Clegg Gardens Capstone Project

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Introduction

        For our senior capstone project, we partnered with Clegg Memorial Gardens, which is the headquarters of NICHES Land Trust. There we worked closely with Greg Shaner (Professor Emeritus in Purdue University's Department of Botany and Plant Pathology) and John Graveel (Assistant Dean at Purdue University with a PhD is Soil Microbiology, past director of NRES, and current NICHES board member).

        Clegg Garden was in need of new and accurate (15 feet accuracy) trail maps and an updated informational sign at their main entrance. Our project entailed re-collecting new data coordinates; adding and eliminating trails and nodes from the original map; incorporating trail names and distances into the map; accurately displaying ecosystem boundaries; working with Greg and John to re-orientate the map at each node, and freshening up the informational sign by adding updated information, pictures, and NICHES properties for each county.

Essential Background & Literature Review

        This review will synthesize scientific information relating to best trail design and management practices with an additional focus on visitor relations and human impacts on trails. Visitor behaviors in ecological areas and trails is a newer scientific field, and the studies chosen are more recent. Signage on trails is ancient, but the study of their role in site management and visitor education is recent and most of the studies chosen are from the last couple years. Promoting increased environmental awareness through environmental engagement must consider trail design and management practices, visitor impacts, and educational signage.

<u>Visitor Relations</u>

        The perception of park and trail environments to visitors is paramount in ensuring longevity of these environments. Guo et al. (2017) looked at the relationship of "off-site educational messages" and how this influenced the activities of visitors in regards to compliance with recommendations on trail behavior. They had three groups of participants, two of which viewed a video as well as a summary statement about suggested low-impact hiking recommendations, and one did not. The results of their study concluded that those who viewed the video and message directly before planning their hike were the most likely to be able to recognize recommended hiking behavior. However, a statistical analysis of the results showed no significance between the two groups that watched the video at different times, suggesting that "the timing of the educational message did not influence knowledge retained" (Guo et al., 2017). The study found that utilizing off-site educational management increased individual's compliance with "walking of trail steps rather than around them" and "walking through puddles, mud or rugged spots" (Guo et al, 2017). Both of these sources highlight the problem of "off-trail hiking" as well as presenting possible causes and solutions to the issue.

How Visitors Impact the Environment

   The principal environmental issues connected to visitor engagement in an area are erosion, weathering, compaction and shifting trails. High foot traffic causes trails and soil to change, and visitors wandering off trail also impacts erosion rates, especially on topography that is sloped (Sakinatu & Ashraf, 2017). When visitors go off trail they loosen, transport, and deposit the soil causing it to deteriorate. This combined with weathering will have greater effects that will have long term impacts not only on the soil, but also water quality. Without management this deterioration may become irreversible (Sakinatu & Ashraf, 2017). Over time this may diminish the quality of the area and visitor experience (Wolf et al., 2019). This is why it is important to create proper trails that help connect visitors with nature, and educate visitors about the long term impacts of wandering off a trail.

Signage

   Colorblind accessibility plays a major part in ensuring that signage is accessible to all park and trial visitors. One of the solutions to this problem is explored in a study by Jamil and Denes (2024) in which they investigate the effectiveness of high contrast in assisting colorblind users while also testing user functionality as well as aesthetics overall. They tested how well colorblind individuals can use a certain interface compared to a non-colorblind person as well as evaluating the interface with the lens of classical aesthetics with a colorblind individual and non-colorblind individual in mind. The results of their study concluded that high contrast screens rated overall lower compared to standard screens with both functionality and aesthetics (Jamil and Denes, 2024). The authors did, however, acknowledge a potential bias from non-colorblind individuals in their research that could have led to this result. (Jamil and Denes, 2024). When designing trail mapping intended for all visitors to a park or trail, it is important to make sure that the signage is readable and easy to decipher for all visitors.

   According to the study done by Cochran et. al (2022), the usage of signage did not distribute visitors in desired locations; however, signs were effective in dispersing large crowds to other areas of the park. Additionally, Cochran et. al (2022) provided evidence of signage utility to visitors, which can help in the design for further research needed to be done. These results can aid in signage placement for the NICHES project and aid in understanding of visitor patterns. The results also showed that directional signage had an influence on how readily the visitors traveled each of the trails (Cochran et al., 2022). This is a factor that needs to be implemented at NICHES Clegg Garden, so that the visitors do not get directionally confused or interpret the trails wrongly. By knowing the travel habits of the visitors it will be easier to know the proper signage and trail notices, placements to inform of updates, or announcements, of the nature preserve.

   In terms of signage effectiveness for preventing off-trailing, Allbrook and Quinn (2020) provided results showing a significant difference in those who chose to go off trail with presence or absence of signs. According to the results, people who were within one meter of the sign did not go off the trail as often as those who did not have a sign when close to wildlife. The

exceptions to these results were people who were photographers who were the only group of people approaching wildlife regardless of the sign (Allbrook and Quinn, 2020). Additionally, the results of the study showed that disturbance was significantly lower with the presence of signage than without (Allbrook and Quinn, 2020). In another study by Hockett et al. (2017), no hiking signs were placed along the trail in certain areas to see if off-trailing could be prevented. The results showed that "the prompter signs clearly and succinctly informed visitors not to travel on the informal trails. For visitors who had read the trailhead educational signs, they served as a reminder and clearly defined what the park meant by an informal trail" (Hockett et al., 2017). These results not only show the effectiveness of signs, but also the reasons people chose not to go off trail (Hockett et al., 2017). Therefore, when choosing placement and design of signs for trails, it is important to account for the areas that need the most protection and the best places to place signs for visibility purposes while understanding the reasoning behind them.

Conclusion

Current research indicates that visitors can be persuaded to stay off trail with the presence of signage, and people on trails can be influenced based on the design as well. Finally, signage and education both can have a great influence in trail management, which can aid in future projects and maintenance. When keeping Clegg Gardens in mind, sign placement, design, and management practices can improve within the areas of mapping, preventative erosion, and trail quality.

Goals and Objectives

Our original goals for the Clegg project were remapping the trails with a 15 foot accuracy while clearly marking the switchbacks, ADA areas, and ecosystem boundaries as well as updating the trail maps and posters to reflect this change. We were unsure how many new trail signs were needed and how Clegg wanted their final GIS folders organized and sent off. As time went on our goals became much more specific. We identified three pillars to focus our work: Accuracy, Accessibility, and Aesthetics. 2 nodes were added for a total of 11 oriented node maps, as well as 1 informational poster and 1 large project file of all our GIS work.

As we talked with our partners, we added in more objectives. We were asked to make the stairs and bridges very clear, as well as marking the dead end trails. We were also asked to add in the length of each trail on the map so visitors could easily see how far each trail was. Additionally, we rewrote some of the informational paragraphs on the large poster and reached out to Sam Cody for more recent pictures to accurately describe all the NICHES properties.

For accuracy, our goals were 15 feet or better, and through the project we also made sure to highlight the location of stairs, bridges, dead ends of trails, and length of trails. Ecosystem boundaries were also made as accurate as possible despite the lack of plant growth. For each of our node signs, we also recorded the direction a visitor is facing when looking at the node, and in turn oriented the sign to face the same way. We asked for an updated property list from NICHES as well to have the most accurate map on the informational poster. Accessibility was mainly

focused on colorblind individuals. We wanted to make sure all the colors stood out from each other and every visitor would be able to interact with the signs. For very steep areas and stairs we also made them more noticeable to keep people safe. The colorblind accessibility also played into our aesthetics. We did not want to compromise the look of the poster, yet wanted it to remain useful. We used large, easy to read fonts and made sure to focus on using recognizable symbols, and made sure to get rid of the gradient background and use NICHES and nature themed colors.

Deliverable Description
- There is 1 updated informational poster (PDF and shape files) that includes background information on NICHES and Clegg Memorial Garden, an Indiana map of every property within each county owned by NICHES and the major city of that county, and photographs and credit due to the photographer. (See Figure 13)
- There is 1 digital and printed GIS trail map (PNG and PDF format). This map includes the 11 nodes on the property, the trail names, the staircases, the bridges, Wildcat Creek labeled, the ADA trailways, the NICHES headquarters, and ecosystem boundaries all present and labeled. (See Figure 1)
- There are 11 oriented node maps. Each is oriented to where you are at each node. Every map has a star to show where you are, a smaller version of the whole map of Clegg Memorial Garden, a key of the colors/ symbols, and a north arrow. (See Figures 2-12)

Metadata/Technical Details

For our trail signage and informational posters, two main softwares were used, ArcGIS Pro 3.1 and Canva, an online graphic design software. In addition to these softwares, we also utilized Maps Plus, a phone application with ArcGIS compatibility. Maps Plus can be found within the App Store or other application purchasing method, if applicable. A comprehensive list of our tools is below:

- ArcGIS Pro 3.1
- Canva.com
- Maps Plus application
- Apple Maps
- Microsoft Excel

Creation of the Main Trail Map and the Node Maps

A zip file with all the data used to create the GIS Maps is included in a ZIP sent to Greg Shaner, John Graveel, and other NICHES affiliates we have been in communication with. This ZIP file, in addition to the GIS data and the GIS project itself, has links to both of the Canva projects, as well as detailed instructions on how to make edits and how our deliverables were created. All data and files should be accessible without a password.

With Maps Plus, we emailed the data we collected on the Clegg Garden's Trails as well as the stairs and bridges data directly to a working email. This data was then directly added into

GIS as a shape file, in the case of the trials and bridges, or KMZ files, in the case of the stairs into GIS itself. Edits of this data can be made with the GIS project file, entitled "Clegg Gardens". The KMZ file for the stairs was used as a template to create a shapefile for the GIS project, entitled "Stairs.shp". This file is also editable and workable in the GIS project. If edits are to be made to the data, editing the shape file will be much easier. The bridge locations were added to the GIS project in the same manner, entitled "Bridges.shp".

Node points, represented as black circles on the trail map, were collected using GIS coordinates from Apple Maps. These coordinates were added to an Excel file that was then incorporated into the GIS map project. These nodes were checked for accuracy, and then correctly labeled and formatted as desired by the NICHES team. (See Figure 1)

Each node was given its own map, oriented to its position on the trail itself, to make navigation easier for the average visitor to Clegg Gardens. Within GIS, we created the based node map for each node, including 11 nodes in total. Each node was given a separate shape file, named to the corresponding node. These nodes were represented using a yellow star.

After these separate oriented node maps were created, these maps as well as a copy of the main trail map were added into Canva, to be combined into a final map. A smaller PNG of the trail map, including the yellow star at the current location, similar to the smaller oriented maps, was added in Canva to the oriented map to give the viewer a better idea of where exactly they are located in relation to the rest of the gardens. (See Figures 2-12).

Ecosystem boundaries were taken from ference of the currently present Clegg Gardens sign near the parking lot of the property. These were edited to closely resemble the ecosystem boundaries of the previous sign and were edited to fit the requests of our project partners. The shape files for these boundaries can also be found within the shared ZIP file under their respective names. The shape file for Wildcat Creek was created using the ArcGIS World Topographic Map layer as a reference. Again, this shape file can be accessed through the ZIP file.

We also included dead end symbols as well as the NICHES main building based on feedback from our final presentation. (See Figure 1). The dead ends were created by creating a new shape file in the GIS project that includes two data points, at the dead ends of the trail. The symbology of the points were the changed to communicate that these are dead ends in the trail. The polygon representing the NICHES building was created by creating a new shapefile in the GIS project.

Creation of the "NICHES Properties by County Map"

A zip file with all the data used to create the GIS County Map for the Informational Sign is included in a ZIP sent to Greg Shaner, John Graveel, and other NICHES affiliates we have been in communication with.

Utilizing IndianaMap, we were able to obtain shapefiles of Indiana counties and state boundary lines. This data was directly imported into ArcGIS Pro 3.1. The counties shapefile was edited to only include counties that NICHES own property within. (See Figure 14). Any

additional edits of this data can be made with the GIS project file, entitled "Indiana Counties and Properties".

NICHES properties are represented as yellow stars on the county map. NICHES staff provided us with approximate locations of their properties, which we converted into GPS coordinates using Apple Maps. We created a new Excel file that included the names and coordinates for each NICHES property. This Excel file was then incorporated into the"Indiana Counties and Properties" GIS project. Properties were checked for accuracy, and then correctly labeled and formatted as desired by the NICHES team. The NICHES Property file is editable and workable in the GIS project and can accommodate for new properties acquired by NICHES.

Cities, represented as blue stars on the county map, were obtained using GPS coordinates from Apple Maps. We created a new Excel file that included the names and coordinates for each major city for each county. This Excel file was then incorporated into the"Indiana Counties and Properties" GIS project. Cities were checked for accuracy, and then correctly labeled and formatted as desired by the NICHES team. The Cities file is editable and workable in the GIS project.

Contacts
- John Graveel (jgraveel@purdue.edu)
- Gregory Shaner (gregory_shaner_454@comcast.net)
- Shannon Stanis (shannon@nicheslandtrust.org)
- Sam Cody (sam@nicheslandtrust.org)
- Becki Reibman (niches@nicheslandtrust.org)

John Graveel and Greg Shaner were the primary contacts throughout our project. They provided us with the main project goals and what they were looking for. Shannon Stanis provided us with some NICHES signage as well as reviewing our deliverables for quality. Sam Cody provided as with the photographs that can be seen on our final informational poster as well as the captions for these photos. The property list we used to construct our NICHES Properties by County map included on the information poster was provided by Becki Reibman.

Conclusions & Future Work

When reflecting back on the deliverables and what future work is needed, the team has a few suggestions. For fully usable deliverables, the primary concern is that everything is readable, updated, and editable for the project partner. The team needs to ensure NICHES will obtain ownership of the materials, which will require transferring it through Canva for the informational sign. Additionally, the other concern is that the map is printed on the aluminum signs that the land trust plans to use so maps can be placed around the property.

Another concern in terms of GIS is that there may be a confusion of layers when looking at the files. Each person usually has their own system within the file, so the team has renamed the layers to make them as clear as possible. Additionally, the team removed any layers that were no longer needed or necessary. For the Canva side, there was a potential concern that the

vocabulary may be too large for children. However, with transferring access, NICHES will have the full ability to edit and make any changes they deem necessary.

Finally, the last concern is that there was some confusion on trail endings for the trail near the creek. Therefore, the team added red hexagonal signs. The only issue is that since it is too small to say "stop", people may still find it slightly unclear.

This capstone project has been highly rewarding for the entire team, and we hope that the deliverables will be implemented and used in the future.

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    Environments 2019, 6(9), 104 https://doi.org/10.3390/environments6090104

Appendices

Figure 1: Final Main Trail Map
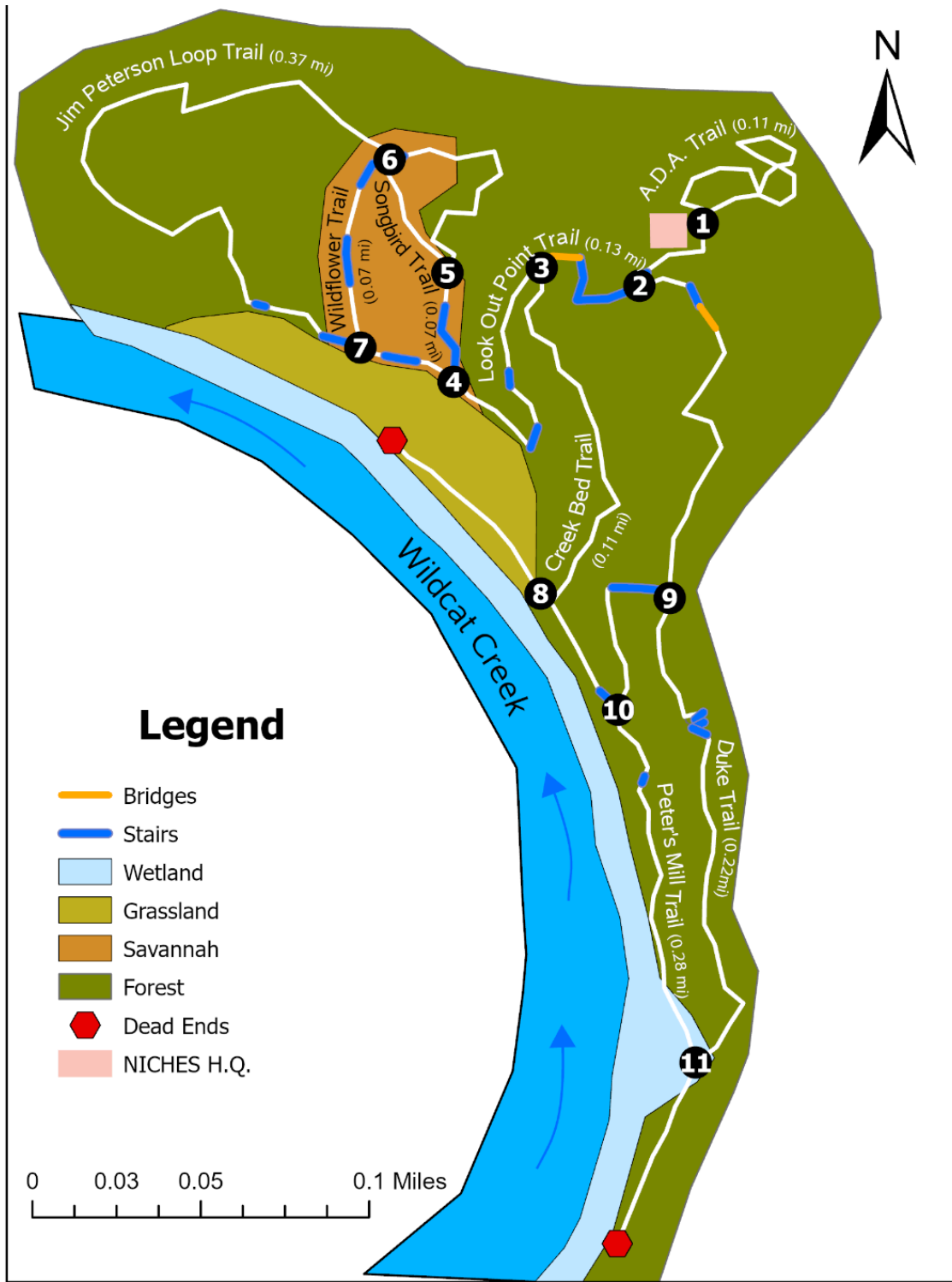
Figure 2: Oriented Node map for Node 1
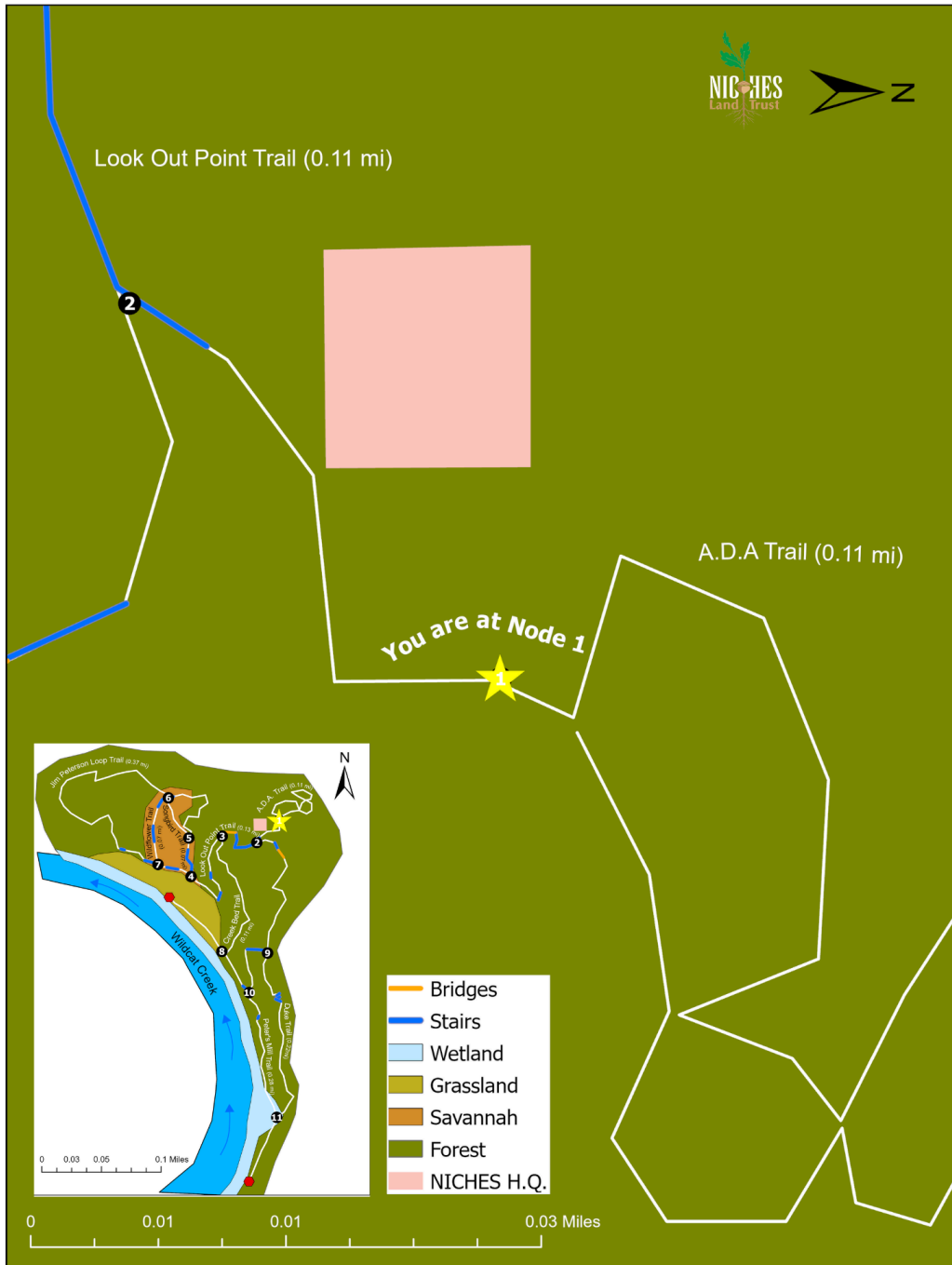
Figure 3: Oriented Node map for Node 2
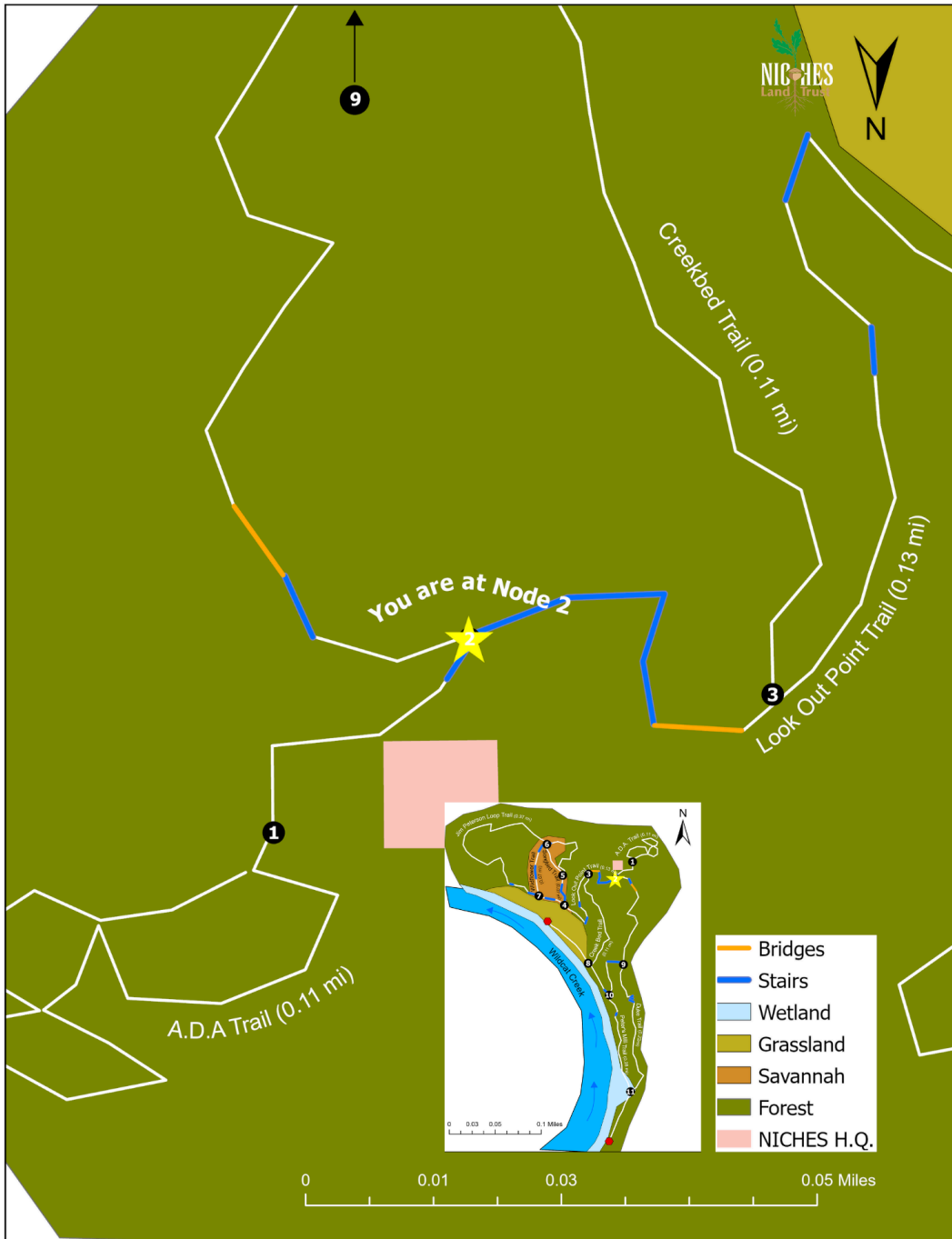
Figure 4: Oriented Node map for Node 3
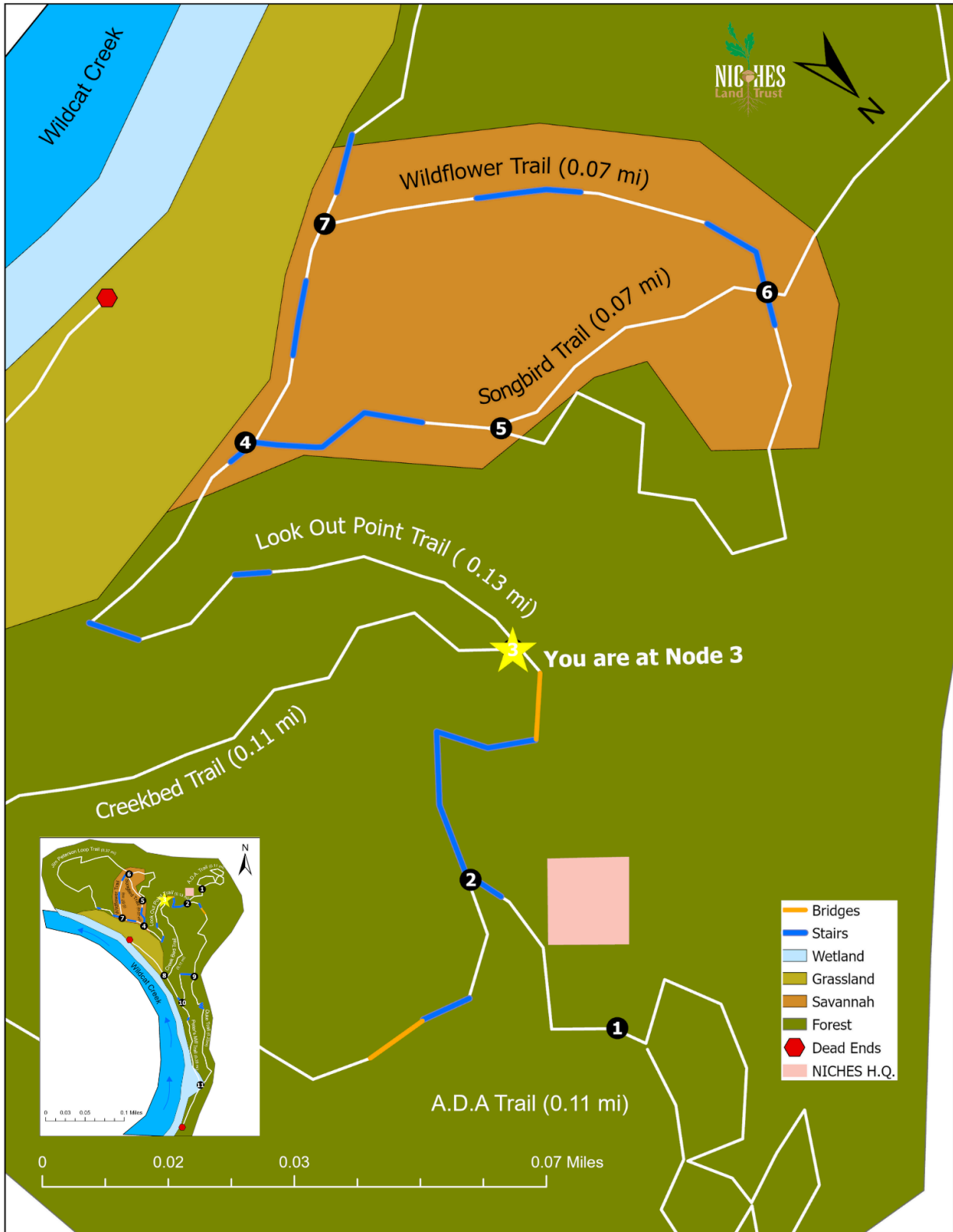
Figure 5: Oriented Node map for Node 4
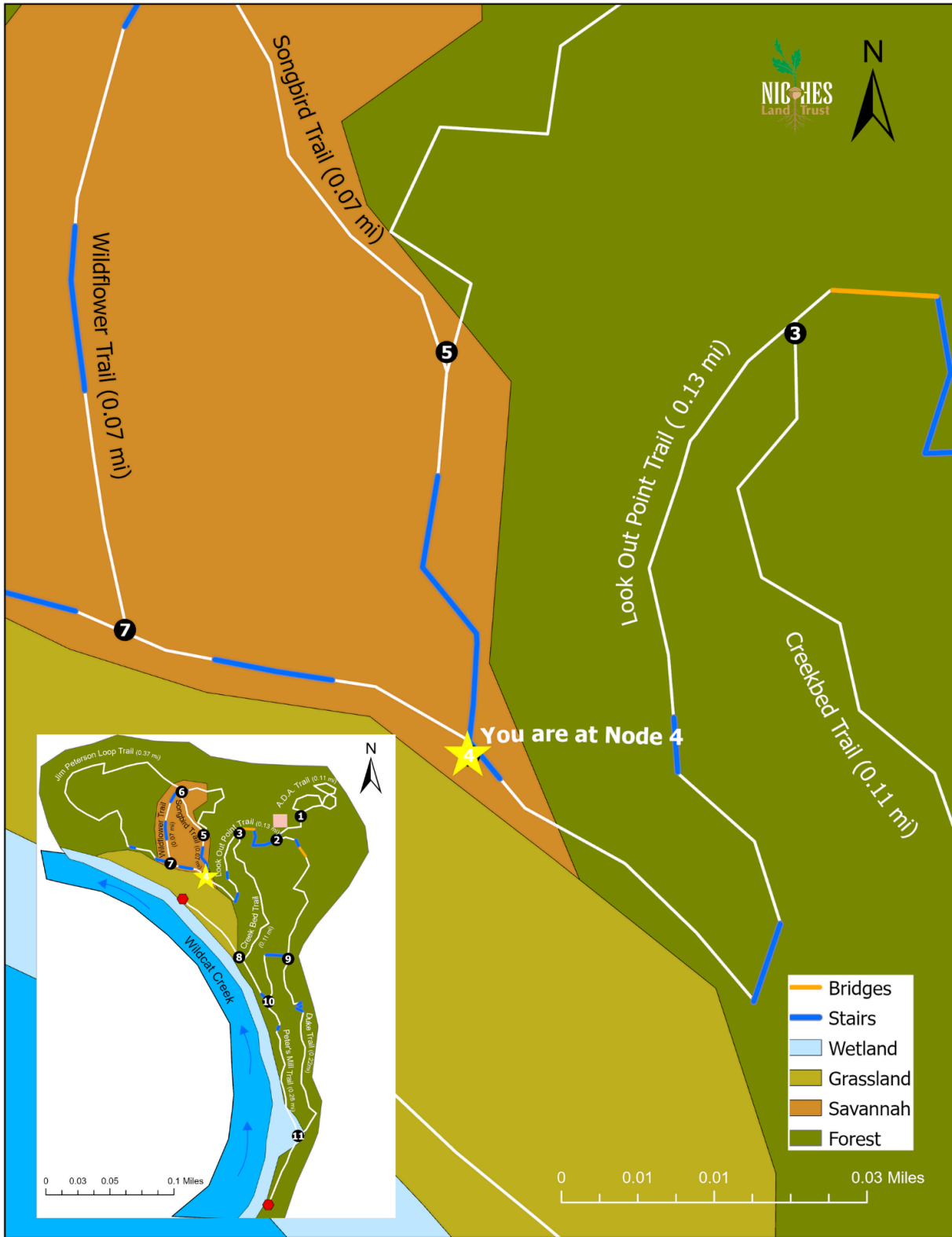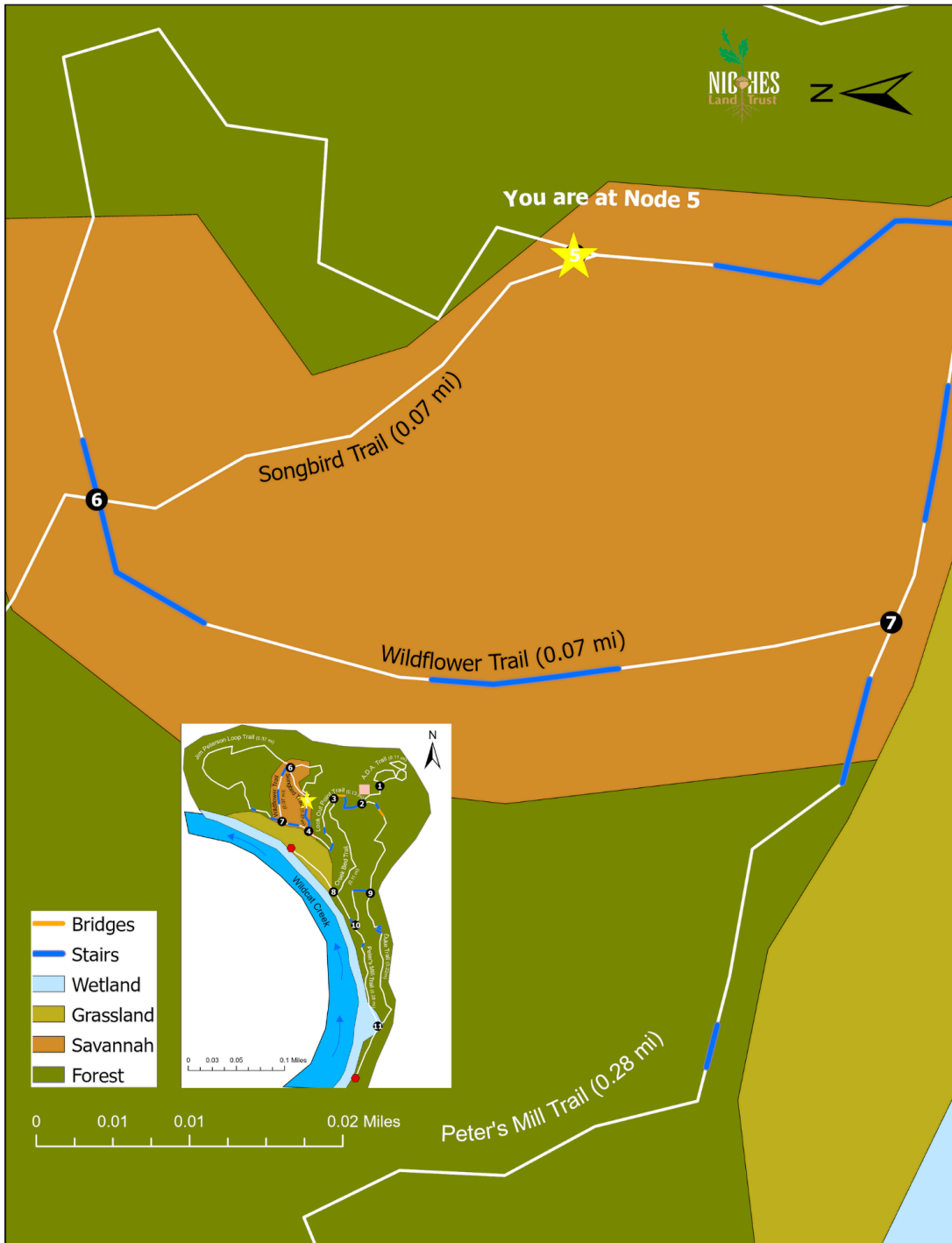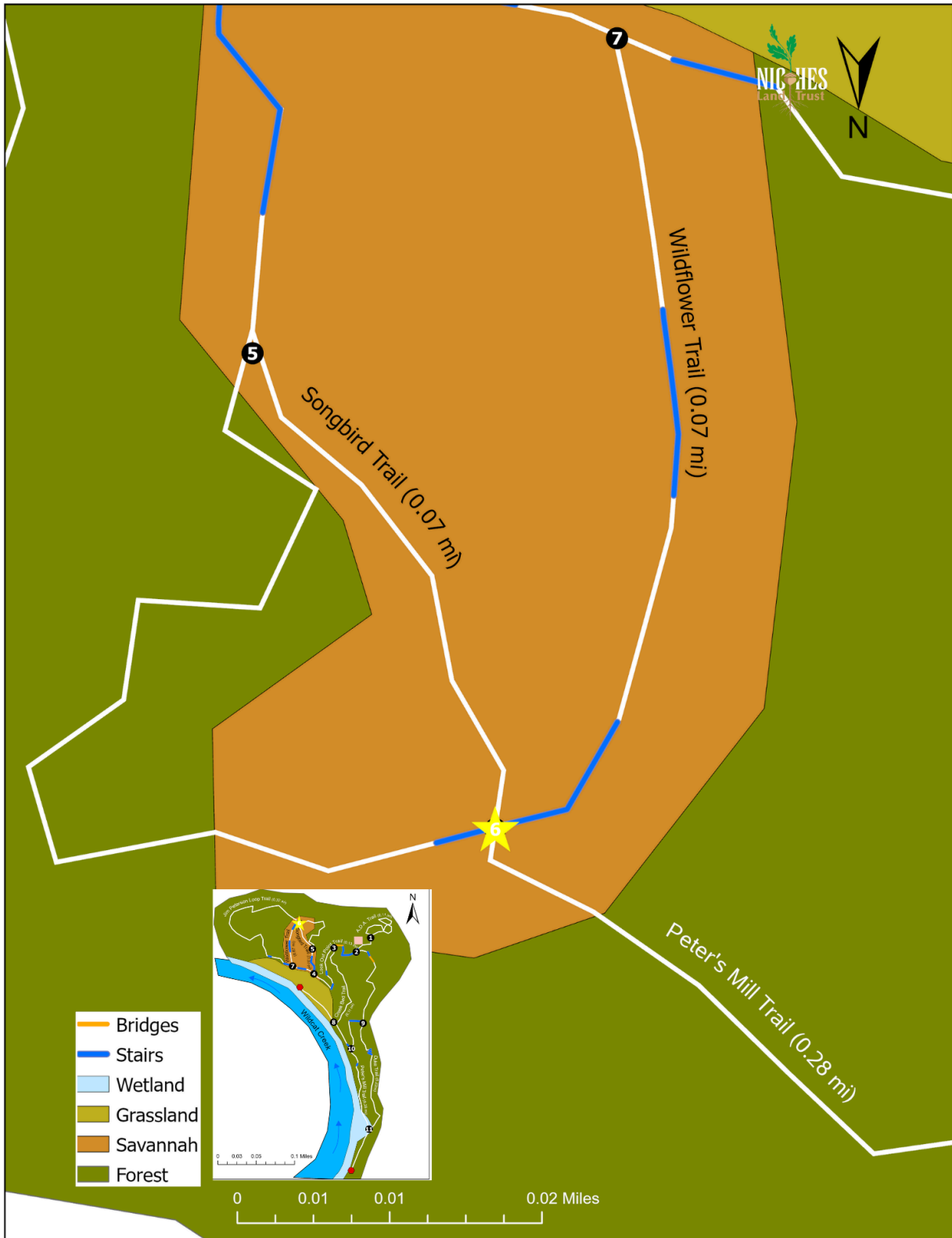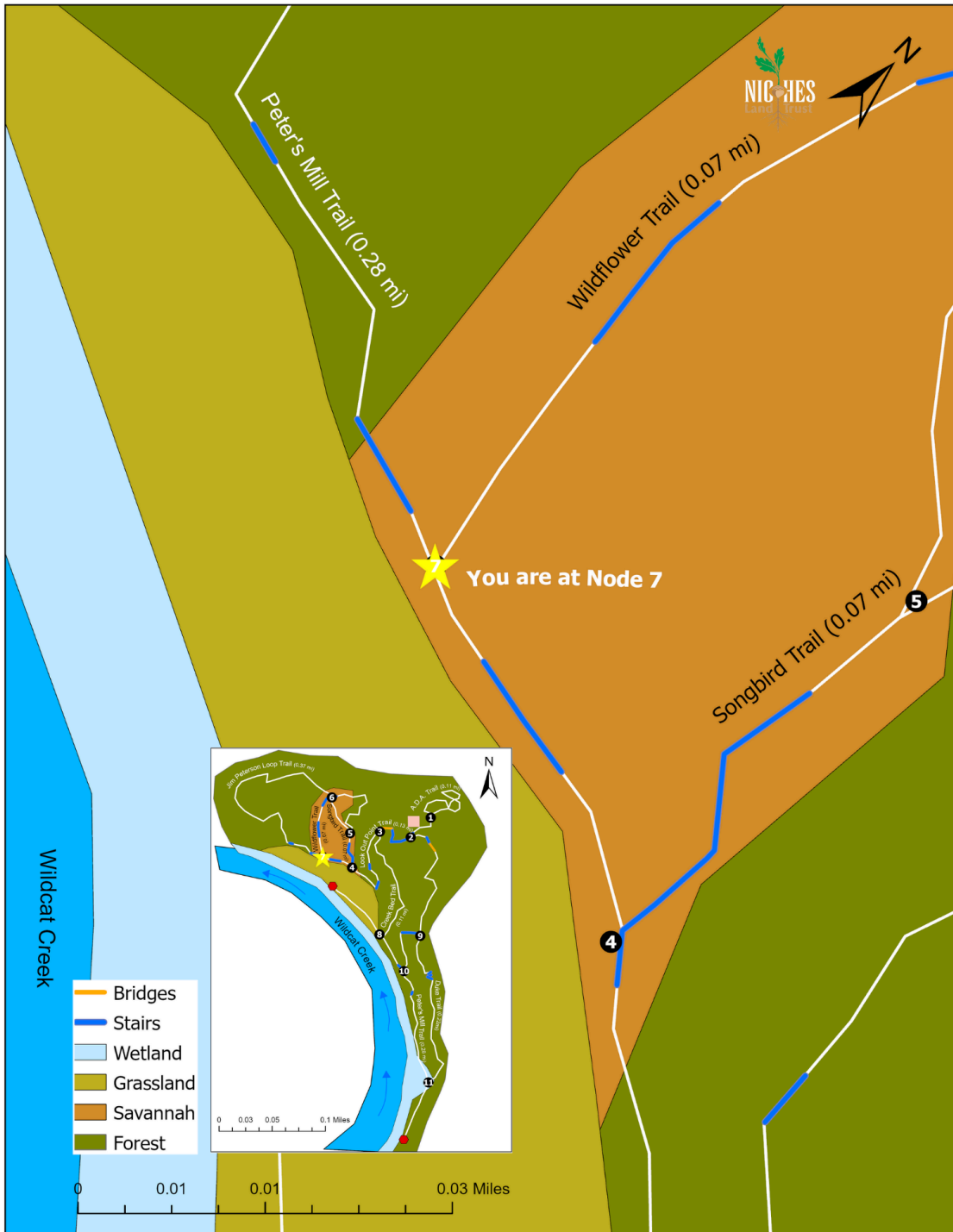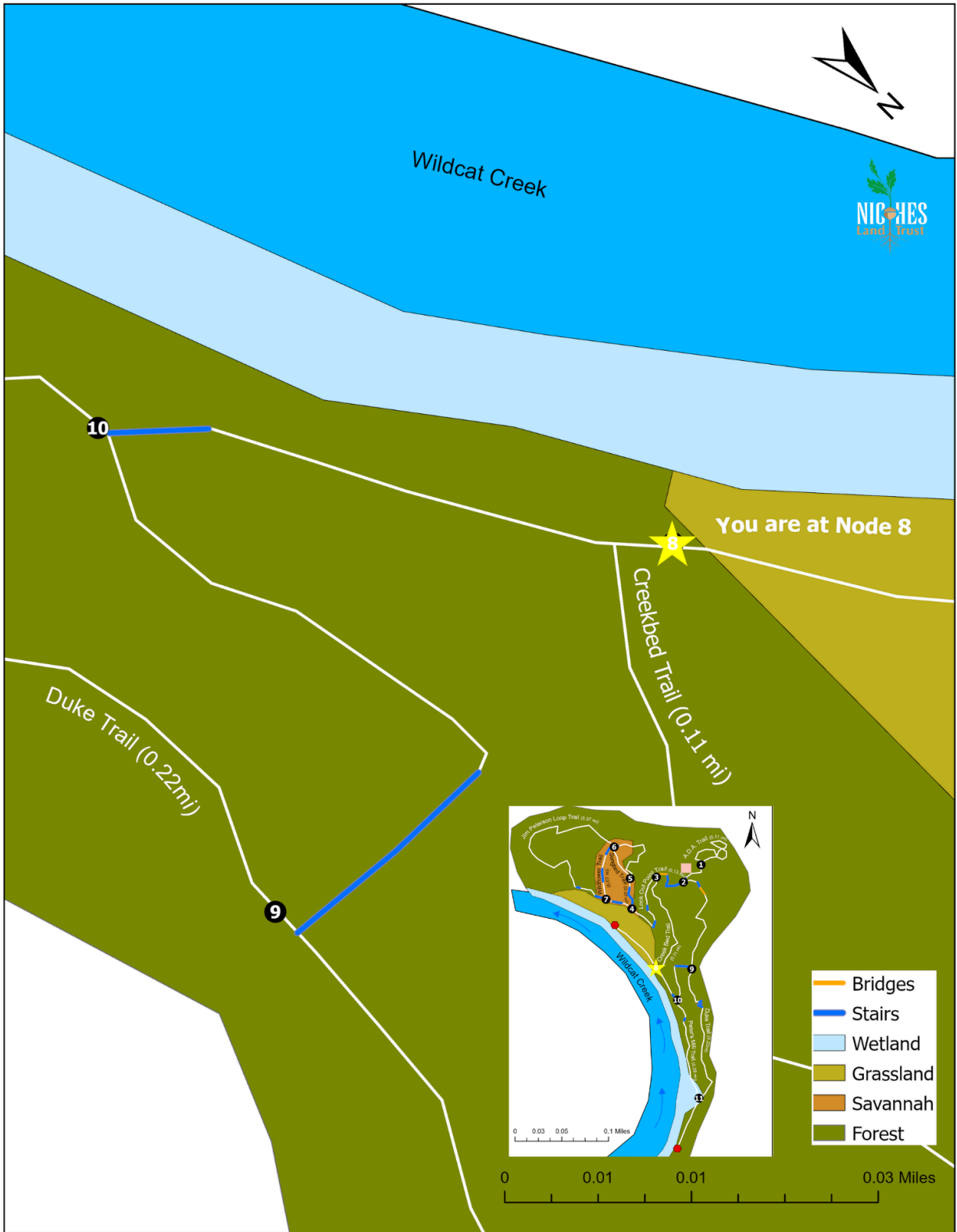
Figure 6: Oriented Node map for Node 5

Figure 7: Oriented Node map for Node 6

Figure 8: Oriented Node map for Node 7

Figure 9: Oriented Node map for Node 8

Wildcat Creek

You are at Node 8

Creekbed Trail (0.11 mi)

Duke Trail (0.22mi)

10

9

NICHES
Land Trust

Bridges
Stairs
Wetland
Grassland
Savannah
Forest

0   0.01   0.01   0.03 Miles

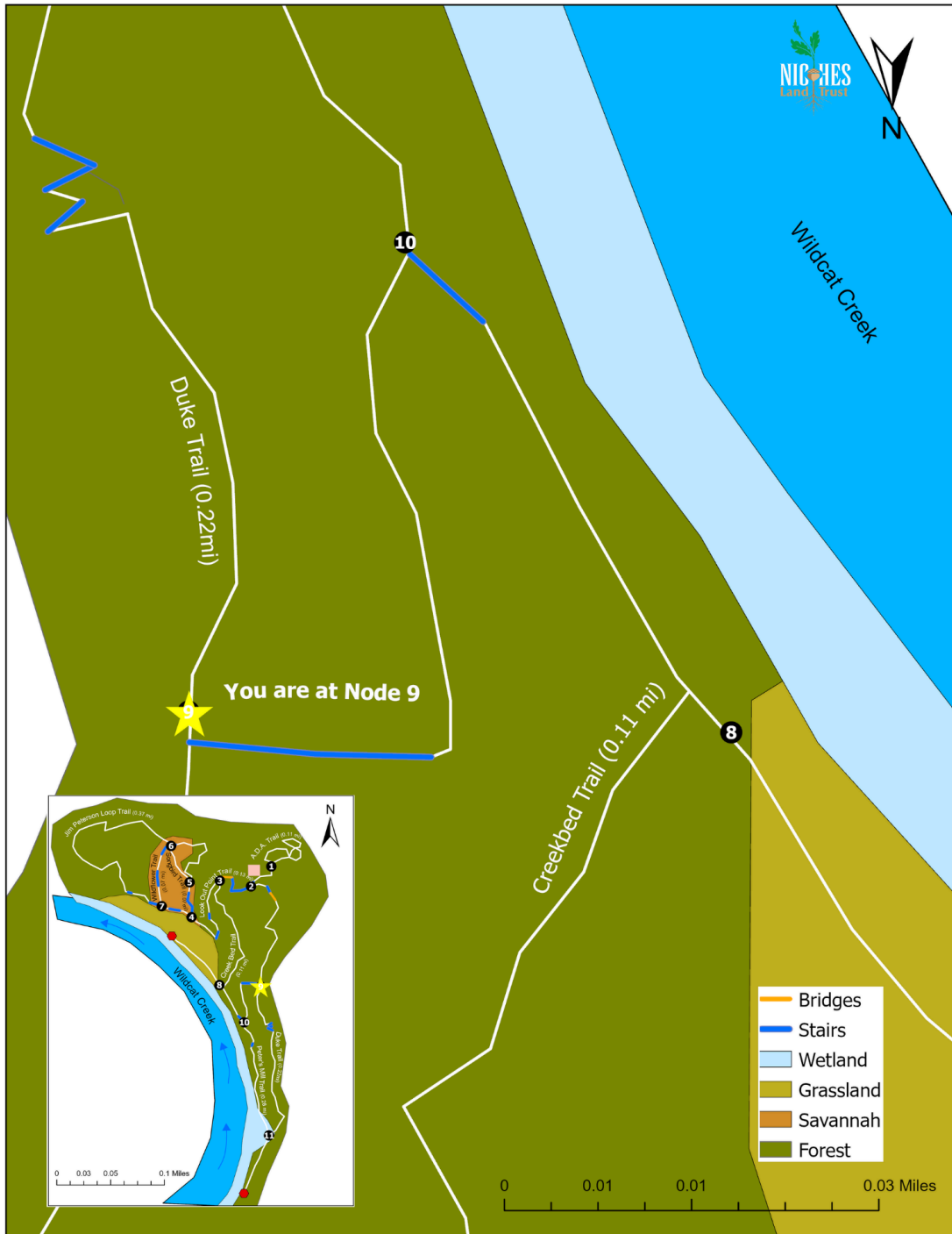Figure 10: Oriented Node map for Node 9

Figure 11: Oriented Node map for Node 10
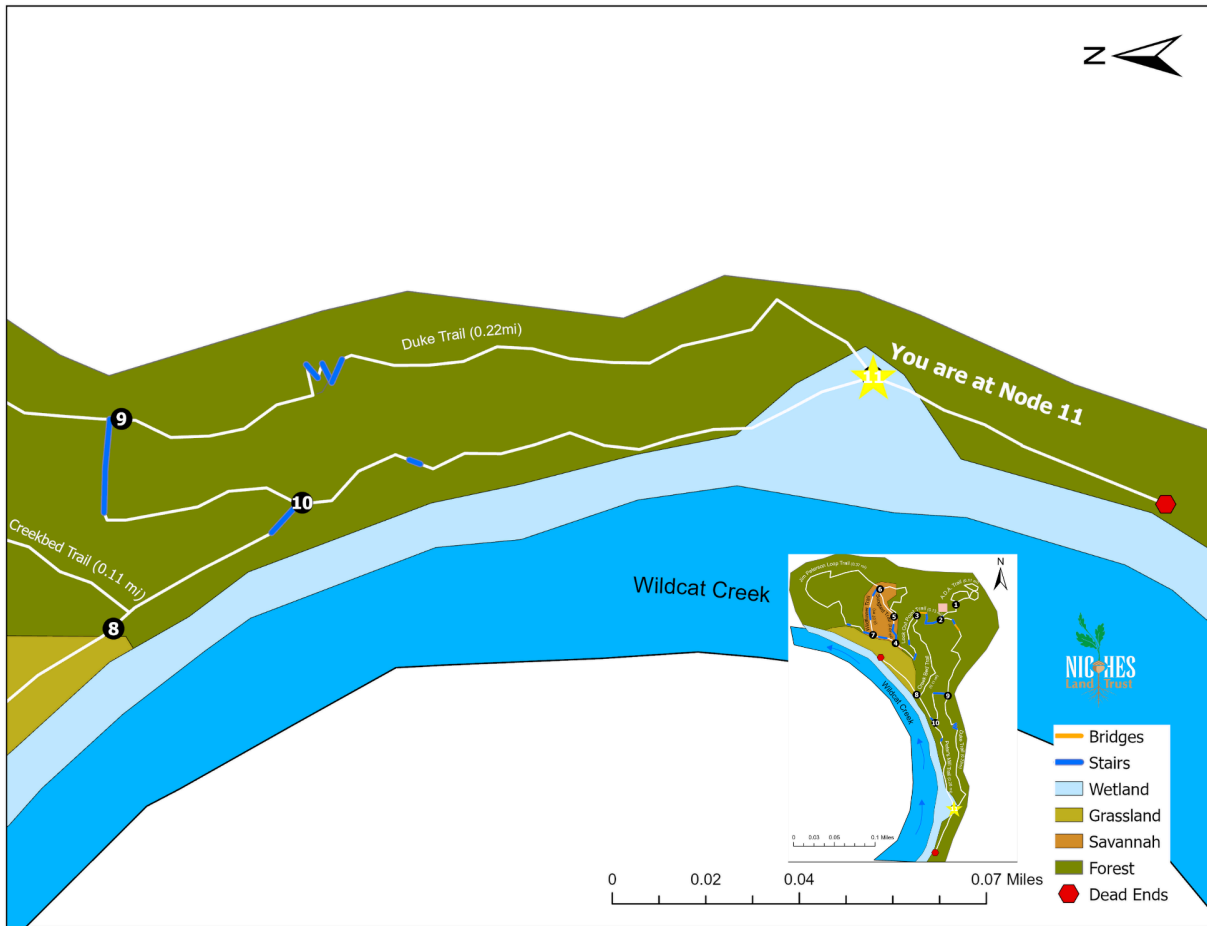
Figure 12: Oriented Node map for Node 11

Figure 13: Informational Sign

Welcome to Clegg Gardens
A NICHES Land Trust Site

Enjoy hiking through Clegg Gardens through all the seasons of the year. Keep an eye out for the first spring trilliums and the beautiful blooms of dogwood trees. Try and catch a kingfisher dive into Wildcat Creek. From creekside to hilltop, you too can experience the 100 ft elevation change and connect with this unique hidden treasure nestled in Lafayette.

Legend
- Bridges
- Stairs
- Wetland
- Grassland
- Savannah
- Forest
- Trail
- Dead Ends
- NICHES H.Q.

0   0.03   0.05   0.1 Miles

History of Clegg Gardens

The public garden began as a private property owned by Harold and Ruth Clegg; purchased in the late 1930s as a country retreat. They converted the private garden into a memorial garden in memory of their son, Jerry. On April 18, 1965, the Clegg family opened the property to the public. Trails were installed for the public to explore the hills and access Wildcat Creek. Jim Peterson, long time steward of Clegg Memorial Garden and treasurer of the Clegg Memorial Garden Board of Directors joined the memorial garden in 1966. In 2014, NICHES Land Trust took over management of the grounds, updated the facility, converted the garden to a native garden, and established NICHES Administrative Office in the Clegg cottage.

Bee getting pollen from purple headed cone flower (Photo by: Zac Cody)

Barred Owl (photo by: Chad Phelps)

Wild Columbine (Aquilegia canadensis) (Photo by: Chat Pehlps)

NICHES Properties by County

Niches Properties
Major Cities

INDIANA

History of NICHES

A local non-profit organization originating from the efforts of concerned citizens, Harry Potter, Persis Newman, and Susan Ulrich, NICHES protects, restores and sustains northern Indiana's ecosystems by providing habitat for native species and offering natural places for the education, appreciation, and enjoyment of current and future generations.

Since its inception in 1995, with the support of many concerned citizens, "Northern Indiana Citizens Helping Ecosystems Survive" (NICHES) Land Trust has grown from a few concerned citizens to a network of engaged citizens through a 13 county service area.

NICHES acquires and preserves land with the support of financial contribution and committed volunteers led by professional stewardship managers, who preserve and restore lands to quality natural ecosystems through invasive species removal, prescribed fire application, and native plant introduction. NICHES operates on the belief that the northern Indiana landscapes are home to ecosystems of native plants and animals that should be protected and provide access and connection with those preserved natural areas improves the quality of people's lives. People in our region should be able to live among sustainable, healthy, attractive landscapes. NICHES also believes that private landowners have an important role to play in helping to provide larger ecological and social benefits for the local community. NICHES works with private landowners to generate landscape level conservation.
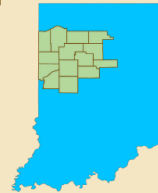
NICHES Summer Adventure Campers learn about native wildlife in Wildcat Creek (photo by: Sam Cody)
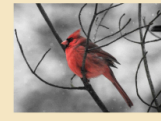
Cardinal (Cardinalis cardinalis), Indiana's state bird (Photo by: Zac Cody)

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Figure 14: NICHES Properties by Counties Map