Southwest Indiana Wetland Corridor Project

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For Sycamore Land Trust

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Acknowledgements

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Wetland Corridor Project

Overview

This report outlines the methods used to design (1) a wetlands-based corridor that begins at the Beanblossom Bottoms Nature Preserve (Beanblossom Bottoms) and extends to the confluence of the Ohio and Wabash rivers, and (2) a corridor-property evaluation toolset for Sycamore Land Trust (Sycamore), a 501(c)(3) non-profit based in southern Indiana. Wetland habitats include emergent, ephemeral, forested, herbaceous, permanent and shrub/scrub wetlands and mudflats (IDNR, 2016a). Wetlands are one of the most biodiverse, productive ecosystems in the world and over one-third of federally threatened and endangered species live exclusively in wetland habitat (EPA, 2015).

Only 5% of all land in the United States (US) is classified as wetlands; however, 35% of all rare and endangered animal species in the US depend on wetlands for survival (IDNR, 2016b). Indiana contains more than 60 wetland-dependent animal species that are listed as threatened, endangered, or of special concern (IDNR, 2016b). Given this information and the clients stated interests, we targeted wetlands to maximize the potential conservation value of the proposed corridor.

Using ecological criteria in a geographic information systems (GIS) spatial analysis, we propose a primary corridor, with secondary corridor options, which connect lands currently in conservation. In addition to mapped corridors, the team created a three-step process to evaluate and compare parcels of land to be considered for acquisition, easement, or other form of conservation as they become available. The process begins with a GIS analysis using a suite of data layers compiled from government agencies and a variety of other sources. The second step provides an ecological and economic model to compare potential parcels as they become available for sale. Finally, we provide a survey instrument; this contains an additional set of decision criteria that allows users to consider factors not captured in the first two steps.

Assumptions and Limitations

We have operated under internal and external assumptions and constraints which have informed the design of the corridor options and the three-step parcel assessment process. The first key internal constraint is that the scope of this project is limited to the 33 counties identified. These counties were selected, in consultation with Sycamore, to include their organization's primary focus area (26 counties) and bordering counties (7 counties) with connected riparian areas (e.g., pathways along major river systems). Another internal assumption is that the data collected is as up-to-date as possible and representative of current conditions. All data we collected and used are less than **7** years old with the exception of the cultivated areas data; however, future corridor recommendations may change in conjunction with changes in the physical and socio-economic environment. Therefore, as noted above, we recommend that layers be updated annually and proposed corridors be evaluated for any significant changes in the landscape as new data become available. The majority of our data are derived from secondary sources, including

the associated metadata. Links to metadata and sources can be found in the Appendix 8: Data Dictionary.

GIS Data and Corridor Selection Process

GIS Data

Layers were collected from a variety of sources including IndianaMap, the Landscape Conservation Cooperatives (LCCs) Mississippi Basin / Gulf Hypoxia Initiative developed by The Conservation Fund and presented on ScienceBase and Data Basin, the Indiana Departments of Natural Resource, Indiana Department of Transportation, the USDA Farm Service Agency, and Sycamore Land Trust. Phil Worrall, Executive Director of the Indiana Geographic Information Council, manages IndianaMap and provided additional parcel data that are not currently publicly accessible. The information contained within the parcel layer is publicly available, but does not yet exist fully aggregated at the state level in a single GIS package. We were given the first attempt at a single GIS layer that contains all tax parcel information across the state; a similar layer will be available soon on IndianaMap and will be updated regularly. All GIS data layers were clipped to contain only our target counties for presentation and usability purposes.

We have transferred the data used in this analysis to Sycamore Land Trust, where it will be served on their computers. The product requires ArcGIS software for further manipulation and analysis of the data. Maintenance of the data layers will require additional resources and efforts beyond the scope of this project. We have not created a user interface that would allow other partners of Sycamore to use the product; however, as we discuss later in this report, portions of the analysis can be readily adapted to fit another user's needs, if desired.

Corridor Selection Process

In this section, we explain our corridor selection decision-making process in a step-by-step discussion. The priorities for the primary corridor are client-driven. The secondary corridors complement the primary corridor for use in future conservation efforts, either by the client or another conservation organization, and demonstrate how our methodology can be applied to areas outside of our specific area of interest.

Step 1: Identify Conserved Lands to Connect with a Corridor

The first step in the corridor selection process is to identify which conserved properties are ideal for connection. Conserved lands are derived from the following GIS layers: the Protected Areas Database of the United States, Indiana Department of Natural Resources Managed Lands Layer, Sycamore Land Trust Conservation Easement and Owned Properties, the National Conservation

Easement Database, and I-69 Mitigation Lands provided by the Indiana Department of Transportation.

The decision-making process regarding which conserved lands to connect can be prioritized in several different ways. For example, a corridor could be created to maximize connection of conserved areas by purchasing the least amount of land. Another strategy would could be to maximize protection for specific endangered species. Per client request, the team prioritized connecting conserved lands in Floyd County (namely, the Brock-Sampson Preserve), to Beanblossom Bottoms, to Goose Pond Fish and Wildlife Area (FWA), to Patoka National Wildlife Refuge (NWR), and finally to the confluence of the Ohio and Wabash rivers at Indiana's southwestern border while capturing the major conserved lands (by acreage) between the locations.

Secondary corridor options were designed to connect other significant (in terms of size) conserved areas to our primary corridor. As we worked to connect Beanblossom Bottoms to the confluence of the Ohio and Wabash rivers, we noticed we were excluding major conservation lands such as the Big Oaks NWR, which is east of our corridor. Including them would force our primary proposed corridor to go far out of the way and become more difficult and expensive to acquire. To expand the application of our analysis to other potential areas of high conservation value within our area of interest, we identify secondary corridor options that may be useful for other conservation projects. An alternative route is identified from Goose Pond FWA to Patoka NWR to provide a more direct route.

Step 2: Identify Route with Highest Ecological Value

The process of identifying high-value routes begins with identifying the nearest and largest conserved land. If a conserved land parcel exceeded 120 acres and was along the way or in between the main lands identified in step 1, we routed the corridor to include these conserved lands.

Using these primary and secondary nodes, we used the Green Infrastructure Network (GI Network) layer as the first input to establish the corridor route. The Conservation Fund identified hubs, sites, cores, and corridors for aquatic, forest, grassland, and wetland areas. This information was made publically available as a GIS layer—called the Green Infrastructure Network in 2011 and was updated in 2014. Hubs, in the GI layer, are defined as slightly fragmented aggregations of core areas, plus contiguous natural cover. Cores are defined as fully functional natural ecosystems which provide high-quality habitat for native plants and animals. GI-layer corridors link core areas together and allow animal movement and seed and pollen transfer between core areas. Sites provide important microhabitats not captured by the rest of the network (The Conservation Fund, 2014). The GI layer was the first step in identifying several (often 3 or 4) routes from one conserved land to another. We gave priority to aquatic and wetland cores and corridors, per Sycamore's interests. If only one route was identified using this layer, that route was determined to have the highest ecological value.

If two or more routes were identified, we next used the National Land Cover Database (2011) to narrow down which of the routes identified by the GI Network had the most ecologically valuable land cover. Rankings of the land cover types are listed below. If a single route was identified with a higher ranked land cover than the other routes, that route was determined to be the ecological route most likely to achieve the client's objectives. Land cover was ranked in consultation with a wildlife ecologist (Dr. Vicky Meretsky, Indiana University, School of Public and Environmental Affairs) and in consideration of the client's desired end state.

NLCDB Ranking from most to least desirable habitat:

1. Emergent Herbaceous Wetlands/Woody Wetlands
2. Deciduous/Evergreen/
3. Shrub/Scrub/Grassland/Herbaceous/Pasture/Hay
4. Cultivated Crops/Barren Land (Rock/Sand/Clay)/Open Water
5. Developed, Open Space
6. Developed, Low Intensity
7. Developed, Medium Intensity
8. Developed, High Intensity

If two or more routes were still possible after querying the National Landcover Database, we added information from the National Wetlands Inventory (NWI) layer to our decision process. Routes which contained NWI wetlands were considered more ecologically valuable. If a single route was identified in this step, that route was determined to be the most ecologically valuable route.

If two or more routes were still possible, we added data from the following layers, weighted equally: Audobon Important Bird Areas, known and predicted Breeding Bird Habitat Priority Areas as determined by the Upper Mississippi River and Great Lakes Region Joint Venture, and Important Forest Areas as defined by National Forest Stewardship Program Standards and Guidelines. These layers, for the most part, do not intersect, so no areas received higher ratings by being part of more than one of these three layers. We defined the route that contained the most overlap in the all of the component layers as the most ecologically valuable route: no ties remained after we added data from these last three layers.

Table 1. Rules for Establishing Route with Highest Ecological Value

Rule	Description
1.	Include large and close conserved lands if they lie between the targeted conserved lands from step 1. If more than one conserved lands are along the way and are in opposite directions, choose the largest and closest land to include. Go to Rule 2.
2.	Use Green Infrastructure Network cores, hubs, corridors, and sites to connect conserved lands. If 1 route exists, use that route. If 2 or more routes exist, go to rule 3.
3.	Use the National Land Cover Database to rank the routes according to their land cover (see ranking above). If one route is rank highest, use that route. If there are two or more

	routes with the highest ranking, go to rule 4.
4.	Use the National Wetlands Inventory. If a single route was identified which includes a national wetland, use that route. If no routes include a national wetlands or if two or more routes include a national wetland, go to rule 5.
5.	Use the following layers: Important Bird Areas, Wetlands Breeding Bird Habitat Priority Areas, and Important Forest Areas. The route which exemplifies the majority of these features is your most ecologically value route.

Step 3: Identify and Assess Potential Barriers

We identified potential barriers using GIS layers that contain locations of barriers that have the potential to decrease the ecological value associated with the corridor: Pipelines and Major Roads, Impervious Surfaces, Incorporated Areas, Cultivated Areas, Dams and Airports, Brownfields and Surface Coal Mines. If the route selected in the previous step is impeded by one of these layers, we assessed the extent of impact on the ecological quality of the corridor. For example, if a major road crossed the corridor, we searched for a nearby underpass to allow connectivity across the road. After identifying and assessing a barrier, we used our best judgment to determine whether the route identified in step 2 was still the most ecologically valuable route.

Step 4: Draw the Connecting Line

We drew our corridor using the freehand selection in the 'Create a Feature' dialogue box of ArcGIS. This tools allowed us to trace the identified route and establish the skeleton of the corridor.

Step 5: Buffer (expand) the Line Based on Minimum Patch Size

We buffered (expanded) selected routes to a width of 300 meters. We determined this buffer width using the Green Infrastructure Network analysis of minimum patch size requirements for various species and core habitats (wetlands, forest, etc.). We compared the median value of the minimum patch size for designated focal (ecologically representative) species and the minimum patch size for core habitat types. We then chose the more conservative (larger) value, which was the habitat patch size median value of 300 meters. This value serves as a guiding measurement for parcel consideration and for our corridor analysis; however, a more detailed analysis of each individual parcel should be done prior to purchase in order to determine if it is of sufficient size for its intended conservation goal.

The following map illustrates the identified corridor using this iterative process. As we mentioned earlier, different priorities in step 1 would likely yield several distinct corridors, as well as different assessments of the barriers identified in step 3. The primary corridor begins in the north at the Brock-Sampson Preserve, routes north through Clark State Forest and the Hoosier National Forest, connects to Beanblossom Bottoms Nature Preserve and extends towards the southwestern corner of Indiana. From Beanblossom Bottoms Nature Preserve, it connects to

Goose Pond Fish and Wildlife Area, then through Naval Surface Warfare Center Crane, on to Patoka River National Wildlife Refuge, then finally to the confluence of the Ohio and Wabash rivers at Indiana's southwestern border.

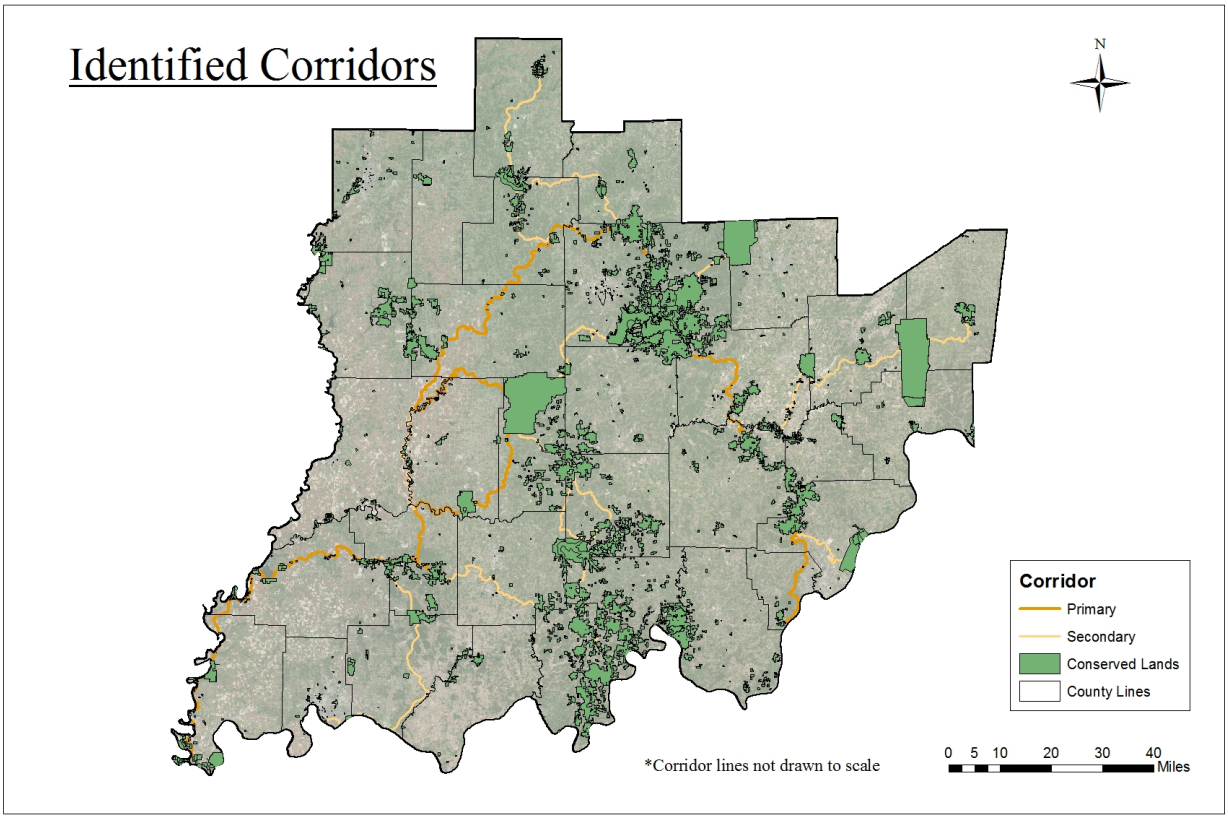


Figure 1: Proposed primary and secondary corridors

Heat Map of Desired Features

We provide this map, in addition to our proposed corridor, as another means of displaying the density of desired features within Sycamore Land Trust's focus area. To create this map, we identified 14 GIS layers used in the Corridor Selection Process that were most heavily relied upon during corridor development. Those layers are listed below in Table 2.

Table 2: Heat Map GIS Layers

GIS Layer	GIS Layer Source
Wetlands Corridor	GI Network – The Conservation Fund
Core Wetlands	GI Network – The Conservation Fund
Aquatics Corridor	GI Network – The Conservation Fund
Core Aquatics	GI Network – The Conservation Fund
Important Bird Areas	The Audubon Society
Important Forest Area – High Stewardship Potential	National Forest Stewardship Program Standards
Wetlands – All Types	National Wetlands Inventory
Wetlands Breeding Bird Habitat Priority Areas	Upper Mississippi River/Great Lakes Region Joint Venture
Allison Wishlist Sites	Sycamore Land Trust
Partially Hydric Soils	NRCS
Predominantly Hydric Soils	NRCS
Hydric Soils	NRCS
Natural Areas	Indiana Natural Heritage Database Center
High Quality Natural Communities	Indiana Natural Heritage Database Center

To create this heat map, we used the Fishnet tool in ArcGIS to create a grid, which we overlaid on top of our corridor area. Each grid cell has a size of 0.5 miles x 0.5 miles (0.25 square miles). In the attribute table of this layer, we added fields (columns) that represented each of the layers in Table 2. We then selected individual cells from the grid based on whether or not they intersected with each layer and populated the field with a "1" for presence. For example, if a grid cell was in an Important Bird Area, then the IBA column had a 1 in that grid cell's row in the database. We then created an additional field that added the scores from all 12 layers, to produce a sum. The larger sums represent cells with more desirable features and thus indicate areas of focus for conservation. The highest-value areas had a sum of 10 and the lowest-value areas had a sum of 0. We then mapped the sums using a gradient of color to display areas where Sycamore could focus their efforts, irrespective of whether the areas were on the corridors we designed.

This map is intended to identify "hotter" (more ecologically valuable) areas of ecological importance to inform broader corridor selection beyond our proposed routes. It can supplement our identified corridors and help visually assess the ecological landscape of southern Indiana. The heat map layer is included in the GIS product.

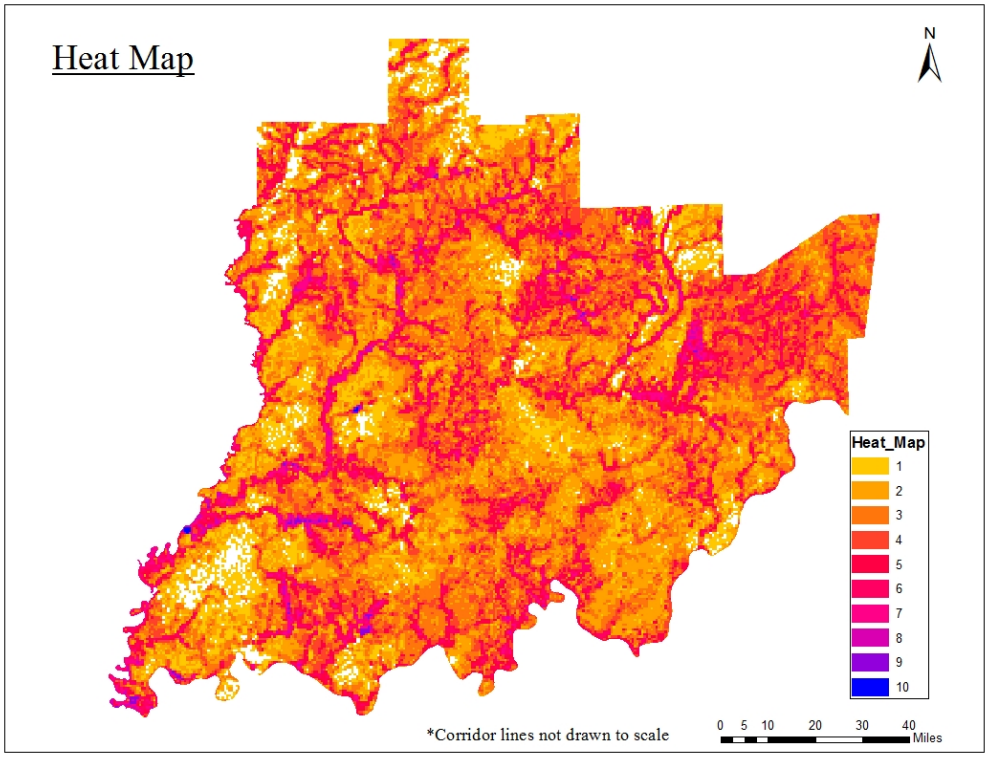


Figure 2. Heat Map of Desired Features

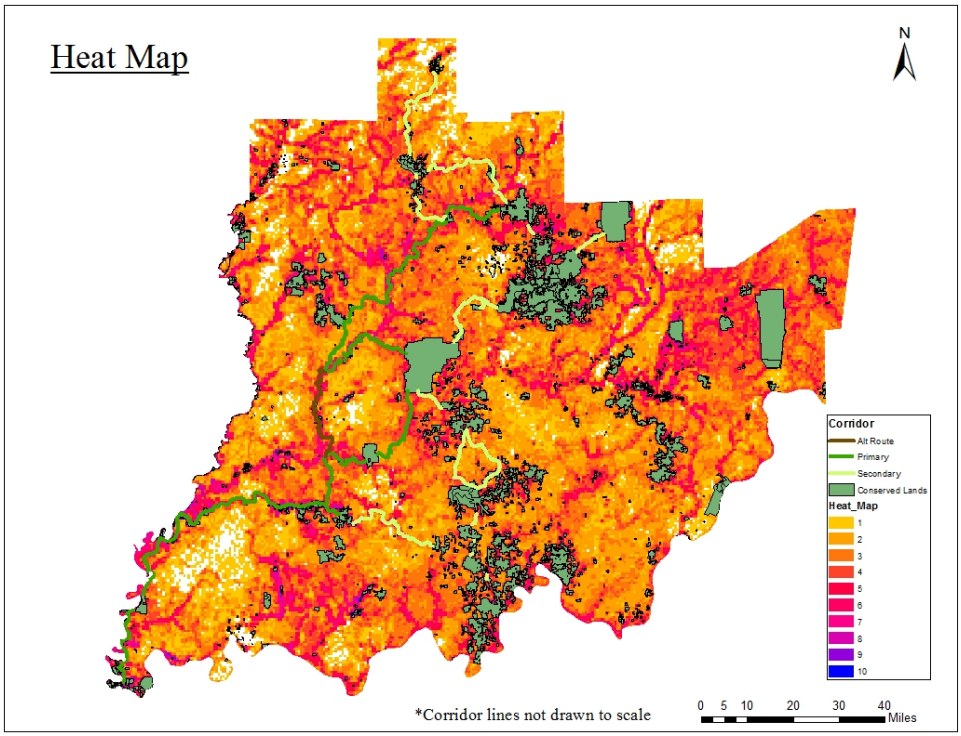


Figure 3. Heat Map of Desired Features with Primary and Secondary Corridors

Three-Step Selection Process

There are limitations to the proposed corridor analysis, given its static nature. The analysis does not account for potential differences in future physical and social conditions that could shift the location of the proposed corridors. For example, commodity prices, land prices, changes in climate, the political environment, and other external factors can change the appropriateness and availability of land parcels. While we recognize that these characteristics are relevant to acquisition decisions, a scenario analysis projecting the effect of changing future conditions was not incorporated into our corridor design analysis—but may be a valuable exercise.

To partially account for these factors, we developed a three-step process for evaluating potential acquisition-parcels. The GIS analysis step reflects the process described above. The economic and ecological model step, and the qualitative survey step, include criteria and survey questions related to the factors not captured by the proposed corridor analysis, as listed above. By incorporating external factors into the last two steps, the process accommodates data not captured by GIS and incorporates useful information at the time of parcel consideration.

Step 1: GIS Analysis

The GIS layers should be used to perform the preliminary analysis of a potential parcel. GIS provides spatial orientation in a visual tool to show highly localized information within the larger spatial context that cannot be easily appreciated in the field.

Step 2: Ecological and Economic Model

The ecological and economic model (model) is intended to provide a preliminary understanding of the relative quality of parcels for the corridor system we designed. This tool allows a comparison of baseline ecological and economic data between parcels of land. The ecological and economic variables used are displayed in Table 2.

Table 3: Codes for Ecological and Economic model variables, scored from least desirable (0) to most desirable (1)

Ecological Variables		
Variable name	Variable description	Code
Land Use	The type of land use or cover of the property, classified using the national land cover database categories	1 = Woody wetlands or Emergent herbaceous wetlands, .9 = Mixed forest, Deciduous forest, or Evergreen forest, .7 = Shrub/scrub, Grassland/herbaceous, or Pasture/hay, .4 = Cultivated crops, Barren land, or Open water, 0 = Developed space (open/low/medium/high)

Wetland Classification	Wetlands identified and classified using the National Wetlands Inventory classification system.	Values range from 0 - 1. See Wetland Classification table (sheet labeled Wetland Classification) for individual values.
Hydric rating	Soils formed under saturated conditions, classified using the soil survey geographic database from the NRCS	Input the soil hydric rating (which is shown as a percentage ranging from 0 - 100) as a decimal value ranging from 0 – 1. 0 is non-hydric, 1 is hydric.
Adjacency	The distance the property is from the nearest land also in conservation	1-99 = Immediately adjacent, .8 = 100 - 499 m, .6 = 500 m - 2 km, .4 = 2 - 10 km, 0 = >100 km
Endangered Species	The presence of a federally endangered species in the county the property is in, serving as a proxy for the potential of an endangered species to be present on the property	(total number of endangered species in the county) / 23 *23 is the total number of federally endangered species present in our target counties.
Total	The summed value of the above variables (maximum value 5).	Add all of the ecological variable values together

Economic Variables		
Variable name	Variable description	Code
Negotiated total parcel cost	The negotiated or approximate expected price for the purchase of the property	Purchase price in USD
Total restoration cost	The expected restoration cost of the land, given the desired use or land restoration level.	Total cost of restoration in USD
# of Acres	Parcel size or total number of acres that would be purchased or entered into conservation.	Total number of acres.
Total cost per acre	This standardized value provides the total cost per acre, when accounting for purchase price and restoration costs.	(Negotiated parcel cost + restoration cost)/total number of acres

Each criterion has its own weighting system from least to most desirable. The weighting value for number of endangered species (# of species) is based on the number of federally endangered species present in the county the parcel is in (Indiana Dept. of Natural Resources, 2016).

Land uses and covers were ranked (see Table 1) in consultation with a wildlife ecologist (Dr. Vicky Meretsky, Indiana University, School of Public and Environmental Affairs). Additionally, clients' interests and objective were considered when assigning weights. We assigned higher

values to land cover associated with wetlands or wooded areas that provide habitat for many wildlife species. Lower values were assigned to those areas that would take significant effort to restore to a natural land cover and to areas in high-value agricultural areas – these areas would involve higher cost and/or greater time commitment.

We ranked NWI wetlands in consultation with a wetlands scientist (Dr. Christopher Craft, Indiana University, School of Public and Environmental Affairs). In accordance with client priorities, the rankings reflect ecological importance for a wildlife corridor, at the Class-level; Classes are based on life form, water regime, substrate type, water chemistry (FGDC, 2013).

The characteristics of hydric soils are defined by the National Technical Committee for Hydric Soils and identified by the US Department of Agriculture and National Resource Conservation Service. Hydric soil ratings range from 0% (non-hydric) to 100% (hydric; see Table 3). A soil developed under conditions sufficiently wet to support the growth and regeneration of hydrophytic vegetation is considered a hydric soil (NRCS, 2016a). Hydric soils are indicative of the wetlands or potential wetlands areas that are of foremost interest in our analysis.

Table 4: Hydric soil rating descriptions (NRCS, 2016b).

Percent Hydric Rating	Category
100	Hydric
67-99	Predominantly Hydric
34-66	Partially Hydric
1-33	Predominantly Non-Hydric
0	Non-Hydric

The distances to conservation land (as defined and outlaid in our conservation lands layer, and categorized in by the variable ‘adjacency’) were ranked using minimum patch sizes for terrestrial and avian focal species in several land use types (forests, wetlands, and grasslands) from The Conservation Fund, as explained in Step 5 of the Corridor Selection Process. Due to the clients stated in interest in a contiguous corridor, preference is given to lands that are more closely located, facilitating an increased potential for connecting parcels through future purchases.

Using the Ecological and Economic Model

We constructed the modeling tool in a set of spreadsheets with built-in formulas for Equation 1; the model extends across four spreadsheets. The tool is set up to automatically incorporate values as they are added into the first two sheets: ecological criteria and economic criteria. The third sheet contains the model. The fourth sheet is a code sheet outlining the potential values for each criterion.

Equation 1 considers ecological criteria indicating habitat quality. Equation 2 takes the economic criteria into consideration and creates a price-like score for each parcel. Each property has an economic score that includes a negotiated parcel sale price and an estimated remediation cost. In Equation 2, the ecological score is used as a multiplier to penalize parcels with low ecological value. The properties with the highest ecological value receive overall scores equal to their economic score, whereas properties with the lowest ecological value receive overall scores that are six times their economic scores. The model is structured so that lower Total Parcel Scores are of higher value; the lower the Total Parcel Score the better.

Equation 1: Ecological Criteria

$$Wetland\ Classification + Hydric\ Rating + Land\ Use + Adjacency + Endangered\ Species = Ecological\ Score$$

Equation 2: Combination of Ecological and Economic Criteria

$$(6 - Ecological\ Score) * \frac{(Negotiated\ Total\ Parcel\ Cost + Total\ Restoration\ Cost)}{\#\ of\ Acres} = Total\ Parcel\ Score$$

Table 5. Sources for data used in ecological criteria for the model

Ecological Criteria	Sources
Land use and cover	US Geological Survey
NWI Wetlands	US Fish and Wildlife Service
Hydric soils	US Department of Agriculture National Resource Conservation Service
Distance to conserved lands	Protected Areas database of the United States Sycamore Land Trust Indiana Department of Natural Resources National Conservation Easement database I-69 Mitigation Lands Data Mississippi River Basin National Wildlife Refuges
Endangered species	Indiana Department of Natural Resources

Step 3: Qualitative Survey

The final step of the three-step parcel assessment process is an in-depth, qualitative survey. The survey captures information not covered by the previous two steps and is structured to include Internal Revenue Service regulations to facilitate tax filings for holdings (land purchases, easements). The survey contains 110 questions (~45-75 minute completion time, on-site) ranging

from "List the major structures, improvements, and infrastructure currently on the property" to "Does the seller or funding partner require any conditions that significantly diminish the property's conservation value?" The survey includes both closed-ended and open-ended question forms; a code sheet is provided with the questionnaire to aid the surveyor. The questions were developed by drawing upon surveys utilized by other land trusts, guidelines from the Land Trust Alliance (LTA, 2016), and the stated interests of Sycamore provided during consultation. The questions are not redundant to the previous two steps and investigate some factors that require a site visit. Given that this will be a labor intensive step relative to the previous two, it is intended to be applied only to those properties that are assessed to be of high-value or of high likelihood to be purchased.

Recording the survey responses

The survey is housed in a spreadsheet that contains three sheets: (1) sheet to print or digitally input; (2) parcels input; (3) code sheet. The sheet to print is a blank copy of the questions for a surveyor to bring to the site in print or digital form. The parcel input sheet is for data input post-survey to collate surveys in a digital format. The code sheet provides explicit directions on how each question should be answered and a list of possible responses for closed-ended questions.

Recommendations for Future Conservation

The methods used to create the corridor options can be adapted for other conservation efforts. For example, a government agency may prioritize other habitat types over wetlands, in contrast to what is done here. Our framework can be adapted to satisfy this need. The weights used in each variable of the model can be adjusted, and the model re-calibrated, to match individualized needs. Additionally, the corridor selection process rules and methods can be adapted in a similar fashion, integrating the desired conservation objectives of the stakeholders involved.

Conclusion

Identifying the areas of highest ecological value allows Sycamore to acquire or otherwise protect lands providing connectivity of the habitat types that support the highest levels of biodiversity. The team proposes a network of corridor options across southern Indiana connecting the areas of highest ecological quality to currently conserved areas. The corridor options can be combined in different arrangements to create a corridor stretching from central Indiana to the southwest region of the state. An analysis of the selection process—including all GIS layers used—for each section of the primary and secondary corridor options can be found in Appendices 2-5. We suggest a corridor running southwest towards the confluence of the Ohio and Wabash rivers as outlined in Appendix 1. All corridor options, including areas outside of the proposed corridor, are provided. Additionally, we provide locations of all GIS layers used in the corridor selection process, supplemental layers not used in corridor selection relevant to Sycamore's interests, and a data dictionary. To aid in individual parcel evaluation, and to account for factors not included in the GIS analysis, we provide a three-step process framework for comparing parcels considered

for acquisition. We designed these deliverables to be user-friendly and easy to update in the future.

Literature Cited

Environmental Protection Agency (EPA). 2015. *Why are wetlands important?* Retrieved from https://www.epa.gov/wetlands/why-are-wetlands-important

Federal Geographic Data Committee (FGDC). 2013. *Classification of Wetland and Deepwater Habitats of the United States*. Retrieved from http://www.fws.gov/wetlands/Documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States-2013.pdf

Indiana Department of Natural Resources (IDNR). 2016a. *Indiana Wetland's Conservation Program.* Retrieved from http://www.in.gov/dnr/fishwild/3350.htm

Indiana Department of Natural Resources (IDNR). 2016b. *Indiana's State Wildlife Action Plan Wetlands Habitat Summary.* Retrieved from http://www.in.gov/dnr/fishwild/files/SWAP/SWAPHabitatSummary_Wetlands.pdf

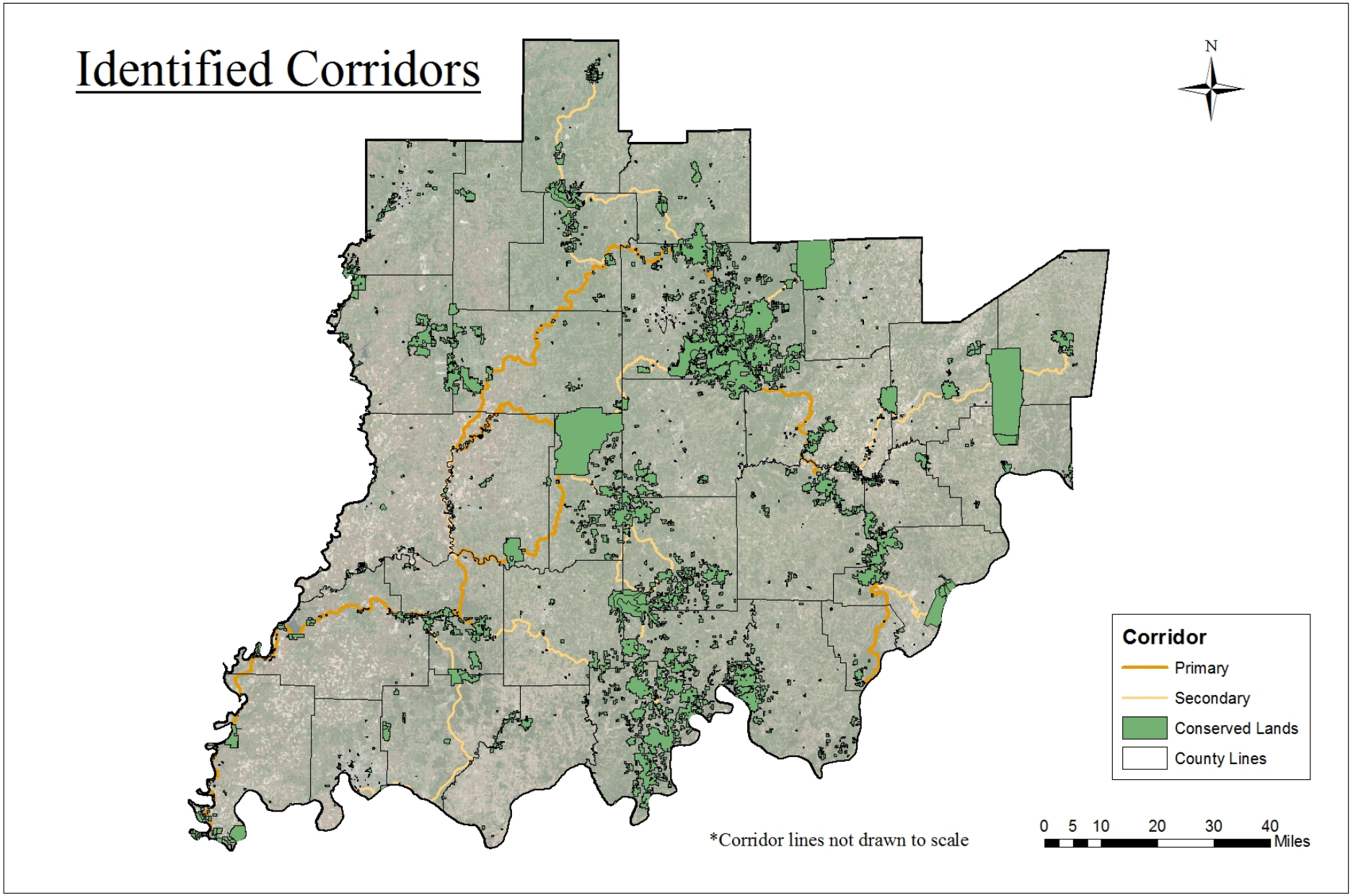
Land Trust Alliance (LTA). 2016. *Accreditation.* Retrieved from http://www.landtrustalliance.org/topics/accreditation

Natural Resource Conservation Service (NRCS). 2016a. *Hydric Soils – Introduction*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961

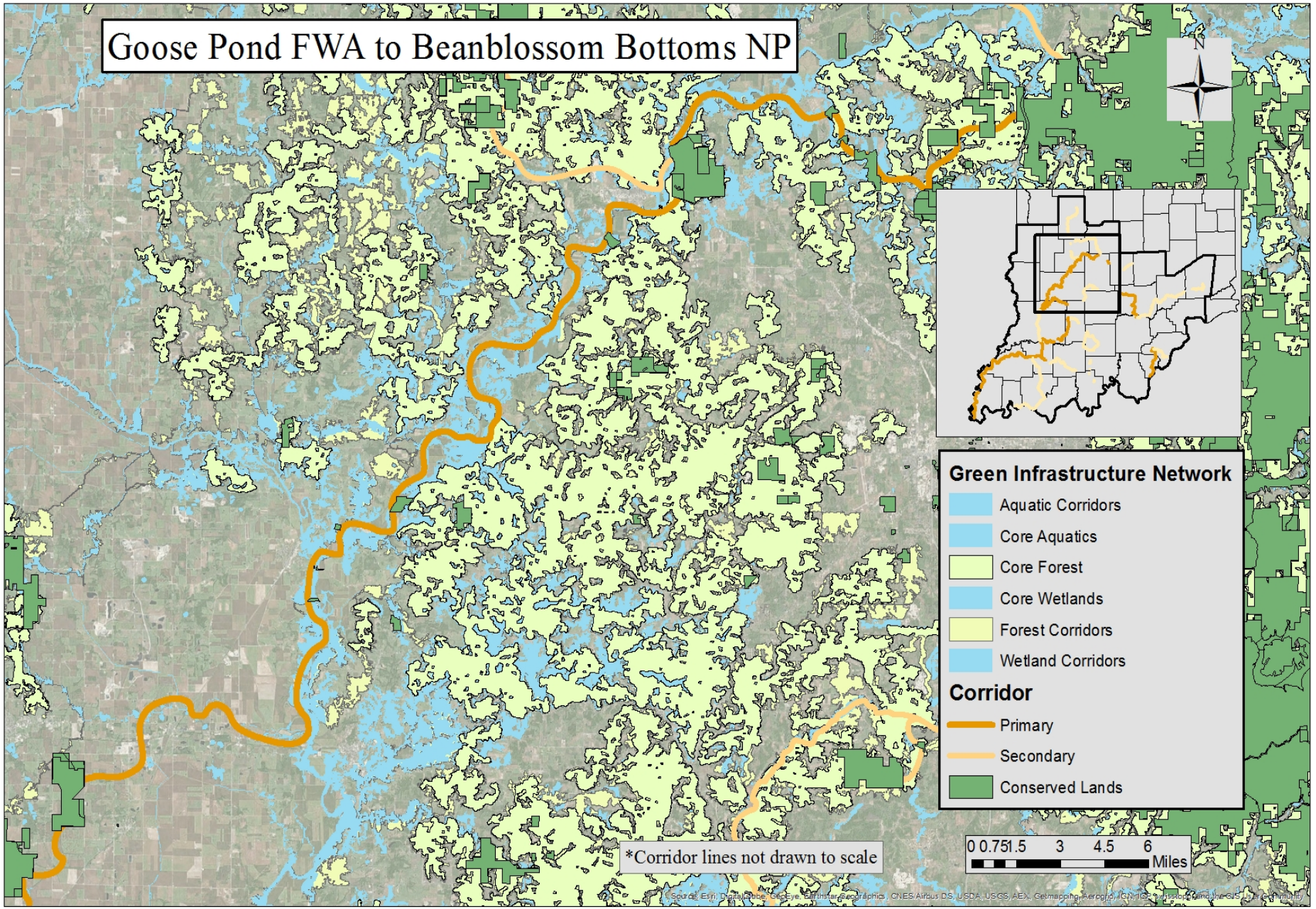
Natural Resource Conservation Service (NRCS). 2016b. *Hydric Soils List Criteria.* Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053959

US Department of Agriculture Farm Service Agency. 2016. *Conservation Reserve Program Statistics.* Retrieved from http://www.fsa.usda.gov/programs-and-services/conservation-programs/reports-and-statistics/conservation-reserve-program-statistics/index

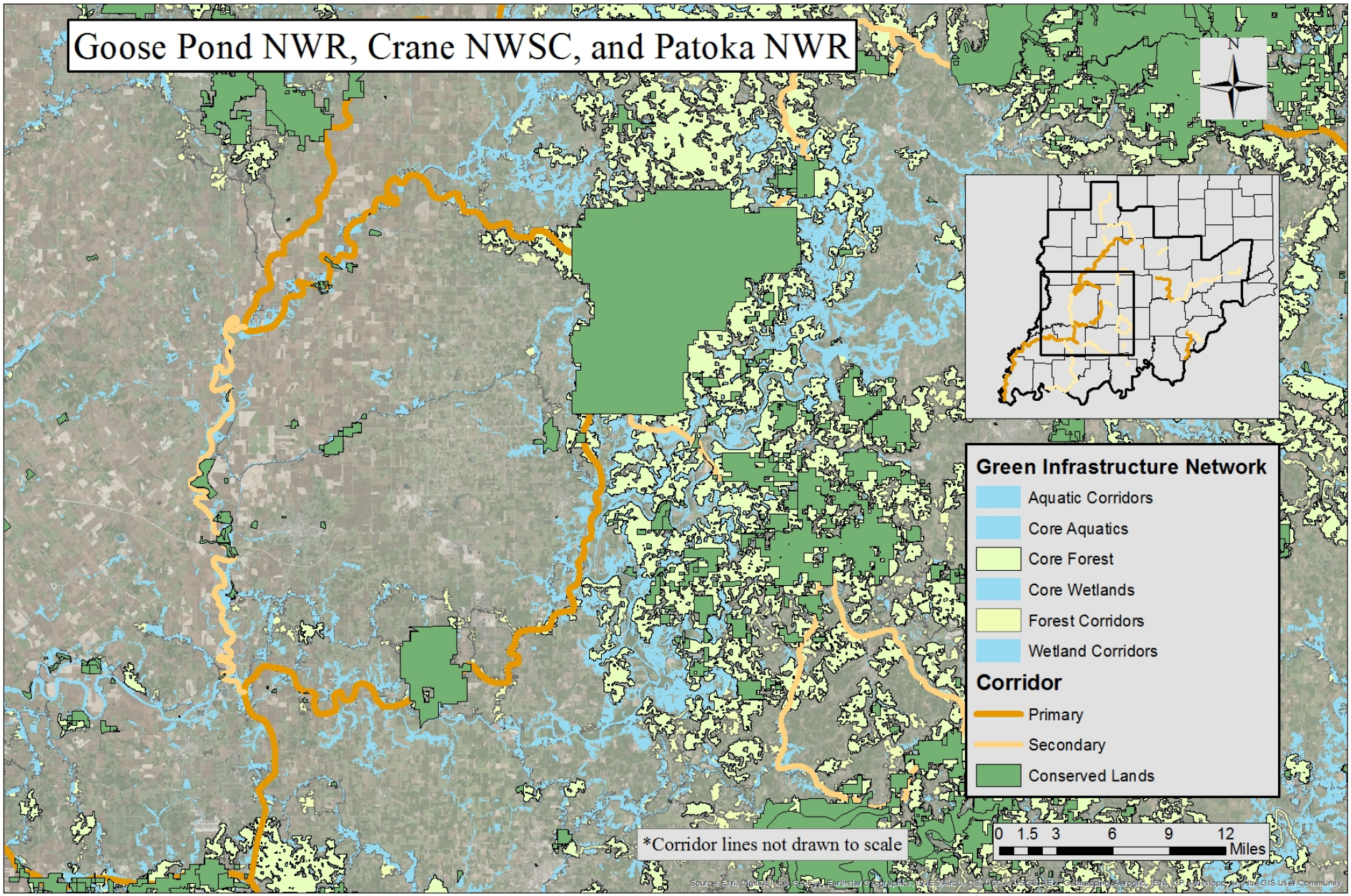
Appendix 1: All Corridor Options



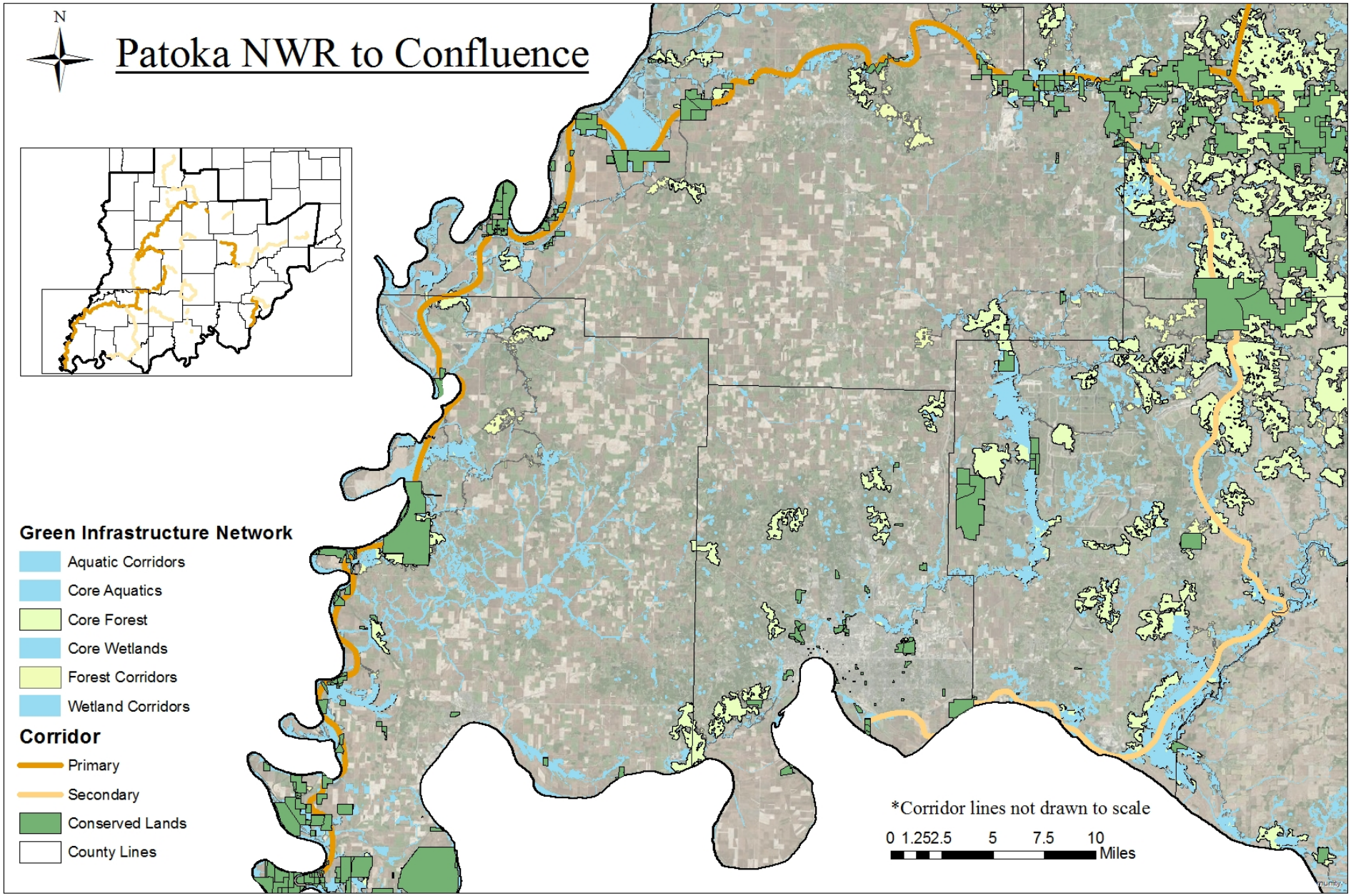
Appendix 2: Primary Corridor Map 1 of 5



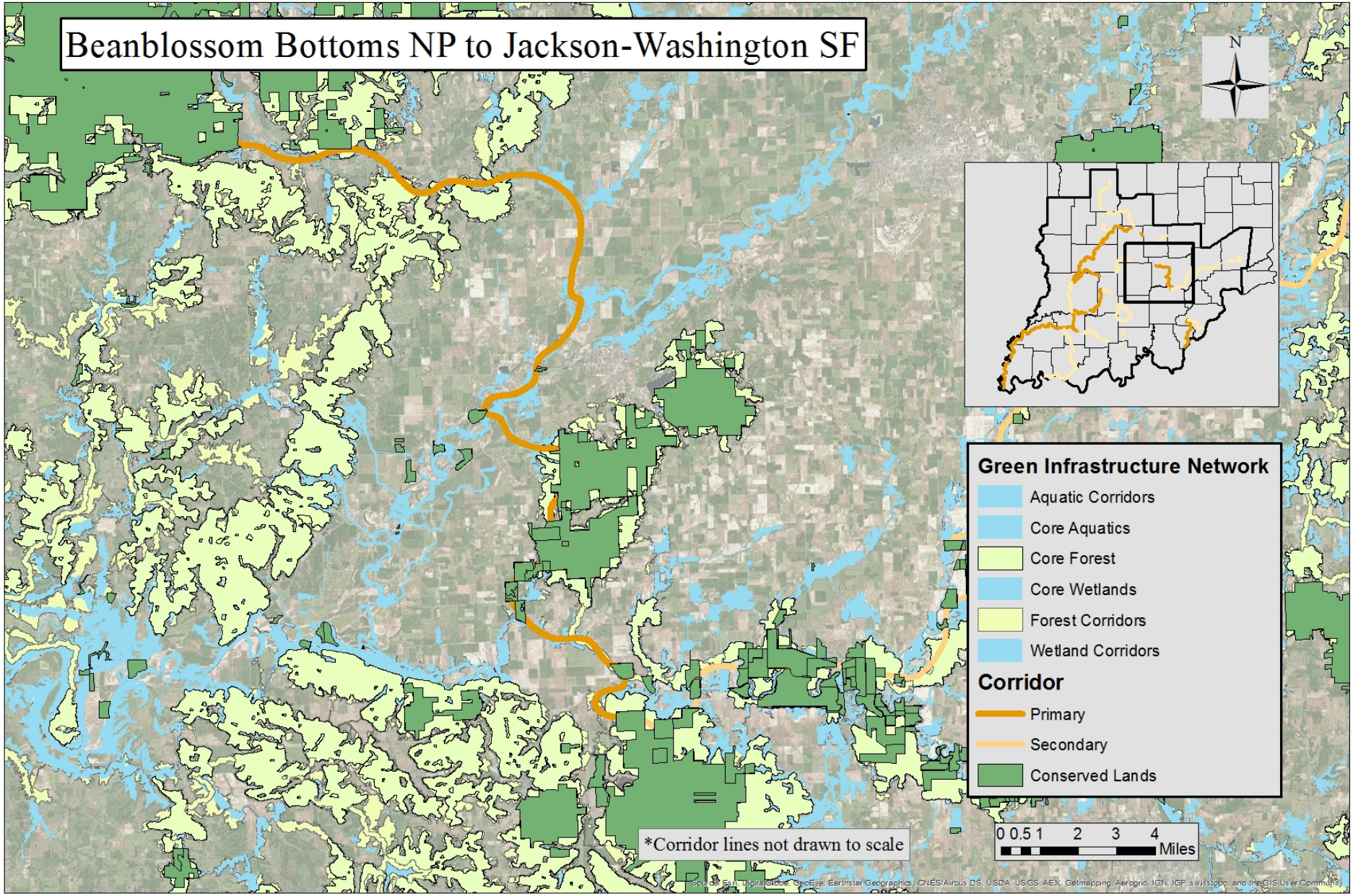
Appendix 3: Primary Corridor Map 2 of 5



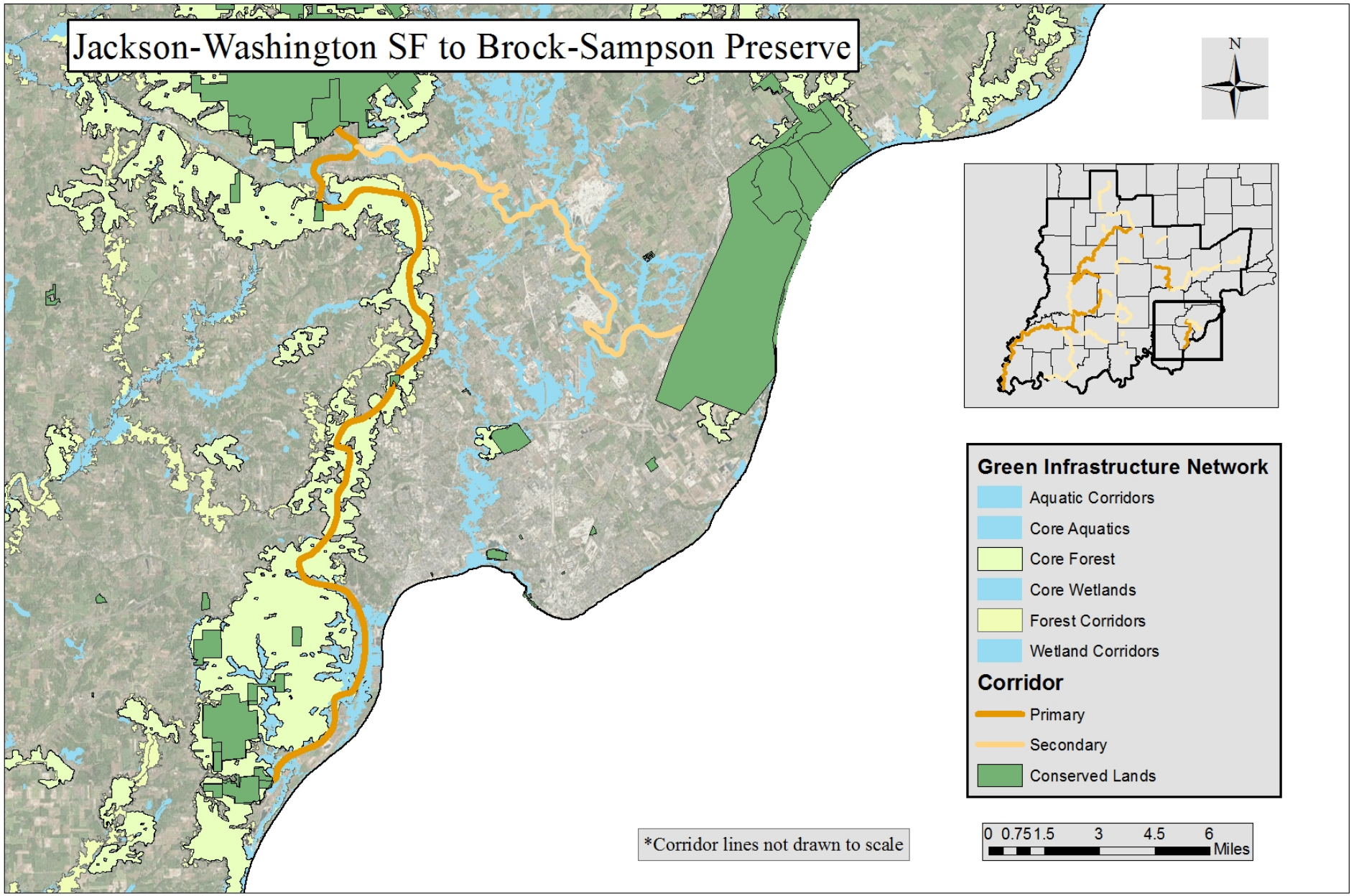
Appendix 4: Primary Corridor Map 3 of 5



Appendix 5: Primary Corridor Map 4 of 5



Appendix 6: Primary Corridor Map 5 of 5



Appendix 7: Qualitative Survey

Q #	Question	Codes	Q Source
1	Assessor name	Name of person conducting assessment	Other
2	Assessment date	Date assessment completed	Other
3	Project or Property Name	Project the property is part of or the property name	Other
4	Site center grid location	Decimal degrees center grid location	LTA
5	Total acreage	# of acres	LTA
6	County	County the property is in.	LTA
7	Zoning	Provide county zoning designation.	LTA
8	Is the property in a SLT priority area?	Yes or No.	Other
9	Type of deal or proposed designation	1 = Purchase 2 = Easement (provide specific program) 3 = Other (provide description)	LTA
10	Describe what the land resources and conservation values (CVs) are.	Provide narrative addressing these factors.	LTA
11	Describe the potential deal.	Provide narrative.	LTA
12	Describe why the project is important.	Provide narrative.	LTA
13	Describe what the major issues may be.	Provide narrative.	LTA

Overall Conservation Values			
14	What are the conservation values?	Values assessed from model and any additional values of note.	LTA
15	Is the property of sufficient size and location to protect the CVs?	Yes or No	LTA
16	If no, can this be mitigated?	Yes or No. If yes, how.	LTA
17	Is the property large enough so that conservation resources remain intact in the face of potential development on adjacent properties?	Yes or No. Provide narrative.	LTA
18	Will water rights remain with the property?	Yes or No.	LTA
19	If no, will the CVs be jeopardized if water is removed?	Yes or No. Provide narrative.	LTA

Natural Resource Conservation Values	from IRS regs 1.170-14(d)(3)	

20	Identify primary habitat type.	1 = Woody wetlands or Emergent herbaceous wetlands, 2 = Mixed forest, Deciduous forest, or Evergreen forest, 3 = Shrub/scrub, Grassland/herbaceous, or Pasture/hay, 4 = Cultivated crops, Barren land, or Open water, 5 = Developed space (open/low/medium/high)	IRS
21	Identify the extent to which the habitat or environment has been altered by human activity.	Provide narrative.	IRS
22	Identify habitats for rare, endangered, or threatened species of animals, fish, or plants.	Provide narrative.	IRS
23	Identify natural areas which are included in, or contribute to, the ecological viability of a local, state or national park, nature preserve, wildlife refuge, wilderness area, or other similar conservation area.	Provide narrative.	IRS
24	Does the property contain significant hydrological features?	Yes or No.	IRS
25	If yes, what features?	Wetlands, bog, pond/lake, floodplain, springs, river/stream corridor, aquifer recharge area, other	IRS
26	Contains endangered species listed by the federal or state government?	Yes or No.	IRS
27	If yes, list the species.	List endangered species present and their classification	IRS
28	Contains a species of special concern to SLT?	Yes or No.	IRS
29	If yes, list the species.	List the species present.	IRS
30	Contains a unique natural feature important to the area?	Yes or No.	IRS
31	If yes, what type of feature?	List type of feature.	IRS

Open space conservation values		from IRS regs 1.170-14(d)(4)	
32	Is there a clearly delineated, federal, state, or local government policy for open space preservation in this area?	Yes or No.	IRS
33	Does preservation of the property further a specific, identified conservation project?	Yes or No.	IRS

34	Is the property contiguous to, or an integral part of, the surroundings of existing recreation or conservation sites?	Yes or No.	IRS
35	Does the government program involve a significant commitment, including preferential tax assessments or zoning, by the government?	Yes or No.	IRS
36	If yes to above, it is funded?	Yes or No.	IRS
37	Does the project preserve a wild or scenic river?	Yes or No.	IRS
38	Will the easement be accepted by a government agency?	Yes or No.	IRS
39	If so, does the agency have a review process?	Yes or No.	IRS
40	Does the project set an important precedent for resource or open space protection in an area of importance to the federal, state or local governments?	Yes or No.	IRS

Scenic Conservation Values		from IRS regs 1.170-14(d)(4)	
41	Development of the property would impair the scenic character or a scenic panorama.	Yes or No.	IRS
42	Is the land use compatible with other land use in the vicinity?	Yes or No.	IRS
43	Will the general public enjoy sufficient visual access to or across the property?	Yes or No.	IRS
44	Does the easement permit a degree of intrusion or future development that would interfere with the essential scenic quality of the land?	Yes or No.	IRS
45	Is the property open?	Yes or No.	IRS
46	Does the property provide relief from urban closeness?	Yes or No.	IRS
47	Is the scenic view consistent with a regional or local landscape inventory?	Yes or No.	IRS
48	Is the scenic view consistent with a methodical state scenic identification program?	Yes or No.	IRS
49	Does the land use maintain the scale and character of the urban landscape to preserve open space, visual enjoyment, and sunlight for the surrounding area?	Yes or No.	IRS

50	Is there a degree of contrast and variety provided by the visual scene?	Yes or No.	IRS
51	Are there a harmonious variety of shapes and textures?	Yes or No.	IRS

Historic Conservation Values		from IRS regs 1.170-14(d)(5)	
52	Does the project preserve an independently significant land area including any related historic resources that meets the National Register Criteria for Evaluation in 36 CFR 60.04?	Yes or No.	IRS
53	Does the project preserve any land area within registered historic district including any buildings on the land area that can reasonably be considered as contributing to the significance of the district?	Yes or No.	IRS
54	Does the project protect any land area adjacent to a property listed individually in the National Register of Historic Places, but not within a registered historic district?	Yes or No.	IRS
55	Does the project protect a historic structure listed in the National Register?	Yes or No.	IRS
56	Does the project protect a historic structure located in a registered historic district and has historic significance to the district?	Yes or No.	IRS
57	Is there visual public access to the land area or historic structure?	Yes or No.	IRS

Outdoor Recreation and Education Values		from IRS regs 1.170-14(d)(2)	
58	Contains or has potential to contain natural features of recreational, educational or scientific significance?	Yes or No.	IRS
59	If yes to above, describe.	Provide narrative.	IRS
60	Provides public access for education or recreation?	Yes or No.	IRS
61	If yes to above, identify the outdoor recreation or education opportunities.	Provide narrative.	IRS
62	If yes to above, identify the type of public access to the property and limitations to the access.	Provide narrative.	IRS

Feasibility Checklist			
Specific Project Issues: Does the project have any problems associated with:			
63	Tax or legal issues	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
64	If yes, describe.	Provide narrative.	IRS
65	Title issues	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
66	If yes, describe.	Provide narrative.	IRS
67	Minerals	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
68	If yes, describe.	Provide narrative.	IRS
69	Hazardous Materials	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
70	If yes, describe.	Provide narrative.	IRS
71	Legal (and saleable) parcels	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
72	If yes, describe.	Provide narrative.	IRS
73	Project funding	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
74	If yes, describe.	Provide narrative.	IRS
75	Other	1 = Unknown 2 = No Problem 3 = Problems 4 = Resolvable 5 = Unresolvable	IRS
76	If yes, describe.	Provide narrative.	IRS

Support / leverage			
77	Does the project support and/or partner with other public or private entities?	Yes or no.	IRS
78	If yes, list.	Provide list.	IRS
79	Does the project leverage the resources of other public or private organizations?	Yes or no.	IRS
80	If yes, list.	Provide list.	IRS
81	Is the project free of conflicts with other conservation projects/priorities in process by a public or private entity?	Yes or no.	IRS

82	If there is a conflict, describe.	Provide narrative.	IRS

Issues for Sycamore			
Issues associated with owning the property in fee:			
83	Is Sycamore the most suitable owner rather than any other entity?	Yes or no.	LTA
84	If not, explain.	Provide narrative.	LTA
85	Does Sycamore intend to hold the property in perpetuity?	Yes or no.	LTA
86	If not, describe the exit strategy proposed/possible for this property.	Provide narrative.	LTA
87	Is the tax burden created by the ownership of this property acceptable to Sycamore?	Yes or no.	LTA
88	If not, explain.	Provide narrative.	LTA
89	Does owning the property create an acceptable liability for Sycamore?	Yes or no.	LTA
90	If not, describe how Sycamore can resolve the liability problem.	Provide narrative.	LTA
91	Does the seller or funding partner require any conditions that significantly diminish the property's conservation value?	Yes or no.	LTA
92	If yes, describe the conditions and the potential adverse affects on the conservation value.	Provide narrative.	LTA
93	Is there more than one legally described parcel that could be sold separately for a residence?	Yes or no.	LTA
94	If so, describe.	Provide narrative.	LTA

Issues associated with holding the conservation easement:			
95	List the major structures, improvements, and infrastructure currently on the property.	Provide List.	LTA
96	List the reserved rights desired by the land owner.	Provide List.	LTA
97	What development rights is the landowner giving up?	Provide List.	LTA
98	Is Sycamore the most suitable owner / CE holder?	Yes or no.	LTA
99	If not, explain.	Provide narrative.	LTA

100	Are there any rights that would significantly diminish the property's conservation values?	Yes or no.	LTA
101	If so, what are the provisions?	Provide List.	LTA
102	Is the holding of this conservation easement free from any other known problems?	Yes or no.	LTA
103	If no, explain.	Provide narrative.	LTA

Project related issue for Sycamore			
104	Does the project extend or buffer adjacent / nearby Sycamore holdings?	Yes or no.	LTA
105	If yes, list.	Provide List.	LTA
106	Does this project establish a toehold in a new area of interest for Sycamore?	Yes or no.	LTA
107	Will Sycamore have adequate authority to complete the project and/or carry out its long-term obligations?	Yes or no.	LTA
108	If not, why?	Provide narrative.	LTA
109	Was the project rejected by another land trust or governmental entity?	Yes or no.	LTA
110	If so, describe why and by whom.	Provide narrative.	LTA

Appendix 8: Data Dictionary

This is an example of an entry in the data dictionary. The full dictionary is provided separately.

Dataset Use	Dataset Title	File Name	Metadata Description	How data was used	Source Name
Corridor Selection	Sycamore Land Trust Conservation Easements	SLT_CE_2-16_2_1.shp	This dataset was provided by Sycamore Land Trust and reflects lands with Sycamore conservation easements placed on them.	This layer provided targets for us to connect with corridors. This layer provided the backbone of our efforts.	Sycamore Land Trust