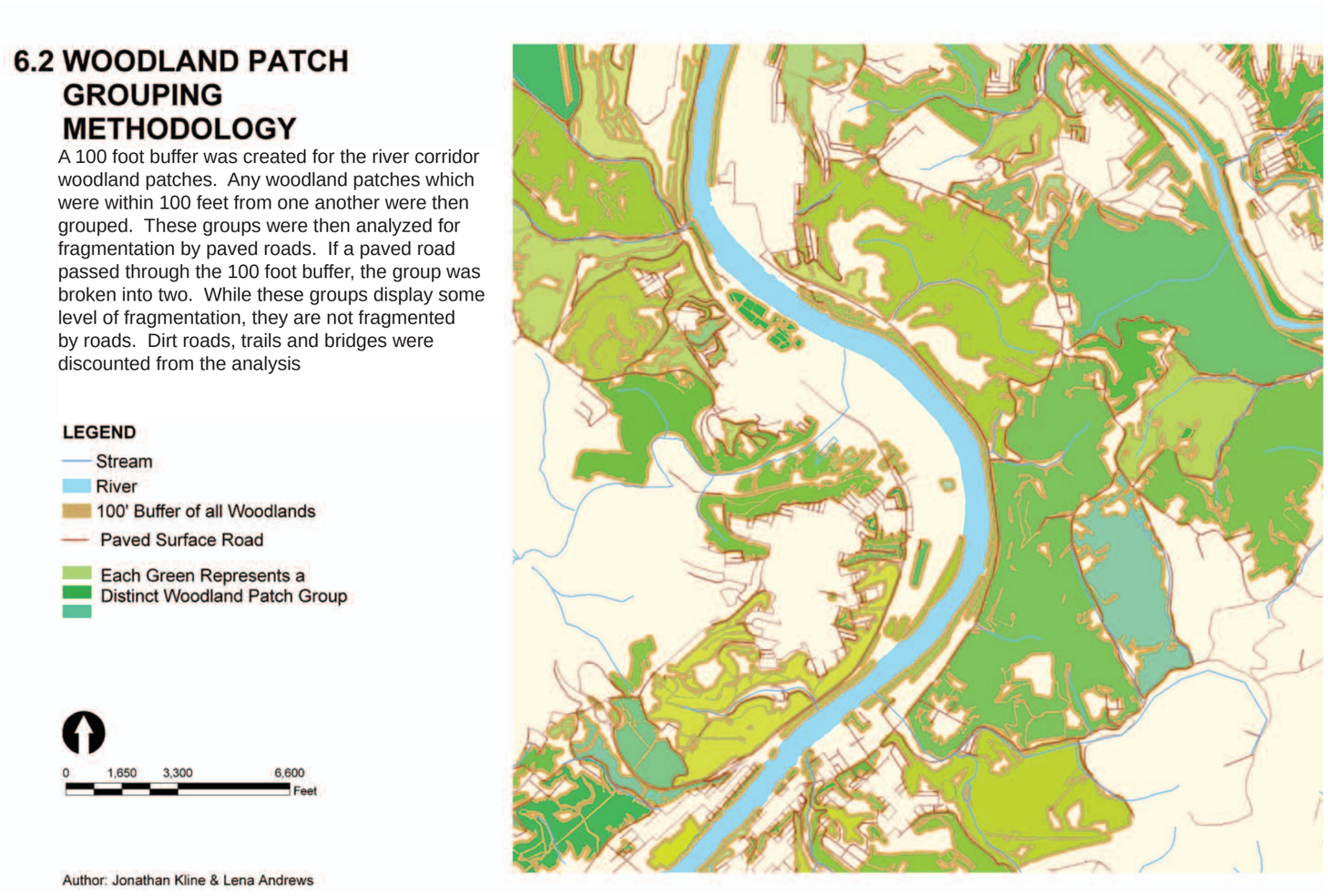
One of the major characteristics of the river corridor woodlands is their severe fragmentation and dissection—dissection being a specific case of fragmentation by narrow corridors. Because this study attempts to identify areas of remnant value in a highly urbanized area, strategies for grouping patches within close proximity were developed to help identify areas of value. Some fragmentation in the corridor is characterized by highly isolated patches such as steep hillsides in otherwise completely developed areas or woodlands within large city parks. However, much of the woodland fragmentation takes the form of dissection by narrow corridors. These corridors are created by paved roads, railroads, trails, power line cuts and in some cases streams. Our strategy was to create groups of patches which were spatially proximate but not separated by paved roads. This allowed large hillside areas fragmented by trails and small breaks but unbroken by roads to be considered together as a single woodland patch system. By measuring and rating the patch groups, we were able to identify larger areas and systems of value within a highly fragmented post-industrial setting.

Map 6.2 Woodland Patch Grouping Methodology

Visual analysis of the dissection patterns of the corridor woodlands reveals that many of these corridors are between 20 and 100 feet wide, with a typical corridor being around 60 feet wide. This is not surprising since a typical legal road right of way in an urbanized area ranges from around 50 to 100 feet. In addition to roads, the woodlands as mapped are dissected by narrow 20 - 60 foot corridors created by unpaved roads, trails, utility easements and at times even small streams. Our goal in grouping the patches was to account for dissection created by these narrow corridors so that larger systems of patches could be measured as a single unit. Given the urban setting and severe degree of fragmentation, we chose a distance of 100 feet as the maximum corridor width between patches that could be considered as a group. Our empirically derived 100 foot maximum distance was tested by creating a joined 100 foot buffer around all woodland patches and then grouping all patches contained within the larger buffered area. This grouping was then tested against the mapping of paved surface roads, excluding aerial bridge structures. If a paved surface road crossed a group, it was divided into two groups by the road corridor. Only paved roads have been removed because roads can act as a filter limiting the movement of certain species or a sink killing animals which try to cross them (Forman 164, 165). The woodland patch grouping method is illustrated in Map 6.2.

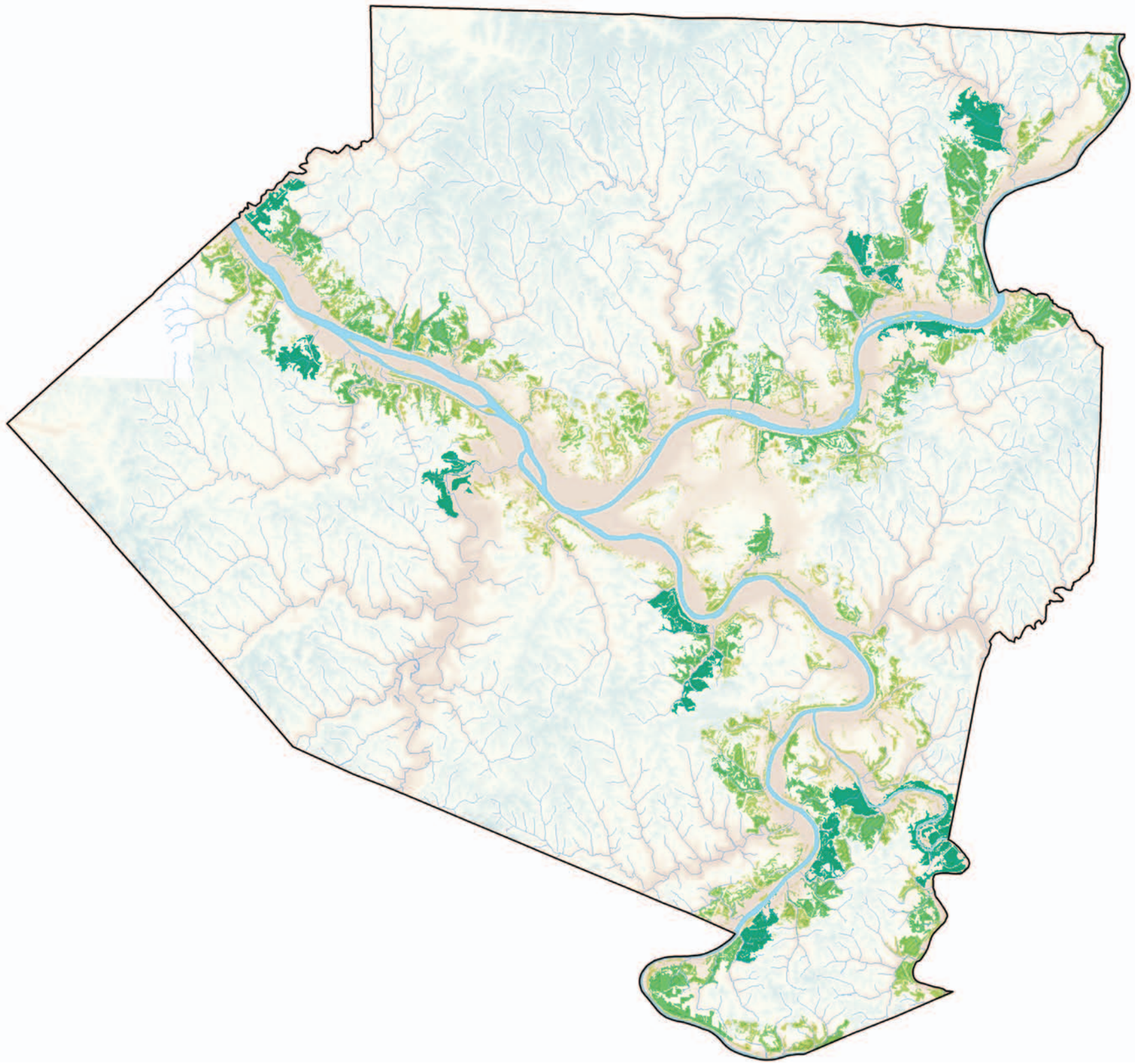
Map 6.3 Woodland Patch Groups by Area

The resulting woodland patch grouping identifies systems of patches which have a close proximity and greater remnant value than small patches isolated by man made land-uses. In Map 6.3 these groups are coded by total group acreage. Also shown are areas of interior woodlands defined as the woodland area approximately 100 meters from the edge of the patch (Moyer 2003). The importance and value of interior woodlands is discussed fully in Section III of this report. Map 6.3 shows that all four rivers have major remnant woodland systems of over 500 acres. Some of the large groups are situated on steep hillslopes and adjacent uplands facing the river. Others are found on the hillslopes of major perpendicular stream valleys. Both total group acreage and total group interior woodland acreage are components of the final patch group rating shown in Map 6.13.



6.3 WOODLAND PATCH GROUPS BY AREA

The river corridor woodlands are shown as groups. A group includes any patches within 100' from each other which do not have road separating the patches. Individual groups are shown in different hues.



LEGEND

- River
- Stream

Woodland Patch Groups

- 0 - 50 Acres
- 51 - 150 Acres
- 151 - 250 Acres
- 251 - 500 Acres
- 501 - 1137 Acres

Interior Forest - 330 ft from Woodland Edge

0 13,000 26,000 52,000 Feet

Author: Jonathan Kline & Lena Andrews

Woodland Fragmentation

As we have already observed, fragmentation and dissection is one of the major problems present in the river corridors. In order to give some measure of the relative degree of fragmentation of the grouping we had created, a percent fragmentation index was created for the patch groups.

Map 6.4 Woodland Group Internal Fragmentation

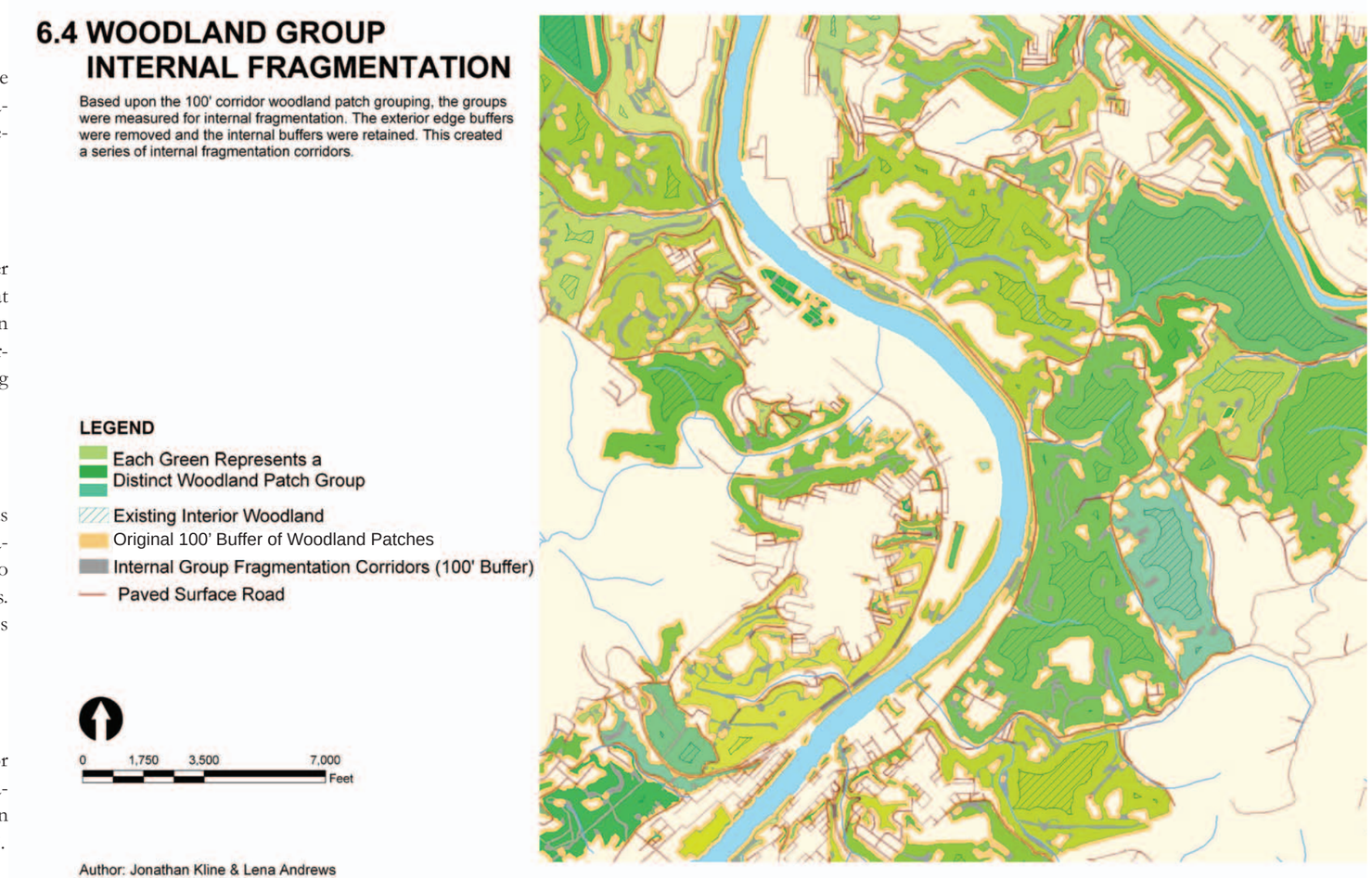
The first step of this analysis was to return to the original 100 foot buffer used to group the woodlands and capture only the parts of the buffer that were internal to the group. These two areas are shown in tan and grey in Map 6.4. This methodology includes both internal fragmentation corridors between patches of the group and small indentations found along the edge of highly convoluted patches.

Map 6.5 Woodland Group Percent Fragmentation

The second step takes the area of the internal fragmentation corridors as a percentage of the total area of the patch group, including the fragmentation corridors to give a percent fragmentation. This methodology tends to work well for large groupings of patches dissected by multiple corridors. However, it does not work well for small convoluted patches. These cases tend to register as highly fragmented due to their complex shape.

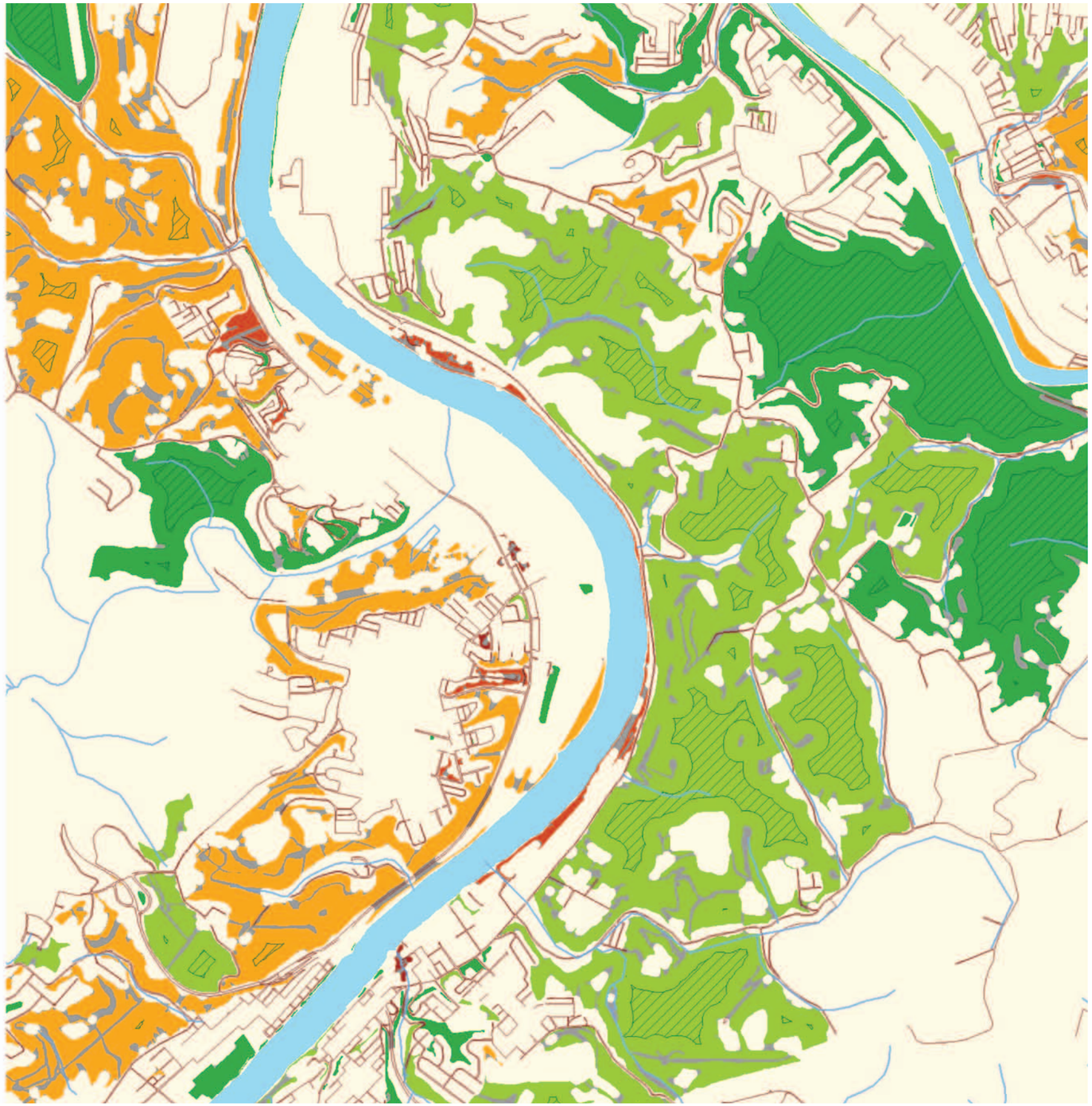
Map 6.6 Woodland Group Percent Fragmentation (County)

Seen at the county scale, the fragmentation index shows that all of major groups have less than 20% fragmentation. This includes a number of major groups with less then 10% fragmentation. The group fragmentation index is a component of the final patch group rating shown in Map 6.13.



6.5 WOODLAND GROUP PERCENT FRAGMENTATION

In order to create a measure of fragmentation for each woodland patch group, the area of the internal corridors was compared to the overall area of the group. This method gave a fragmentation percentage. Note: this methodology tends to generate misrepresentations for very small groups of patches, particularly single patch groups. This is a result of the buffering geometry for small patches of irregular shape.



LEGEND

Woodland Group Percent Fragmentation

- 0 - 5%
- 5% - 10%
- 10% - 20%
- 20% - 30%
- 30% or more
- Internal Fragmentation Corridors (100' Buffer)
- Existing Interior Woodland

(Interior forest area created if internal fragmentation is elminated)

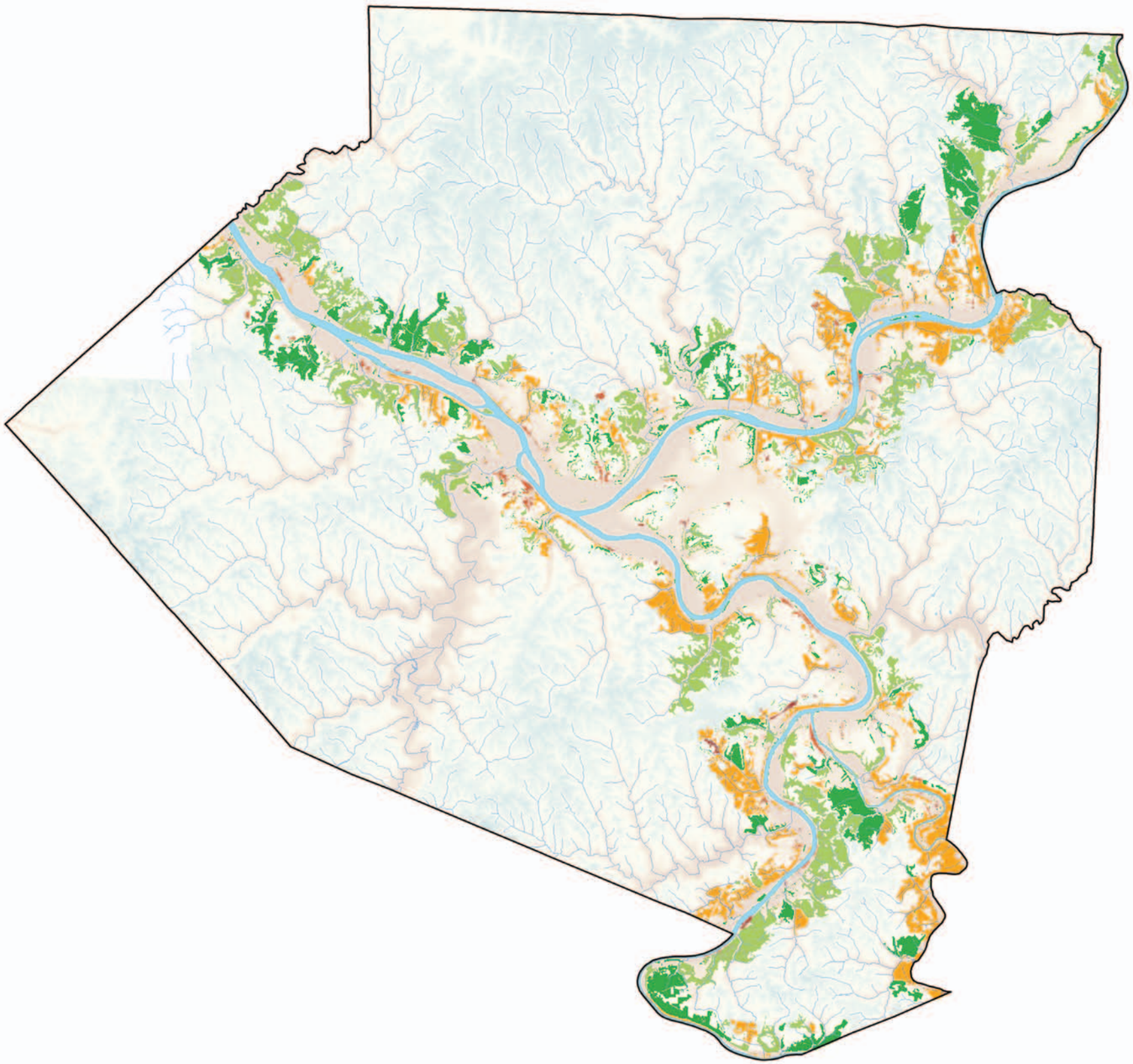
- Paved Surface Road

0 1,750 3,500 7,000 Feet

Author: Jonathan Kline & Lena Andrews

6.6 WOODLAND GROUP PERCENT FRAGMENTATION

The percent fragmentation for woodland patch groups based upon 100 foot internal fragmentation corridors. The percent represents area in the missing corridor relative to the total area of the group including the fragmentation corridor.



LEGEND

- River
- Stream
- Internal Fragmentation Corridors

Woodland Patch Group - Percent Fragmentation

- 0 - 5%
- 5% - 10%
- 10% - 20%
- 20% - 30%
- 30% or more

0 13,000 26,000 52,000 Feet

Author: Jonathan Kline & Lena Andrews

Potential for Restoring Fragmentation

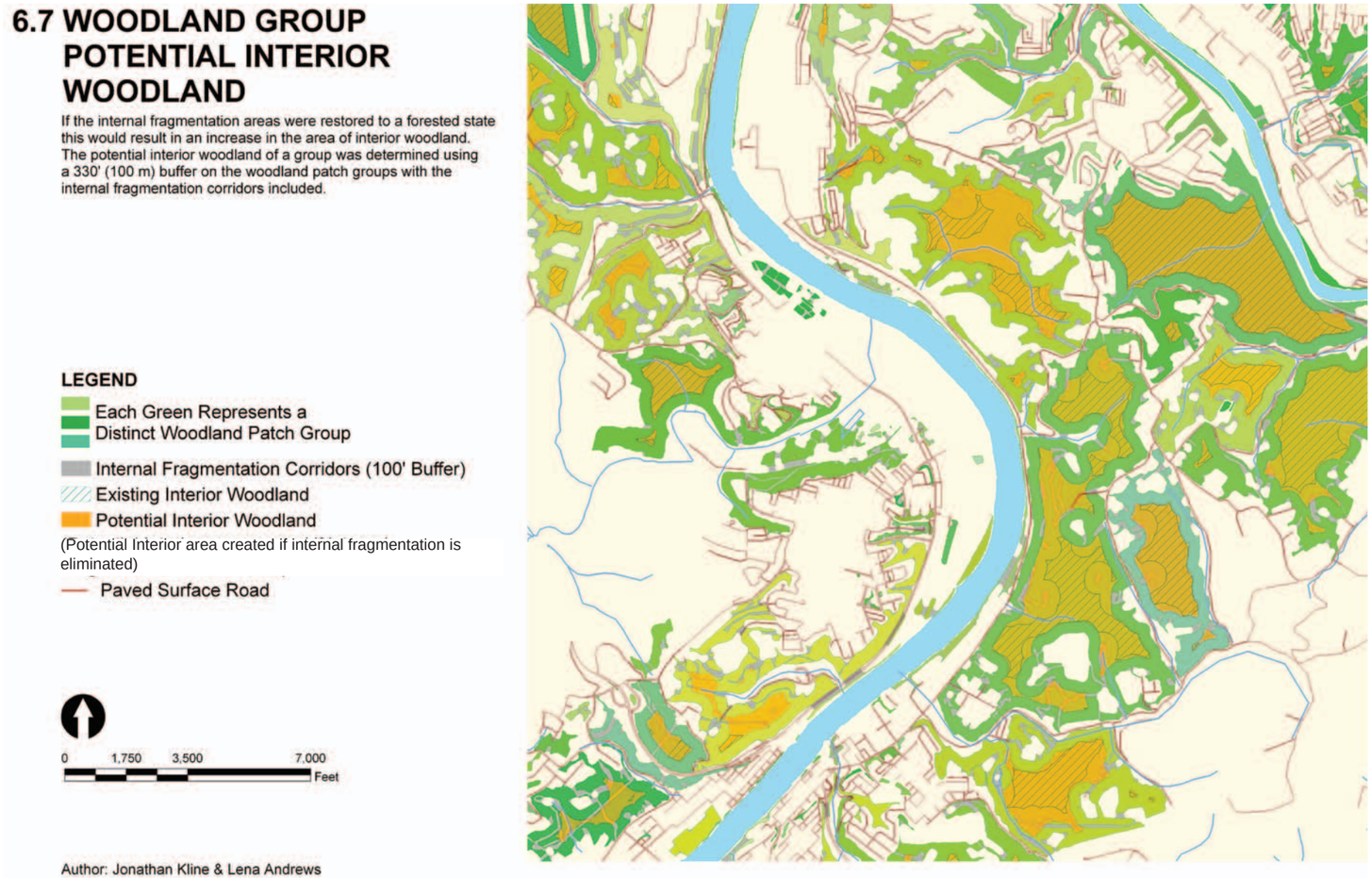
Because fragmentation is one of the largest ecological issues facing the county woodlands, we performed a speculative test to gauge restoration potential of our woodland patch groups. This test is purely spatial in that it does not account for regulatory, land ownership or political factors. It does, however, tell us that, given the existing woodlands, much more substantial areas of interior forest could be created through relatively minor restoration efforts to relink major patches.

Map 6.7 Woodland Group Potential Interior Woodland

The methodology for this test uses the patch group area including the fragmentation corridors. Speculatively assuming that the fragmentation corridors could be reforested, the same test for interior woodlands using an internal 330 foot buffer was performed to yield a potential interior woodland patch for the group. These are shown in orange in both Map 6.7 and 6.8. This can then be graphically compared to the existing interior woodland area which is hatched in dark green. In some areas, this method shows that little or no increase in interior woodlands is possible due to roads and development. However, some patch groups reveal that minor reforestation would yield sizable areas that would have the spatial characteristics of interior woodlands.

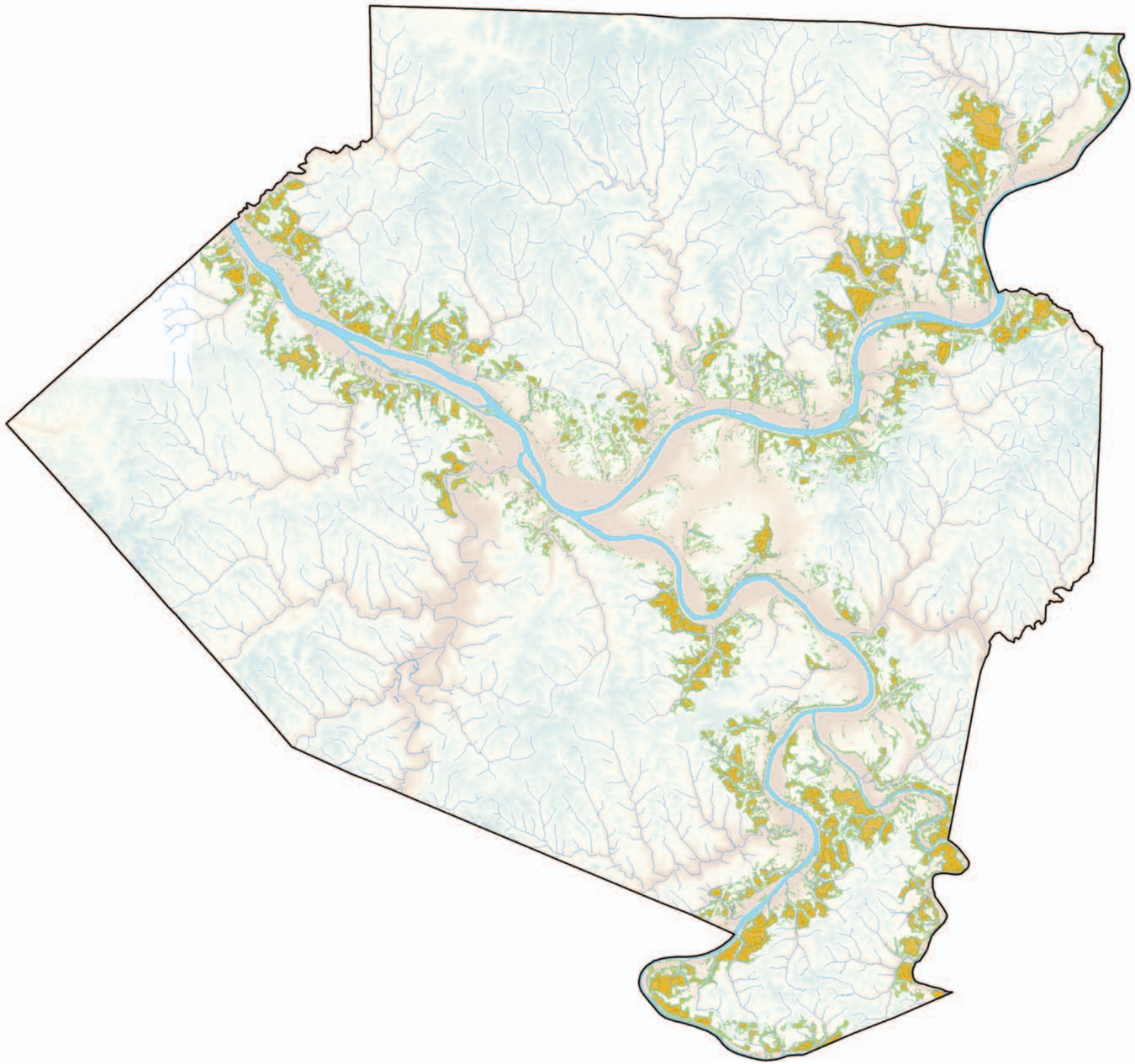
Map 6.8 Woodland Group Potential Interior Woodland (County)

Seen at the county scale, this test reveals the potential for restoration efforts to dramatically increase the area of valuable interior forest found in the county river corridors.



6.8 WOODLAND GROUP POTENTIAL INTERIOR WOODLAND

If the internal fragmentation areas were restored to a forested state this would result in an increase in the area of interior woodland. The potential interior woodland of a group was determined using a 330' (100 m) buffer on the woodland patch groups with the internal fragmentation corridors included.



LEGEND

- River
- Stream
- River Corridor Woodlands
- Existing Interior Woodlands
- Internal Fragmentation Corridors
- Potential Interior Woodlands

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

Woodlands in Relation to the Floodplain

As we have previously observed, very little of the ecologically valuable native floodplain vegetation remains in the river corridors of Allegheny County. Two hundred years of urban and industrial development and hydrological manipulation have transformed the native floodplain valley floors into urban settlements and industrial brownfields laced with various transportation corridors. Vast sections of low-lying riparian floodplain have been filled and raised to bring industrial and railroad uses above the level of perennial flooding. Perpendicular streams and their floodplains have been channelized and often culverted in the areas where they meet the river, usually in attempt to control flooding in adjacent urban areas. Over time, the native floodplain vegetation which would have covered the valley floor of the river corridors has all but disappeared.

In addition to the loss of native floodplain vegetation, the natural hydrological flow of the river has been fundamentally altered by the introduction of a lock and dam system beginning in 1874 (Moxley, 2001, ii). This system, created, maintained and run by the Army Core of Engineers, divides the rivers into a series of relatively fixed elevation pools using a series of locks and dams. The lock system is intended to facilitate industrial and recreational use of the river and to minimize impacts from perennial flooding. The creation of the lock and dam system, combined with decades of filling to bring railroad and industrial sites above flood level has resulted in a dramatic decrease in the area of land which has the perennial flooding characteristics necessary to support native riparian plants.

Thus, the original natural floodplain system of the river corridors has been fundamentally altered, with the net result being a severe loss of native riparian floodplain vegetation. The introduction of urban land uses has resulted in a severe loss of land area which has the characteristics needed to support riparian vegetation. It is in natural floodplain valleys that the county river corridors are furthest from the ideal ecological system. Almost no areas of the county have the ideal condition of an uninterrupted natural vegetation transect running from riverbank to upland. While our rivebank field data documents the existing conditions of the immediate river banks in detail, we performed a series of tests to look for links which connect the hillslopes to remnant areas of valley floodplain vegetation. Our assumption was that there was remnant ecological value in any connections between the modified floodplain areas and the river corridor woodlands. This was done by testing the patch groups in relation to the floodplain in a variety of ways. The first two tests look for patch groups which touch the extents of the floodplain as it is defined by the Federal Emergency Management Agency (FEMA). FEMA defines different zones for the one hundred year storm and the five hundred year storm based upon the ability of the lock and dam system to control flow in a storm event. We took the entire area that is inundated by flood waters and tested to see if a group touched this area at any point. In addition to testing the artificiality defined FEMA floodplain, we defined an area defining the natural valley floor based upon the digital elevation model. Patch groups were also tested for connection to this approximation of the historic natural floodplain as a point of comparison.

Map 6.9 Woodland Groups Touching the 100 Year Floodplain

Map 6.9 shows only the patch groups which touch or are within the one hundred year floodplain area. This test shows that there are a number of substantial patch groups which still have a direct relationship with the floodplains of the river, particularly on the outlying edges of the county. However close inspection of the map reveals that the majority of patch groups highlighted have a relationship not with the river itself but with a sub-watershed floodplain zone. While some patch groups do connect directly to the river floodplain zone, in most cases, filling for railroads and roads has separated the wooded hillslopes from the floodplain. For the purposes of this analysis, no distinction was made between river floodplain and adjacent stream floodplain because all connections to floodplain areas were seen as having value. Section VIII explores in detail some of the areas along the major rivers where direct connections exist between the river floodplain and major woodland patch groups. The test for connection to the one hundred year floodplain is a component of the final patch group rating shown in Map 6.13.

Map 6.10 Woodland Groups Touching the 500 Year Floodplain

As a point of comparison, we also mapped patch groups which touch the five hundred year floodplain. Comparing the two reveals almost no difference between the set of groups touching the one hundred and five hundred year floodplains. The five hundred year floodplain, which covers a slightly larger area, only captures a few additional groups, and most of them are small insubstantial patches along perpendicular stream valleys.

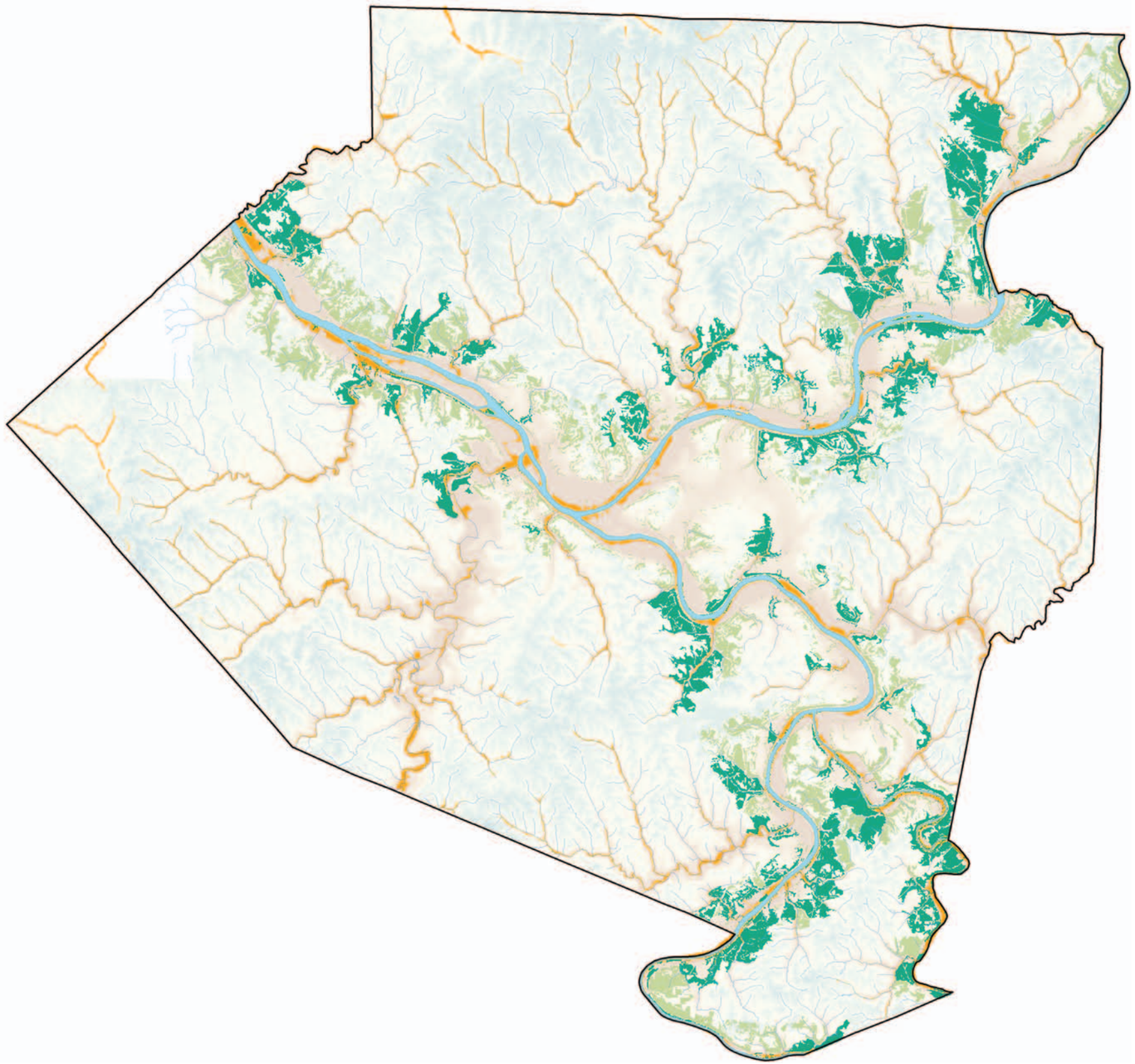
Figure VI.2 The Monongahela River with its lock and dam system.

Map 6.11 Woodland Groups Touching the Natural River Valley Floor

As a second point of comparison, we mapped patch groups which touch an approximation of the floor of the river valley itself, based upon the digital elevation model. This area is intended to model the approximate natural floodplain of the river in a pre-development state. This test revealed that some existent wooded hillslopes have lost their connection to the floodplain, which is not surprising. However, when compared to Map 6.9, it also reveals that a large number of the major woodland patch groups have maintained some connection to the floodplain in its current controlled state.

6.9 WOODLAND GROUPS TOUCHING 100 YEAR FLOODPLAIN

The relationship between woodland patch groups and the 100 year FEMA floodplain mapping. Darker woodland patch groups touch the floodplain area in one or more places.



LEGEND

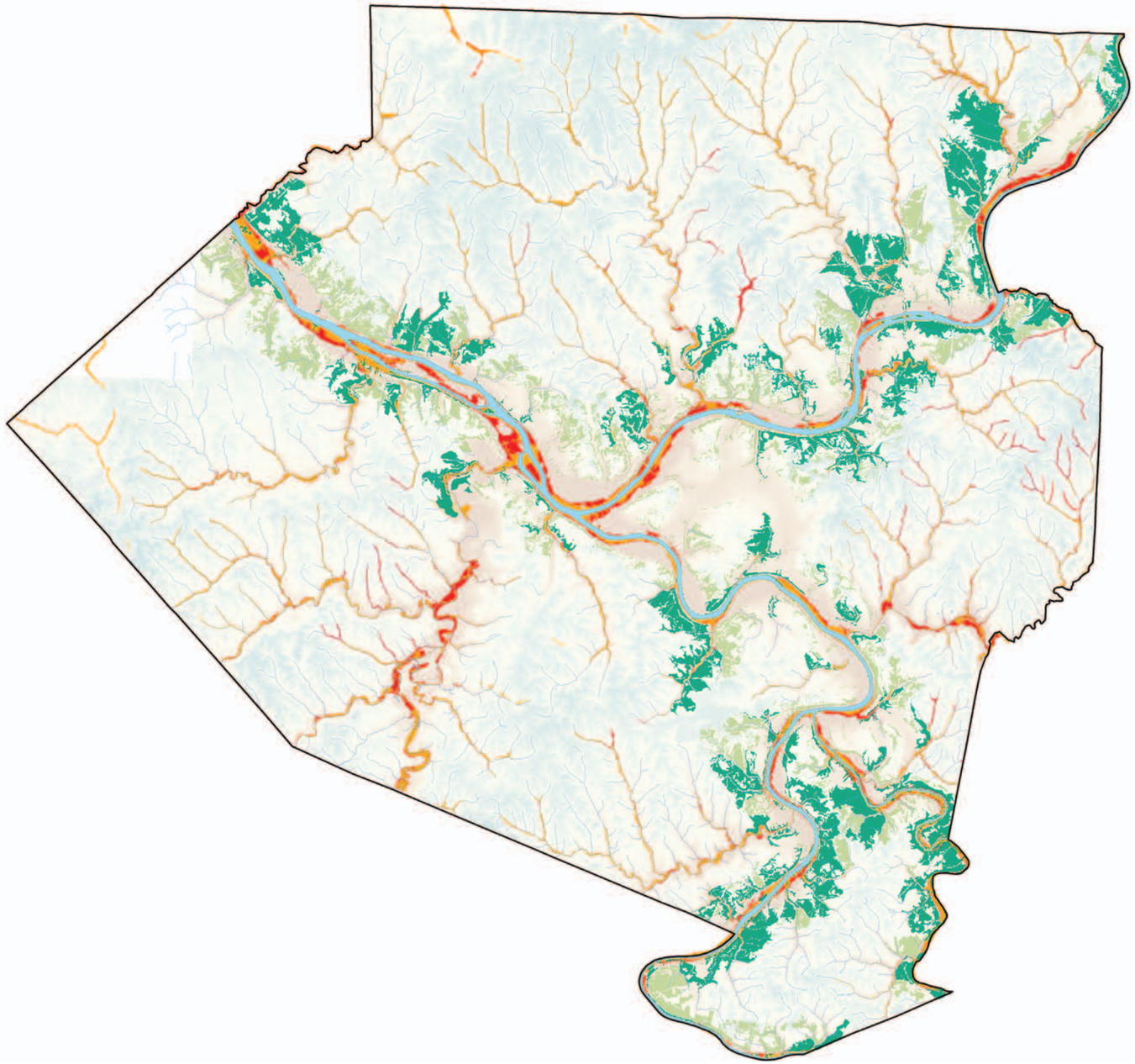
River
Stream
Woodland Patch Groups Touching FEMA 100 Year Floodplain
Group Touches 100 yr
Group Outside 100 yr
FEMA 100 Year Floodplain Zones
Flooding contained in channel banks
Area inundated by 100 year flooding

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

6.10 WOODLAND GROUPS TOUCHING 500 YEAR FLOODPLAIN

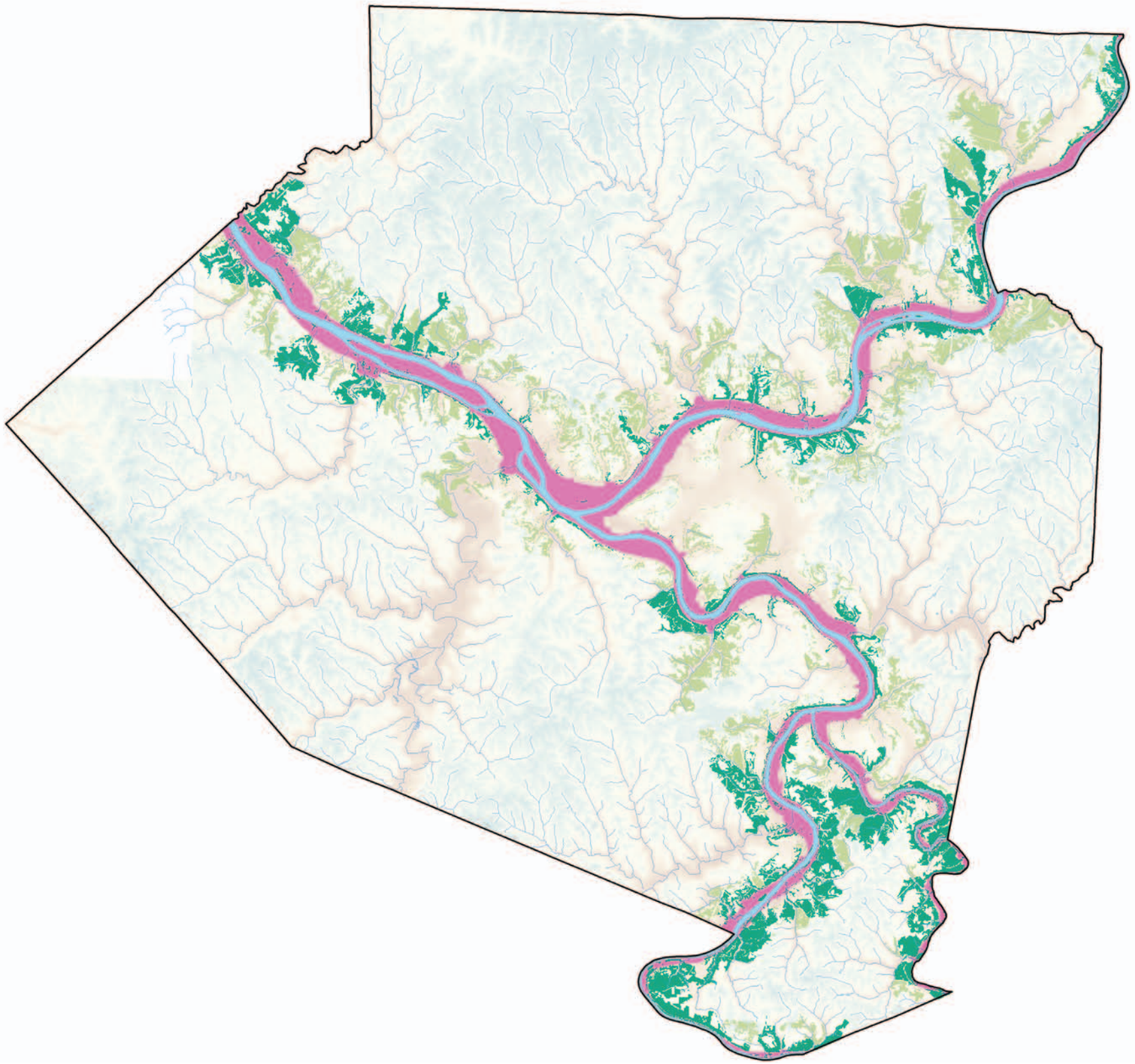
The relationship between woodland patch groups and the 500 year FEMA floodplain mapping. Darker woodland patch groups touch the floodplain area in one or more places.



Author: Jonathan Kline & Lena Andrews

6.11 WOODLAND GROUPS TOUCHING NATURAL RIVER VALLEY FLOOR

The relationship between woodland patch groups and the natural river valley floor. The valley floor area is based upon topography. It was determined using a digital elevation model.



LEGEND

River

Stream

Natural River Valley Floor

Woodland Patch Group Touching Natural River Valley Floor

Group Touches Valley Floor

Group Upland of Valley Floor

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

Rating the Woodland Groups

For the final analysis, various measurements were combined to rate the woodland patch groups relative to one another. This relative rating allows us to identify:

B. Presence of woodlands on hillslopes and
C. Continuous bands of upland interior woodlands above hillslopes
Test woodland mapping for:
1. Patch group size
2. Patch group interior presence and size
3. Patch group percent fragmentation

D. Patches of interior native floodplain vegetation extending from river edge to hill slope base alternating with patches of ecologically compatible land uses.
Test woodland mapping for:
1. Patch group connection to the 100 year floodplain

For the woodland patch data, the group values under B, C and D were combined to rate the woodland patch groups relative to one another. Thus, while the measurements taken are based upon an ideal conditions presented in the Forman model, the actual rating is based upon existing fragmented woodlands measured relative to one another. This approach was taken because we are trying to measure areas of remnant value in a post-industrial setting. In addition, a series of other tests were performed on the woodland patch groups to look at restoration potential and to establish comparison values for the 100 year floodplain.

Map 6.12 Woodland Groups - Overall Ranking of Ecological Significance

The Overall Ranking of Ecological Significance map identifies the woodland groups in Allegheny County with the highest relative value in relation to the major river corridors. Measured against each other, these are the most significant woodland groupings in Allegheny County. The colors indicate the relative ecological vale of the patch groups in relation to one another, with dark green indicating the most significant and pale orange the least. Ecological significance is determined by the relative size of the forest, its contiguity with other forested areas, as well as its proximity to rivers and streams. In addition, interior forest was used as a point of reference, in that it is the best indicator that is known for potential biodiversity. The map indicates that the most significant groups tend towards the edges of the county away from the confluence of the rivers and the center city. However, a few notable groups do exist in surprisingly close proximity to highly developed urban areas including the areas along Nine Mile Run in Frick Park and the major woodland system between Becks Run and Glass Run. These areas will be examined in further detail in section VIII.

Map 6.13 Woodland Groups Touching Managed Open Space

The last map examining woodland patch groups tests the overall ranking in relation to managed open spaces in the county. For the purposes of the analysis, managed open spaces were considered to be any dedicated open space with some level of management. This includes parks, athletic fields, cemeteries and other types of management. These were typically, but not exclusively, public open spaces and the analysis was limited to areas in the Allegheny County GIS database of open spaces. Major trail systems were also included. While the relationship to open space was not included in the rating of the patch groups, it does begin to reveal patterns of use and ownership in relation to the woodland patch groups. In terms of woodland management and preservation, Map 6.13 shows that very few of the most ecologically significant groups fall within or even touch a managed open space. While some may be publicly owned land, few are actually designated as parks; more typically they are privately owned. The map also shows that the existing park and trail system, a primary interface between the human inhabitants and natural amenities, has very little relationship with the largest and most contiguous woodland groups along the rivers. Section IX discusses the woodlands in relation to systems of human use and regulation in much greater detail.

Woodland Groups - Conclusion

Given the fragmented reality of any urban forest and the history of industrial pollution and environmental degradation in this region, Allegheny County has a number of surprisingly large areas of urban forest still related to its rivers. Measured against ideal ecological conditions, these areas of woodland are far from optimal, but they do have remnant value when examined relative to one another using landscape ecology principles. In the overall ecology of greater Southwestern Pennsylvania, these patches of woodlands are small, highly degraded and relatively insignificant. However in relation to their surrounding dense human settlement, these woodlands have enormous value, adding aesthetic, economic and environmental value to the surrounding urban region. They also do contribute in a small way to the overall ecological health of the greater Ohio River Watershed by creating habitat, adding organic material and slowing runoff. In the ecology of a large river, all parts of the river corridor affect the system.

In recent years, Allegheny County has been transformed through the remarkable reemergence of forested river valley hillsides after one hundred years of industrial pollution. The incredible visual proximity of green hillsides to dense urban neighborhoods is now the defining characteristic of life in Pittsburgh and its surrounding towns and cities. While pollution regulation has allowed much of this resurgence, regulatory controls on land-use and development have not moved in step to protect the reemerging woodlands. Allegheny County and its cohort of municipal governments should first attempt to protect lands that seem both ecologically valuable and accessible. While the analysis showed uplands and hillsides to have significant areas of woodland, the ecologically essential areas of floodplain woodland are revealed to be small-disconnected fragments. To ensure the future preservation of existing woodlands, the region could establish a series of protected natural stream valley and steep slope forest corridors. From that foundation of protected forest, it would be possible to devise a restoration plan to assure natural amenities and services for generations to come.

Figure VI.3 A forest patch on the Allegheny River (Photo 3R2N)

6.12 WOODLAND GROUPS - OVERALL RANKING OF ECOLOGICAL SIGNIFICANCE

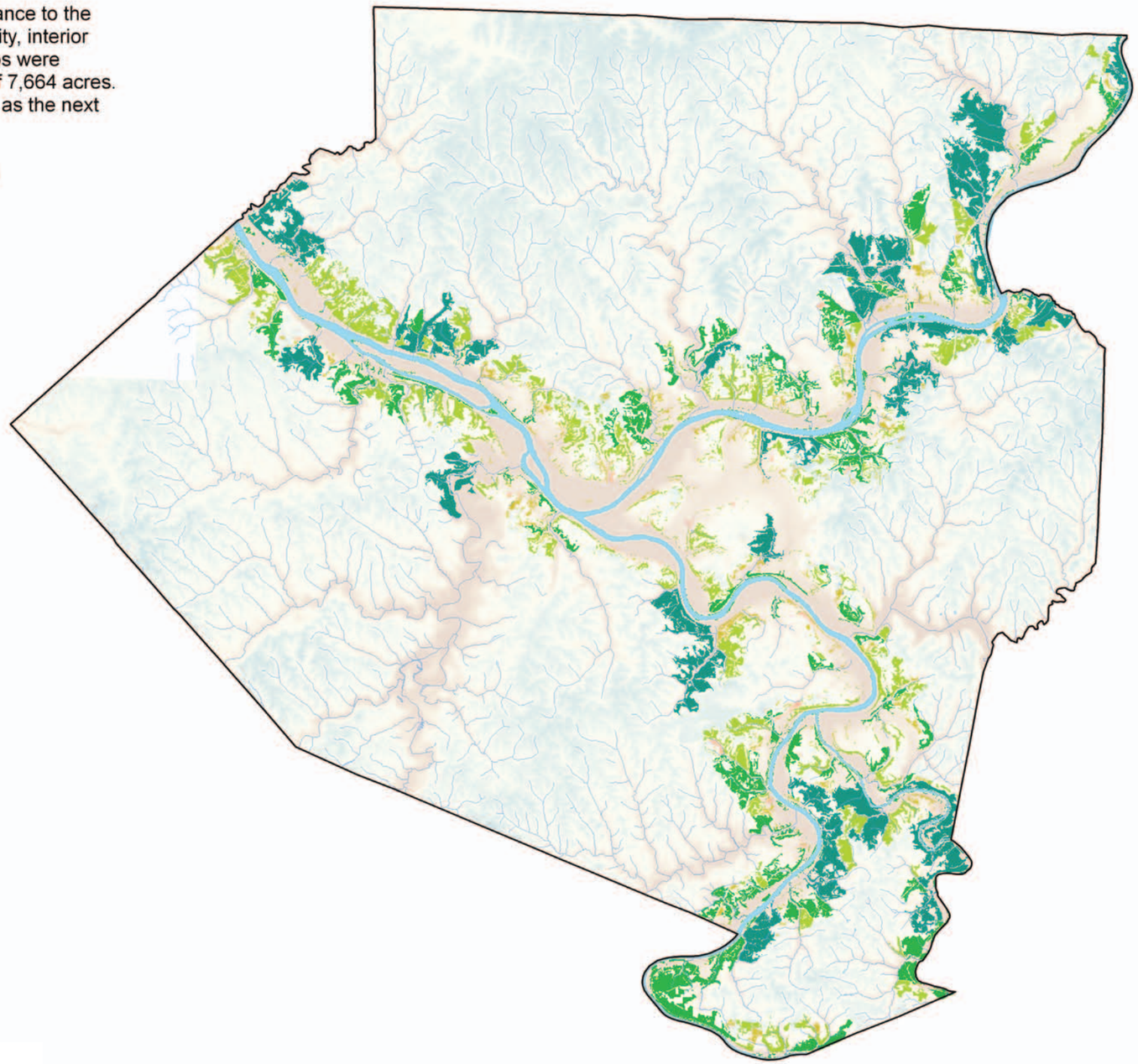
The river corridor woodland groups ranked by overall ecological significance to the river corridor. The factors in ranking the patch groups were size, continuity, interior and proximity to the rivers and streams. The acreage of woodland groups were normalized to a scale of 0-1 using the second largest woodland group of 7,664 acres. The largest group was taken as an outlier because it was twice as large as the next group. It was given a value of 1 with 1 being the largest area.

The acreage of interior woodlands for each group were also normalized to a scale of 0-1 using the largest interior acreage value with 1 being the largest area.

Because a lower fragmentation number is more valuable the percent fragmentation for groups was considered as a negative value on a scale of -1 - 0 with 0 being the least fragmented.

Woodland groups with a direct connection to the 100 year floodplain were given an additional value of +0.5, while groups without this connection were given -0.5.

These four values were summed to give an overall ranking to the woodland groups.



LEGEND

- River
- Stream

Woodland Group Overall Rank

- 1- Least Significant
- 2
- 3
- 4
- 5 -Most Significant

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

6.13 WOODLAND GROUPS TOUCHING MANAGED OPEN SPACE

The relationship between woodland patch groups and managed open space. Managed open space is taken to include any dedicated open space with some level of management. This includes public parks, athletic fields and cemeteries. Patch groups touching any such space are shown according to their overall ecological rank.

LEGEND

- River
- Stream
- Parks & Managed Open Space

Trails

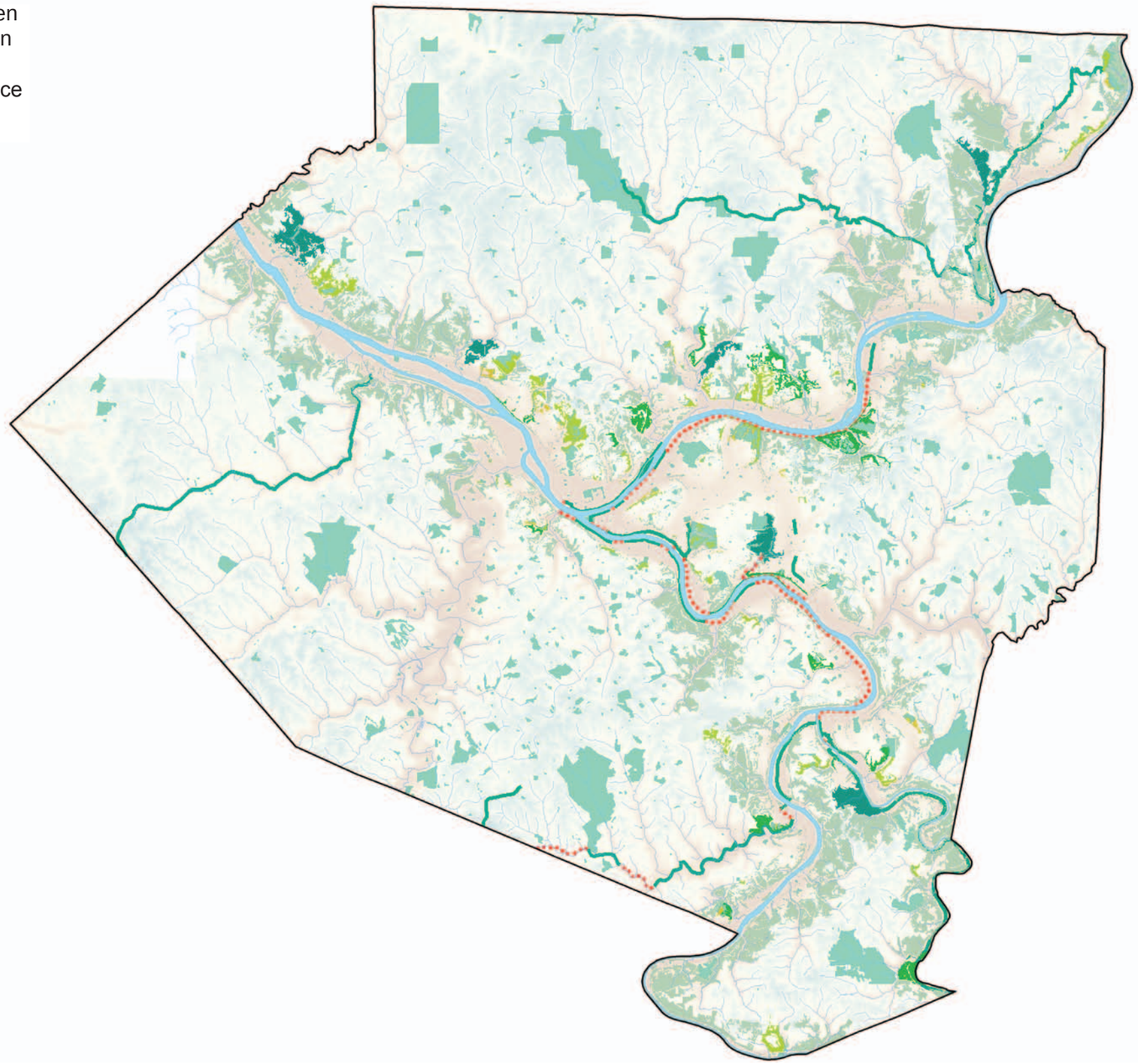
- Existing
- Proposed

Woodland Group Touching Managed Open Space

By Overall Group Rank

- 1- Least Significant
- 2
- 3
- 4
- 5 - Most Significant

Woodland Group Not Touching Managed Open Space



0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

VII. Measuring the Riverbank Data

Riverbank Field Data

The 3 Rivers 2nd Nature botany and geology team collected data from boats, working their way up and down the three rivers from the year 2000 to 2004. The teams used global positioning systems to identify and record 1/10 of a mile sections in field notes that were then transcribed into databases that could be analyzed by geographical information system software. The geologists were interested in the bank - berm relationship—in other words, the gentle slope which first occurs at the transition edge between water and land (berm) and the more obvious slope that indicates the river bank itself, as well as the material composition of that bank. Our goal with the geology was to think about human access to and from the river. Our goal was also to understand those places where vertical walls or hand placed stone had replaced natural slopes as well as those places where natural soils had been replaced by fill dumped at its angle of repose, rubble that is typical of urban and industrial excess. The slope and type of "soil" dictates the potential for natural recovery.

Map 7.1 Riverbank Obligate Wetland & Potential Perennial Floodplains

Botany data included identification of wetland species wherever possible which, through the Clean Water Act, could provide a standard for river edge land protection. Whether small or large, functioning wetlands are an indicator of remnant river edge ecosystems and floodplains that deserve attention and protection if we are to invest in nature and its services for generations to come.

Map 7.2 Riverbank Botany Continuity

We also reviewed all main-stem river banks for value that would indicate increasingly intact forests. The botany team was primarily interested in forest areas with no breaks in the tree canopy and the presence of a vegetated under-story. This was the best condition possible. It was examined against six diminishing conditions, beginning with the lapse of under-story species and culminating in the absence of any vegetation whatsoever.

More generally, the botanists analyzed for dominant and subordinate species in each 1/10 of a mile section, as well as the total percentage of vegetation, the continuity of forest cover vegetation as well as the relative impacts of invasive species such as Japanese knotweed, Purple loosestrife and Garlic mustard.

Figure VII.1 Riverbank sections of the Allegheny River (top) and the Monongahela River (bottom) (Photos 3R2N)

7.1 RIVERBANK OBLIGATE WETLANDS & POTENTIAL PERENNIAL FLOODPLAINS

Areas of occurrence of two or more vegetative obligate wetland species. The presence of obligate wetland species indicates the possibility of a wetland habitat that is protected under Section 404 of the Clean Water Act.

LEGEND

- River
- Stream
- Presence of Obligate Wetland Species
- Potential Perennial Floodplain
- Natural River Valley Floor

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

7.2 RIVERBANK BOTANY CONTINUITY

A value of forest continuity was assigned by 3R2N's botany team to each tenth of a mile section of the Allegheny County riverbanks. The values 1-7 represent an increasing intact forest.

Continuity:

1. No or almost no woody vegetation
2. Little woody vegetation with no forest structure
3. Fragments of remnants of forest structure (i.e. scattered trees and shrubs but not forested)
4. Presence of forested areas with large or several breaks in continuity (e.g. powerlines)
5. Presence of forested areas with some breaks in continuity
6. Forested area with very few breaks in canopy continuity or completely continuous forested area but with no or little understory species
7. Intact forested area with no breaks in canopy continuity as well as presence of a vegetated understory

LEGEND

- River
- Stream

River Bank Botany Community Continuity

- 1
- 2
- 3
- 4
- 5
- 6
- 7

- Natural River Valley Floor

0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

Map 7.3 Riverbank Botany Preservation Priority

The riverbank botany preservation map identifies those waterfront parcels that have either continuous forested areas, indications of obligate wetland species or presence of floodplain hardwood trees. Continuous forested areas have value unto themselves. Properties with obligate wetland species fall under the jurisdiction of the Clean Water Act and can provide a potent argument for the preservation of land. Hardwood trees on river floodplains are considered to be imperiled by the Pennsylvania Department of Conservation and Natural Resources, which may or may not be a source of support for preservation, conservation or restoration of the identified parcels and land that adjoins them.

Map 7.4 Riverbank Botany Restoration Potential

Areas recommended for restoration were chosen based on geological data and vegetative data, specifically natural substrate conditions and low forest continuity values. The natural substrate conditions provide the opportunity to replant native trees and shrubs, thereby reforesting a fragmented area or area impacted by vegetative invasive species.

Riverbank Conclusion

The riverbanks of Allegheny County have been much abused through the years. First, the level of the rivers is five to six feet higher than it would have been one hundred years ago. Second, the riverbanks themselves have become the repository for a range of urban and industrial detritus (Figure VII.2). And while these kinds of practices may feel odd and ancient to many of us today, you only have to find your way to the mouth of Plum Creek or Squaw Run on the Allegheny River to find mounds of fill that have been placed on these floodplains in the years since 2000. That is the bad news. The good news is the riverbanks of Allegheny County are sprouting sizable and continuous forest growth for the first time in one hundred years. Thirty years of industrial downturn and an accumulation of natural soils upon building debris that lines some of our riverbanks, has given nature a foothold. We all must make a decision. Do we work to make things better using the methods, means and programs of restoration ecology, land conservation and preservation? Or do we pursue growth at any cost as our forefathers once did? Once again we are deciding upon the future for our children.

Figure VII.2 An eyesore or recovering riverbank?

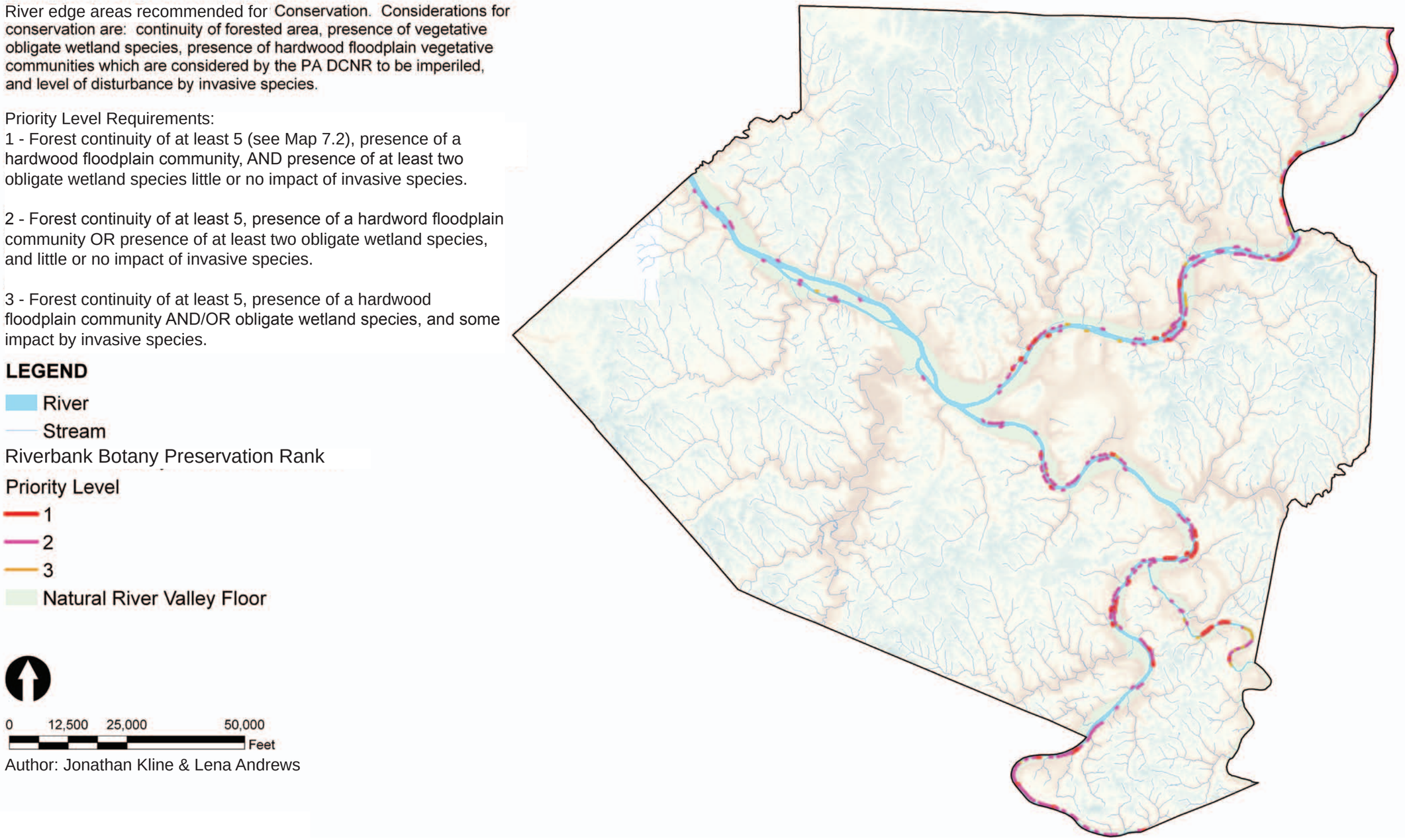
7.3 RIVERBANK BOTANY PRESERVATION PRIORITY

River edge areas recommended for Conservation. Considerations for conservation are: continuity of forested area, presence of vegetative obligate wetland species, presence of hardwood floodplain vegetative communities which are considered by the PA DCNR to be imperiled, and level of disturbance by invasive species.

Priority Level Requirements:
1 - Forest continuity of at least 5 (see Map 7.2), presence of a hardwood floodplain community, AND presence of at least two obligate wetland species little or no impact of invasive species.

2 - Forest continuity of at least 5, presence of a hardword floodplain community OR presence of at least two obligate wetland species, and little or no impact of invasive species.

3 - Forest continuity of at least 5, presence of a hardwood floodplain community AND/OR obligate wetland species, and some impact by invasive species.



Author: Jonathan Kline & Lena Andrews

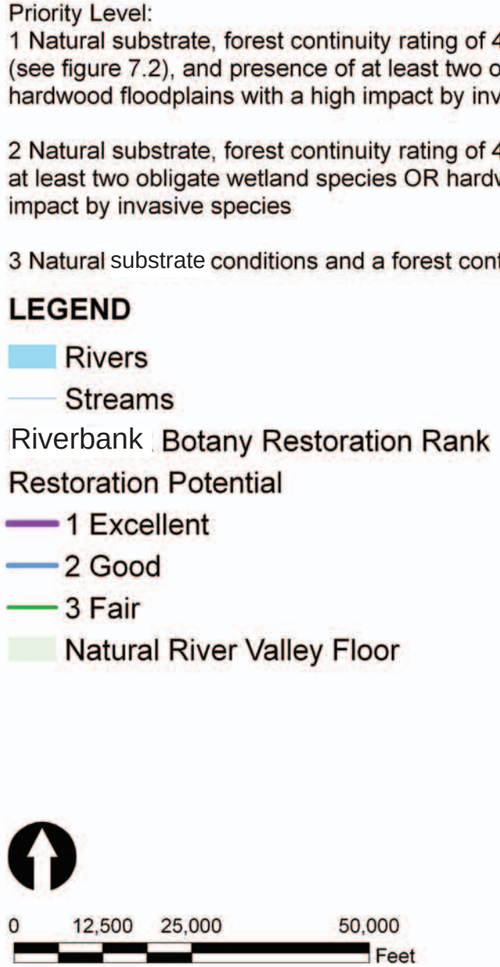
7.4 RIVERBANK BOTANY RESTORATION POTENTIAL

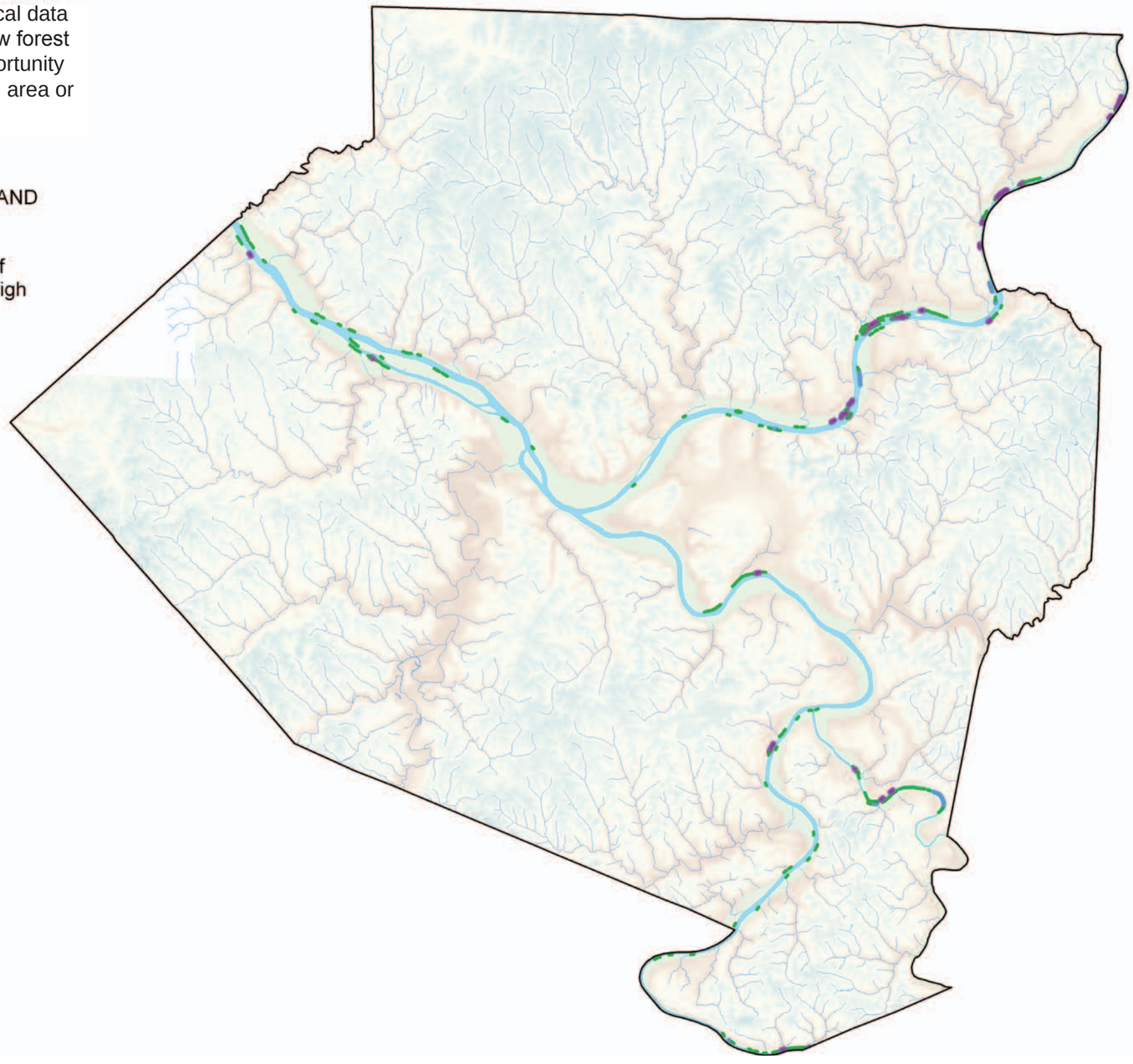
Areas recommended for restoration were chosen based on geological data and vegetative data, specifically natural substrate conditions and low forest continuity values. The natural substrate conditions provide the opportunity to replant native trees and shrubs, thereby reforesting a fragmented area or area impacted by vegetative invasive species.

Priority Level:
1 Natural substrate, forest continuity rating of 4 or less (see figure 7.2), and presence of at least two obligate wetland species AND hardwood floodplains with a high impact by invasive species

2 Natural substrate, forest continuity rating of 4 or less, and presence of at least two obligate wetland species OR hardwood floodplains with a high impact by invasive species

3 Natural substrate conditions and a forest continuity rating of 4 or less





Author: Jonathan Kline & Lena Andrews

VIII. Identifying Areas of Opportunity

Overlaying the Different Measurements

Thus far, our landscape ecology analysis has examined three different measures of ecological health in Allegheny County. The study began at the scale of the sub-watershed, moved to the scale of the river-corridor woodland patch-group and finally examined tenth-of-a-mile points along the riverbanks of the four major rivers. At each scale, different kinds of data were combined to create a ranking of ecological health for a different unit of measurement, the sub-watershed, the woodland patch-group and the riverbank point. Because of the varying scales, measurement units, data types and ranking schema, it is not feasible or useful to attempt combining them into a single quantitative measure. As individual quantitative rankings, they illustrate different aspects of the hydrological ecology of the county and have different uses for planning.

However, all being spatial measurements, it is possible to graphically overlay the various rankings to create a general qualitative picture of the health of the hydrological system in the county. A spatial overlay allows the rankings of different measurements to be related to one another. It also reveals spatial convergences and connections between areas of ecological significance. For future development planning, advocacy efforts and regulatory changes, understanding the spatial relationships between ecologically valuable areas and existing urban development is essential. The overlay of the different rankings creates a single picture that summarizes the findings for these purposes.

The data layering is particularly useful for understanding the zone of the river corridor, revealing spatial relationships between significant hillside woodland patch-groups and stretches of riverbank with high preservation and restoration potential. In this way, it relates the different measures back to the Forman model of a healthy river corridor shown in Figure VIII.1, and our interpretation of it used to find remnant ecological value in a post-industrial urban setting shown in Figure VIII.2. One group of measurements look for value in woodland patch-groups, examining size, interior size, proximity, percent fragmentation and relationship to floodplains. Another set look for continuity and quality of the riverbank edges based upon field observation and measurement. Seen together these measurements reveal systems of remnant ecological value woven into a developed urban setting. The overlay also allows these convergences of healthy systems to be seen in the context of their sub-watershed and its relative health.

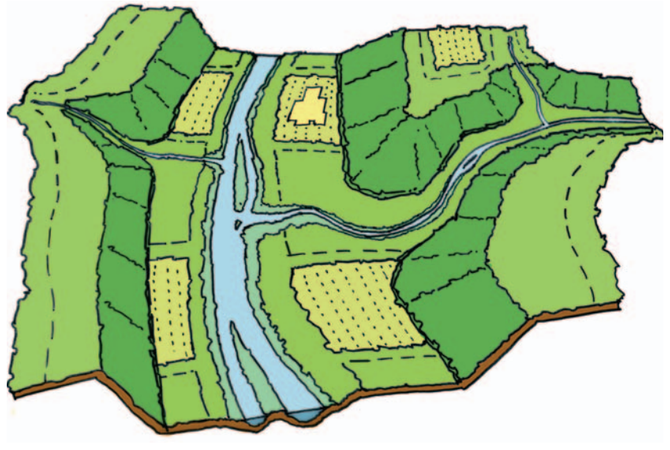


Figure VIII.1 A three-dimensional interpretation of the Forman river corridor model. (Jonathan Kline-3R2N, after Forman)

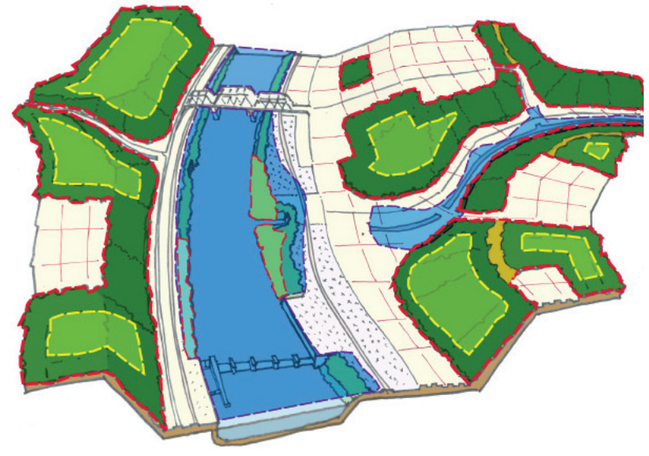


Figure VIII.2 Measured aspects of the river corridor including bank data and woodland patches used to find remnant value. (Jonathan Kline-3R2N, after Forman)

Map 8.1 River Corridor Summary - Areas of Greatest Significance

The River Corridor Summary map brings together the ecological measures of watershed health, woodland group significance, and riverbank botany preservation and restoration ranking. Different measures are overlaid to create a picture of the landscape ecology of the county from a hydrological perspective. The map is not a single quantitative measure of overall significance, but a spatial layering of interrelated measures of ecologically significant systems in the river corridor.

The River Corridor Summary shows highly ranked areas increasing as the rivers move away from the confluence at the Point towards the edges of the county. It also shows a greater presence of highly ranked sub-watersheds in the north of the county than in the south. These patterns are not surprising given the historical urban development of Allegheny County moving primarily east and south of the confluence at the Point where downtown Pittsburgh is located. However, the mapping does reveal some major areas of value along the Monongahela River, historically the most industrialized area in the county. The area in the south of the county between the Monongahela and Youghiogheny rivers contains a surprisingly large number of significant woodland-patch groups as well as a number of very healthy small sub-watersheds. This and other spatial convergences of remnant value will be further examined as opportunity areas.

Map 8.2 River Corridor Summary – Opportunity Areas for Study

The map of Opportunity Areas for Study calls out eight overlapping areas in the county where there are significant spatial convergences of ecological value in the river corridors. In most cases these areas contain a signifi-

8.1 RIVER CORRIDOR SUMMARY AREAS OF GREATEST SIGNIFIGANCE

Combining the various ecological measures of watershed, woodland groups and riverbank botany creates a landscape ecology summary of the county from a hydrological perspective.

LEGEND

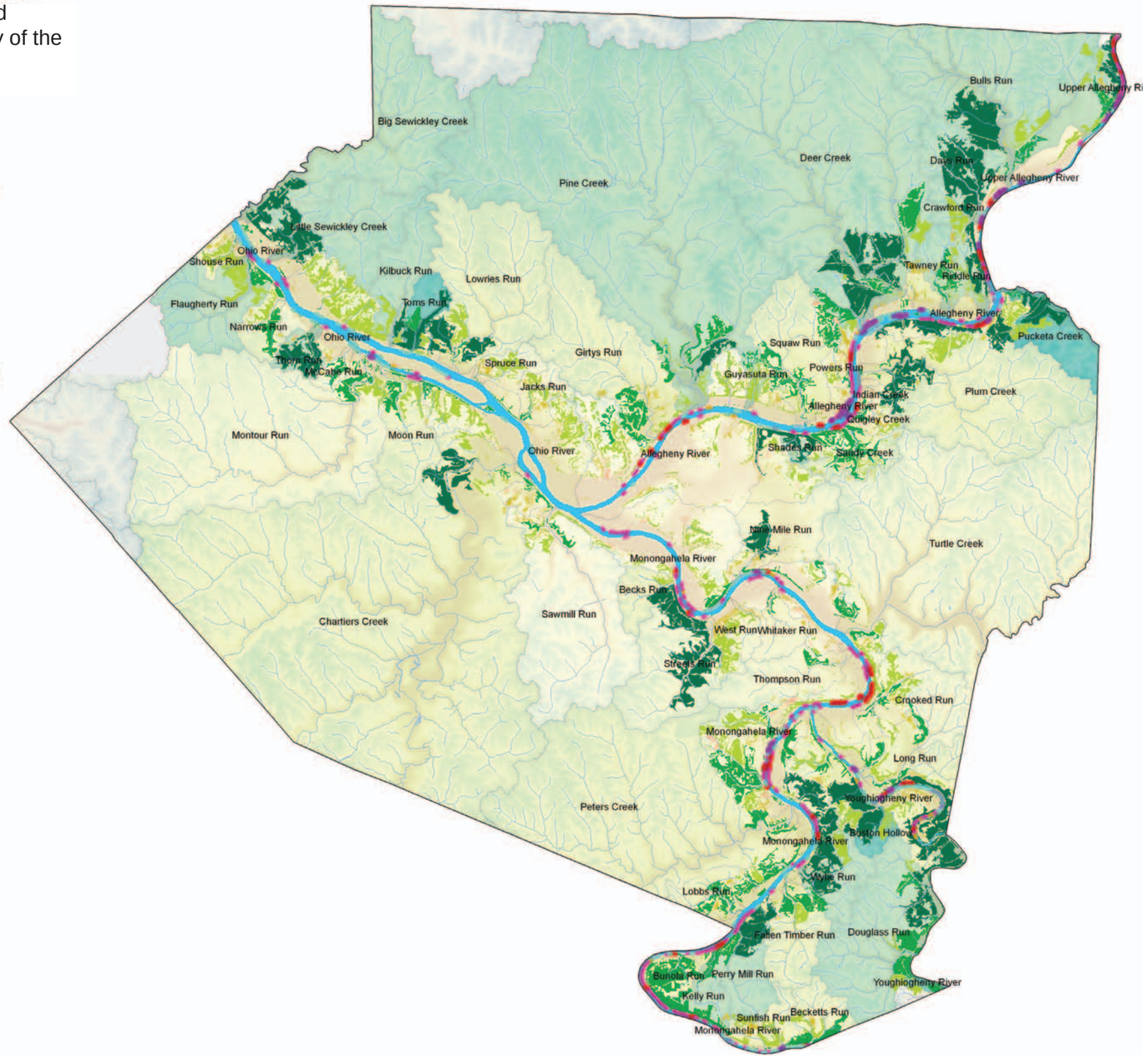
Rivers
Streams

Woodland Group Overall Rank
5 - Most Significant
4
3
2
1- Least Significant

Watersheds Ecological Health
Overall Rating [Background Color]
5 - Best
4
3
2
1 - Worst
Excluded Partial Watershed

Riverbank Botany Preservation Priority
1
2
3

Riverbank Botany Restoration Potential
1 Excellent
2 Good
3 Fair



0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

cant grouping of highly ranked woodlands combined with a stretch of riverbank with numerous points of preservation or restoration potential. They also typically are connected to a highly ranked watershed. It must be emphasized that the River Corridor Summary is a spatial overlay of related quantitative measures, not a single ranking. The selection on the opportunity areas is based on observation of the spatial convergence of related rankings. It identifies areas of the county that appear to have high preservation or restoration potential based upon the related measurements. Areas were also selected with some consideration of their relationship and proximity to urban systems of human use with the assumption that these remnant ecological systems are particularly valuable to human health, environmental aesthetics and urban sustainability. These are intended to be areas for further investigation including field studies of environmental system quality, analysis of relationships to urban infrastructure, human use and regulation and feasibility of preservation and restoration.

The largest cluster of opportunity areas is found in the upper north-west corner of the county along the Allegheny River. This area contains a number of large relatively healthy watersheds with large intact woodland patches, some of which have relatively uninterrupted connectivity with floodplain vegetation. The Upper Allegheny also has large stretches of riverbank with high preservation and restoration potential including a number of small islands. Deer Creek (Map 8.8), Days and Bulls Run (Map 8.9) and The Upper Allegheny (Map 8.10) all have large intact areas of value with very high preservation potential. Plum Creek (Map 8.7) was chosen despite its low ranking as a sub-watershed because of the presence of a large system of woodland patches along the creek and the southern slopes of the Allegheny River valley in close proximity to a group of dense urban settlements. Plum Creek looks to be an ideal area for coordinated riverbank, floodplain and stream restoration combined with hillside woodland preservation.

Another cluster is located along the north and south shores of the Ohio River around Neville Island. Both Thorn Run (Map 8.6) and Tom's Run (Map 8.5) contain small, relatively healthy sub-watersheds dominated by large intact woodland patches. These two areas were chosen for their high preservation potential.

The last two areas are found along the Monongahela River corridor to the south of the county. The Emerald Arc (Map 8.4) was chosen for the presence of relatively contiguous forest cover spanning the hills between the Monongahela and Youghiogheny Rivers in addition to a number of small healthy sub-watersheds and stretches of healthy riverbank. This area is particularly striking for its proximity to both active and brownfield industrial sites that dominate the lower Monongahela. The second Monongahela site, Hays and Streets Run (Map 8.3) was chosen because of the presence of large groups of woodland patches in close proximity to the central city. While the sub-watersheds of Streets Run and Nine Mile Run both have a watershed health ranking of only two, they also contain major interconnected patches of woodlands. The presence of highly ranked woodland patch groups in relation to the compromised streams combined with proximity to dense urban areas, parks and trail systems creates a unique opportunity for restoration.

Map 8.3 – 8.10 Opportunity Areas

Maps 8.3 through 8.10 show the opportunity areas identified in greater detail. The opportunity area maps reproduce the landscape ecology data from the summary map at a larger scale allowing spatial relationships to be analyzed in greater detail. The woodland groups, riverbank data and watershed rankings are shown in relation to human infrastructure of streets railroads and managed open space. Networks of road and railroad infrastructure create enormous challenges for reconnecting fragmented woodland stream and floodplain systems. Managed open spaces indicate existing areas with some level of regulatory control and indicate systems of relatively compatible human recreational use. These maps begin to show the complexity of preservation and restoration of natural systems in a dense urban environment. Section IX of this report will examine the urban fabric and land-use regulation of the Hays and Streets Run area (Map 8.3) and the Emerald Arc area (Map 8.4) to understand the general challenges and strategies for preservation and restoration in the county.

Areas of Opportunity – Conclusion

The River Corridor Summary and the selected Areas of Opportunity should be seen as tools for further analysis and action. Although Allegheny County is a highly urbanized post-industrial landscape, our landscape ecology analysis reveals that it contains major remnant systems of ecological value. Stretches of riverbank are returning to health and reestablishing after over a hundred years of industrial abuses. Large patches of river valley forest have returned after dying off during the intense industrial pollution of the early twentieth century. Nature is returning to the river valleys of Allegheny County as historical photographs attest.

Figure VIII.3 Hays and Streets Run Opportunity Area

And yet, despite a static regional population and a general population decline in the center city, land continues to be developed in ways that are highly destructive to these remnant and returning ecologies. Hillsides are striped of woodlands, streams are filled, culverted and channelized, riverbanks are aggressively managed with grey infrastructure, and proposals that add even more layers of highway infrastructure to our river valleys continue. Public officials have even supported proposals for mountain top removal mining as an appropriate practice in the Hays and Streets Run Opportunity Area.

Nature is returning to our river valleys. We can choose to aid, ignore or fight this process. This study advocates for a restoration ecology approach that actively aids the process through restoration projects, land conservation and preservation for future generations. To do this, much more work is needed to understand, protect and restore the river valley ecological systems that dominate our region. The opportunity areas of this study point to a few key locations to start, but they are only a beginning.

8.2 RIVER CORRIDOR SUMMARY OPPORTUNITY AREAS FOR STUDY

Based upon the overlaid ranking of watersheds, woodland patch groups and bank condition, eight areas were identified as major opportunity areas in the county. The boxes indicate the areas shown in detail in Maps 8.3 - 8.10. The major watersheds connected to these areas are cross hatched in orange.

LEGEND

Rivers
Streams

Woodland Group Overall Rank
5 - Most Significant
4
3
2
1- Least significant

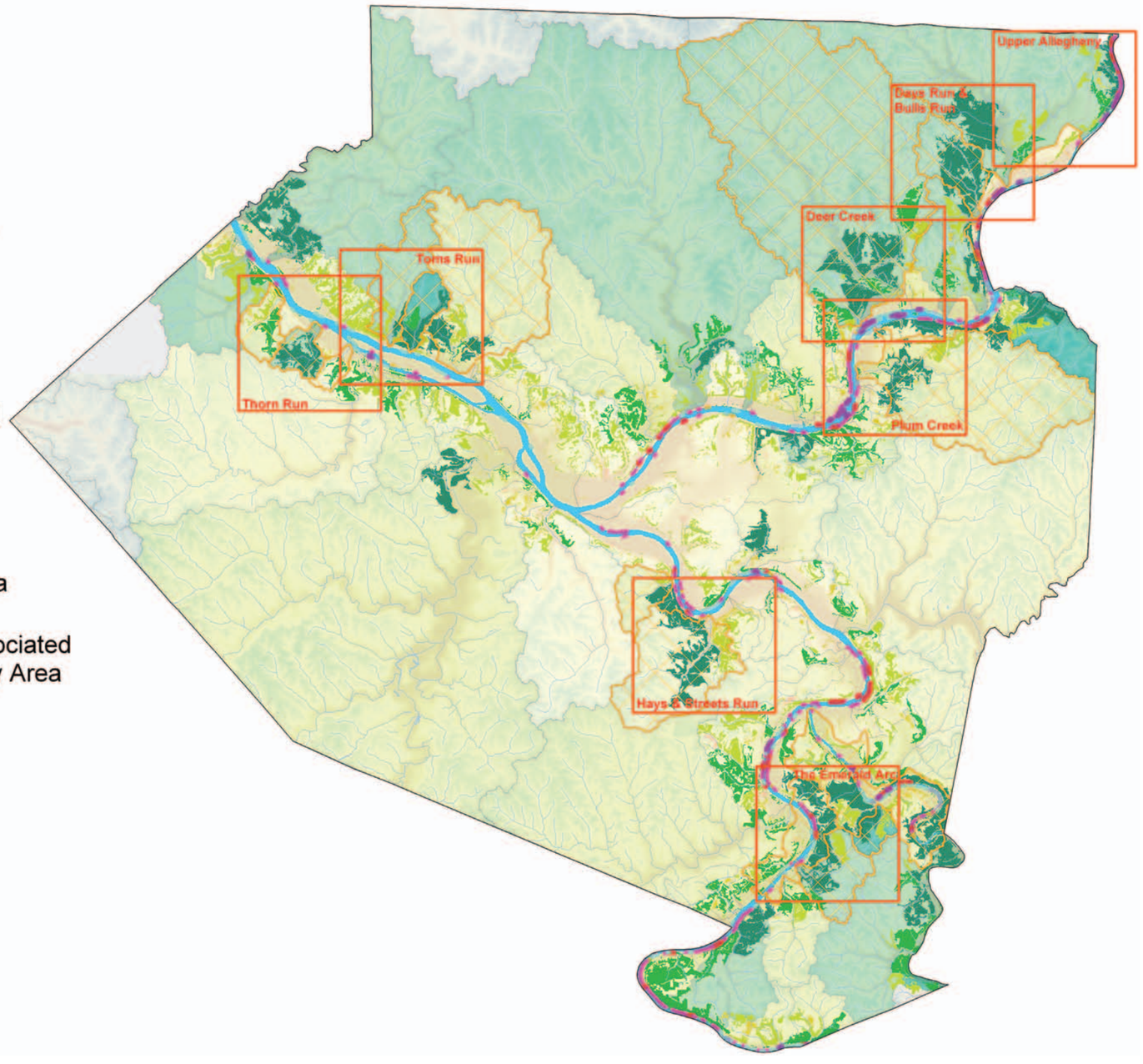
Watersheds Ecological Health
Overall Rating [Background Color]
5 - Best
4
3
2
1 - Worst
Excluded Partial Watershed

Riverbank Botany Preservation Priority
1
2
3

Riverbank Botany Restoration Potential
1 Excellent
2 Good
3 Fair

Opportunity Area

Watershed Associated with Opportunity Area

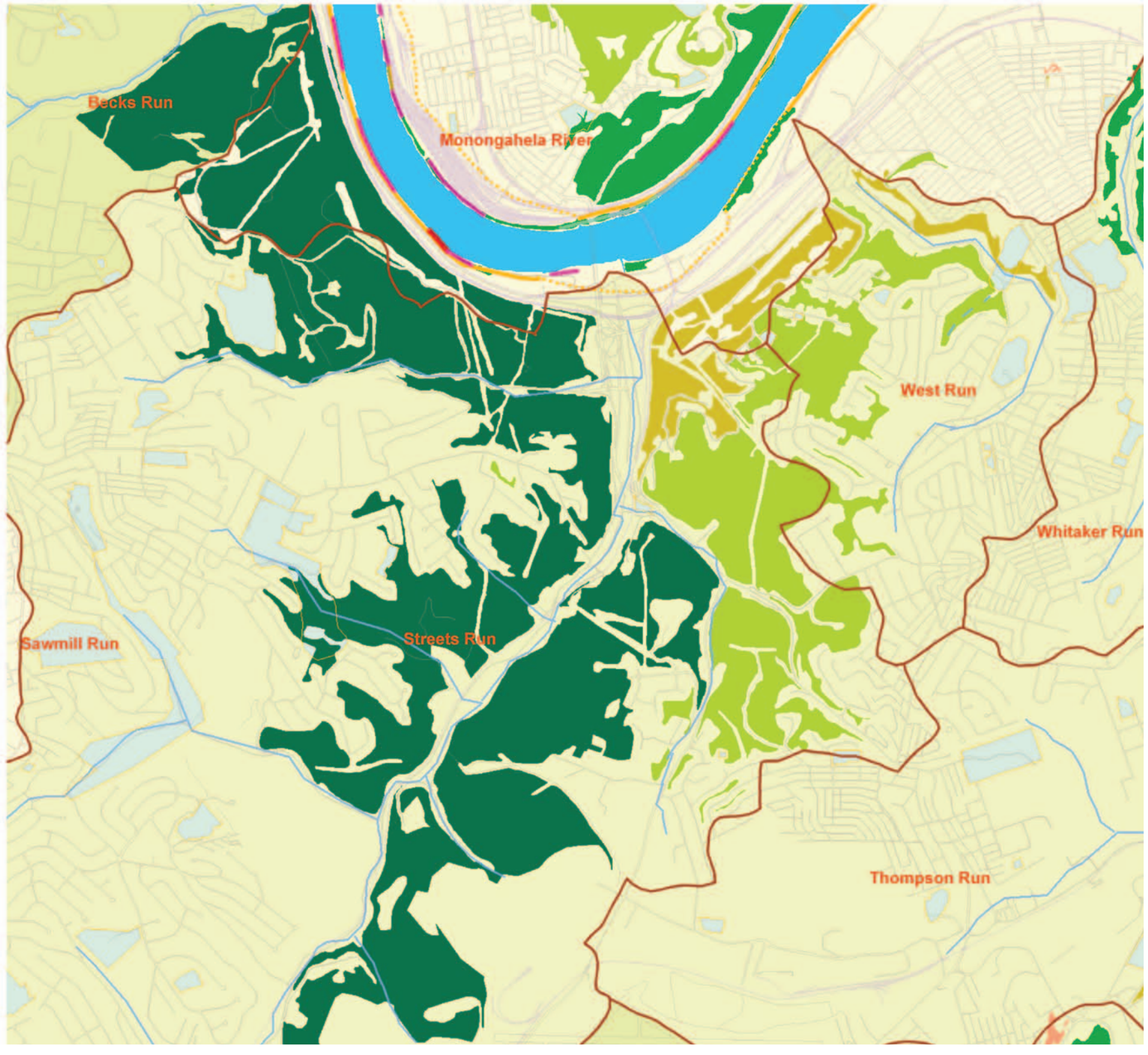


0 12,500 25,000 50,000 Feet

Author: Jonathan Kline & Lena Andrews

8.3 OPPORTUNITY AREA: HAYS & STREETS RUN

The woodlands on either side of Streets Run and the top of Hays hilltop between Glass Run and Becks Run form a very large woodland patch system in close proximity to the most heavily urbanized areas of the county. Very little of this system is part of a managed open space or park, and the system has no direct connectivity with the river itself. The south shore of the river below the Hays hilltop has significant areas of riverbank of a high preservation priority.



Legend

- Rivers
- Streams

Woodland Group Overall Rank

- 5 - Most Significant
- 4
- 3
- 2
- 1- Least Significant

Watersheds Ecological Health

Overall Rating [Background Color]

- 5 - Best
- 4
- 3
- 2
- 1 - Worst

- Streets
- Railroads

Trails - Status

- Existing
- Proposed
- Parks & Managed Open Space

Riverbank Botany

Preservation Priority

- 1
- 2
- 3

Riverbank Botany

Restoration Potential

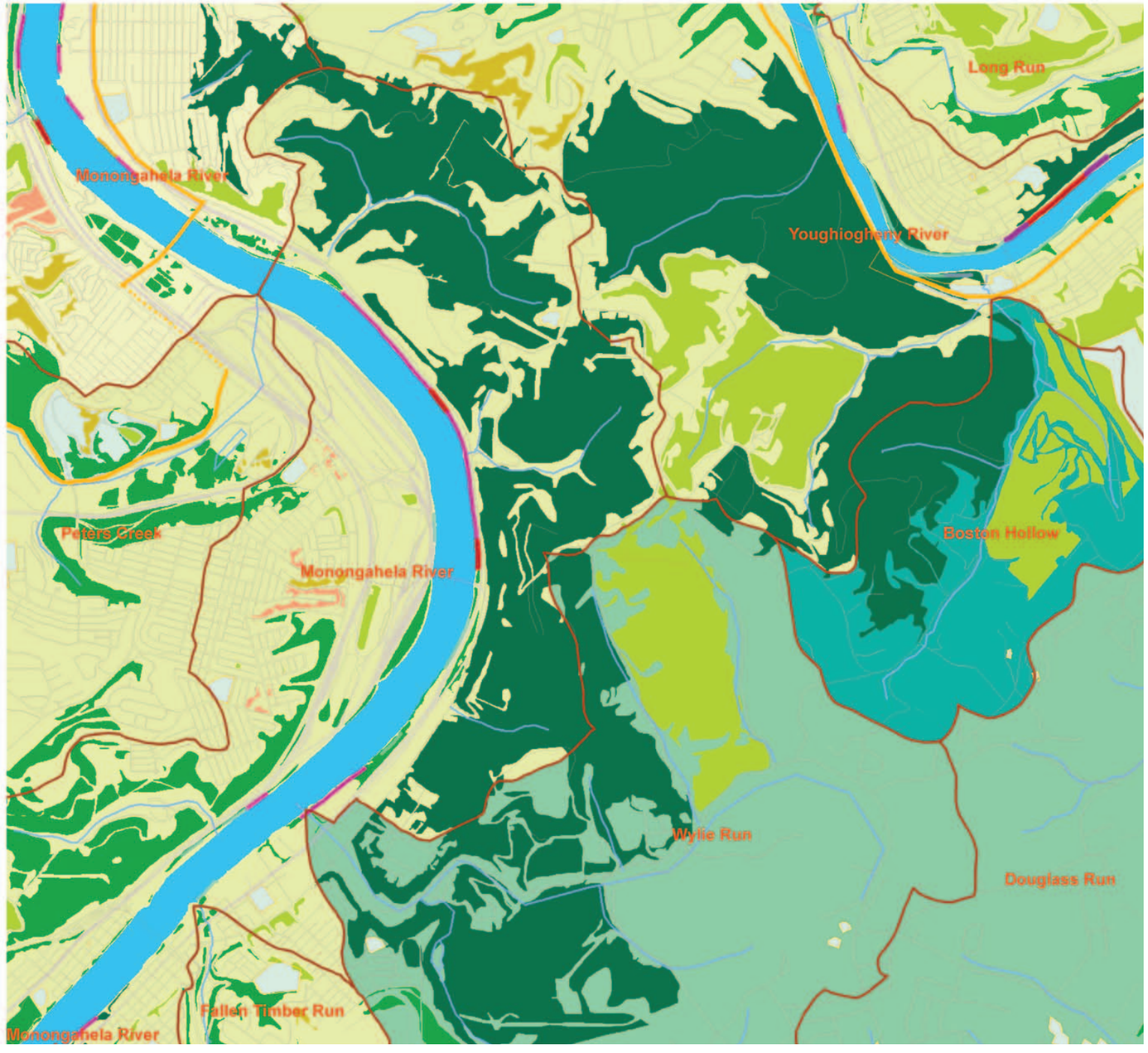
- 1 Excellent
- 2 Good
- 3 Fair

0 2,000 4,000 8,000 Feet

Author: Jonathan Kline & Lena Andrews

8.4 OPPORTUNITY AREA: THE EMERALD ARC

The steep hillsides of the Monongahela River valley in the area across from the Municipality of Clairton form an almost continuous band of woodlands which we have named the ‘Emerald Arc.’ In this same area there are also substantial woodland patch groups that touch the Youghiogheny River. This wooded area between the two rivers is only dissected by a few minor roads and it contains four small first order streams as well as the highly rated watersheds of Boston Hollow and Wylie Run. In this section of Monongahela there are substantial sections of preservation priority one and two riverbank. Unfortunately the wooded hillsides are separated from these banks by a major road.



Legend

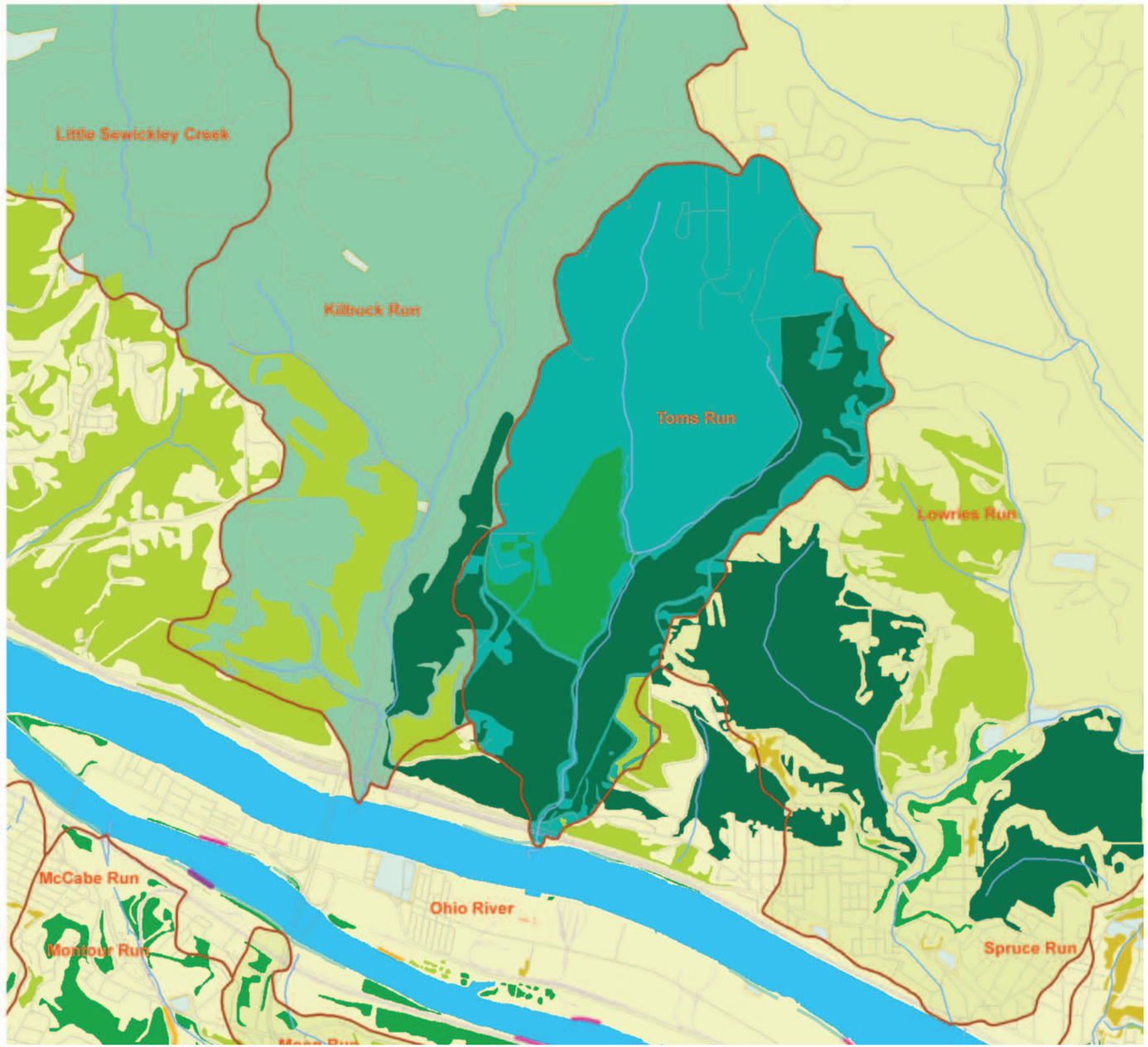
- Rivers
- Streams
- Woodland Group Overall Rank
  - 5 - Most Significant
  - 4
  - 3
  - 2
  - 1 - Least significant
- Watersheds Ecological Health
- Overall Rating [Background Color]
  - 5 - Best
  - 4
  - 3
  - 2
  - 1 - Worst
- Streets
- Railroads
- Trails - Status
  - Existing
  - Proposed
- Parks & Managed Open Space
- Riverbank Botany
- Preservation Priority
  - 1
  - 2
  - 3
- Riverbank Botany
- Restoration Potential
  - 1 Excellent
  - 2 Good
  - 3 Fair

0 2,000 4,000 8,000 Feet

Author: Jonathan Kline & Lena Andrews

8.5 OPPORTUNITY AREA: TOMS RUN

The small highly rated watershed of Toms Run is the center piece of this opportunity area. The woodlands of Toms Run cover both sides of the stream valley and connect to the wooded hillsides of the Ohio River valley. These woodland systems also connect to woodlands in the adjacent Lowries Run and Kilbuck Run watersheds. Although a major road separates Toms Run from the Ohio River, the creek remains open to the river and the banks to either side of the creek mouth have some restoration potential.



Legend

- Rivers
- Streams

Woodland Group Overall Rank

- 5 - Most Significant
- 4
- 3
- 2
- 1- Least Significant

Watersheds Ecological Health

Overall Rating [Background Color]

- 5 - Best
- 4
- 3
- 2
- 1 - Worst

- Streets
- Railroads

Trails - Status

- Existing
- Proposed
- Parks & Managed Open Space

Riverbank Botany

Preservation Priority

- 1
- 2
- 3

Riverbank Botany

Restoration Potential

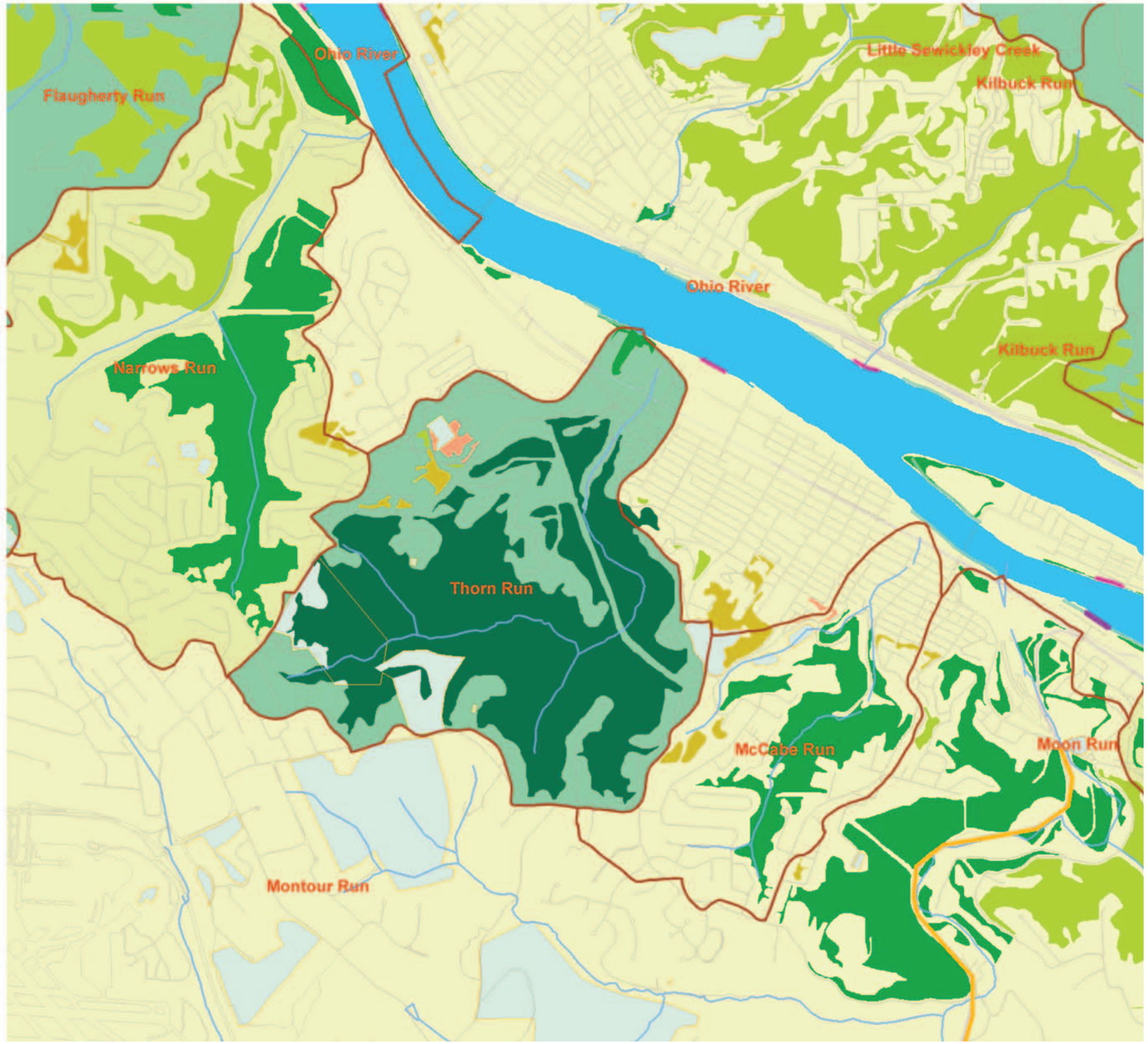
- 1 Excellent
- 2 Good
- 3 Fair

0 2,000 4,000 8,000 Feet

Author: Jonathan Kline & Lena Andrews

8.6 OPPORTUNITY AREA: THORN RUN

The small highly rated watershed of Thorn Run is the center piece of this opportunity area. The hillsides and uplands around Thorn Run form an almost completely contiguous woodland patch around the steam. However, as Thorn Run approaches the Ohio River, it passes through the town of Coraopolis, where it is partially culverted just before it reaches the river. There is some restoration and preservation potential on either side of the outlet of Thorn Run.



Legend

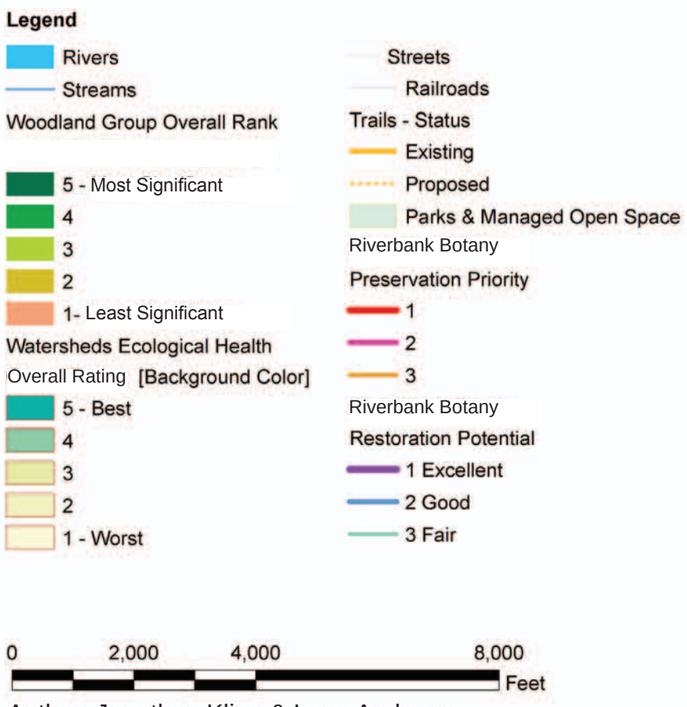
Rivers
Streams
Woodland Group Overall Rank
5 - Most Significant
4
3
2
1- Least Significant
Watersheds Ecological Health
Overall Rating [Background Color]
5 - Best
4
3
2
1 - Worst
Streets
Railroads
Trails - Status
Existing
Proposed
Parks & Managed Open Space
Riverbank Botany
Preservation Priority
1
2
3
Riverbank Botany
Restoration Potential
1 Excellent
2 Good
3 Fair

0 2,000 4,000 8,000 Feet

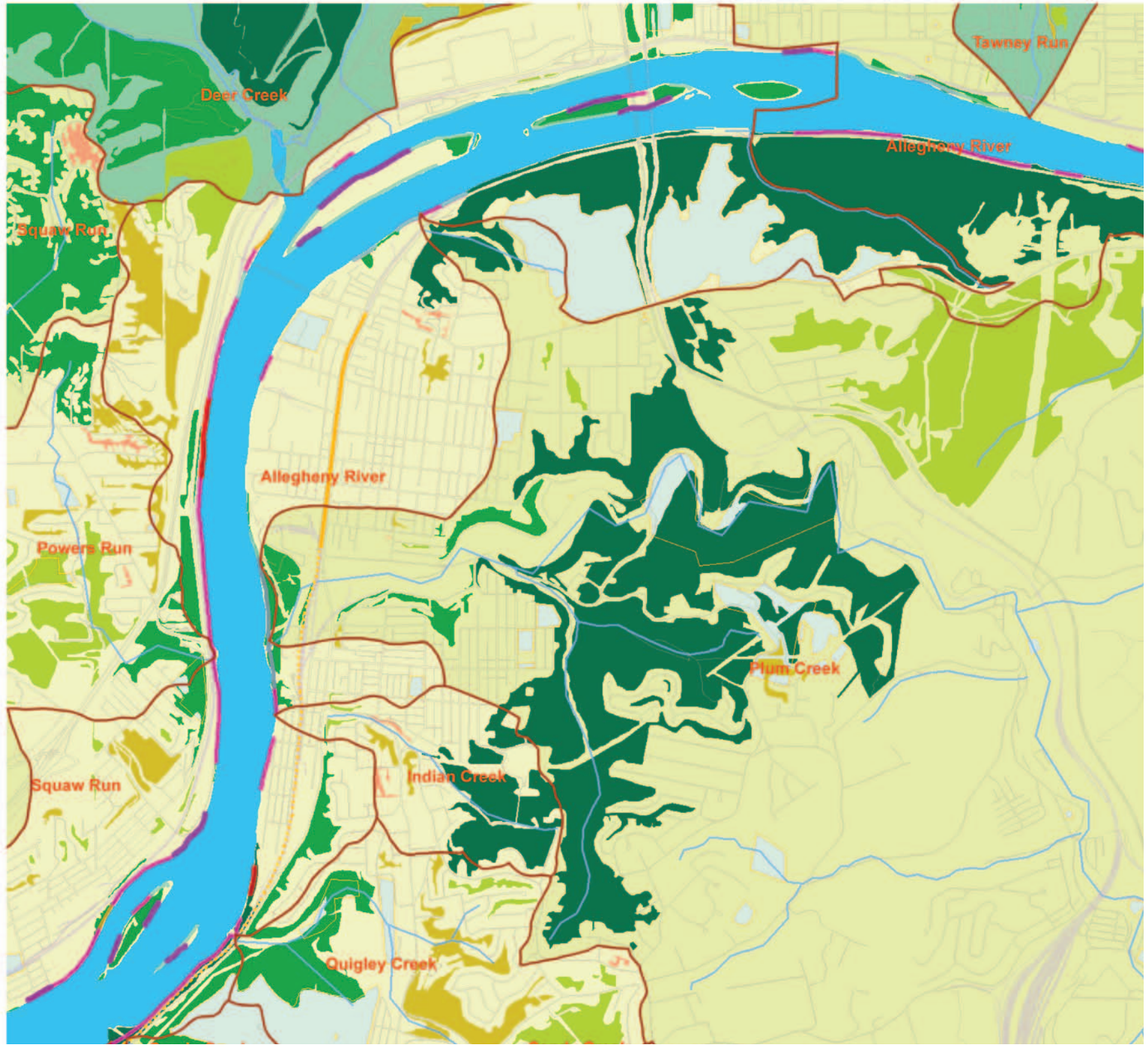
Author: Jonathan Kline & Lena Andrews

8.7 OPPORTUNITY AREA: PLUM CREEK

Plum Creek is a significant higher order stream which flows into the Allegheny River between Oakmont and Verona. It is identified as an opportunity area because of the presence of a large system of woodland patches surrounding multiple branches of the creek as well as the presence of a significant patch of remnant floodplain vegetation where the stream meets the river. Parts of the Plum Creek valley are already managed as public parks. Also found in this opportunity area is a major system of woodlands on the hillsides of the Allegheny River valley above Oakmont and a series of small islands found in the Allegheny River. This section of the Allegheny River also has large stretches of highly rated preservation and restoration riverbank.

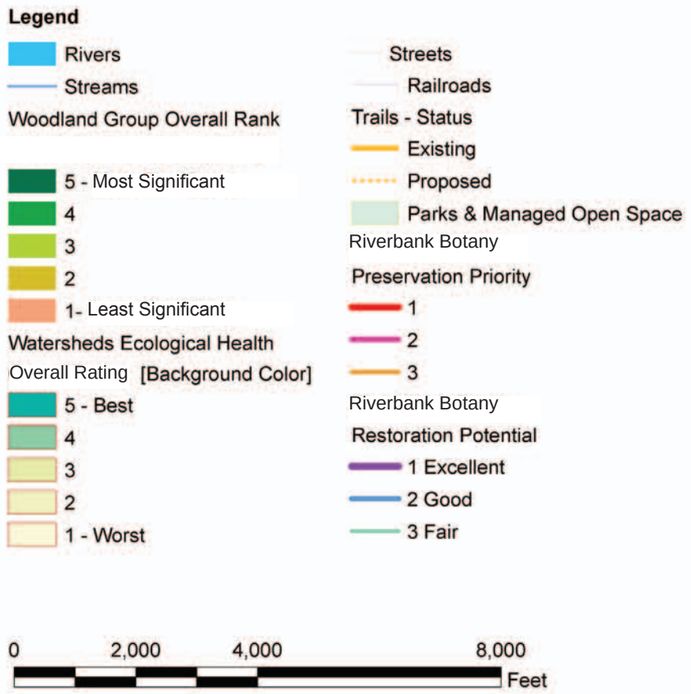


Author: Jonathan Kline & Lena Andrews



8.8 OPPORTUNITY AREA: DEER CREEK

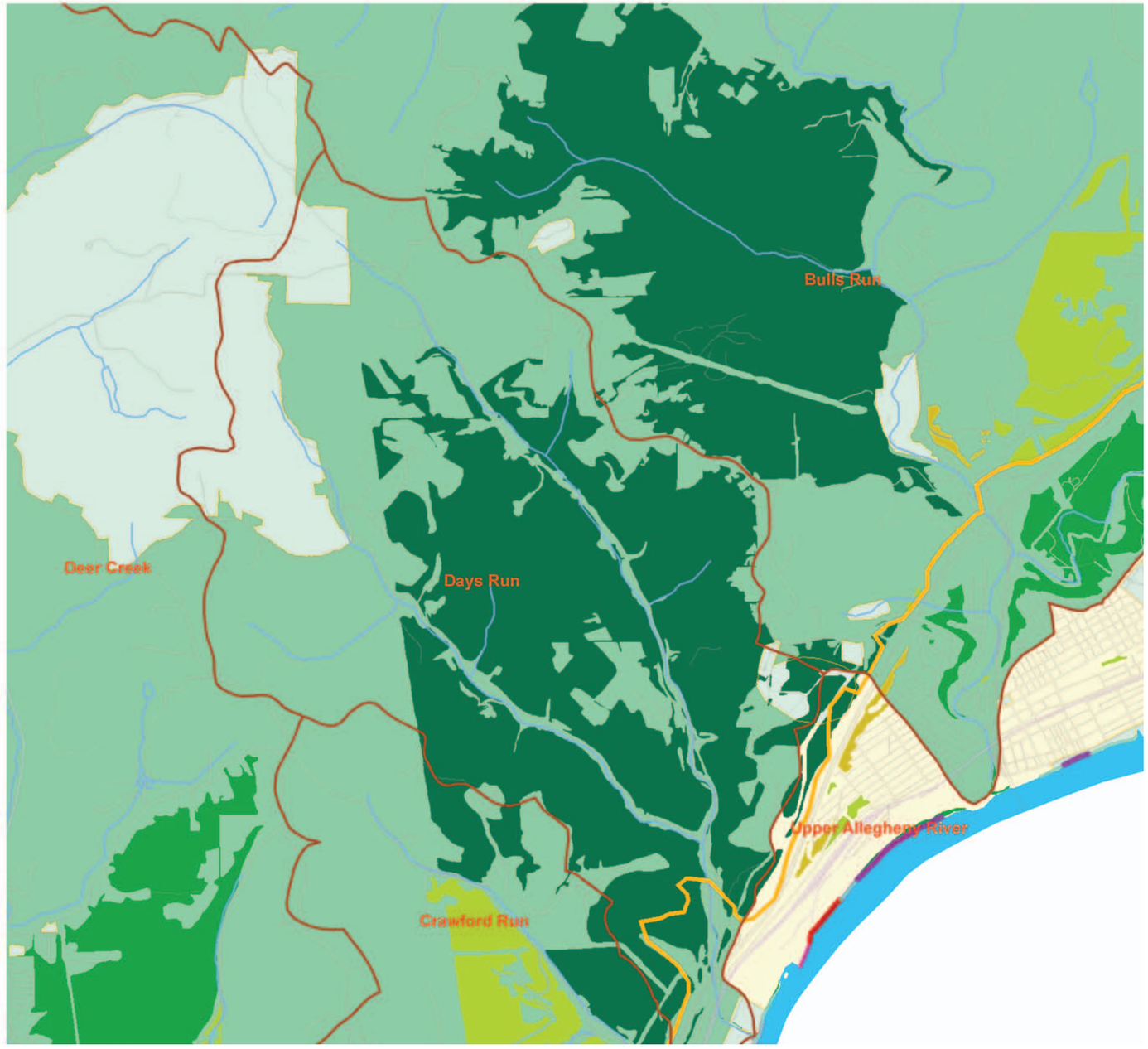
Deer Creek is a significant higher order stream which flows into the Allegheny River at Twelve Mile Island. It is a highly ranked watershed covering a very large northern section of the county. The sections of Deer Creek in the river corridor contain a series of very large woodland patches connected to various sub branches of the stream. Unfortunately the valley of the main branch of Deer Creek also contains a major interstate highway.



Author: Jonathan Kline & Lena Andrews

8.9 OPPORTUNITY AREA: DAYS RUN & BULLS RUN

Days Run and Bulls Run are two highly rated watersheds in the northern corner of the county. Both have very large woodland patch systems following the stream valleys. Bulls Run flows through the center of the single largest large woodland patch in the county with 553 acres of highly valuable interior woodlands. Like the majority of major woodland areas in the county, these systems are separated from the river itself by urban development, railroad lines and major road infrastructure. However, the point at which Days Run meets the river is a public open space and the riverbank date shows restoration potential around the mouth of the creek and preservation potential further up the river.



Legend

- Rivers
- Streams

Woodland Group Overall Rank

- 5 - Most Significant
- 4
- 3
- 2
- 1 - Least Significant

Watersheds Ecological Health Overall Rating [Background Color]

- 5 - Best
- 4
- 3
- 2
- 1 - Worst

- Streets
- Railroads

Trails - Status

- Existing
- Proposed
- Parks & Managed Open Space

Riverbank Botany Preservation Priority

- 1
- 2
- 3

Riverbank Botany Restoration Potential

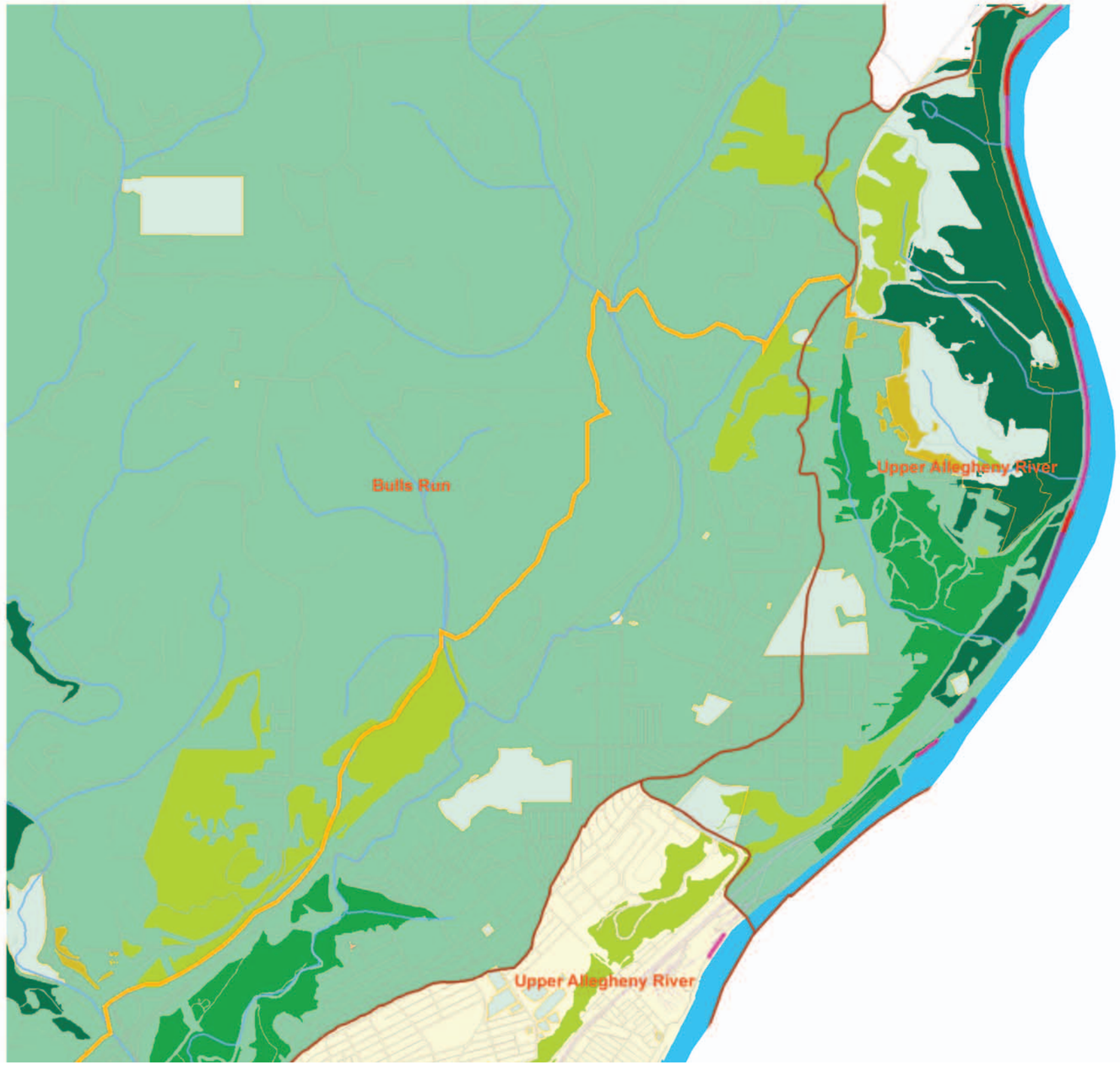
- 1 Excellent
- 2 Good
- 3 Fair

0 2,000 4,000 8,000 Feet

Author: Jonathan Kline & Lena Andrews

8.10 OPPORTUNITY AREA: UPPER ALLEGHENY

The northern shore of the Allegheny River in the northeastern corner of the county contains a very substantial area of wooded hillside with a direct relationship with the river. This area contains four small first order streams and has long stretches of riverbank with high preservation potential. This stretch is particularly significant because the only infrastructure barrier present between the wooded hillside and the river is a set of railroad tracks. A large section of this woodland area is also part of a major public open space called Harrison Hills Park.



Legend

- Rivers
- Streams

Woodland Group Overall Rank

- 5 - Most Significant
- 4
- 3
- 2
- 1- Least Significant

Watersheds Ecological Health

Overall Rating [Background Color]

- 5 - Best
- 4
- 3
- 2
- 1 - Worst

- Streets
- Railroads

Trails - Status

- Existing
- Proposed
- Parks & Managed Open Space

Riverbank Botany

Preservation Priority

- 1
- 2
- 3

Riverbank Botany

Restoration Potential

- 1 Excellent
- 2 Good
- 3 Fair

0 2,000 4,000 8,000 Feet

Author: Jonathan Kline & Lena Andrews