

GIS and Conservation: Internship with the Division of Parks and
Recreation at DNREC

Binghui Li

ABSTRACT

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DNREC

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This report summarizes my internship experience with the Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Parks and Recreation, where I utilized GIS tools to support conservation and land management efforts. My key responsibilities included conducting spatial analysis and mapping of natural areas and nature preserves to assess their current state, identifying and documenting land use changes over the past decade, and managing the accuracy and integrity of DNREC's geodatabase.

During my internship, I gained hands-on experience using tools such as ArcGIS Pro and ArcGIS Field Maps, which allowed me to apply theoretical knowledge to practical tasks, such as natural area analysis and geodatabase management. This experience enhanced my understanding of how GIS supports environmental management in a governmental context, under the mentorship of experienced professionals, I developed technical skills, contributing to DNREC's mission of preserving Delaware's natural resources.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to everyone who made my internship experience at the DNREC so meaningful and enriching. I am immensely grateful to my manager, Melanie Cucunato, for her guidance, mentorship, and encouragement throughout my internship. Her expertise and support gave me the confidence to take on challenges and learn new skills.

I would like to express my sincere gratitude to my professor, Yelena Ogneva-Himmelberger, for her valuable guidance and advice throughout my academic journey and internship. Her guidance played an important role in bridging the gap between classroom knowledge and real-world application.

Finally, I would like to thank all the individuals behind the scenes who contributed to my learning experience, including the GIS experts, administrative staff and my parents, who provided the tools and financial support necessary to complete my project. Thank you all for helping me along this journey.

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Chapter 1: Introduction

My journey that began during my undergraduate studies at Penn State University, where I majored in civil engineering, a field closely tied to my family's business. My academic foundation in civil engineering provided a strong grounding in the design, construction, and maintenance of the built environment, including roads, bridges, water supply systems, and more. Upon graduation, my academic advisor encouraged me to explore the concept of smart cities, telling me that the concept of smart cities and explained that GIS serves as the backbone of smart city planning, offering a new lens through which to understand and shape urban environments. I decided to pursue a Master's degree in Geographic Information Science at Clark University to gain specialized knowledge and skills in GIS.

At Clark University, courses such as Advanced Vector GIS, Introduction to Geographic Information Science, and Introduction to Remote Sensing etc. have enabled me to dive deep into geospatial techniques and technology, equipping myself with the skills needed to address complex spatial challenges. Under the guidance from this GIS master program, I chose an internship track during this summer break. Fortunately, I got a valuable internship offer from Department of Natural Resources and Environmental Control(DNREC), Division of Parks and Recreation. My internship started in June toward to the end of August 2024 as the summer stage.

During my summer internship as a Land Preservation Intern with the DNREC, Division of Parks and Recreation, I had the opportunity to support critical initiatives in conservation and land management. I worked under the guidance of Melanie Cucunato, the land preservation manager, to support critical initiatives aimed at sustaining Delaware's nature preserves. Each week, I went to preserves across New Castle, Kent, and Sussex counties, monitoring diverse ecosystems and collect valuable conservation data. My responsibilities went beyond fieldwork; they extended into spatial data analysis, where I refined existing layers, distinguished natural areas from built-up zones, and applied geospatial data to generate actionable insights for my land preservation manager, who collaborates with DNREC staff and city officials to develop and implement long-term preservation strategies.

This internship provided me with hands-on experience in using GIS for environmental conservation, allowing me to apply my technical skills in a real-world context, benefit me from a different angle about GIS compared with what I have obtained from the classes and final projects.

Chapter 2: Description of DNREC and Division of Parks and Recreation

2.1 Mission and Areas of Expertise

The Delaware Department of Natural Resources and Environmental Control (DNREC) is deeply committed to sustainable environmental stewardship throughout the state, includes a broad mission that prioritizes resource conservation, public health and improving quality of life. Guided by this mission, DNREC's objectives include promoting responsible natural resource management, ensuring clean air and water, offering accessible outdoor recreation, advancing climate resiliency, and engaging the public in environmental education.

DNREC's Natural Resource Conservation efforts are exemplified by initiatives like the Delaware Bayshore Initiative and strategic conservation easements. These programs collectively safeguard over 20,000 acres of state parks and an additional 68,000 acres of public lands, supporting biodiversity and offering residents spaces for recreation and wildlife observation. Through these conservation efforts, DNREC not only protects forests, wetlands, and coastal areas but also establishes natural carbon sinks, aiding Delaware's climate goals and enhancing ecological resilience.

In Public Health and Environmental Protection, DNREC enforces regulations across air, water, and land to prevent pollution and mitigate hazardous substances. The Division of Air Quality monitors emissions, develops compliance plans aligned with the Clean Air Act, and enforces standards to maintain clean air for Delaware's communities. The Division of Water focuses on watershed management and pollution control to protect water quality, addressing both public health concerns and ecological balance within the state's ecosystems.

DNREC's Outdoor Recreation and Parks Management division plays a key role in promoting a connection with nature through Delaware's extensive state park system. Managing 17 state parks and over 100 miles of trails, along with additional conservation easements, provides diverse recreational options for residents and tourists. Programs like "No Child Left Inside" encourage outdoor education and help residents of all ages engage with the natural world. This division also protects Delaware's cultural and historical sites, enriching the community's recreational and

educational experiences.

In the area of Climate Preparedness and Energy Policy, DNREC actively address Delaware's vulnerability to climate change and sea level rise. Through the Delaware Climate Action Plan, DNREC aims to reduce greenhouse gas emissions, promote renewable energy use, and implement adaptive measures to enhance Delaware's resilience. A key initiative within this plan is the goal of achieving an 82% zero-emission vehicle rate by 2032, fostering a more climate-conscious infrastructure and reducing the state's carbon footprint.

Public Education and Community Engagement are core aspects of DNREC's mission, aiming to foster a culture of environmental responsibility. The department offers workshops, public outreach programs, and provides accessible environmental data through resources like Delaware's Open Data Portal. These initiatives educate residents on conservation practices, sustainable energy and natural resource management, promoting community engagement.

DNREC operates statewide from its headquarters in Dover, with offices and facilities that ensure comprehensive regional coverage for conservation, recreation, and regulatory services. By coordinating across sectors, from natural resource management to climate policy and public health, DNREC effectively accomplishes its mission, working to create a sustainable future for Delaware while providing the community with accessible and valuable resources.

2.2 Organization's Structure

DNREC has approximately 661 employees, of which approximately 15% are minorities, a slight increase from previous years. DNREC is committed to providing equal employment opportunity and developing a diverse and inclusive workforce. It works with organizations such as Delaware State University and other historically black colleges to recruit a broader range of candidates.

DNREC is organized into three primary offices, each focused on distinct aspects of its mission to manage and protect the state's natural resources and public health:

1. Office of the Secretary: this office provides overarching leadership, policy guidance, and essential administrative support across DNREC. It manages functions such as human resources, budget, fiscal planning, and IT. Within this office, specific units focus on enhancing equity, financial support, and community relations:

- Environmental Justice Office: Ensures equitable access to green spaces, recreational opportunities, and environmental health protections, promoting fair treatment for all Delaware residents.
- Environmental Finance Office: Oversees financial support for water infrastructure and environmental projects, managing funds that assist communities with water treatment, stormwater management, and pollution control.
- Division of Community Affairs: Acts as a liaison between DNREC, the public, and the General Assembly, facilitating compliance with environmental laws and promoting transparent communication.

2. Office of Environmental Protection: This office addresses pollution control and resource protection through various specialized divisions:

- Division of Air Quality: Monitors air quality, enforces emission standards, and ensures comply with the Clean Air Act.
- Division of Waste and Hazardous Substances: Manages waste reduction, hazardous material control, and emergency response for environmental incidents.
- Division of Water: Protects Delaware's water resources through regulatory guidance, watershed management, and pollution prevention.
- Division of Climate, Coastal, and Energy: Leads statewide efforts in climate change mitigation and adaptation, supports renewable energy, and manages Delaware's federal coastal zone.

3. Office of Natural Resources: Focused on conservation and public recreation, this office manages Delaware's parks, wildlife, and watersheds:

- Division of Fish and Wildlife: Manages habitats, controls wildlife populations, and provides public access to fishing, hunting, and boating on public lands.
- Division of Watershed Stewardship: Protects soil, water, and coastal resources through watershed-based programs and water quality initiatives, supporting

sustainable land use and water management.

- Division of Parks and Recreation: Overseeing a range of conservation programs, land protection initiatives, and public recreation services across the state. Develop long-term preservation strategies, managing recreational facilities.

2.3 GIS in Division of Park and Recreation

The Division of Parks and Recreation is responsible for managing over 20,000 acres of state parks, 34 nature preserves, and numerous trails, along with cultural and historical sites. This division plays a key role in public recreation and conservation, ensuring Delawareans and visitors have access to natural spaces and recreational activities. While the division does not have a dedicated GIS team, GIS are integral to its operations, supporting tasks such as land preservation, resource management, and public access planning. The use of GIS within the division varies among staff due to differing educational backgrounds and levels of GIS expertise. Many staff members have taken GIS courses and are familiar with using ArcGIS products like ArcGIS Pro for basic mapping and spatial analysis tasks.

For more complex GIS tasks or issues that require advanced technical expertise, the division collaborates with the Delaware Department of Technology & Information (DTI). Staff can submit support tickets to DTI for assistance with complex functions, troubleshooting, and implementing advanced geospatial solutions. DTI's GIS specialists provide support, ensuring that the Division of Parks and Recreation can achieve its GIS-related goals even when in-house expertise is limited. This approach allows the Department of Parks and Recreation to effectively utilize GIS without the need for a dedicated GIS team, relying instead on in-house skills and the support of DTI's GIS experts.

2.4 Areas for Improvement and Mission Effectiveness

While DNREC is highly effective in addressing environmental challenges and upholding its mission, there are areas for improvement, particularly in workforce diversity and recruitment for specialized roles. DNREC faces ongoing challenges in

filling positions in engineering, enforcement, and technical fields due to competition with the private sector and federal agencies, where salaries and benefits may be more competitive. Although it implemented recruitment incentives and partnerships with local institutions such as Delaware State University to increase diversity, representation remains low in certain professional positions.

Another area for improvement is expanding public engagement efforts. While DNREC has a strong foundation in public education and community involvement, there is potential to deepen these initiatives, especially in underserved and minority communities.

Chapter 3: Internship Responsibility

3.1.1 Nature Preserve Monitoring

First, my first step was to access the Nature Preserve Database, an Excel file containing essential details about each preserve, including natural area names, tracts, deeded and mapped acreages, county, and management contacts. I began by getting an overview of potential preserves for monitoring, examining details like tract information, parcel numbers, and conservation easement status (CE) to understand the unique conservation obligations associated with each site. Clicking on individual “TRACTS” provided more detailed information, including parcel specifics, ownership status, deeded acreage, and recent monitoring dates. With this information in hand, I would then select the preserves I wanted to monitor, ensuring a variety in type, location, and ecological features. The choice of preserves often depended on weather conditions; for example, on extremely hot days, I would avoid unshaded beach areas to prevent heat-related risks. Similarly, on cloudy days, I would steer clear of marshlands where mosquitoes are more active, especially in the summer months.

Second, send a Monitoring of Conservation Easement/Nature Preserve notice (figure 1) to the appropriate contact person to confirm the scheduled visit. For example, send a letter to the park superintendent two weeks in advance or, if the preserve is on private property, send a notice to the landowner at least three weeks ahead of time. Then, use the company’s internal system to reserve a vehicle for transportation and head to the nature preserve.

Additionally, before heading to the conservation easement or nature preserve, conduct a thorough review of its location and access details. For sites in New Castle County, use the [Tax Map Viewer](#) or [Parcel Search](#) for precise information. In Kent County, refine the search using the [General Purpose Map App](#), and for Sussex County, use the [Sussex County Map Viewer](#). These tools will help identify the approximate location, boundaries, and nearby landmarks. Next, consult the DNREC website ([Delaware State Parks](#)) to obtain specific details about the nature preserve, including

size, habitat types, and notable features. Read through the historical deeds to understand any restrictions—activities permitted or prohibited—to ensure compliance during the visit. Using satellite images and maps, identify accessible entry points and nearby parking areas to streamline site access. However, to simplify the process and enhance accessibility, I use ArcGIS pro to integrate satellite imagery, parcel maps, nature preserves and natural areas. This setup allowed my co-workers and me to easily identify our planned preserves and visually distinguish them from surrounding private properties, reducing the risk of accidental trespassing and these layer view provided enabled precise boundary identification and allowed us to understand the surrounding area's context, improving both accuracy and efficiency in site preparations.

On the day of the visit, coordinate arrival times with the park superintendent or community representatives, as they may join for the assessment. During the visit, capture general photos to document the preserve's condition, including signage, wayside exhibits, and any plant or animal species observed. Document any signs of encroachment, such as graffiti, litter, or other unauthorized activities, and record any informal or "social" trails that could impact the preserve's integrity. Document the status of plant and animal habitats, assess potential threats like invasive species, and identify areas needing attention. Monitoring efforts included noting visible environmental changes, checking for signs of illegal activities, such as unauthorized dumping or off-trail activities, and documenting human impact on the natural landscape. Any potential encroachment activities were carefully documented.

Last, organizing documentation and submitting the nature preserve field monitoring form. Upon returning to the office, I organize all collected documentation, storing photos, notes, and GIS data in designated folders for each nature preserve. After organizing, I complete the Nature Preserve Field Monitoring Form with details such as the date, location, observed conditions, and any noted encroachments or disturbances. This form also includes specific information such as boundary conditions, adjacent land uses, and any natural disturbances impacting the preserve. Once completed, I send the form to the relevant contact—typically the park

superintendent for state-owned preserves or the landowner for privately held conservation easements. This follow-up provides key stakeholders with an updated assessment of their preserve, strengthen DNREC's commitment to protecting Delaware's natural resources while keeping land managers informed of any necessary actions.



June 26, 2024

[REDACTED]

Subject: Monitoring of Conservation Easement/Nature Preserve

Greetings!

I am writing to inform you that I will be visiting your property, which is a part of the Freshwater Marsh Nature Preserve, for routine Conservation Easement monitoring.

I am planning my visit for **Monday, July 1, 2024**. You do not need to accompany me, but you are certainly welcome to if you would like. Please let me know if you would like to schedule a specific time or a different day.

Lastly, thank you for participating in the Natural Areas Preservation Program! Our State's Nature Preserves are ensuring areas of significant ecological, cultural, geological, or scientific features are staying here forever for future generations of Delawareans – and it is because of land stewards like you.

Do not hesitate to reach out to me if you have any questions or concerns,

Sincerely yours, Binghui Li

Intern of Natural Heritage Program Manager

Office of Nature Preserves

[REDACTED] delaware.gov

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Figure 1: Letter sent to a property owner notifying them about an upcoming Conservation Easement/Nature Preserve monitoring visit.



State of Delaware
Department of Natural Resources and Environmental Control
Division of Parks and Recreation
89 Kings Highway
Dover, Delaware 19901

NATURE PRESERVE FIELD MONITORING FORM

INSPECTION DATA

Date:	July 1, 2024
Nature Preserve:	Freshwater Marsh Nature Preserve
Monitored by:	Melanie Cucunato, Natural Heritage Program Manager Binghui Li, Intern of Natural Heritage Program Manager
Management/Owner:	[REDACTED]
Contact Name:	[REDACTED]
Contact E-mail/Phone:	[REDACTED]
Did Landowner Attend (if private)?	[REDACTED]
Tract(s):	[REDACTED]
No. of Acres:	12.216
Description of Property:	[REDACTED]

FIELD OBSERVATIONS

1. Adjacent Land Use (Mark all that apply)
 Ecosystem/Species Preservation (no active management)
 Wildlife/Habitat Management
 Science/Education
 Recreation (trails, parking lot, Nature Center)
 Residential

Figure 2: Completed Nature Preserve Field Monitoring Form for the Freshwater Marsh Nature Preserve. The form documents inspection data, field observations, and land use characteristics.

3.1.2 Data collect using ArcGIS Field Maps

For this project, I was using ArcGIS Field Maps to collect the data, and it was proved a valuable tool for efficient data collection and field documentation. I used it

primarily to log parking spots and document instances of encroachment across various nature preserves. This mobile app allowed me to collect spatial data directly in the field with my phone, providing real-time, location-based insights that were instantly recorded into DNREC's GIS database.

To get started, I logged into ArcGIS Online to set up the data layers and form structure, focusing primarily on location information to assist future interns or managers in easily locating parking spots within nature preserves. I designed the form fields to allow users to attach photos to each data point, enhancing the usability and detail of the data. Given that nature preserves often contain multiple tracts, some of which may be quite distant from each other, I designed the layers to support multiple location points for each preserve. This flexibility shown that no matter how spread out the tracts were, all could be recorded under a unified dataset, maintaining a comprehensive view of each preserve's layout. Additionally, to simplify the data and keep it focused on essential details, I removed unnecessary fields like speed, elevation, and other attributes irrelevant to our conservation objectives.

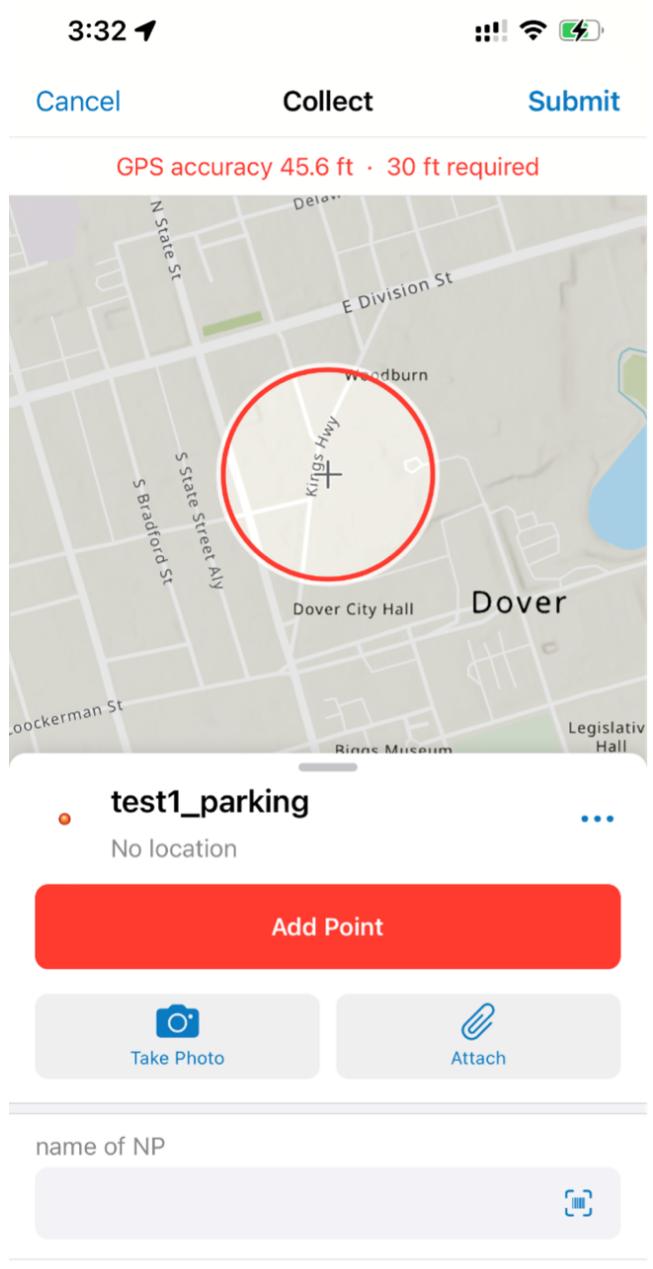


Figure 3: ArcGIS Field Maps interface, used for collecting parking spot locations and field data.

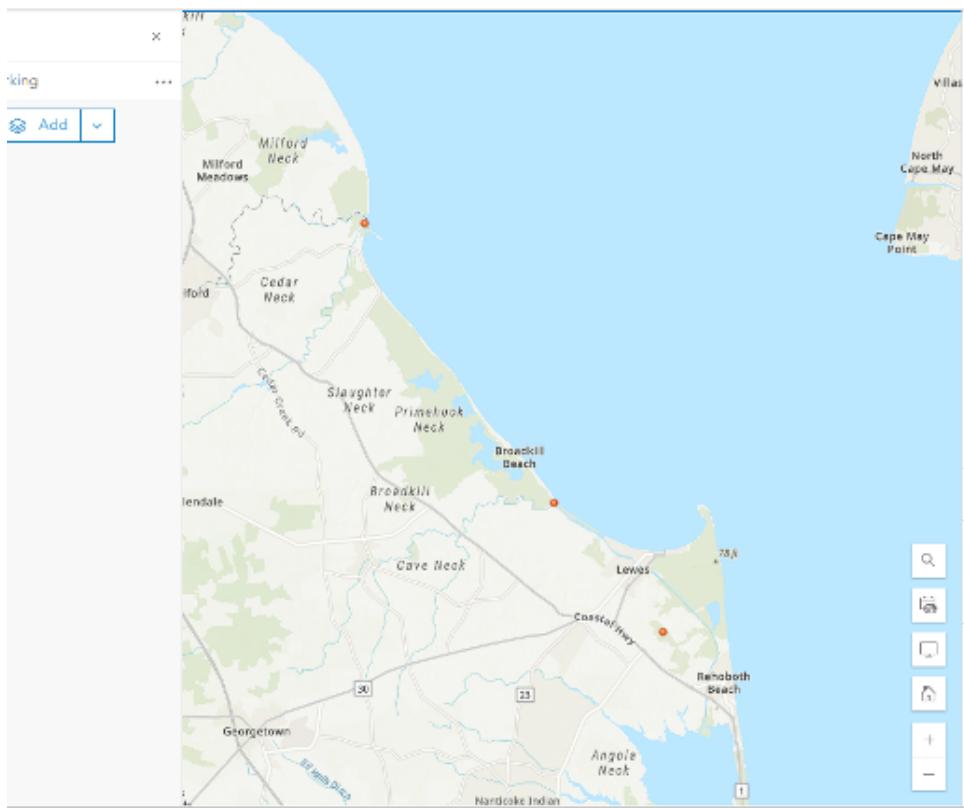


Figure 4: Recorded data layer automatic sync and displayed in ArcGIS Pro, showing parking spot locations collected during fieldwork.

3.1.3 Application of ArcGIS Field Maps for Encroachment Documentation

For documenting encroachment, ArcGIS Field Maps offering accurate, location-specific data. Using the app, I could log encroachment incidents with precise coordinates, notes, and photos, enabling park superintendents or private landowners to locate these areas easily and take necessary actions, address each encroachment promptly and effectively.

3.1.4 Database Management

To further streamline data management and improve organization's nature preserve database, I implemented a systematic naming convention based on my manager's recommendation. This approach assigning unique, hierarchical identification codes to each natural area, nature reserve and tracts, making it easier to locate, reference and manage data for each specific location.

Each Natural Area was assigned a unique identifier in the format of 001, 002, and so on. For example, a Natural Area could be labeled as “Natural Area 001.” Within each Natural Area, I designated unique codes for each Nature Preserve, structured as 001-001, 001-002, and so forth, depending on the Natural Area to which it belonged. Finally, each tract within a Nature Preserve received its own specific identifier in a more detailed format, such as 001-001-001, 001-001-002, and so on. It allowed precise tracking and documentation of individual sections within each preserve.

To start, loading the relevant layers into ArcGIS Pro: in the natural areas layer, create a new field named NaturalAreaID. Assign each Natural Area a unique identifier starting with 001 and incrementing sequentially (e.g., 001, 002, etc.). This ID will serve as the first part of the hierarchical ID structure. The next step is performing a Spatial Join between the Natural Areas layer and the Nature Preserves layer, the join allows each Nature Preserve to inherit the NaturalAreaID of the Natural Area it belongs to. Then, create a new field in the Nature Preserves layer called NaturePreserveID and assign it values in the format of NaturalAreaID-PreserveCounter (e.g., 001-001 for the first preserve in Natural Area 001).

Since each Nature Preserve contains multiple tracts, it stored in the same layer as the Nature Preserves, I use Python to update the TractID field, assigning unique identifiers to each tract. Below is a sample Python script that assigns IDs to each tract based on its parent Nature Preserve’s ID:

```
import arcpy

# Define the Nature Preserve layer
nature_preserve_layer = "path/ nature_preserve_layer "

# Initialize counters for each Nature Preserve's tracts
tract_counter = {}

# Create hierarchical TractIDs based on Nature Preserve IDs
with arcpy.da.UpdateCursor(nature_preserve_layer, ["NaturePreserveID", "TractID"])

as cursor:
```

```
for row in cursor:
```

```
    preserve_id = row[0] # Retrieve the Nature Preserve ID (e.g., 001-001)
```

```
    # Initialize tract counter for each unique Nature Preserve ID
```

```
    if preserve_id not in tract_counter:
```

```
        tract_counter[preserve_id] = 1 # Start tract counter for each preserve
```

```
    # Generate the TractID in the format of 001-001-001
```

```
    row[1] = f'{preserve_id}-{str(tract_counter[preserve_id]).zfill(3)}'
```

```
    tract_counter[preserve_id] += 1 # Increment the counter for the next tract
```

```
cursor.updateRow(row)
```

3.2 Boundary Refinement Project

For the Boundary Refinement Project, I received an updated survey map (Figure 5) from my manager, which included detailed measurements of property boundaries. Using this map as a reference, I refined the boundary data in ArcGIS Pro to accurately represent the surveyed area.

I began by opening ArcGIS Pro and loading the relevant base map layer for the project area. Using the survey map, I located the Point of Beginning (POB)—the starting reference point marked on the survey from which all boundary measurements originate. The POB is critical in boundary mapping, as each subsequent segment builds from this initial point. Then, to map the boundary precisely, I used the Traverse Tool in ArcGIS Pro, which is designed for entering and visualizing survey data based on bearings and distances. The Traverse Tool allowed me to input each boundary segment sequentially, capturing the directional bearings (e.g., north, south, east, west) and distances exactly as indicated on the survey map.

For each line segment, I input the survey's specified bearing (e.g., N 45° E) and distance (e.g., 200 feet) directly into the Traverse Tool. This tool converts each measurement into a line on the map, automatically placing it in the correct orientation and position. The Traverse Tool provided immediate visual feedback, displaying each line segment as it was added. This allowed me to verify the alignment and find any potential errors in real-time, ensuring that the boundary reflected the precise layout indicated on the survey. After entering all line segments, I closed the boundary by connecting the final segment back to the Point of Beginning, thus creating a complete and closed-loop boundary in ArcGIS Pro. At this stage, I checked each line segment in detail to ensure that all lengths and bearings met the specifications of the survey map. Besides, I also double-checked the boundary against visible features on the base map, such as roads, parcels, or natural landmarks, to confirm spatial accuracy within the broader geographic context. Once satisfied with the accuracy of the boundary, I saved the newly created layer and ready to send it to my manager.

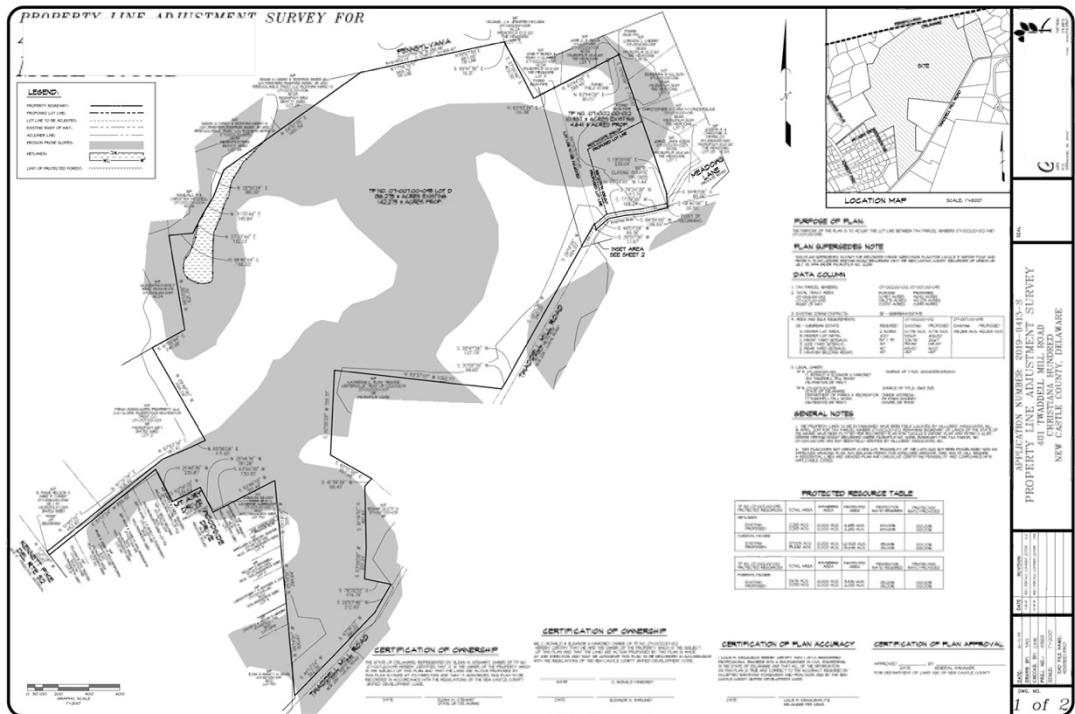


Figure 5: Survey map, and was used as a reference for refining boundaries in ArcGIS Pro.

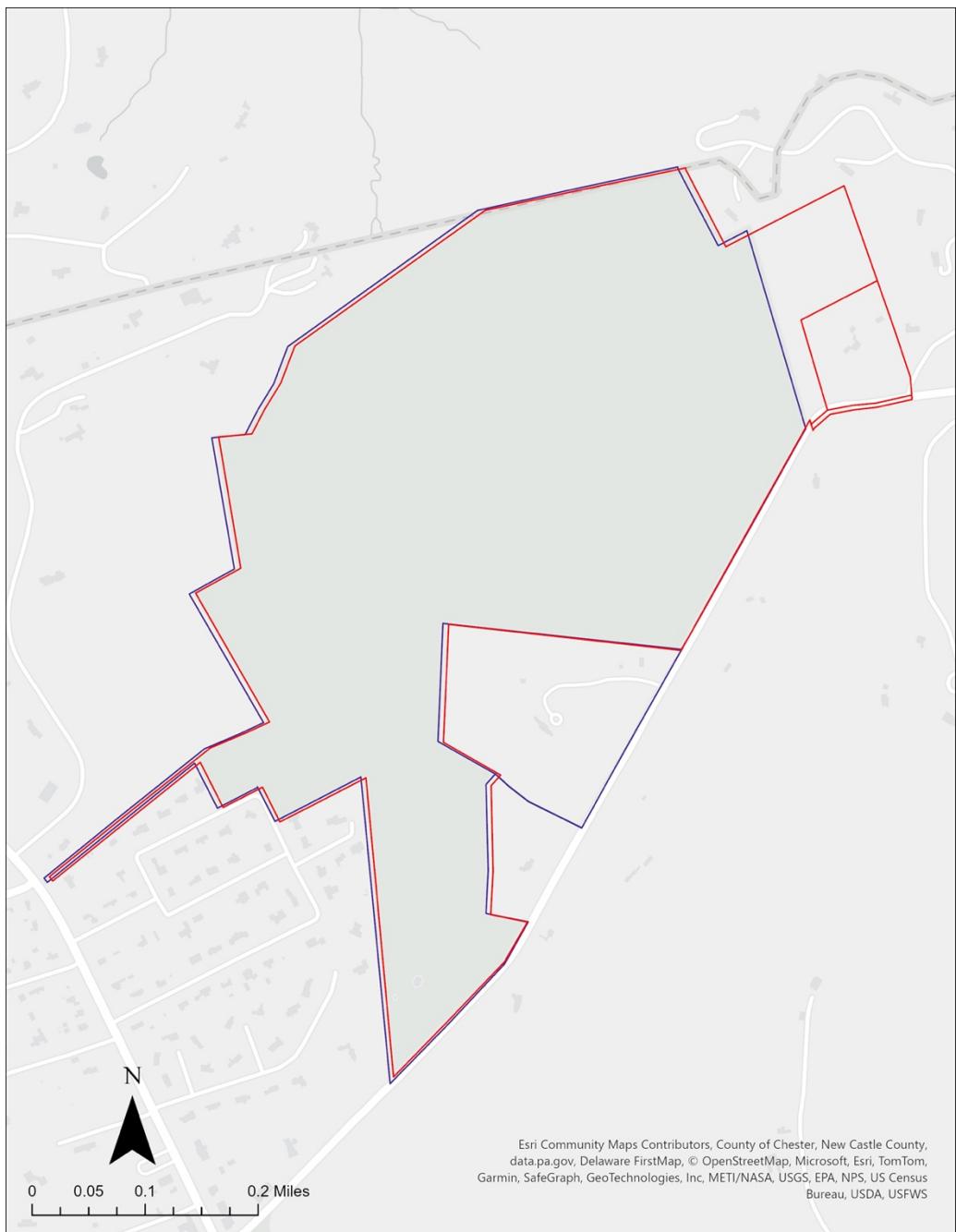


Figure 6: Updated boundary of the property following refinement using the survey map. The red line represents the latest boundary, while the purple line indicates the old boundary.

3.3 Removing Built-Up Areas from Natural Areas Project

In this project, focused on refining the boundaries of designated natural areas by removing built-up zones. To achieve this, I utilized the 2022 Land Use Land Cover (LULC) classification as the primary dataset for identifying developed zones.

I began by examining the 2022 LULC dataset to identify specific land use codes representing developed areas. Focusing on developed zones was essential to exclude non-natural features accurately from the natural areas. Key land use codes selected for exclusion included:

110-129: Residential and Commercial Areas – Encompasses various residential types (e.g., single-family dwellings, multi-family dwellings, mobile home parks) and commercial zones.

130: Industrial Areas – Includes zones designated for manufacturing, processing, and other industrial activities.

122-149: Transportation, Communication, Utilities – Covers transportation infrastructure, utilities, and communication facilities.

160-170: Mixed Urban/Built-up Areas – Captures areas where urban development is mixed, indicating built-up environments that do not align with natural conservation.

180: Institutional/Governmental – Includes areas dedicated to government, educational, and institutional facilities.

By selecting these codes, representing all areas classified as built-up within the designated natural areas, providing a clear view of which parts of the natural areas needed to be excluded. To refine the natural area boundaries, I employed the Erase Tool in ArcGIS Pro to remove the built-up zones from the natural area polygons, this tool allowed me to “erase” all areas classified under the selected land use codes from the natural areas, leaving behind only the undeveloped and ecological value land.

After erasing the developed areas, I verified the refined boundaries by cross-referencing the updated natural area with recent satellite imagery and Landsat 8-9 Normalized Difference Vegetation Index (NDVI) Colorized.



Figure 7: An example from removing built-up area from natural area project, purple area indicates built-up zone within a natural area that has been excluded during the refinement process.

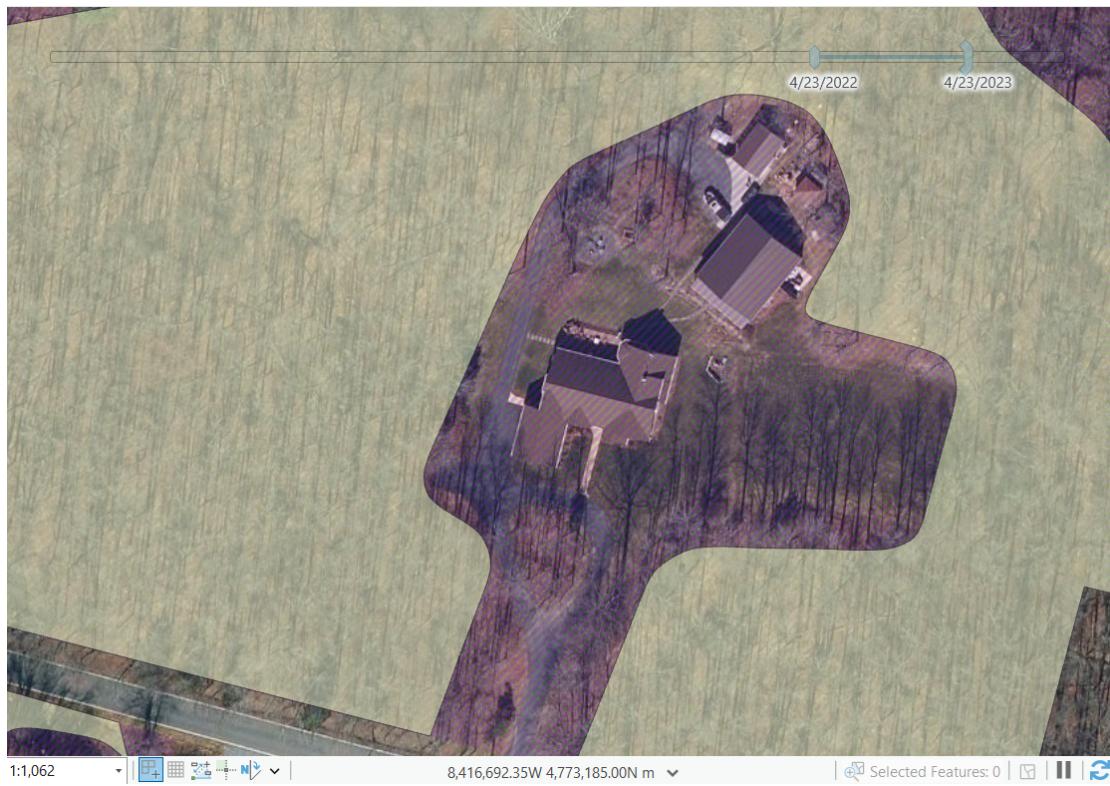


Figure 8: A second example.

Chapter 4: Internship Assessment

4.1 Learning Outcomes and Relevance to Course of Study/Career Goals

My internship with DNREC's Division of Parks and Recreation was an enriching and transformative experience that allowed me to apply my GIS skills in a practical conservation setting. One of the most significant learning outcomes was mastering the use of ArcGIS Pro for analysis. I had the opportunity to engage with these tools beyond basic coursework, applying spatial analysis and data management techniques to tasks like removing built-up areas from natural boundaries and boundary refinement. I gained invaluable insights into environmental management and land preservation, as well as hands-on experience with advanced GIS techniques and data management processes.

In addition, I learned to use specific GIS functions, such as the Traverse Tool for boundary mapping. These tools allowed me to perform precise, complex transformations that I had previously only encountered in theory. The practical application of these methods has deepened my understanding of spatial data management and equipped me with skills that can be directly applied to careers in environmental management and conservation planning. Moreover, working with survey data and conducting property boundary refinements provided insight into legal and regulatory aspects of land management, a valuable perspective for anyone pursuing a career in the public sector or land conservation.

Another important learning outcome was gaining hands-on experience in project planning and data documentation, for example, using ArcGIS Field Maps for conservation-based data collection. I clearly know each project's required objectives, planning steps for data collection and analysis, and documenting each phase to ensure clarity and accuracy. This aspect of the internship helped me develop necessary project management skills, from setting priorities to resolving unexpected issues, which are critical in any professional role. Through this structured approach, I strengthened my attention to detail, ensuring that every data output met DNREC's standards and could be easily understood by future users. The ability to effectively

document and organize data is an essential skill in GIS work, especially in an organization where accurate data is the foundation of conservation efforts.

Beyond technical and project-based skills, this internship allowed me to see how GIS can support decision-making in the public sector, particularly in areas related to land use planning and environmental policy. It also provided a clearer understanding of the day-to-day challenges and considerations faced by public sector agencies, such as balancing conservation priorities with the needs of landowners.

4.2 Recommendation for Other IDCE Students

I would highly recommend this internship with DNREC's Division of Parks and Recreation to other students IDCE department, especially those pursuing GIS, environmental science, or conservation management. This internship offers a unique opportunity to apply academic GIS skills in a real-world setting where every project contributes to meaningful conservation outcomes.

For students in GIS specifically, this role provides hands-on experience with essential tools like ArcGIS Pro and ArcGIS Field Maps, moving beyond typical classroom exercises to engage with real conservation data and field applications. You'll have the chance to work on different tasks, all of which require attention to detail, critical thinking, and technical problem-solving, gaining a significant advantage in the course and future career.

One of the biggest benefits of this internship is the exposure to public sector work and the valuable insight into how government agencies operate in the field of environmental protection. DNREC's team provides both guidance and autonomy, allowing interns to take ownership of projects while also offering support when dealing complex tasks. Working in a government agency allows students to gain direct insight into how policies and conservation strategies are developed and implemented, and how GIS can help make those decisions.

Chapter 5: Conclusion

My internship with DNREC's Division of Parks and Recreation was an invaluable experience that provided both professional growth and practical skills development. Through projects like boundary refinement and the exclusion of built-up areas from natural conservation zones, I was able to apply GIS techniques in ways that directly support DNREC's conservation objectives. This internship not only enhanced my technical skills in tools like ArcGIS Pro and Field Maps but also deepened my understanding of how GIS can shape environmental policy and conservation planning.

This experience also makes me realized my shortcomings and needed to continuously improve my GIS technical skills, project management abilities, and adapt to the strict regulatory standards in a professional environment. Working for a government agency emphasized the importance of procedural rigor, as DNREC requires the use of licensed software, and prohibits unauthorized software such as QGIS and PostgreSQL, and this emphasis on compliance requires me to strengthen my skills.

Besides, I would like to express my sincere gratitude to my professor, Yelena Ogneva-Himmelberger, for her guidance and support throughout this journey, and to my manager, Melanie Cucunato, whose mentorship was invaluable in helping me navigate each project with confidence. I am also deeply grateful to all the colleagues and team members at DNREC who provided their expertise, assistance, and encouragement. Their support made my experience rewarding and inspiring.

The real-world applications and practical experience of GIS have strengthened my resolve to continue working in geospatial technology. Overall, this internship provided a bridge between academic learning and professional practice, equipping me with skills that are directly transferable to a future career in geospatial technology. I am grateful for the opportunity and confident that the knowledge and experience gained will guide me in making a meaningful impact with GIS in whichever path I choose.