



GIS Training in Transportation And Environmental Justice for Promoting Student Success in STEAM Education

Joowon Im, Ph.D.
Alan Klein, MCRP
Amruta Sakalker



GIS TRAINING IN TRANSPORTATION AND ENVIRONMENTAL JUSTICE FOR PROMOTING STUDENT SUCCESS IN STEAM EDUCATION

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by

Joowon Im
Alan Klein
Amruta Sakalker
University of Texas at Arlington

for

National Institute for Transportation and Communities (NITC)
P.O. Box 751
Portland, OR 97207



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16. Abstract <p>Transportation land uses have a significant impact on vulnerable ecologies, especially in a rapidly urbanizing region like Dallas-Fort Worth. To study this relationship, the research team will develop a pilot ArcGIS lab course to expose high school students to critical regional tools and technology. This course will demonstrate the connections between transportation planning and design and environmental justice. The College of Architecture Planning and Public Affairs at UT Arlington will partner with CityLab high school in the Dallas Independent School District to develop a four-week lab course curriculum in ArcGIS and other emerging regional mapping technologies.</p> <p>High school students will be introduced to mapping tools, literature on transportation land uses, and access to alternative transportation types around the Trinity River in Dallas. The curriculum will be developed jointly by the research team and the high school teachers to ensure replicability by the teachers beyond the pilot course. The pilot course will include a lab course in GIS, guest lectures by transportation and environmental planning experts, and site surveys with emerging technologies such as an analysis using a drone. The GIS analyses and findings from the lab course will help students formulate a program for their planning and design studios that addresses transportation and environmental justice issues of accessibility around the Trinity River. The findings will also feed into the larger research that documents various aspects impacting the well-being of the Upper Trinity watershed.</p> <p>The pilot course aims to demonstrate the interdisciplinary relationship between transportation planning, sustainability, and architecture to students with future trajectories in transportation and related fields. It will also help students to apply new software skills to real-world cases around them.</p>			
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Kathleen I. Stanford | Regional & Community Planning Graduate Student, Graduate Research Assistant at IUS I UTA
Avery Dearing-Frank, Graduate Research Assistant | Landscape Architecture Program I UTA
Dasom Mun Graduate Research Assistant | Landscape Architecture Program I UTA

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EXECUTIVE SUMMARY

Transportation planning integrated with considerations of environmental justice and equity is critical to achieving sustainable and resilient cities by addressing ecological and social issues. Early exposure to related subjects to young students can help to raise awareness regarding environmental issues and transportation planning. To raise awareness and promote the importance of environmental justice in transportation planning, the research team developed a GIS (Geographic Information System) workshop focusing on the relationship between the Trinity River, a primary waterway in the Dallas-Fort Worth Metroplex, and transportation accessibility for high school students. GIS was selected as an instrument to provide a lesson for transportation planning in this matter focusing on STEAM education that can help students develop skills useful to promote their academic success in higher education and future career success.

The project had three phases that are Curriculum Development & Data Collection, GIS Workshop & Tutorial, and Exhibition & Course Feedback. Each phase is designed as follows:

Curriculum Development & Data Collection: The research team developed a curriculum to teach high school students GIS (ArcGIS Pro) program. The curriculum was planned to focus on the transportation network and issues related to environmental justice in the communities along the Trinity River. The GIS workshop was designed to support the existing course at the partner high school, so the research team collaborated with the teacher to develop a tailored program for the existing coursework. The data was collected regarding the course topics from governmental and official websites to ensure a validated and accurate analysis of the data.

GIS Workshop & Tutorial: The GIS workshop consisted of tutorials, guest lectures, and a field trip to provide students with multifaceted experience. Tutorials are focused on getting students familiar with the interface and learning different analysis tools. Guest lectures provided opportunities to engage with practitioners and see real projects utilizing GIS analysis. The field trip provided an opportunity for students to explore and learn about the Trinity River, surrounding trail networks, and ecological conditions onsite that have been discussed in class as they work on creating maps using GIS.

Exhibition & Course Feedback: The work of the students has been displayed at AD EX (Architecture and Design Exchange), an architectural exhibition space, to showcase and celebrate their work. The feedback from the participating teachers and students was collected and informed future considerations for the GIS workshop.

1.0 ABOUT THE GIS WORKSHOP

The goal of the project was to raise awareness of the importance of environmental justice in transportation planning by introducing high school students to mapping tools and data on access to alternative transportation types around the Trinity River in Dallas. The research team focused on introducing real-world data and topics in GIS that were relevant to the class projects. To ensure appropriate knowledge transfer, the teachers from the partner school were partly involved in the curriculum development.

1.1 BACKGROUND AND IMPORTANCE OF THE RESEARCH

Significance of university and high school partnership – Universities are known to produce high-quality research. However, in most cases, it is published and shared in higher academic outlets and journals (López Turley & Stevens, 2015). This significantly reduces its impact on the youth studying in high schools, who would be the future students at those universities. As a research university, UTA (University of Texas at Arlington) has access to a variety of resources which includes data, software expertise, interdisciplinary knowledge of complex problems, and a strong industry network. Though research-education partnerships are highly beneficial to both partnering institutions - universities and high schools - it has been cited to be challenging to set up and difficult to maintain (Snipes, 2006). This project aimed to address the gap in research universities focusing on publishing research in prestigious journals (López Turley & Stevens, 2015), rather than applying the research in settings that could benefit from the knowledge, like schools and youth living in and around Trinity. This helps build upward mobility.

Unlike a typical university research grant, this project utilized the university-school partnership to co-create a curriculum with high school teachers. The project utilized data from an existing research project done at UTA, but also located around the school context.

Utilizing project-based learning - The DFW (Dallas Fort Worth) metroplex is experiencing drastic urbanization due to a population boom in the region. This has resulted in a large amount of impact on natural resources like the Trinity River and the green spaces around it. To address these urban changes, topics of active transportation planning around Trinity River are trending. Many neighborhoods, especially in south and west Dallas, have lacked access to walkable and safe green spaces. The research team tried to deliver related issues while developing the curriculum.

Engaging the youth with urban challenges around them

As the momentum to make the river accessible increases, this project aims to include the expectations and interpretation of the youth of Dallas for the future of Trinity River with their studio projects. Engaging the youth with real-world data on a topic that is actively being pursued by the city and its residents will help them engage with current challenges and apply their skills to understand how their education can provide solutions to the problems surrounding them.

1.2 OBJECTIVES

There are numerous reports that show teaching in transportation planning and environmental justice varies from state to state and among classrooms (Jelks & Jennings, 2022). Therefore, this project provided youth with STEAM-supported, interdisciplinary transportation planning-based topics to supplement what they may or may not receive in their classrooms. Taking advantage of the design elective available to students at CityLab, this project integrated the studio curriculum with data gathering and representation on GIS, and a field trip that focused on observing ways to improve amenities and access to the Trinity River.

In contrast to a purely conceptual approach to introducing GIS that uses foundational and standard data that is unrelated to what the students observe around them, this workshop encouraged students to engage with data and topics that they inferred required attention. This helped to deepen and foster the understanding of the role of education in solving real-world problems that they observe, build knowledge of important terminology of transportation planning, and build a personal experience in solving problems. Teaching about transportation planning, environmental justice, and design concurrently with an emphasis on developing buildable solutions helped students build an in-depth case study of studying their contexts through an interdisciplinary lens.

The UTA researchers and the participating teachers from CityLab believed that young people have the knowledge and awareness to identify the issues of importance in their communities. Allowing the youth to engage with data helps them study the issues that they observe around them and provides them with tools that help them to create evidence from their observations. This will result in building their confidence and voice in civic efficacy. Also, an active learning-based pedagogy has been shown to improve student engagement, increase academic achievements in STEM (Derevenskaia, 2014; McCright, 2012), and motivate students to do better by showing the connection of their learning to a larger purpose (Soper et al., 2015). It will ultimately help to improve student retention in higher education.

2.0 THREE RESEARCH PHASES

2.1 CURRICULUM DEVELOPMENT AND DATA COLLECTION

The research team developed a curriculum to promote a multifaceted learning experience for high school students (See Fig. 1). In the process, the research team invited the teacher from the partner school and the GIS Workshop instructor to finalize the curriculum development. It was intended to connect the project's topic scope to the GIS data that would be made available for the students and integrated to the GIS instructor's class activities and teaching needs. The data on Trinity River, the adjacent amenities and infrastructure, transportation network, and data relating to environmental justice were gathered for the project.

During the curriculum development phase, the research team provided the scope of the data and the type of data available for the DFW region. The partnering schoolteacher helped to ensure that the data would be suitable for their studio projects and provided inputs on selecting types of data adequate for the high school students. The GIS instructor helped to ensure that the scope could be translated to teaching.

The GIS workshop was planned as a four-week training and scheduled to be at the beginning of the studio classes in Architecture, Environmental Sustainability, and Urban Planning Paths. To ensure that the findings from the GIS training are used by the students in their class projects, the team focused on collecting data and creating the GIS curriculum that informed the studio project's scope.



Figure 1 Project Timeline

2.1.1 Methodology

The scope of the grant primarily focused on developing GIS training and lectures to address issues concerning transportation and environmental justice for high school students who set their career goals within STEAM education, especially concerning urban planning, architecture, and landscape architecture. The methodology used aimed to provide students with an opportunity to advance their skills to be successful when they pursue degree programs at higher education institutions and/or professional careers in the related fields after graduation.

Phase 1 - Curriculum Development & Data Collection

The research team developed a curriculum for GIS training that was integrated into curricula in multiple disciplines (Architecture, Environmental Sustainability, and Urban Planning Paths) at the partner high school in collaboration with the teachers (CityLab in Dallas). The collaborative research team together developed the schedule for a four-week GIS training that included GIS workshops and lectures from professionals of related fields (e.g., active transportation planning company, NCTCOG, Trinity Coalition). The collaborative team discussed the scope of the project and the UTA research team collected GIS data layers and modified them for convenient use for high school students accordingly. The organization of the GIS training session is presented in the Curriculum Structure section below.

Phase 2 – GIS Workshop & Tutorial

The UTA research team coordinated with the partner school to provide GIS training to students when the new semester started, for the month of September. A total of 30 students participated in the workshop. The UTA research team supervised the overall schedule, communicated with the faculty at the partner high school, organized lectures of invited professionals, and ensured the program's successful implementation. One designated person with professional knowledge in GIS analysis was hired as a primary instructor of the GIS tutorials and workshops. There was also a supporting instructor, a teaching assistant who had ample knowledge in GIS analysis, finishing their master's in planning from UTA. Guest lectures were provided that were integrated with the GIS training. The field trip was scheduled after the GIS training was completed to provide the students an opportunity to observe if their observations and analysis on GIS were comparable to site observations. The field trip was scheduled at a park that was accessible to Trinity River, a DART station, a bus stop, and a kayak launch.

Phase 3 Exhibition & Course Feedback

The research team conducted a post-evaluation survey for the teachers and students at the partner high school to examine the effectiveness of the GIS training program. The findings are being used to modify and improve the developed curriculum so that it can be adopted by other similar schools. Also, an exhibition of the student work took place in March and April of 2022, which highlighted the effectiveness of the GIS transportation analysis as a context study for the students' studio projects. The exhibition was arranged by the research team in collaboration with the staff at the American Institute of Architects Dallas head office. Lastly, the research team submitted an improved proposal

to the CTEDD grant for the expanded impact that this research has on two other local high schools that expressed the desire to include GIS training as part of STEAM education.

2.1.2 Data Collection

The data on Trinity River segments that flow across multiple cities in DFW, shapefiles of cities of DFW, shapefiles on neighborhood amenities that are adjacent to the Trinity River like parks, river access points, trails, bus stops and DART rail stops, highways, and the CDC (Centers for Disease Control and Prevention) vulnerability data for the neighborhoods adjacent to the Trinity River were downloaded, cleaned, and simplified during this phase.

A base map was created using some of the shapefiles that were collected for the training. This base map served as a starting point for the students to engage with the GIS interface, observe and interact with all the information made available.

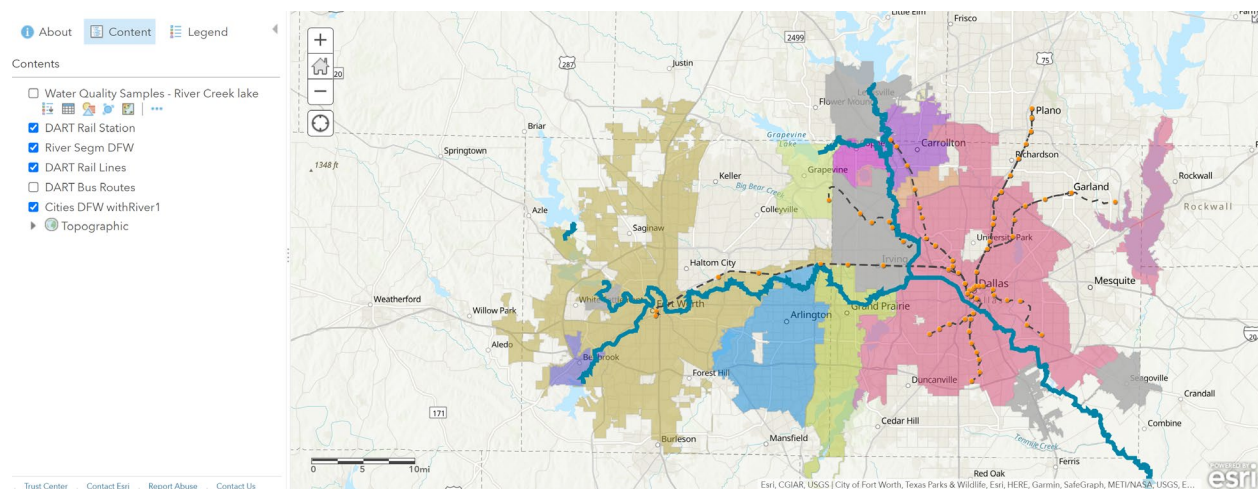


Figure 2 A base map was created with basic data on ArcGIS Online for demonstration.

The UTA research team used multiple data sources to create the base map.

1. City boundaries, Trinity River – North Central Texas Council of Government's (NCTCOG) data portal was used to download data on city boundaries for the DFW MSA. Out of all the city boundaries, only those cities through which Trinity River flows were selected for the base file.
2. DART metro station and metro line data – This dataset was acquired from the transit agency. Our partnering GIS instructor helped to acquire this dataset from DART.

2.2 GIS WORKSHOP AND TUTORIAL

2.2.1 GIS Workshop Instructor

The instructor was carefully selected to teach the GIS program. The instructor is a practitioner who actively works with the GIS program and has the most updated knowledge in GIS analysis. The instructor was in charge of teaching the GIS program based on the provided curriculum.

2.2.2 GIS Workshop Guest Lectures

Guest lectures provided opportunities for students to learn about real-world projects and interact with professionals who utilized the GIS program in their projects. The breadth of the topics that guest lecturers talked about broadened the perspective of students learning the GIS program. Each lecture was integrated with one of the GIS tutorial modules.

2.2.2.1 Guest Lecture 1: The Art and Science of Planning and Design – Finding Ways through Floodplain and Forest by a Special Projects Manager at Halff Associates, Inc.

Multipurpose transportation-trail alignments, once prioritized, oftentimes require feasibility analysis before engineering and landscape architecture construction documents and specifications can be developed. In working through the implementation steps for the Trinity Forest Spine Trail that was master planned during 2013, the Halff teams found using GIS to be a valuable tool for the alignment study. Incremental, more granular studies such as this have proven to be a valuable method for vetting the final trail routing, and for helping determine estimates of potential costs. Bud Melton of Halff Associates, Inc. will share how their planning and landscape architecture team utilized ArcGIS to evaluate both the horizontal and vertical alignment opportunities and constraints for this forest trail connection project.



Figure 3 Floodplain analysis model to determine optimum alignment and trail surface elevation



Figure 4 KCS Rail Trestle Underpass concept

2.2.2.2 Guest Lecture 2: From River of Death to National Water Trail by Trinity Coalition

The Trinity River is one of the most valued natural assets in Texas. The lives of everyone living in the Trinity River watershed are intimately connected to the naturescape of the river, and nature-based tourism is a thriving industry in Texas. The quality of the water in the Trinity River is pristine, and a safe place for recreation and fresh-water fishing along the river to the Gulf of Mexico. The entire Trinity River corridor through DFW (Dallas Fort Worth) is designated as a National Recreation Area, creating the largest National Recreation Area in the country.



Figure 5 Location map of launchpads on Trinity River, across the DFW metroplex



Figure 6 Slide representing the projects undertaken by Trinity Coalition to address trash problems in Trinity River

2.2.2.3 Guest Lecture 3: Access and Mobility - Making Transit Connections Across the Region by a Transportation Planner at North Central Texas Council of Government (NCTCOG)

Transit planning in North Central Texas is a complex process directly impacting individuals' access and mobility throughout the region. At a regional level, staff must collect and evaluate mobility gaps using a combination of both spatial and anecdotal evidence. The barriers to access are further exacerbated by environmental justice concerns. Lack of access to transportation often translates to lack of access to necessities and services such as food, healthcare, or employment. Coverage does not always provide comprehensive access, with first/last mile concerns, fare equity, and multimodal trip needs requiring additional consideration and unique solutions. This lecture will explore these challenges to coordinating public transportation throughout the region and provide insight into several initiatives and projects created to address them.

2.2.3 Field Trip

Partnering with Trinity Coalition, an environmental and recreation-based regional non-profit organization, the research team provided a field trip to a local park in Dallas, Moore Park. Moore Park is located adjacent to the Trinity River with a river launch, DART rail station, DART bus stop, and a neighborhood park. On the field trip, students had the opportunity to do a short kayak trip in the river with the help and guidance of volunteers from Trinity Coalition. The UTA team developed a field trip observational survey. Volunteers from the North Texas Master Naturalists brought environmental educational materials to talk about wildlife, wetland, and nature in general.



Figure 7 Field trip location: Moore Park

2.3 EXHIBITION AND FEEDBACK

2.3.1 Exhibition

After the GIS Workshop has been completed, students continued to work on their class projects using the information gathered during the GIS sessions. The exhibition showcased students' achievements and provided an opportunity for them to publicly share their work. The exhibition was held at AD EX (Architecture and Design Exchange) in Dallas and the opening reception was held with professional partners of the provided GIS Workshop, design reviewers for the course works at the partner school, teachers, and parents.



Figure 8 Student Exhibition at AD EX, Dallas



Figure 9 Opening Reception at the Exhibition

2.3.2 Feedback on the GIS Workshop

The research team asked the teachers and students to provide feedback using an online survey. The teachers were satisfied with the overall GIS Workshop program while students showed neutral satisfaction. However, most of the comments showed that students were glad to learn a new program. One student said that he/she appreciated learning the skill that many of them did not have and got proficient with the basics of the GIS program after the workshop. Another student said that the GIS workshop was well-paced and informative. Some students thought that the GIS workshop was “opening mind” and enjoyed learning new skills. Students who had some concerns thought the online format made learning the GIS program challenging. Teachers appreciated that they learned how to connect data to maps in simple ways and work on spatial analysis, while one teacher thought a supplementary session could be provided for participating teachers.

3.0 LESSON PLANS

3.1 CURRICULUM STRUCTURE

The curriculum focused on providing tutorials of the GIS program for participating high school students and a multifaceted experience by including other types of education such as a field trip and guest lectures. The GIS workshop was provided for three hours per class for four weeks. The tutorials were provided virtually, and guest lectures were provided either virtually or in person due to the surge of COVID-19 cases at the time of the project. The research team also provided two additional supplementary sessions after the GIS Workshop was completed.

MODULE 1: Introduction to the GIS Workshop & GIS Program

Objectives

The lesson introduces the GIS workshop by providing information about the overall topics and explains what GIS is by providing information about its importance and the properties of maps created by GIS.

Lecture Content

Introduction

- Scope of the study area.
- Understanding environmental assets and benefits in transportation planning.
- The procedure of the GIS workshop.

GIS Workshop

- What is GIS?
- Benefits and resources of GIS
- Various kinds of GIS software
- Exploration of spatial data types (raster, vector, TIN, etc.)
- Scale and its role regarding the importance in mapping and spatial analyses
- Projection/Coordination system

Class Activities & Assignments

- Open the provided map and explore how to navigate the map.

Class Resources

- ArcGIS map online: <https://arcg.is/1uXn9H>

MODULE 2: Starting GIS

Objectives

The lesson provides an understanding of how to start using GIS, the program interface, and the properties of spatial data. It also provides a general understanding of the DFW region regarding natural resources and transportation network.

Lecture Content

- Set up a map.
- Understanding the program interface and functions
- Understanding the difference between ArcGIS Pro and ArcGIS Desktop.
- Working with spatial data in ArcGIS (add/delete data, organize data, create bookmarks, etc.)
- Working with non-spatial data (attributes) in ArcGIS (add/drop fields, calculate/update fields, create graphs, etc.)
- Spatial data visualization (polygon, line, point)
- Spatial data query/filters
- Data view and layout view
- Guest lecture 1

Class Activities & Assignments

- Create a basemap.
- Mark the location where your school is.

Class Resources

- GIS layers (modified and clipped by the research team): Trinity River, Highways, City boundaries in DFW
- GIS References: Shapefile for Trinity River, Highways, and DFW cities boundaries were downloaded from the NCTCOG data website (data-nctcoggis.opendata.arcgis.com). Data on DART bus stops, bus lines, metro stops, and metro lines were acquired from DART.

MODULE 3: Working with Spatial Data and Creating a Map

Objectives

The lesson provides an understanding of how spatial data can be created and modified, and introduces spatial analysis tools regarding their functions and purposes. It also provides an opportunity to think about accessibility to the Trinity River and current modes of transportation that can support it.

Lecture Content

- Edit/modify spatial data in ArcGIS
- Edit/modify symbology
- Labeling
- Attribute (join)
- Spatial data (join)
- Introduction to spatial analysis tools
- Guest lecture 2

Class Activities & Assignments

- Add critical map elements to the basemap from Module 2 considering access to Trinity River and the transit network.
 - Demographics
 - Transit routes/stops
 - Tree cover
 - Land use
 - Public transit

Class Resources

- GIS layers (modified and clipped by the research team):
 - Block group level socio-demographic data 2016
 - DART metro and bus stations
 - 2016 land use data
 - National Land Cover Database 2016
- GIS References:
 - Shapefile land use and socio-demographics was downloaded from the NCTCOG data website (data-nctcoggis.opendata.arcgis.com).
 - Data on DART bus stops, bus lines, metro stops, and metro lines were acquired from DART.
 - Texas Natural Resources Information System (TNRIS) datahub was used to download National Land Cover data and clipped it to relevant geography.

MODULE 4: Working with Spatial Analysis and Exporting a Map

Objectives

The lesson provides exercises in spatial analysis in relation to explored data layers. It also provides an understanding of how to export the created map to make it appropriate for analysis and publicly presentable. Students will be able to examine ground-level accessibility to the Trinity River and trails regarding the site conditions.

Lecture Content

- Spatial analysis tools
 - Clip
 - Buffer/Euclidean Distance
 - Slope
- Layout (map export)
 - PDF
 - Illustrator
- Guest lecture 3

Class Activities & Assignments

- Use at least one spatial analysis.
- Improve map style (symbol) to make it legible and concise.
- Observe how people may access the river considering the transit network and existing trails.

Class Resources

- GIS layers (modified and clipped by the research team):
 - Block group level socio-demographic data 2016
 - DART metro and bus stations
 - 2016 Land use data
 - National Land Cover Database 2016
- GIS References:
 - Shapefile land use and socio-demographics was downloaded from the NCTCOG data website (data-nctcogis.opendata.arcgis.com).
 - Data on DART bus stops, bus lines, metro stops, and metro lines were acquired from DART.
 - Texas Natural Resources Information System (TNRIS) datahub was used to download National Land Cover data and clipped it to relevant geography.

EXTRA: Additional GIS Sessions

Objectives

The lesson provides additional GIS sessions for the teachers (online) and the students (invited to the CAPPA computer lab) due to the delayed class schedule. The content of the sessions is based on the teachers' and students' requests.

Lecture Content

- Loading data layers
- Spatial analysis tools
- Editing the created map (modifying shapefiles, editing symbols)
- Layout (map export)

Class Activities & Assignments

- Go to different websites and download data layers for your project.
- Create/delete data layers as needed.
- Clip the data specific to your site.
- Improve map style (symbol) to make it legible and concise.

Class Resources

- GIS layers (modified and clipped by the research team):
 - Block group level socio-demographic data 2016,
 - DART metro and bus stations,
 - 2016 Land use data,
 - National Land Cover Database 2016
 - Poverty rate at Block group scale
 - Percentage of minority at block group scale
- GIS References:
 - Shapefile land use and socio-demographics was downloaded from the NCTCOG data website (data-nctcoggis.opendata.arcgis.com).
 - Data on DART bus stops, bus lines, metro stops, and metro lines were acquired from DART.
 - Texas Natural Resources Information System (TNRIS) datahub was used to download National Land Cover data and clipped it to relevant geography.
 - CDC Vulnerability Index data for 2016 – Poverty rate and percentage of the minority by block group was clipped and modified from this dataset for neighborhoods related to student's studio project teams.

FIELD TRIP

Objectives

The lesson provides students an opportunity to observe the site in person using various methods such as sketching, taking photos, walking along the river and trails, and flying a drone. It also provides an opportunity for students to measure and observe what they have created using the GIS program onsite.

Location

Moore Park. The selected location has access to the Trinity River with kayak launch pads and is adjacent to the Corinth Wetland, which has a significant ecological value.

Field Activities

- Exploring in the Trinity River: Kayak riding
- Observing the ecology along the Trinity River and trail connections: Online survey and documentation (photos, sketches)
- Learning ecology along the Trinity River: North Texas Master Naturalist's Nature Discovery Trunk regarding wetlands, Trinity River, urban wildlife on the Trinity River, aquatic plants, riparian environments, runoff, pollution
- Learning how to fly a drone: Observation and documentation of environmental resources and trail connections

* Please see Appendix A through Appendix C for supporting materials of the Lesson Plans.

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APPENDIX A

GIS TUTORIAL PREPARED FOR THE PARTNER SCHOOL

A-1. GIS Tutorial for the Workshop

Esri ArcGIS Pro: How-To Guide

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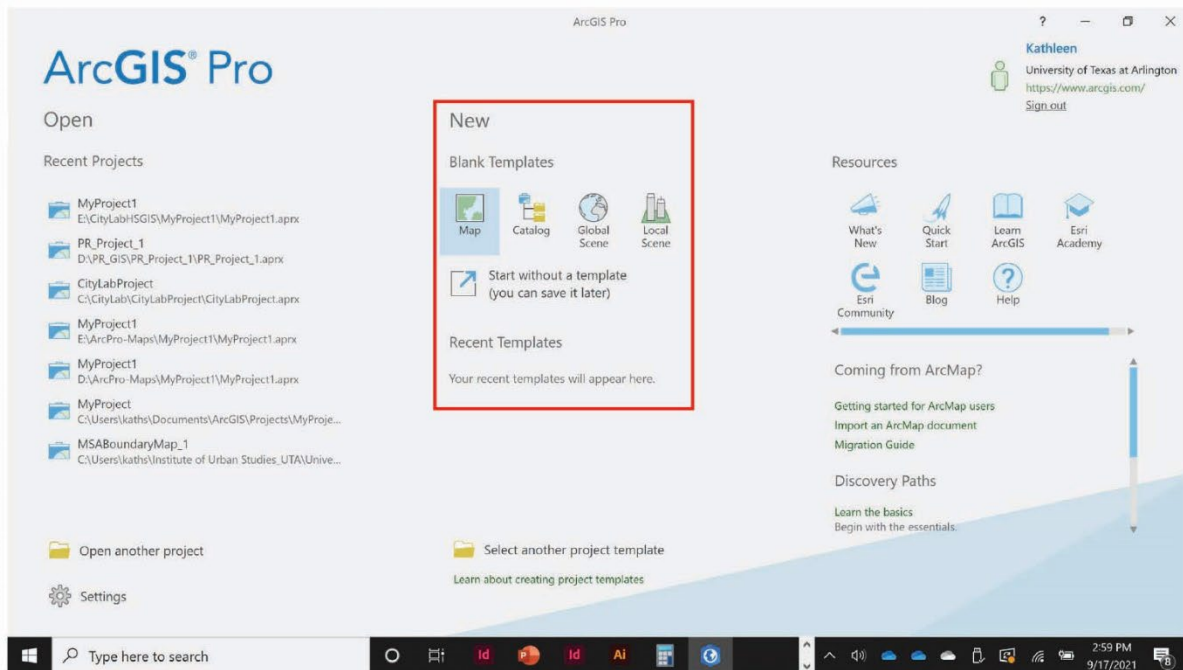
Introduction

This How-To Guide is for setting up a **Map Project** through **ArcGIS Pro**. The topics covered in this document include:

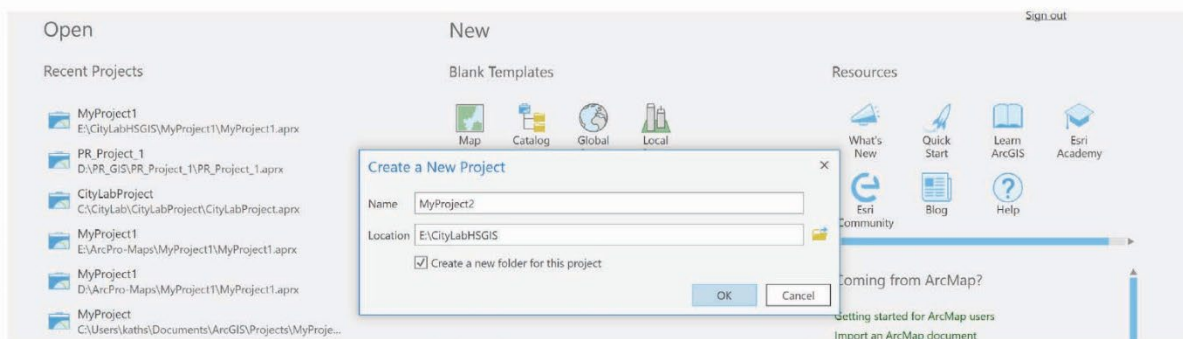
- How to create a new Map Project
- General workspace set up
- Setting up your data
- Ways to add external data to your map
- Using certain tools such as the locate tool and the select by attribute tools
- Changing the symbology of map features

How to Create a New Project Map

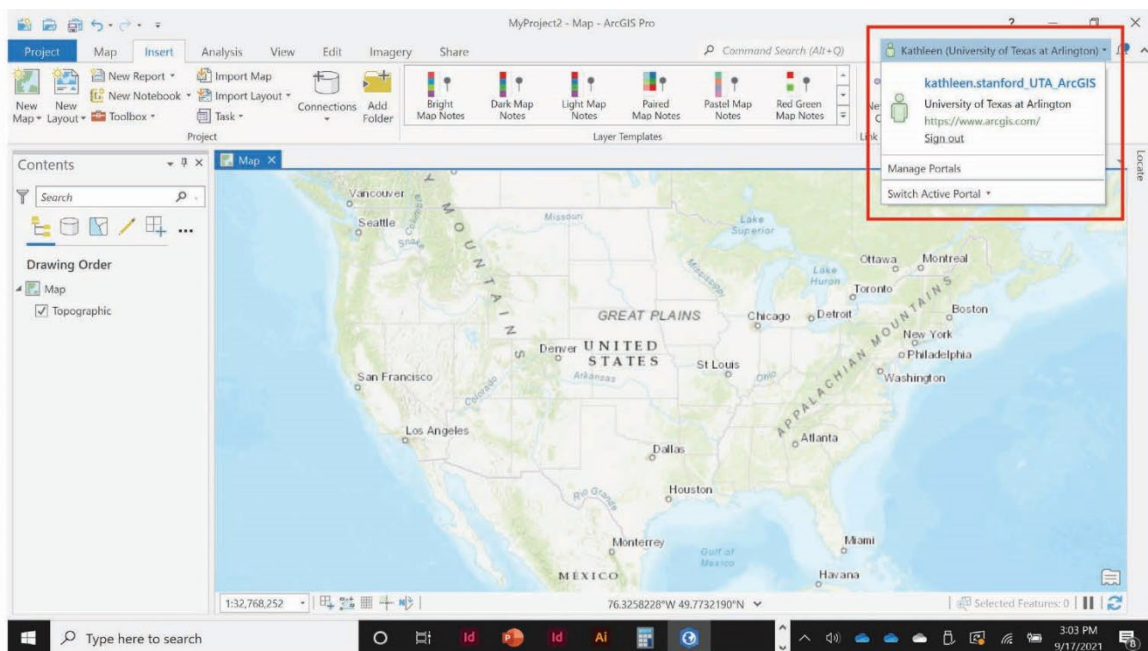
- Open ArcGIS Pro
- Under the middle column **New** → **Blank Templates** → select a new **Map**



- Next, be sure to name your project and to save it in the correct **project folder**.

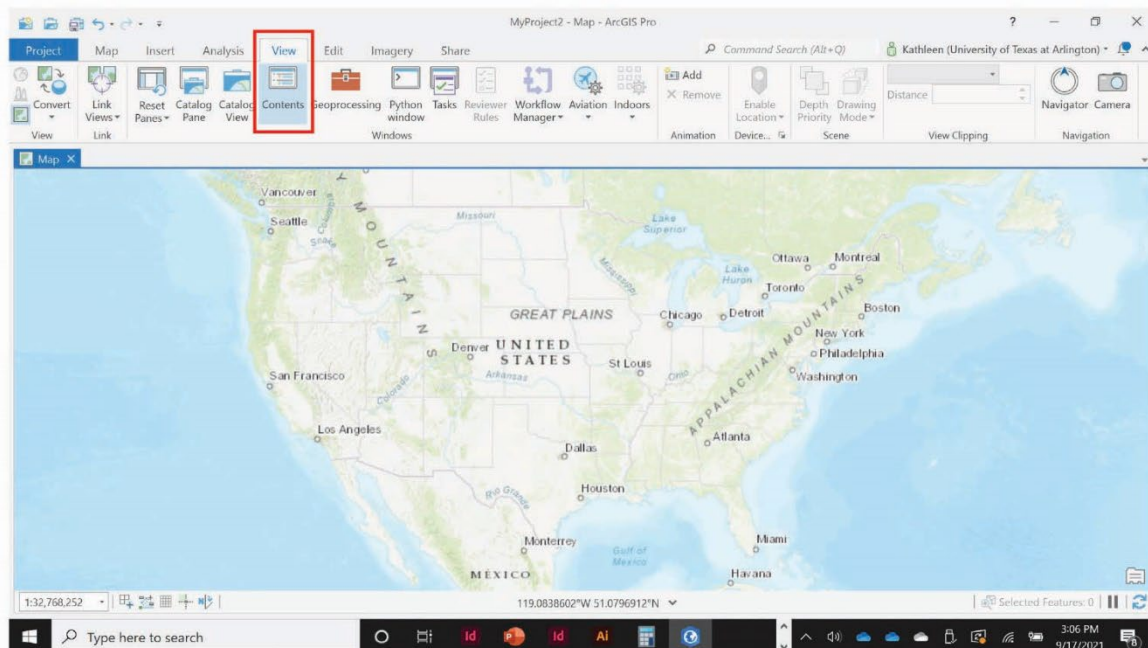


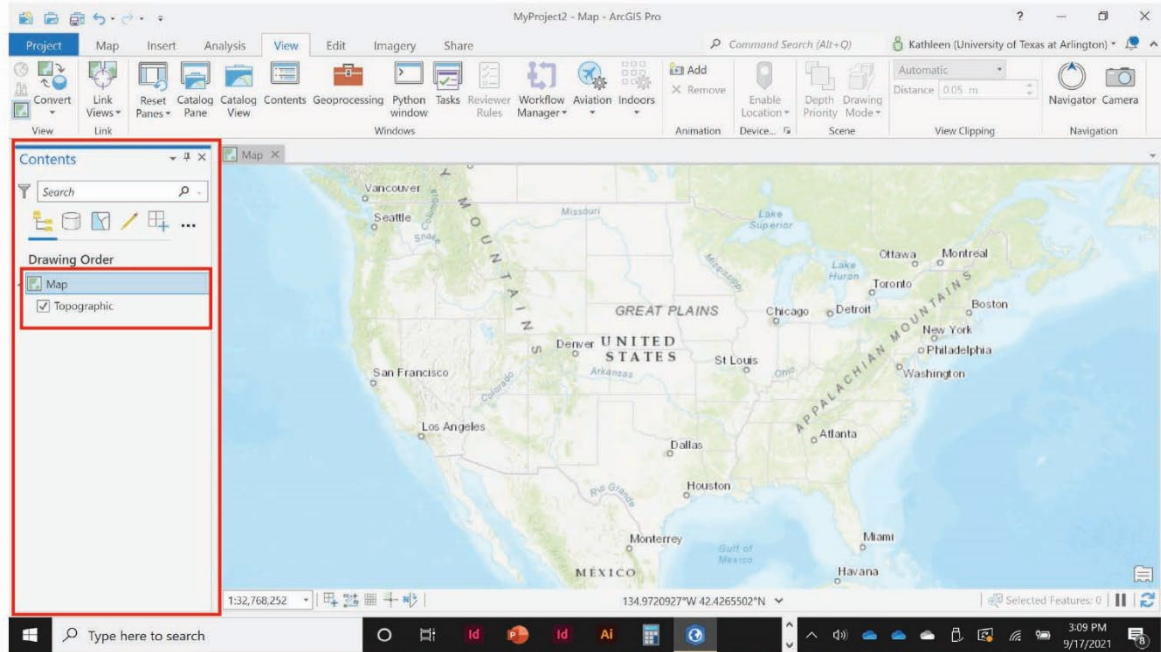
- **Optional Step:** Once ArcGIS Pro has loaded, login to your Esri Account to be able to access more basemaps, certain analysis functions, and more.



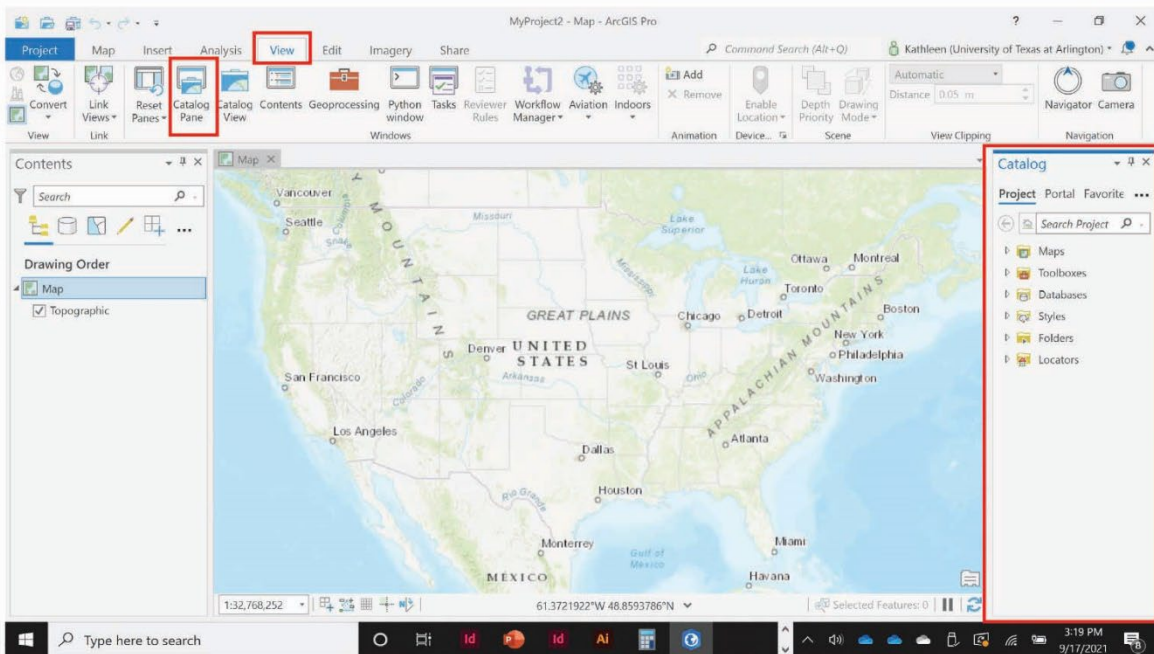
Setting Up the Map Workspace

- If your map did not appear with the **Contents** window pane on the left side of the screen, go to **View** tab → **Contents**
 - a. The **Contents** pane shows users what is being displayed on the map. By default, Esri's topographic map will be the first item in the Contents pane. *Please look at the two screen captures below.*





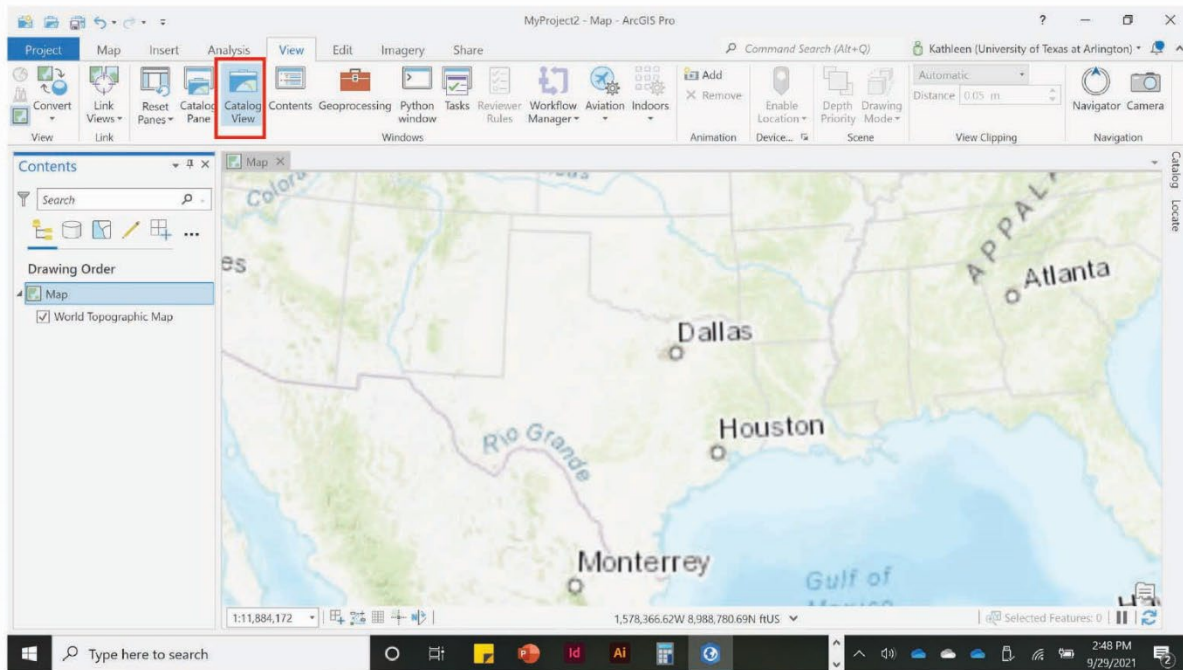
- Next, open the **Catalog Pane** that can also be found under the **View** tab.
 - a. The Catalog Pane shows the project folder and other **folder connections** that will have stored data, created data, etc. for your project.



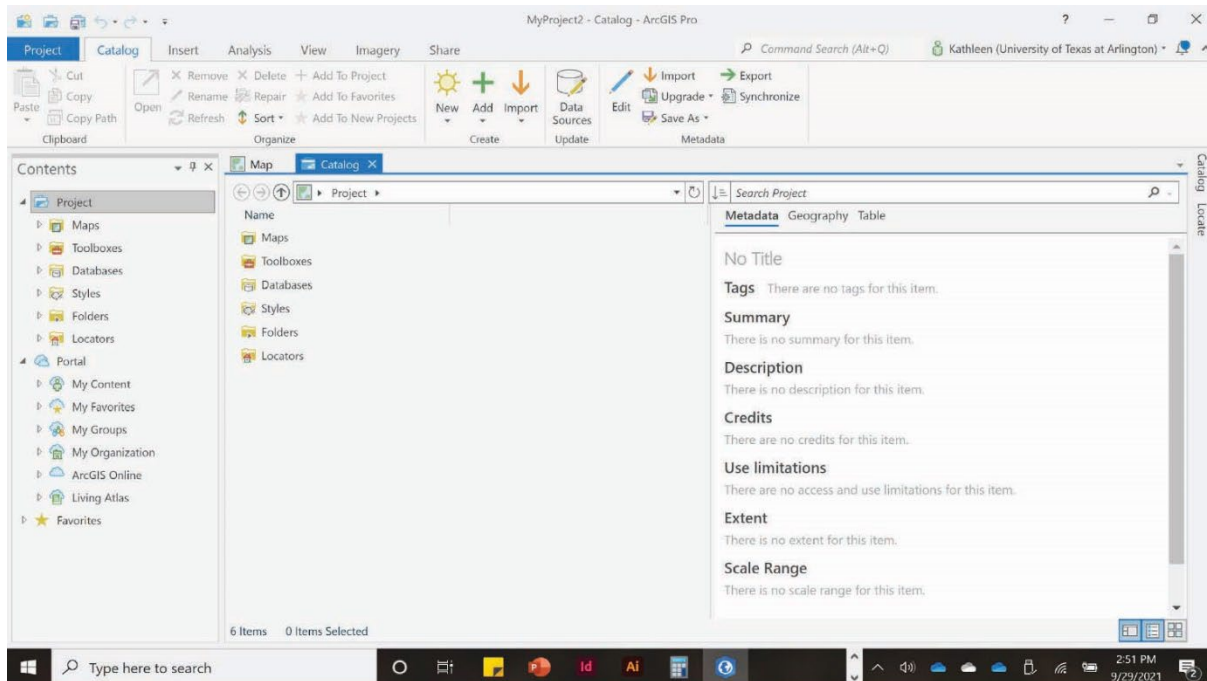
Setting Up Your Data using Arc Catalog

You will access and set up your external data using Arc Catalog. Arc Catalog allows you to add folder connections, to preview data, to edit data, as well as to archive and backup your original data.

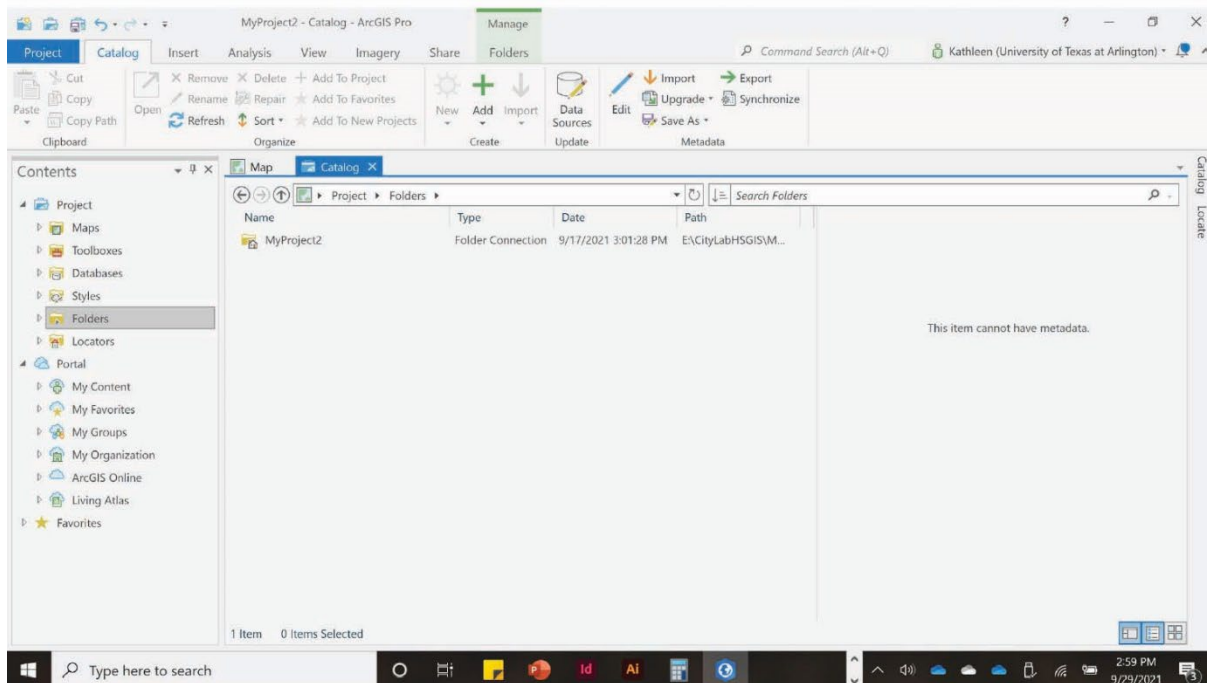
- Go to the **View** tab → click on **Catalog View**



- The screen capture below is the **Arc Catalog** or **Catalog View**.

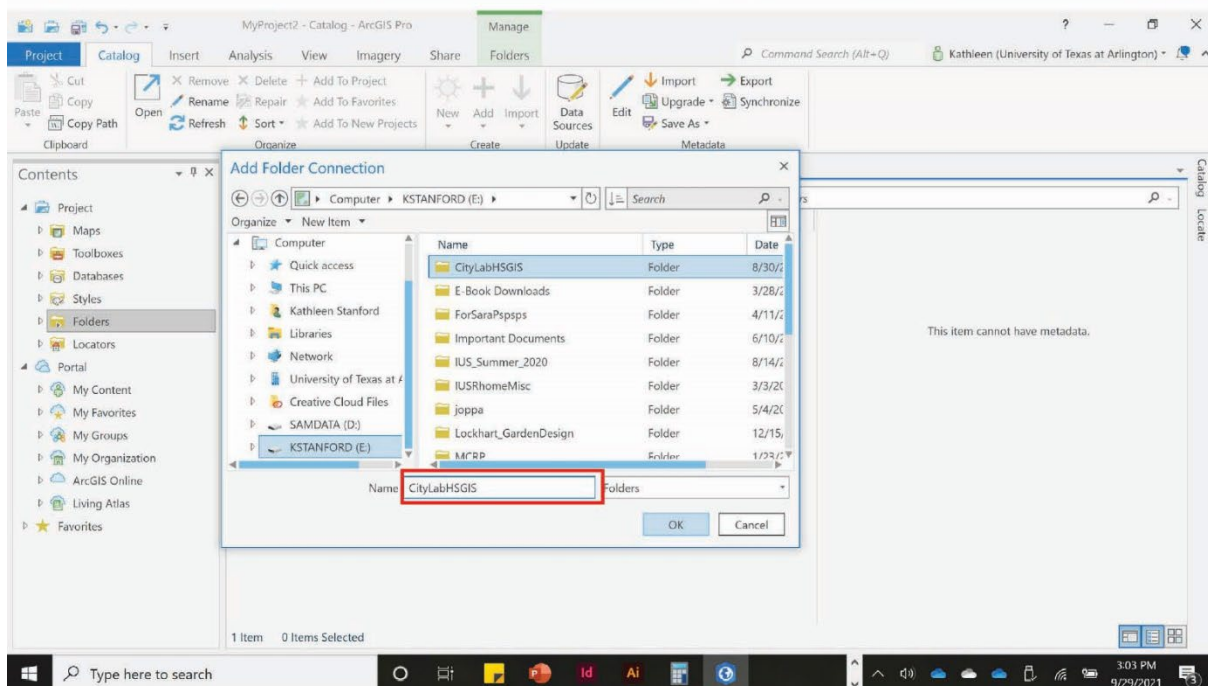
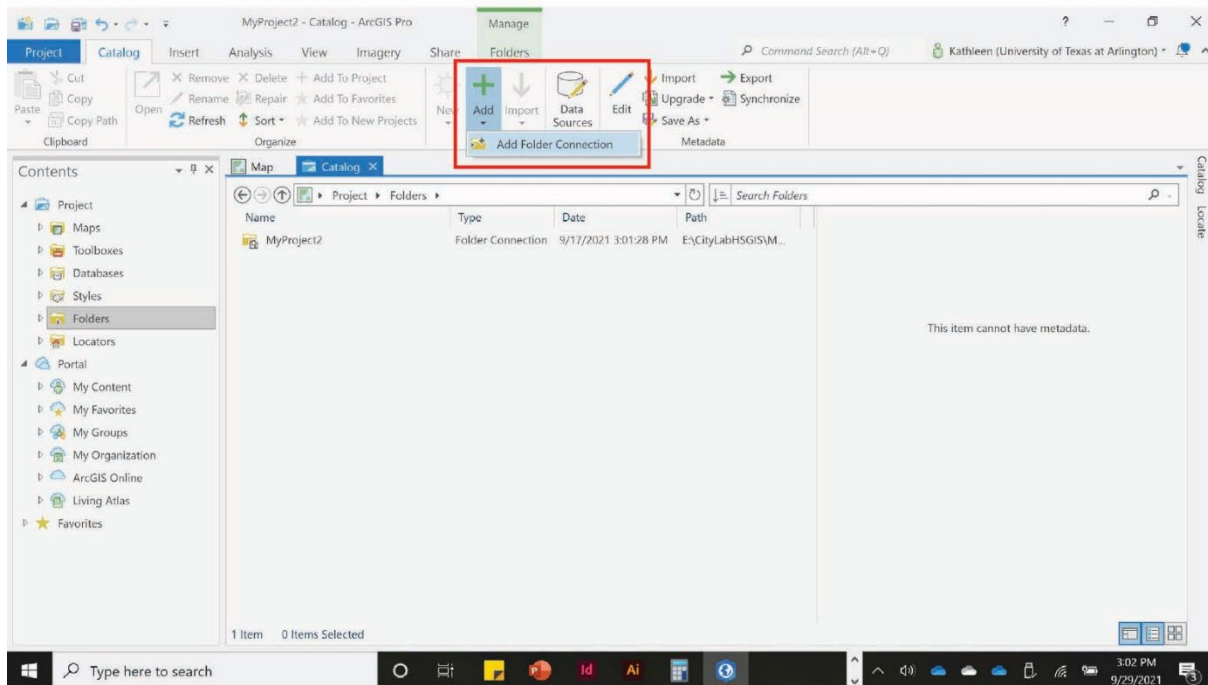


- Next, double click on **Folders** to access your folder connections. It should show your **project folder** and any other folder connections you have. If you do not see a connection to the GIS Data folder, proceed to the steps below.

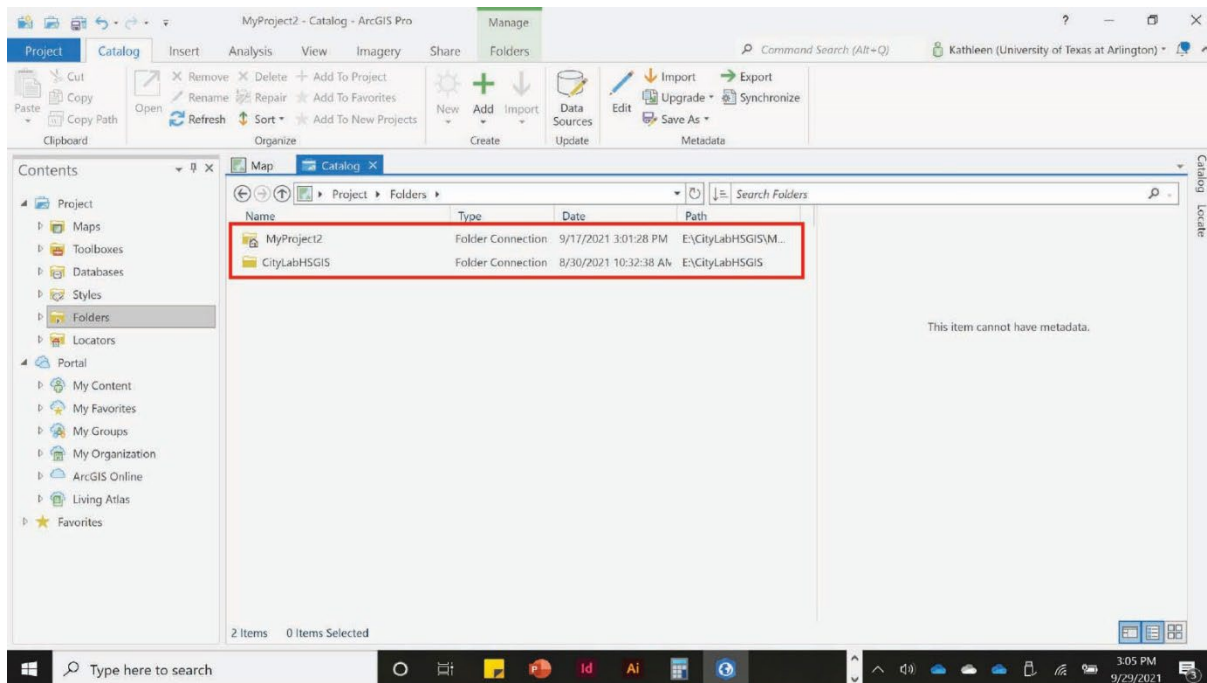


- To add a new folder connection e.g., GIS Data folder go to
 - **Add → Folder Connection** as shown below.

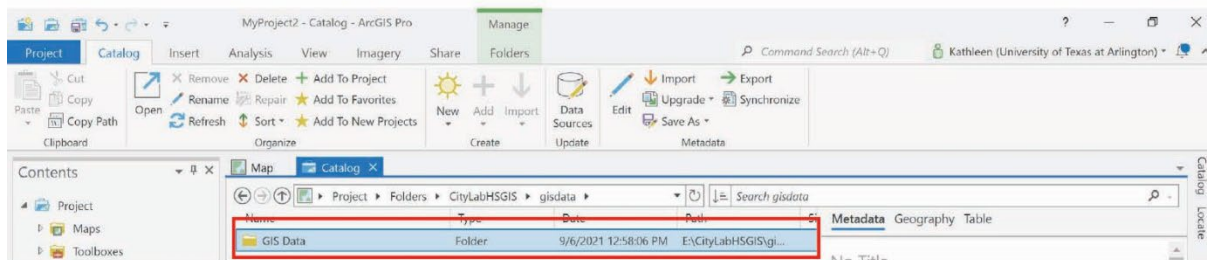
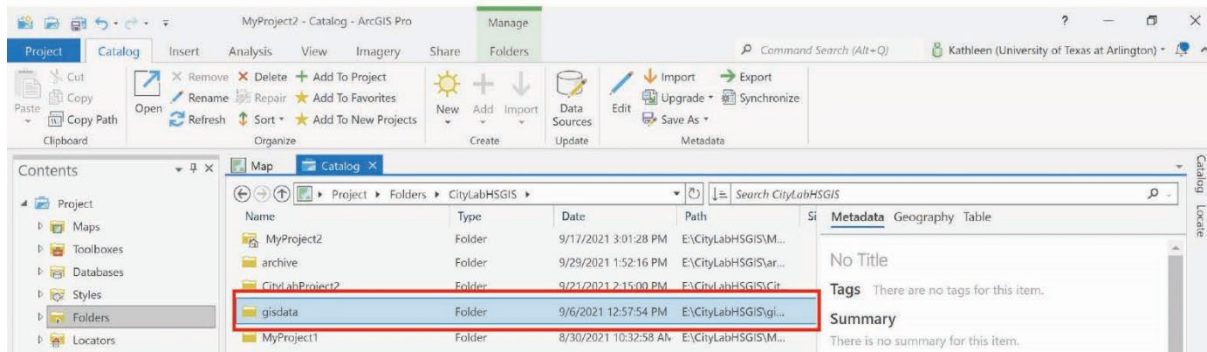
- Then, **navigate** to the CityLab folder with the GIS Data files → Select the **CityLab Folder** and click OK



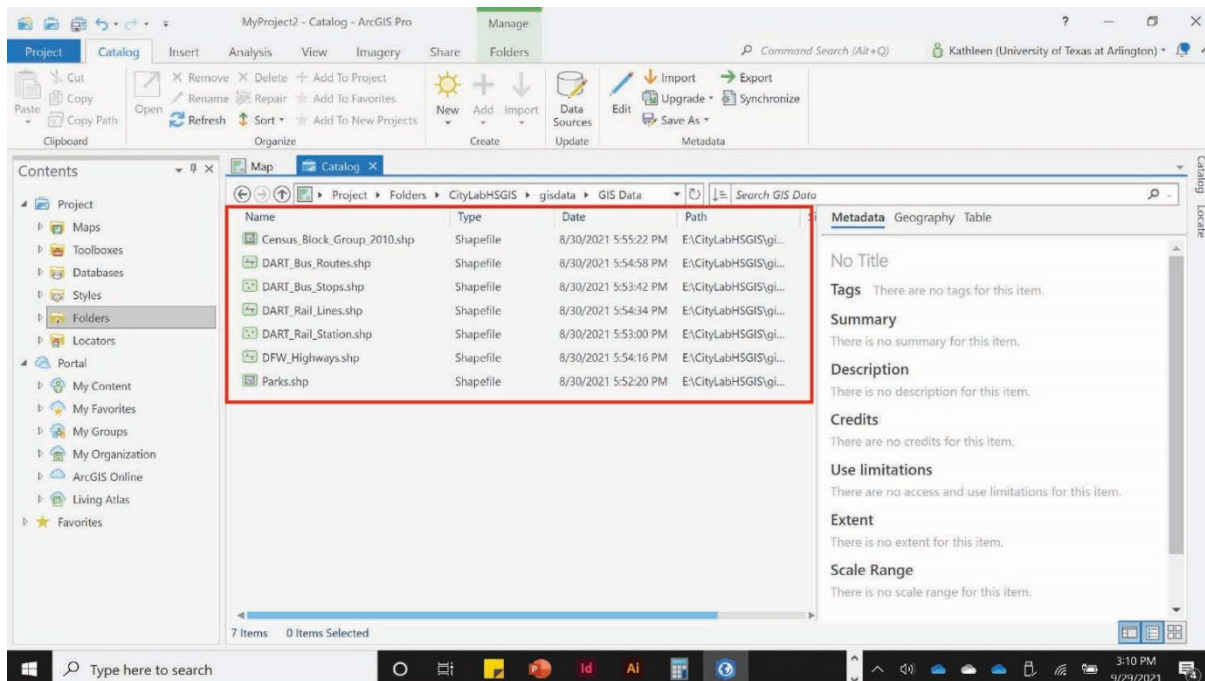
- Your Catalog View should now show (2) folder connections: your project folder and the overall project folder with the GIS data files.



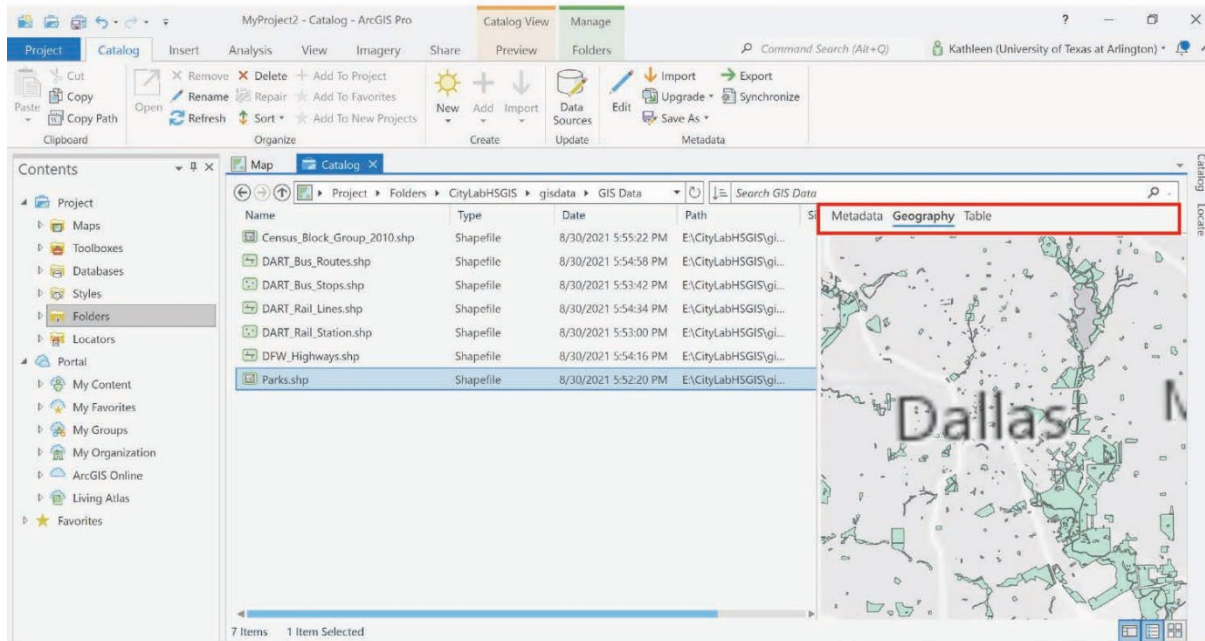
- To view the GIS data for this project, double click on the **CityLab** folder → **gisdata** folder → **GIS Data** folder.



- Now you will see the GIS data for your project in the Arc Catalog View.

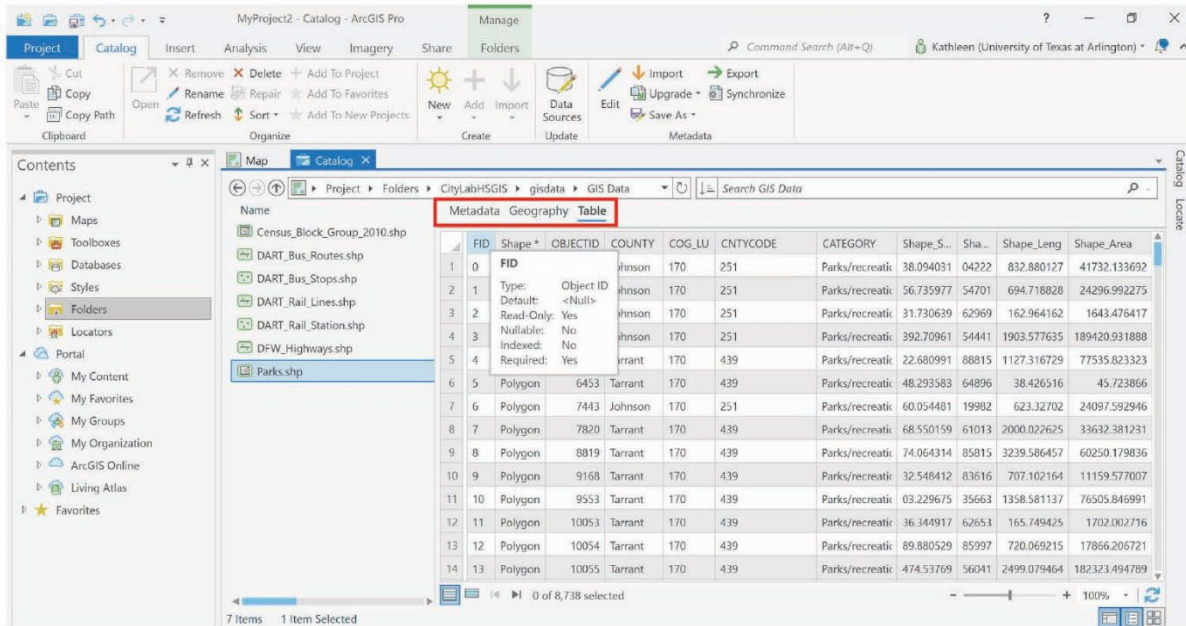


- To view and explore the data files, click once on each and use the right-side window pane to explore the Metadata, Geography, and Table.
 - Metadata** provides a description of the data if the author made it available.
 - Geography** shows you where the data is located and how it will appear on your map. From the geography tab, you can begin to visualize the data, determining if the data is a point, line, or polygon.



- And **Table** shows the additional attributes for the data such as FID (the GIS unique ID), name, location, length, area, etc.

- The columns represent the attribute categories; in the case of parks: FID, Shape, County, etc.
- The rows represent each feature; in the case of parks: each park.

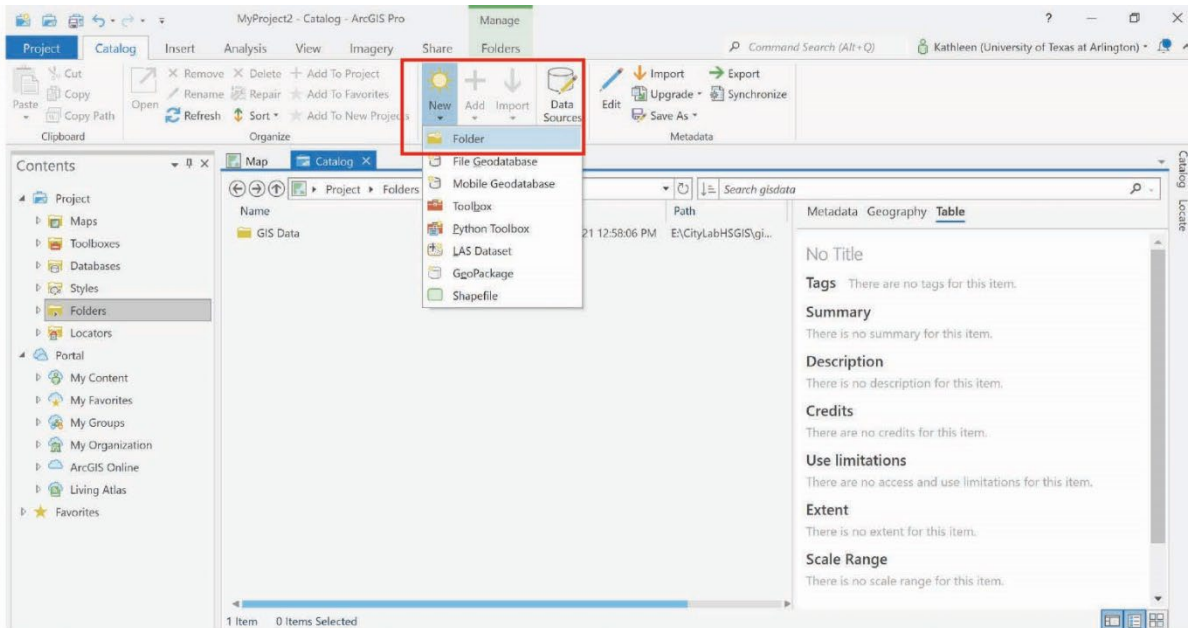


Backing Up Data in Arc Catalog

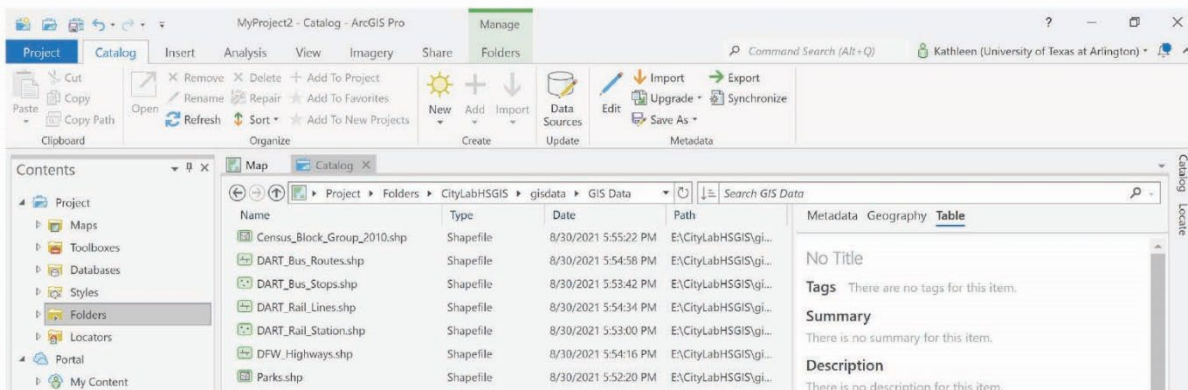
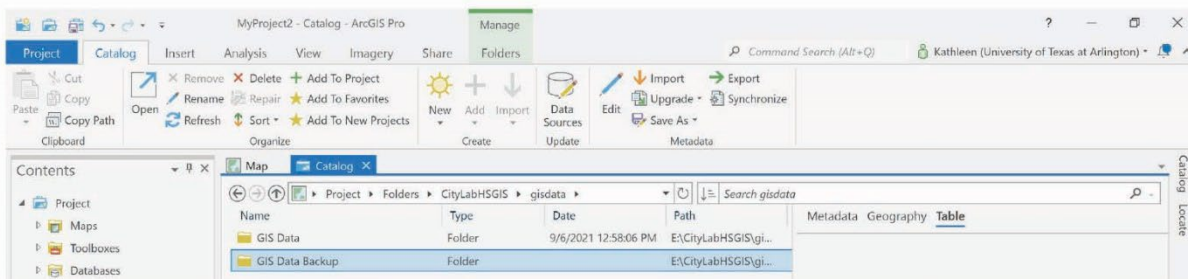
After view the data files, we will back-up or archive these original data files in a new folder. It is important to back-up data files whenever working on an official project. **It is possible that files can get corrupted or accidentally deleted, therefore it is best to save a copy in case this scenario happens.**



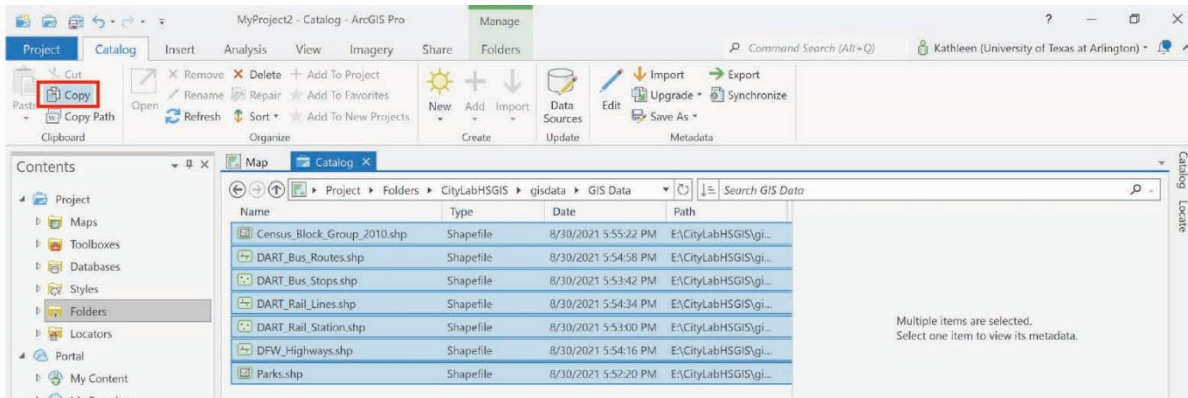
Create the new backup folder by either going to **New → Folder** or right clicking → select **New Folder**



Rename the folder **GIS Data Backup** then return to the original data files as shown in the two screen captures below.

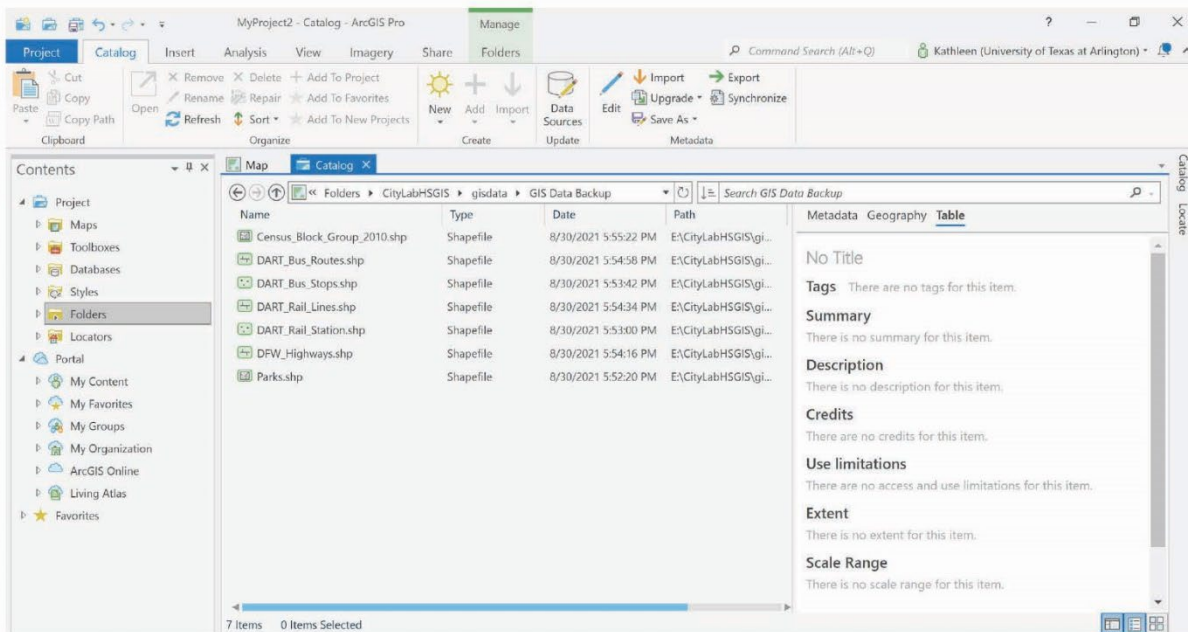


Next, select all the GIS files (shift + click the first and last file) and Copy files using either Control + C OR using the Copy command on the left-hand side.



Next, navigate back to your GIS Data Backup folder, open the folder, and paste the files either using Control + V or the Paste command on the left-hand side. This process may take a few moments depending on the number of files and file sizes.

Once you see the data files in the folder, you have successfully archived/backed-up your data.

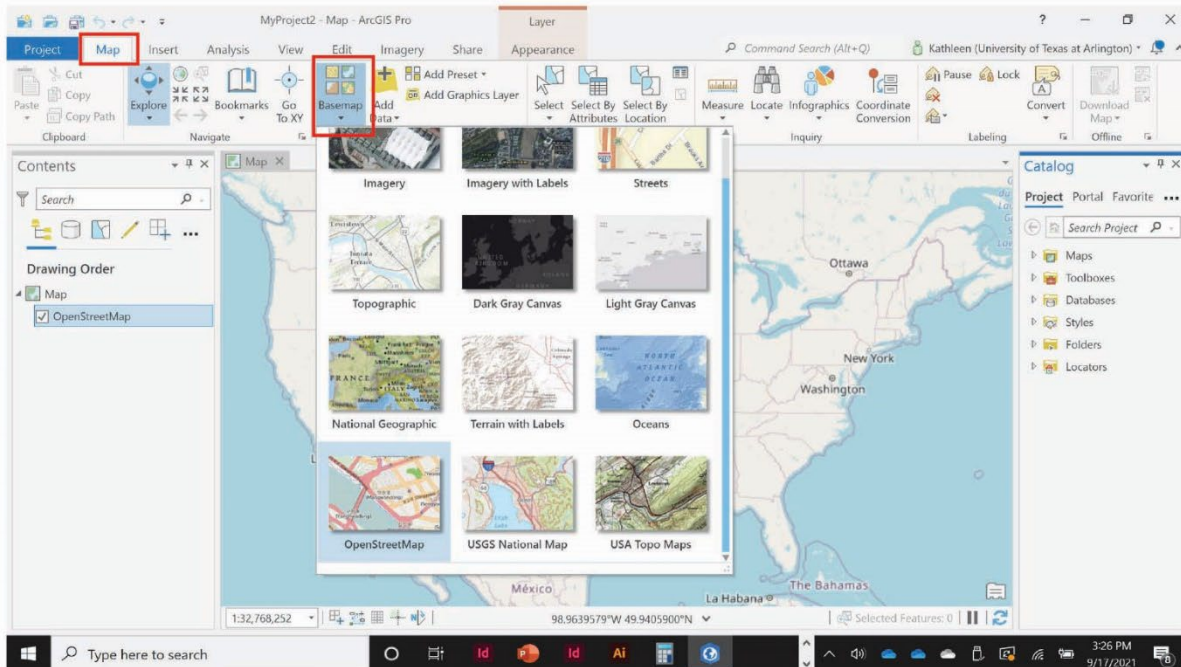


Adding Data to Your Map

There are several ways to add data to your map. The two ways that will be discussed are and **1) Adding data directly from the ArcCatalog View** and **2) Adding data through the Catalog Pane**. However, before adding external data, it is important to first select a **Basemap**.

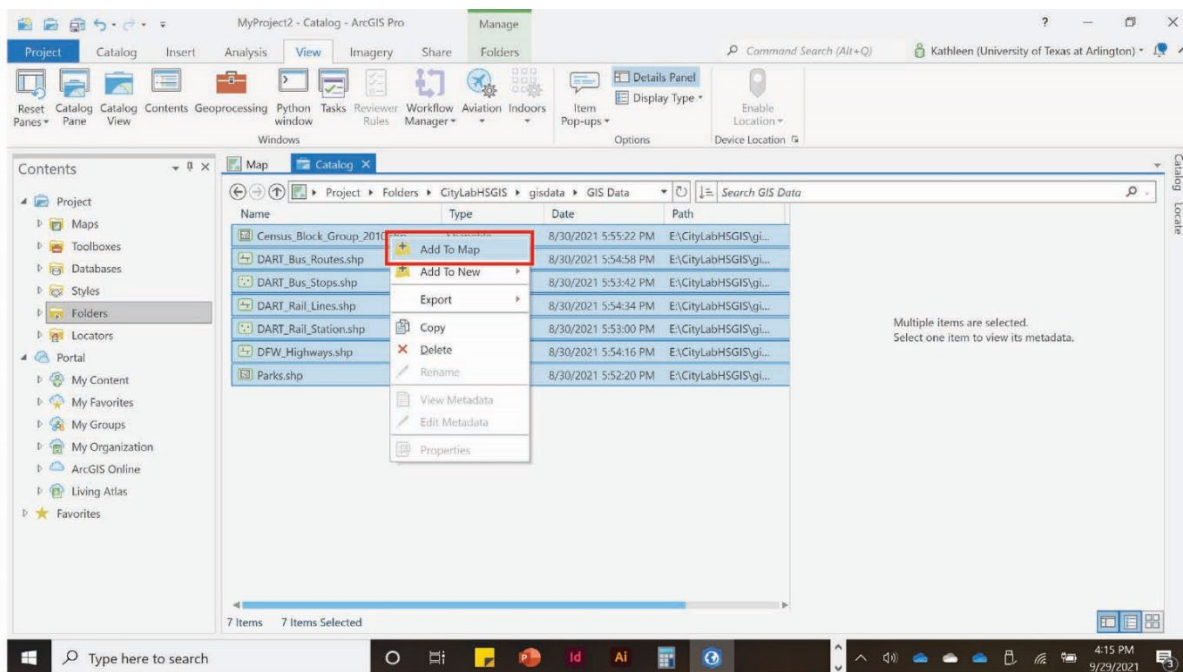
Selecting a Basemap

- Before adding external data to your map, first select the desired or the appropriate **basemap** for your project.
 - Go to the **Map** tab, click on the **Basemap** icon and view and browse Esri's collection of default Basemaps
 - Note:** Unlike ArcGIS Desktop, which can show multiple Basemaps layers, ArcGIS Pro only shows **one Basemap layer per Map project**.

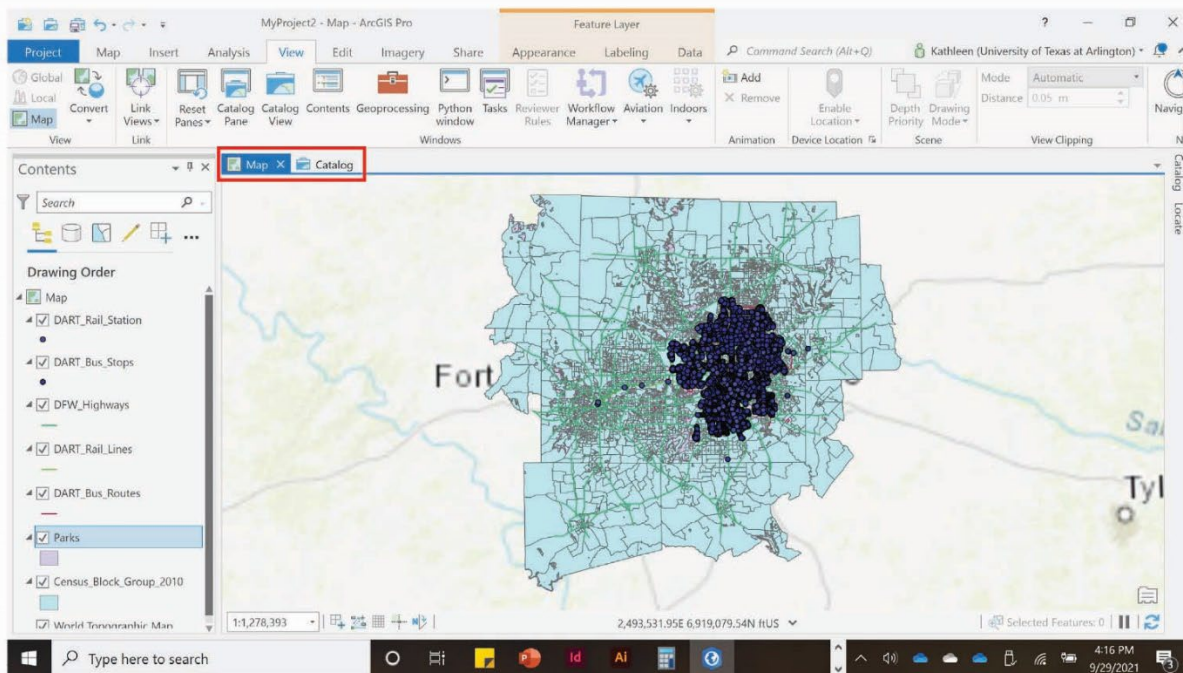


Adding Data to Your Map using Arc Catalog View

- Open the **Arc Catalog View** from the **View** tab
- Navigate to your **GIS Data** files from the **folder connections**
- Select which data will be added to your map
- To add the data to your map, right click → **Add Data to Map** (screen capture below)
 - This will add the data to the current map selection



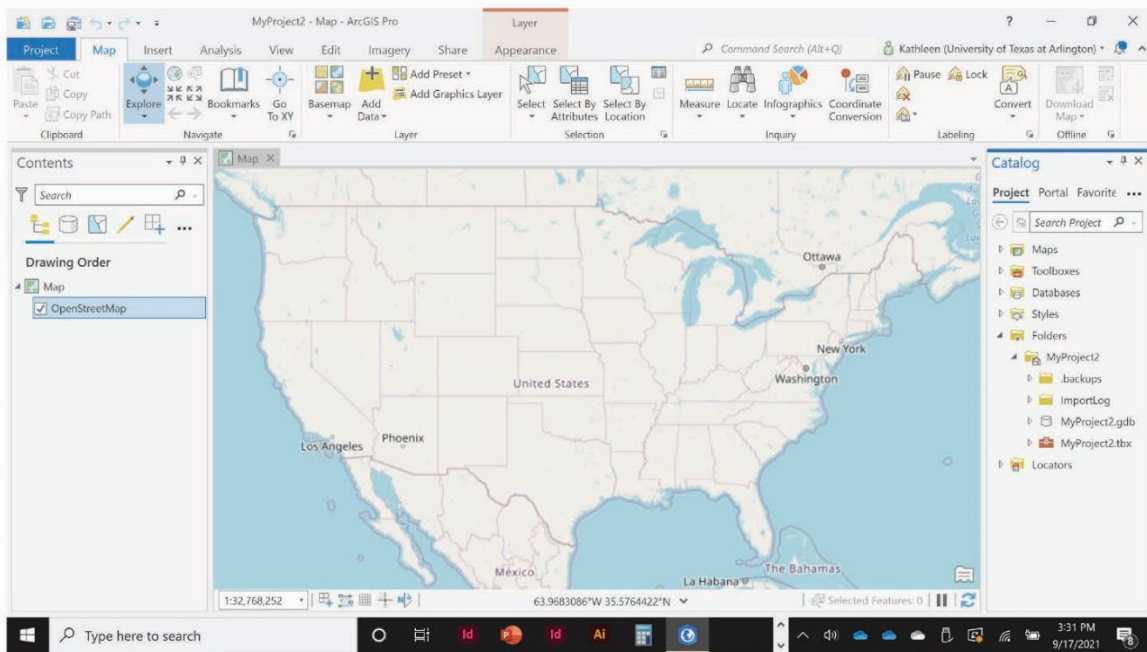
- Toggling back to the **Map** tab, the selected data should now appear on your main project map. You may now close the Arc Catalog View tab.



Adding Data to Your Map using the Catalog Pane

- In the **Catalog Pane** (right window), expand the **Folders** icon.

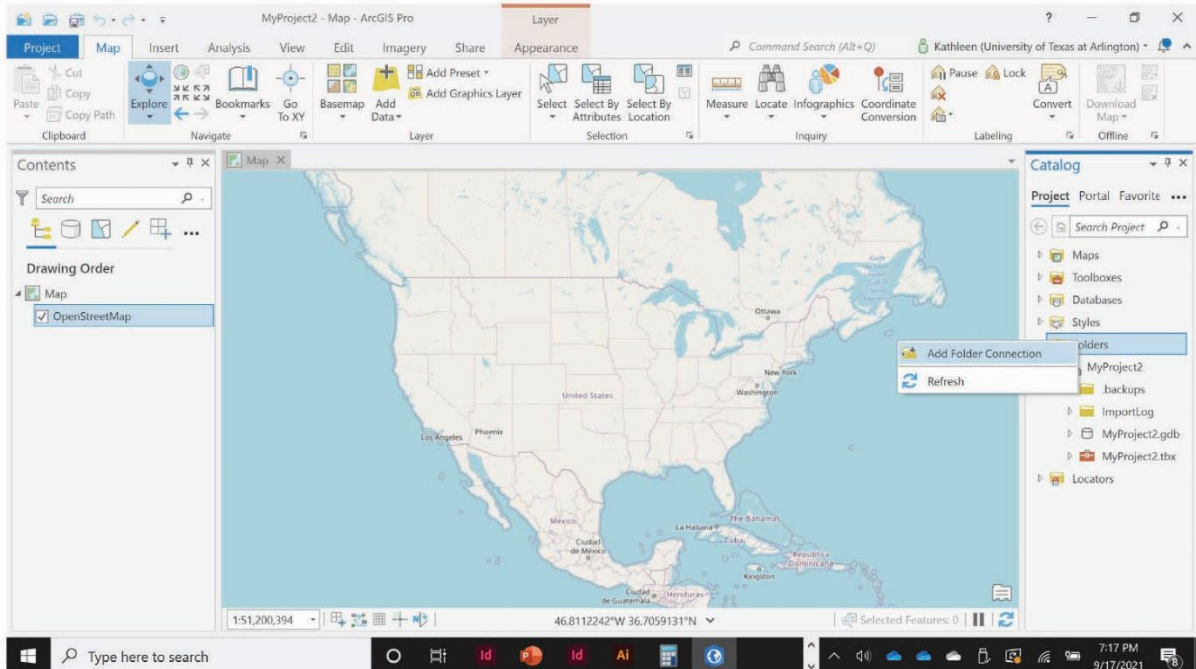
a. Under Folders, your Project folders and files will be shown.



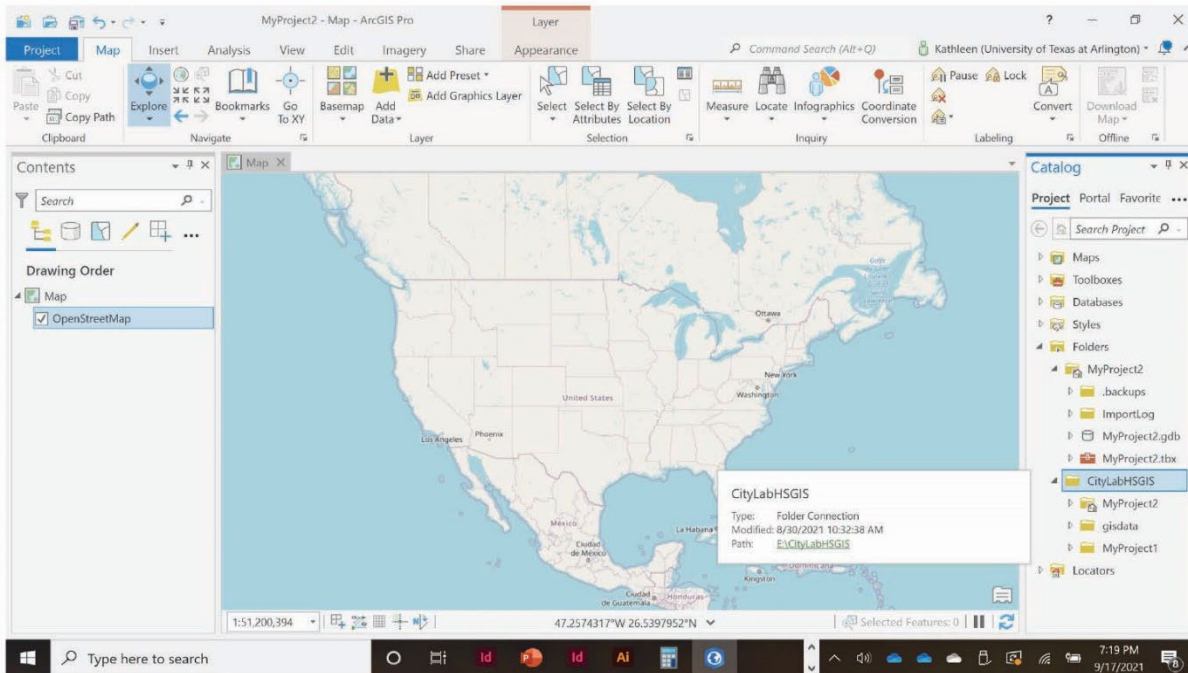
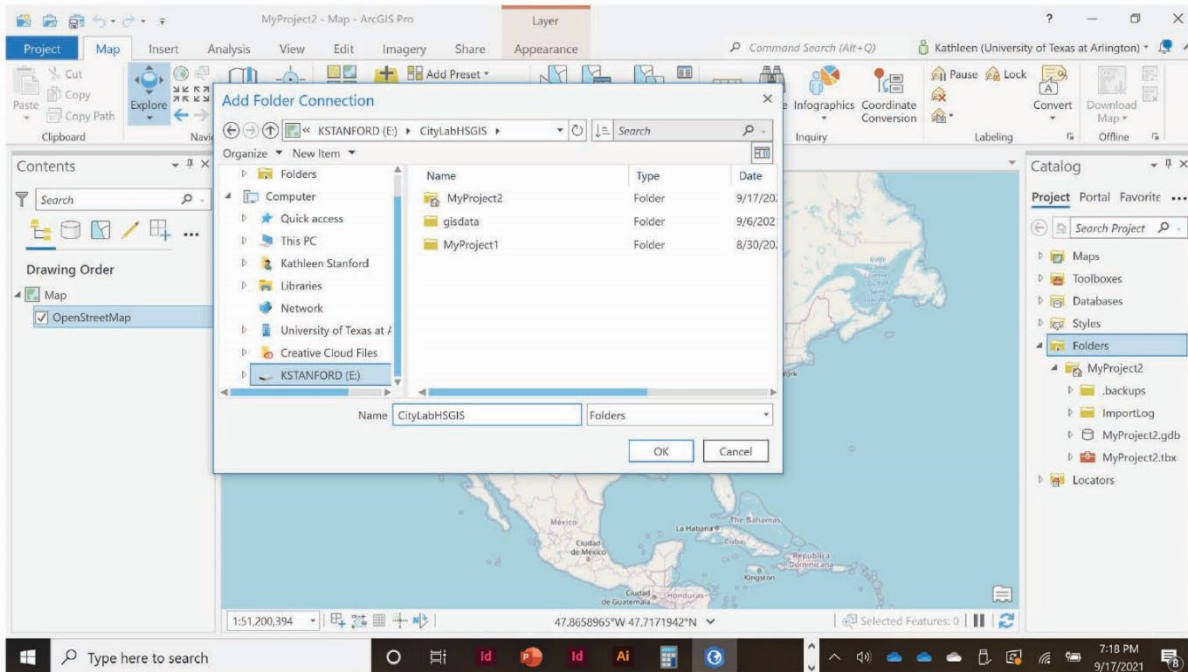
- **Optional Step:** If you were not able to set-up your folder connections through the Arc Catalog View, you can do so using the Catalog Pane.

a. Next, we will add a new Folder Connection

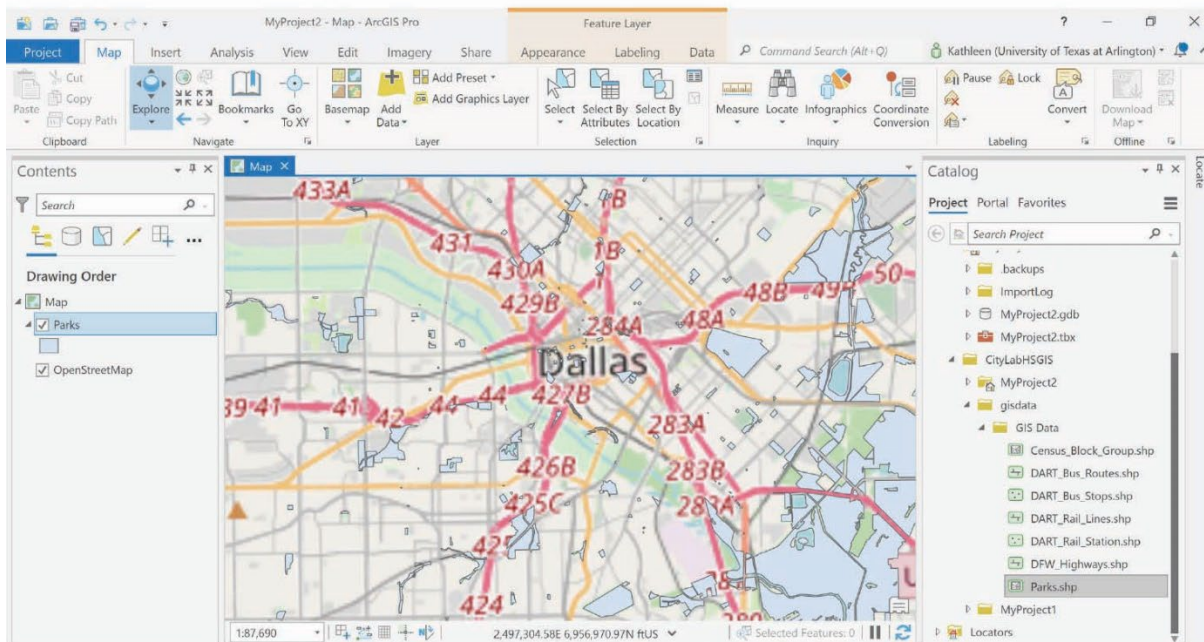
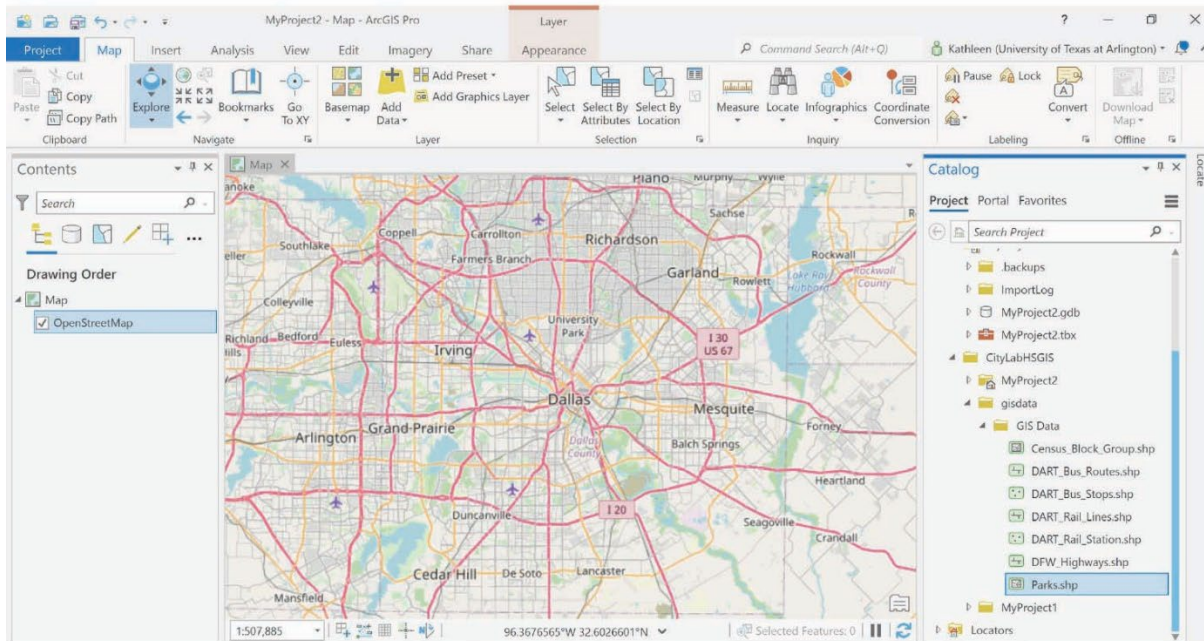
b. Right click on **Folders** in the **Catalog Pane** → click **Add Folder Connection**



- Select the folder of interest, in this case the CityLab folder.
 - a. Once the folder is added, you will see it in the list of Folders.



- Next, we will add **GIS data shapefiles** to the map.
 - a. Shapefiles – spatial data represented by vectors that come in the form of points (places), lines (lengths), and polygons (areas); the files end with **.shp**.
 - b. Go to your **Catalog Pane** → **Folders** → **Expand** the gisdata folder → **Expand** the GIS Data folder → **Click and Drag** the 'Parks.shp' shape file onto the Map
 - i. **Note:** Adding the data may zoom out your map extent; using your mouse, zoom back in
 - c. The parks.shp will now show up on your map and also in your Content Pane on the left
 - d. Repeat this process to add data to your project

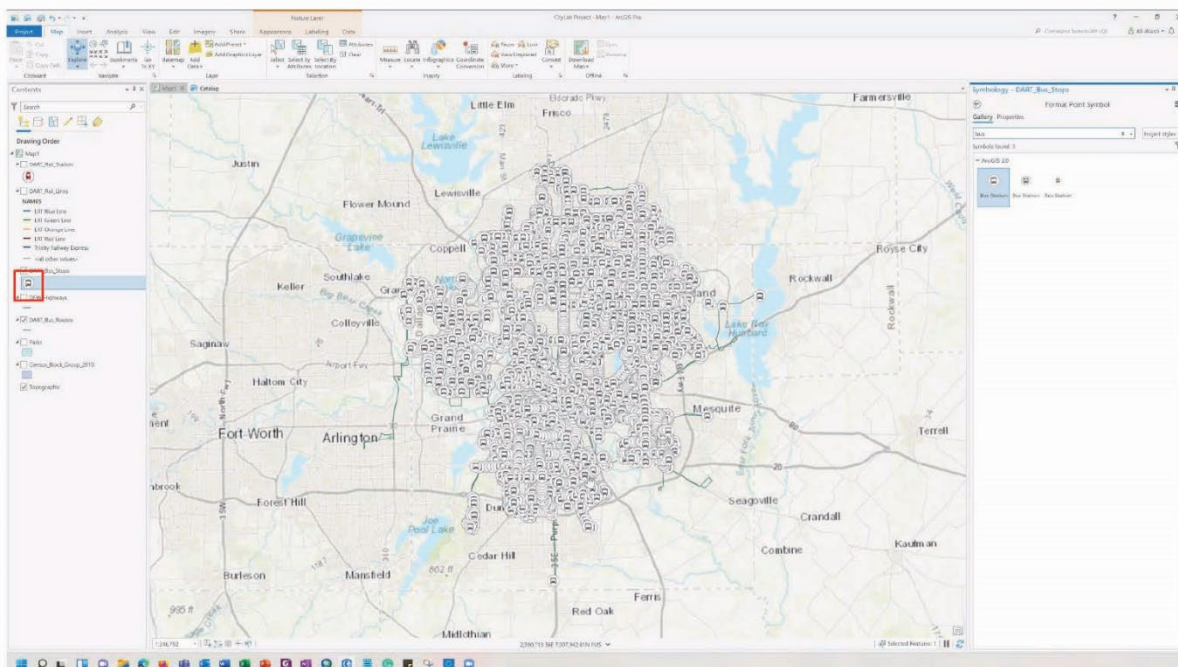


Changing Data Symbols (Symbology)

Changing your maps data symbols is a critical for visualization. Appropriate color schemes and symbols help you to create a meaningful map for both you and your audience.

Changing Layers to Commonly Used Symbols

- To make your map more intuitive, go to your catalog panel on the left side of your screen and **click once on one of the symbols of your layers**. This will bring up the Symbology panel on the right side of your screen.
 - For layer such as DART_Bus_Stops, you might want to use a symbol of a bus. To do this, click on the **Gallery tab**, in the Symbology panel and search “bus.” Various options will appear. Choose the one you feel is most fitting. You can change other symbols by scrolling through the gallery or searching in the specific type of icon you are looking for.
 - **To change the color of the symbol**, click on the **Properties tab** in the Symbology Panel, click the **paintbrush icon**, and, under appearance, change the color.









- For layers that have multiple categories based on the attributes, you can designate a specific color to each category. For instance, DART_Rail_Lines have 5 different lines—LRT Blue Line, LRT Green Line, LRT Orange Line, LRT Red Line, and Trinity Railway Express. Each of these lines can be represented by the color of the rail line.
- To change these types of categories, click once on one of the symbols of your layer. The symbology panel will appear on the right side of your screen.
 - Click on the back arrow “←” on the top left of the symbology panel.
 - Under “Primary Symbology” click “Unique Values”
 - For “Field 1” select “NAMES”
 - In the “Classes” chart, you will see 3 columns as shown below. Click on the individual-colored line you want to change the color of.

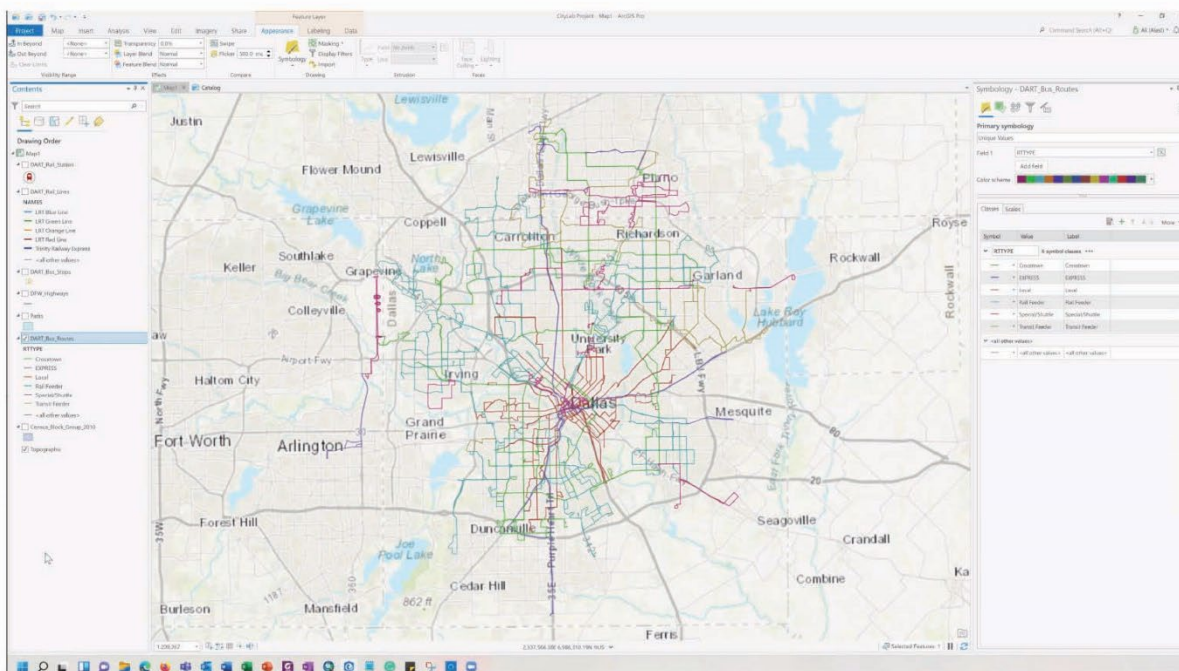
Classes

Scales

More ▾

Symbol	Value	Label	
▼	NAMES	5 values	×
	▼ LRT Blue Line	LRT Blue Line	
	▼ LRT Green Line	LRT Green Line	
	▼ LRT Orange Line	LRT Orange Line	
	▼ LRT Red Line	LRT Red Line	
	▼ Trinity Railway E...	Trinity Railway E...	
▼	<all other values>		
	▼ <all other value...	<all other value...	

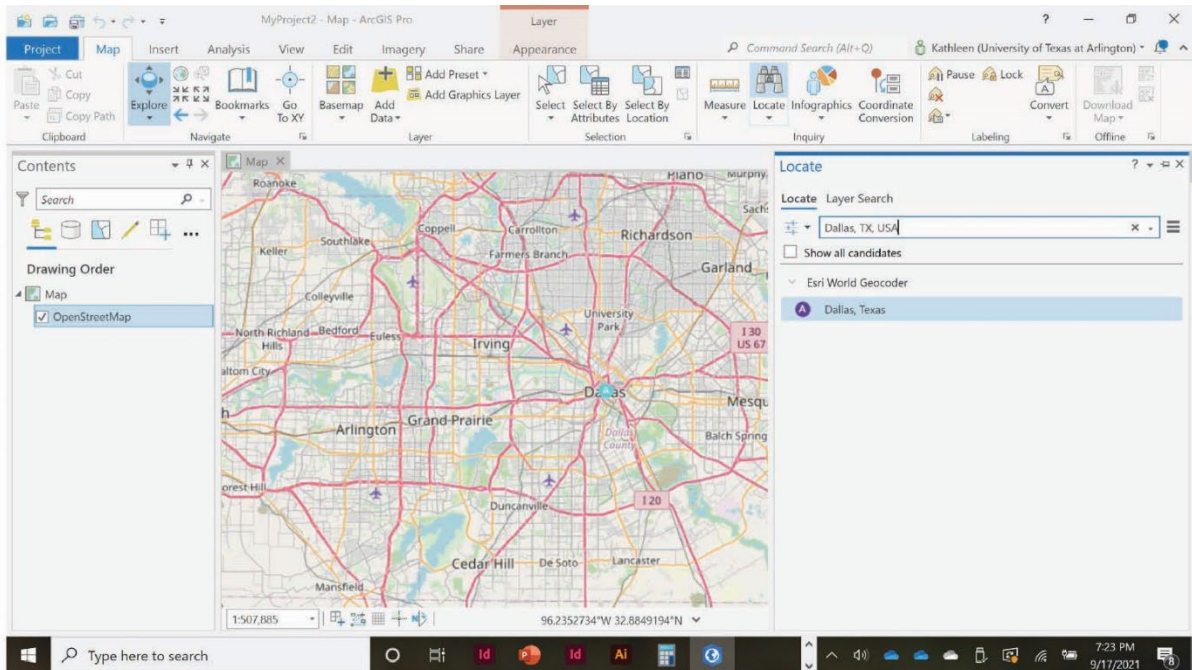
- The “Properties” tab will come up. Make sure the paintbrush option is selected. Under “Appearance” change the color and line width.
- Click “Apply” at the bottom of the panel.
- Click the back arrow “←” to return to previous pane. Repeat for all necessary components.



ArcGIS Pro Tools

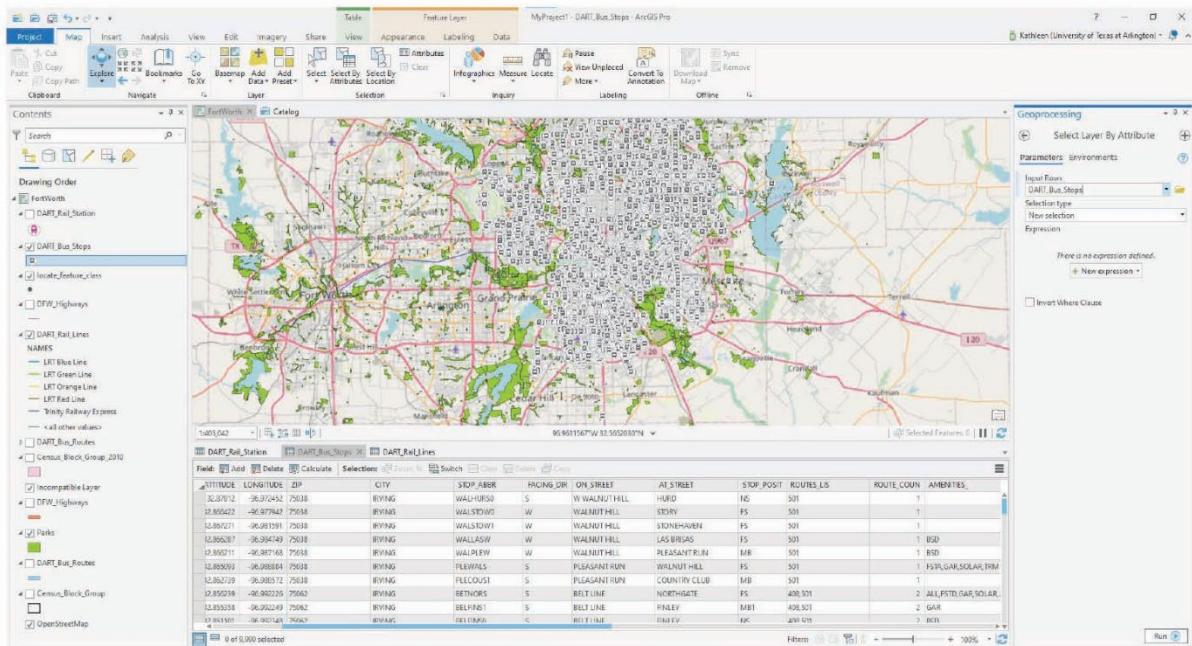
The Locate Tool

- Next, we will locate the general project location.
 - a. This can be done in several ways – in this case, we will start by using the **Locate** function in the **Map** tab under the **Inquiry** tools.

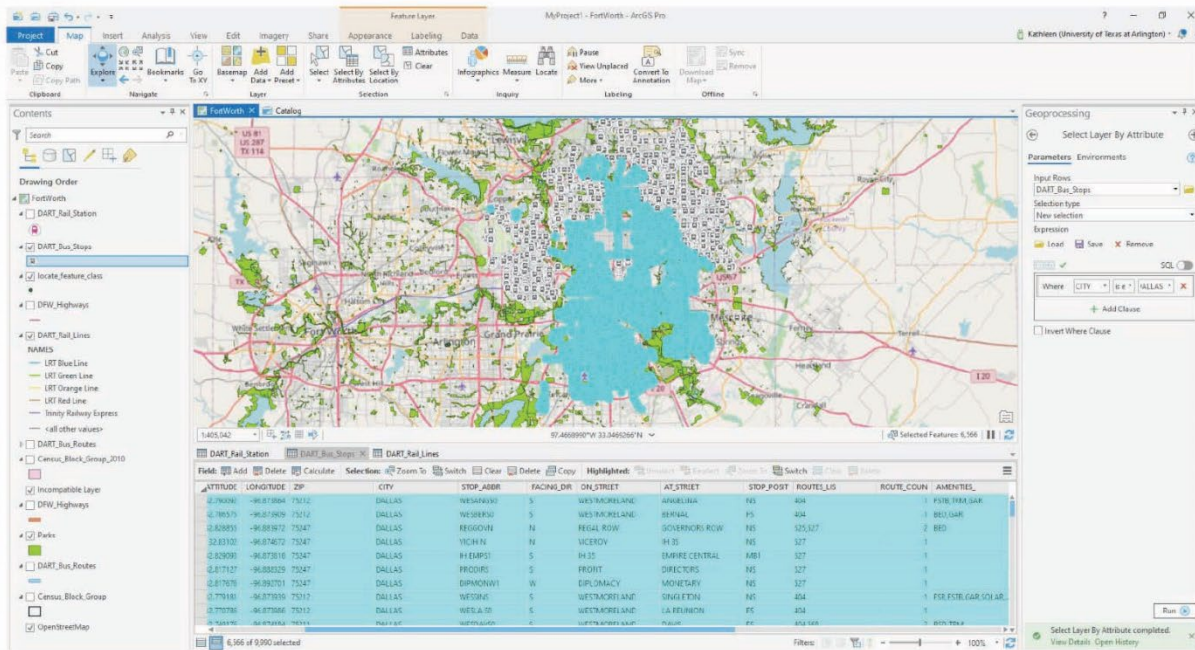


Using the Select 'By Attribute' Tool & Queries

- Select **Map** → **Select by Attributes** then in the Geoprocessing panel on the right side of your screen, choose your Input Rows. Next, choose **new selection** in selection type, then choose your expression. Click **Run** at the bottom of the panel.

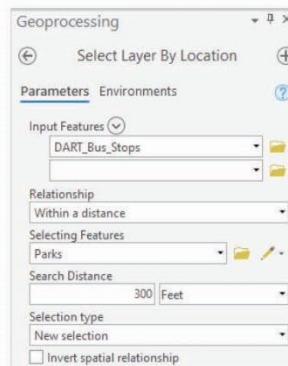


- Ex 1. Input is DART_Bus_Stops and the expression is “Where CITY is equal to DALLAS.”
 - Using this attribute selection will show you all of the bus stops in Dallas and where they are located, as shown in the screenshot immediately below.



Using the Select Attribute By Location Tool

- Select **Map** → **Select by location**. Geoprocessing panel will appear on the right side of the screen. Insert **Input feature(s), relationship, selecting features, and distance** (if needed). Selection type is **New selection**. Click **Run** in the bottom right of the geoprocessing panel.



- Ex. We want to know how many DART bus stops (**input feature**) are within a distance (**relationship**) of a park (**selecting feature**) with a search distance of 300 feet. The resulting map search is below.

MyProject - DART Bus Stops - ArcGIS Pro

Kathleen (University of Texas at Arlington)

Project | Map | Insert | Analysis | View | Edit | Inquiry | Share | Table | Feature Layer | Appearance | Labeling | Data

Contents | Search | Drawing Order | Footprints | DART_Rail_Station | DART_Bus_Stops | locate.feature.class | DPA_Highways | DART_Rail_Lines | DART_Bus_Routes | Census_2010_Group_2010 | Census_2010_Group_2010 | DPA_Highways | Parks | DART_Bus_Routes | Census_2010_Group_2010 | OpenStreetMap

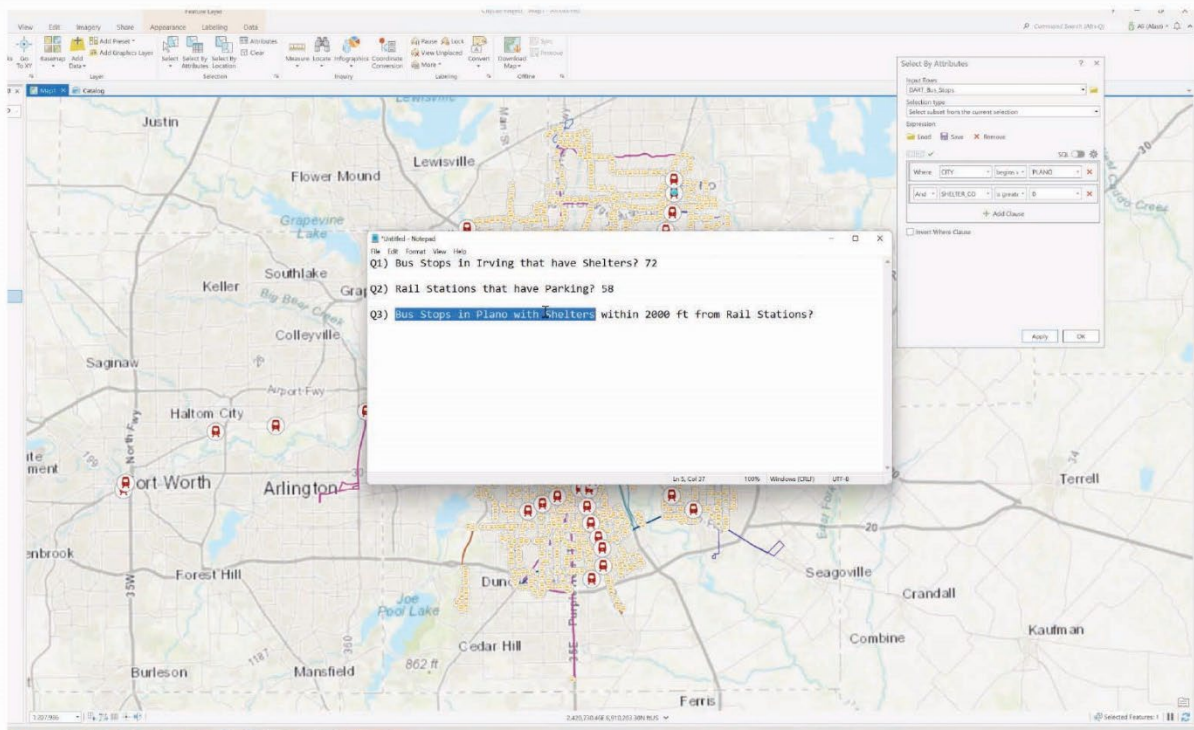
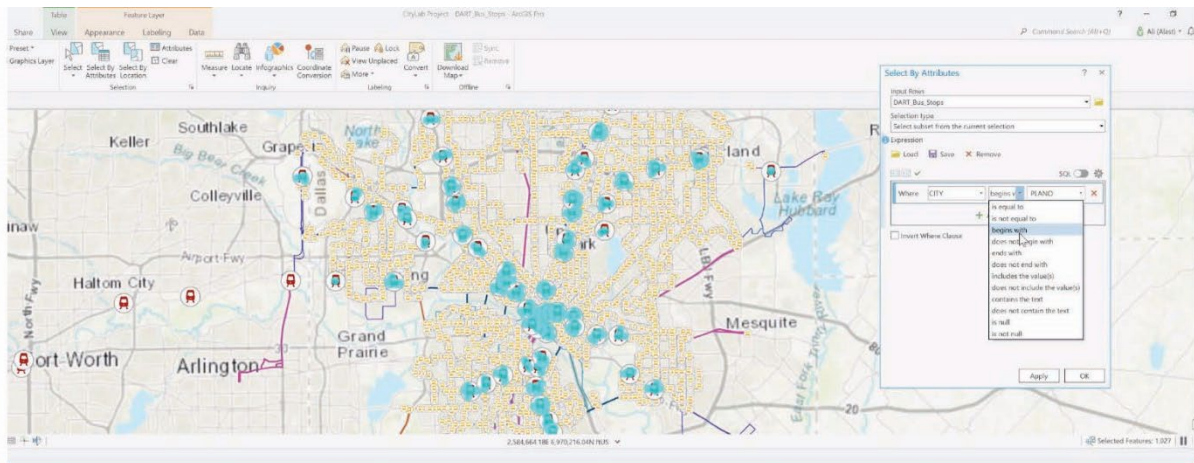
1,622,878 | 36.1524819°N 93.2443317°W | Selected Features: 1,325

ID	Shape	OBJECTID_1	OBJECTID	STOP_ID	STOP_NAME	LATITUDE	LONGITUDE	ZIP	CITY	STOP_ABBR	FACING_DIR	ON_STREET	AT_STREET
8	Point	7	117761	13427	PLEASANTVIEW @ CO.	32.382759	-96.888572	75038	IRVING	PLEASANTVIEW	S	PLEASANTVIEW	COUNTRY CLUB
18	Point	16	117772	13430	STORY @ LASALLE + S.	32.381049	-96.876982	75062	IRVING	STORY	S	STORY	LASALLE
22	Point	25	117777	13430	STORY @ IRVING - S - PS	32.326573	-96.874481	75081	IRVING	STORY	S	STORY	IRVING
26	Point	27	117784	13430	STORY @ IRVING - N -	32.327041	-96.874367	75081	IRVING	STORY	N	STORY	IRVING
28	Point	32	117785	13434	STORY @ ROCKWELL -	32.342251	-96.876330	75042	IRVING	STORY	N	STORY	ROCKWELL
46	Point	47	117802	13508	WETMORE @ S. L.	32.780725	-96.877089	75074	DALLAS	WETMORE	S	WETMORE	STRAW
56	Point	58	117803	13770	OCCONOR @ MALLS -	32.330957	-96.920119	75062	IRVING	OCCONOR	N	N/O CONNOR RD	NORTH GATE
57	Point	58	117808	13785	ROCKWELL @ ALMA -	32.342121	-96.875587	75062	IRVING	ROCKWELL	W	ROCKWELL	ALMA
78	Point	77	117878	13315	HURSHY @ ELWOOD -	32.318686	-96.834319	75061	IRVING	HURSHY	S	HURSHY	ELWOOD
97	Point	96	117879	13334	HURSHY @ ELWOOD -	32.318686	-96.834319	75061	IRVING	HURSHY	N	HURSHY	ELWOOD

1,325 of 9,990 selected

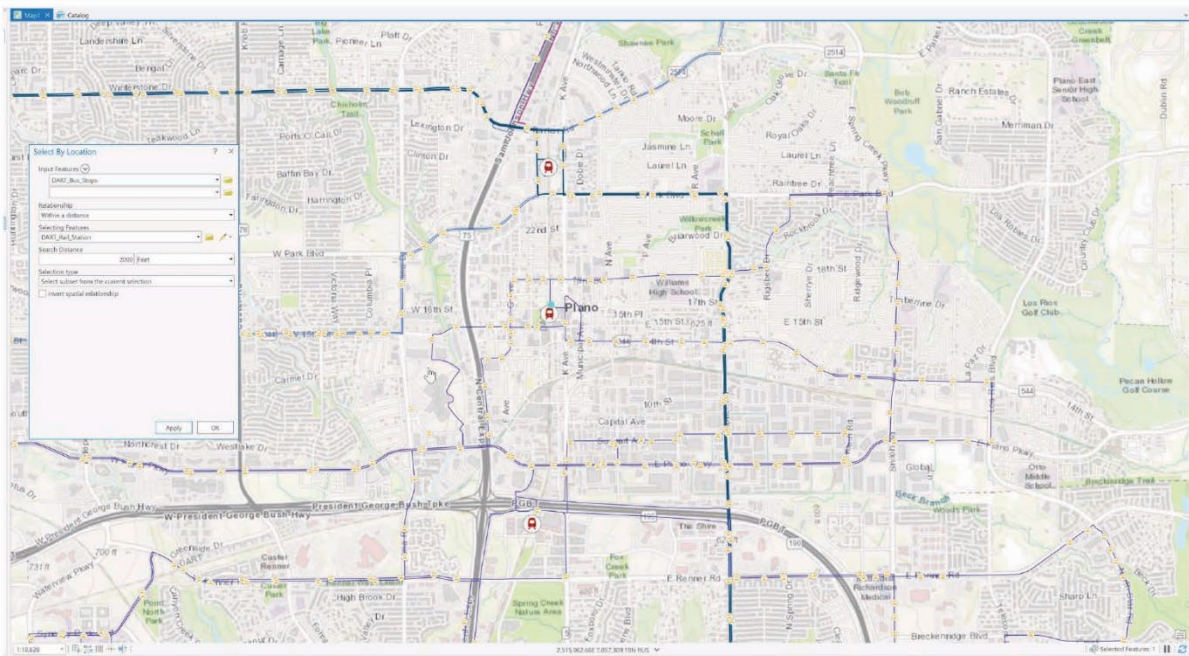
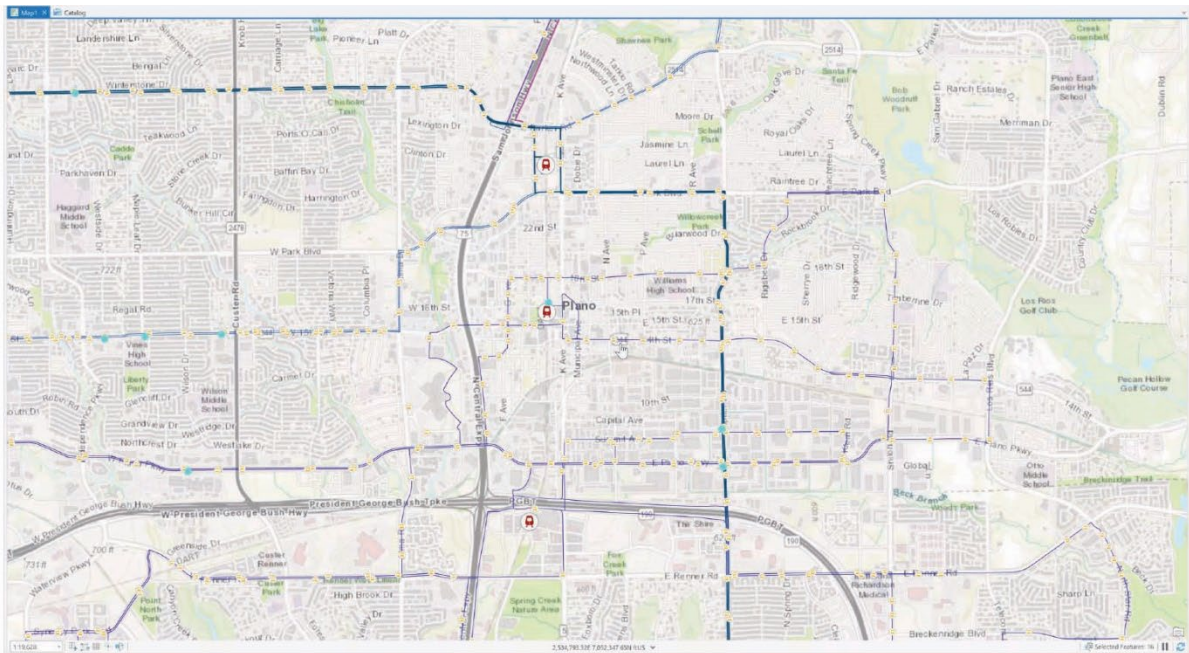
Geoprocessing | Select Layer By Location | Parameters | Environments | Input Features | DART_Bus_Stops | Relationship | Within a distance | Selecting Features | Parks | Search Distance | 300 Feet | Selection Type | New selection | Invert spatial relationship | Run

Select Layer By Location completed | View Details | Open History

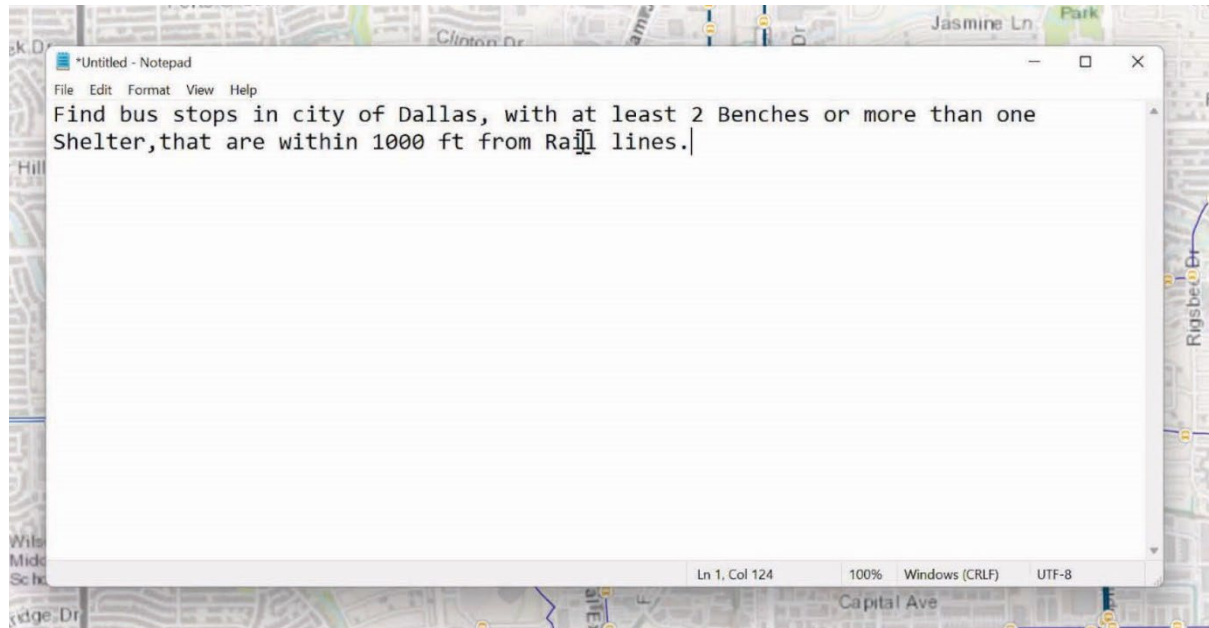


Solution: Only 1 bus stop!

Can we reverse the process?



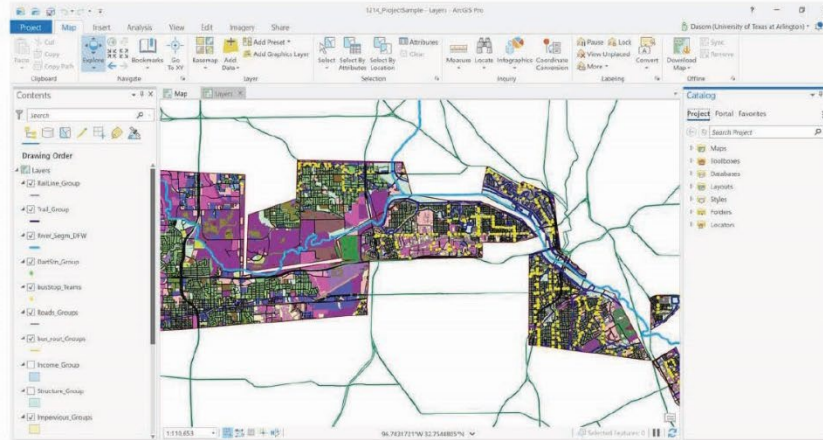
The same solution which is the same (1) bus stop!



A-2. GIS Tutorial: How to Export to PDF

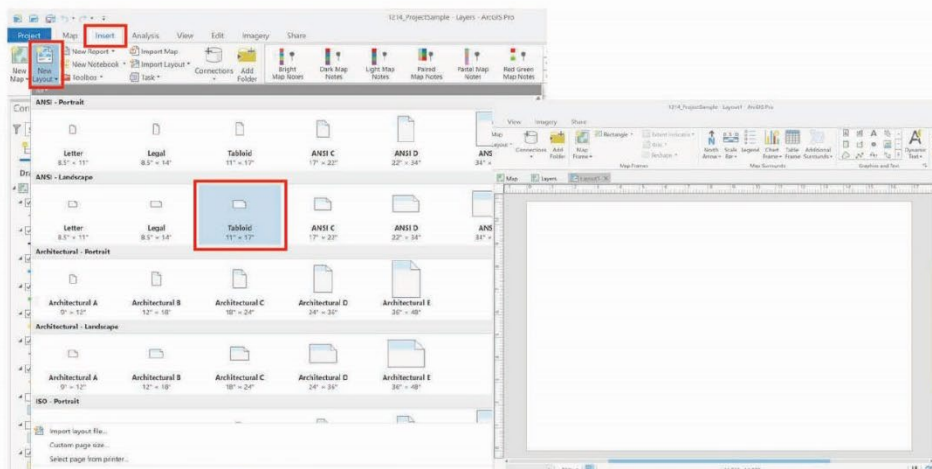
How to make Layout on ArcGIS Pro

- Open ArcGIS Pro and data file



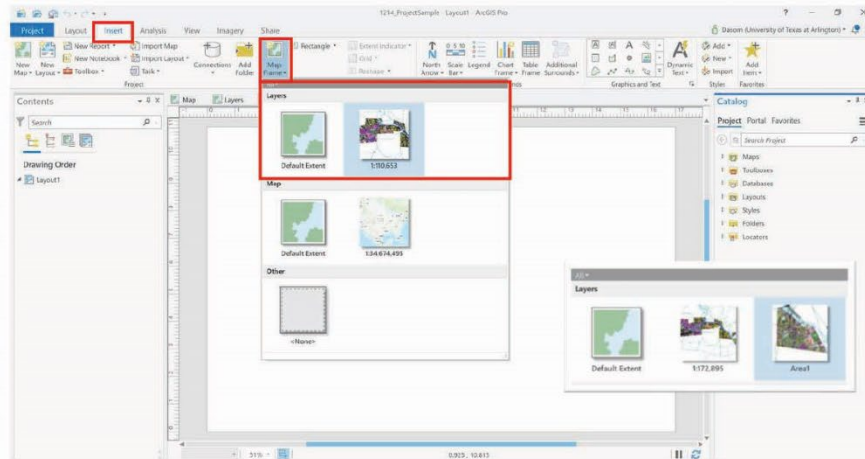
1

- Click Insert tab > New Layout > Tabloid(Landscape)



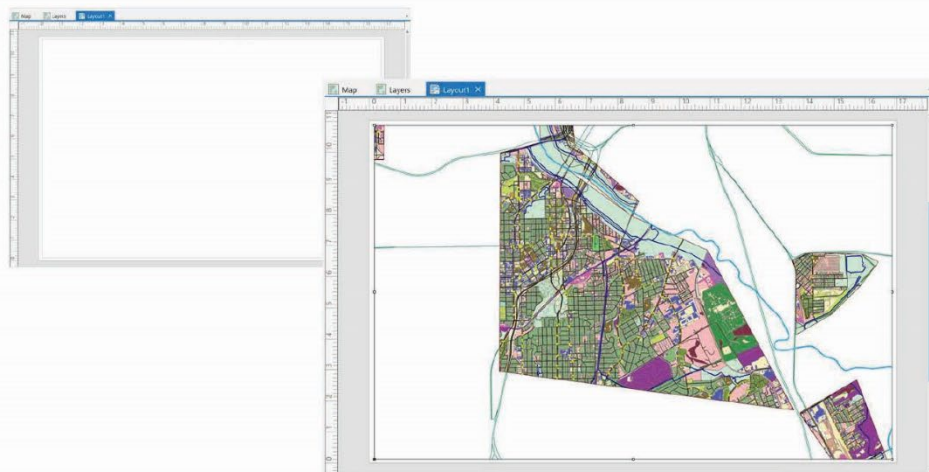
2

- To add a layer on the layout, Click Insert tab > Map Frame > Layer
 - If you made bookmark for your area, use bookmark.



3

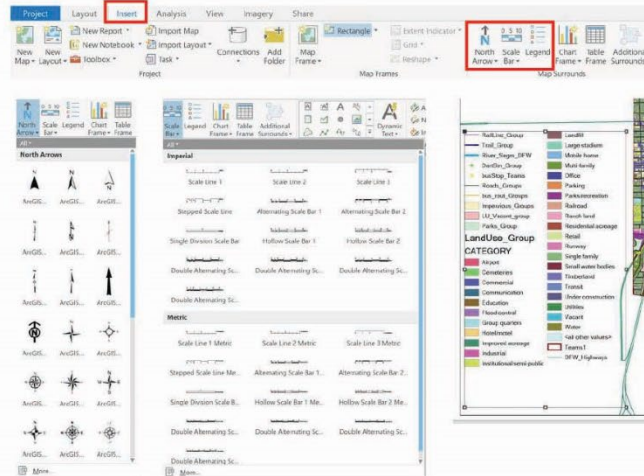
- Specify the area to put the layer



4

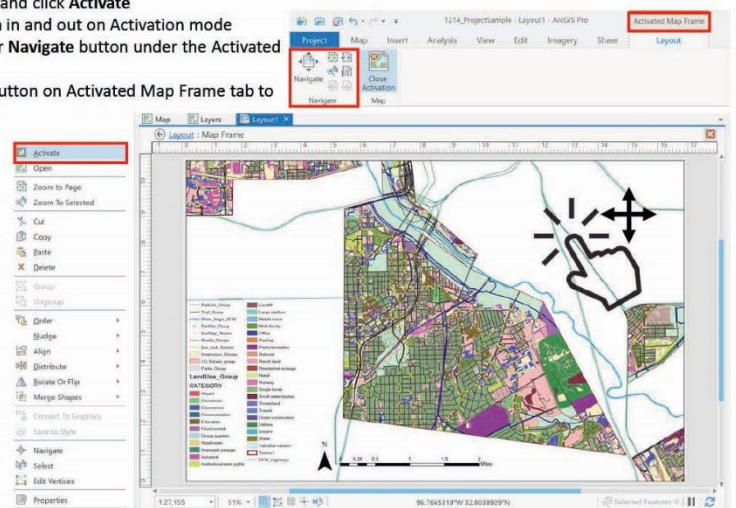
2

- Click Insert tab, insert North Arrow, Scale Bar, and Legend



5

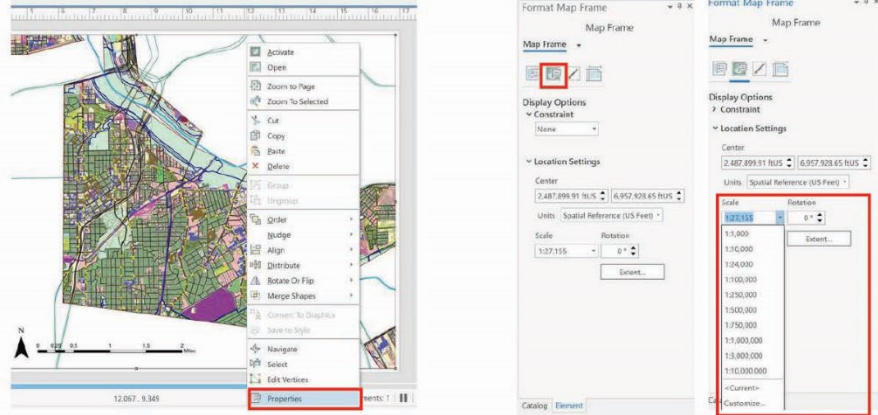
- Right click on the map, and click Activate
 - You can pan, zoom in and out on Activation mode
 - Use your mouse or Navigate button under the Activated Map Frame tab
- Click Close Activation button on Activated Map Frame tab to exit Activation mode



6

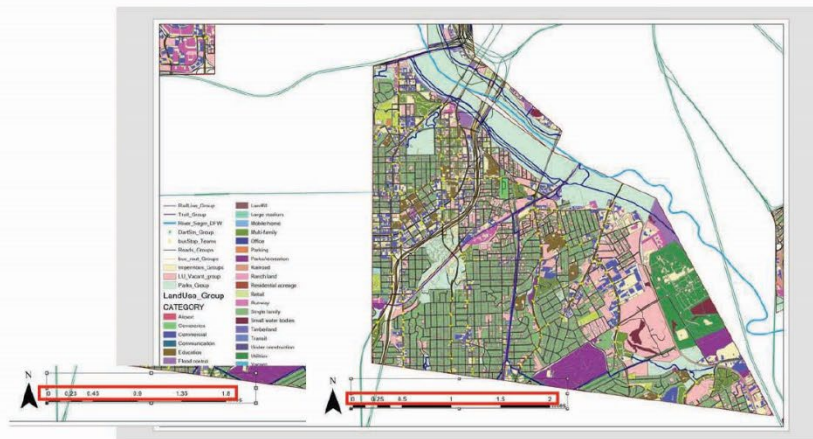
3

- If you want to convert the map to a specific scale,
 - Right-click on the map > Properties > Format Map Frame > displayed second icon > Scale
 - Select or enter the scale you want to convert



7

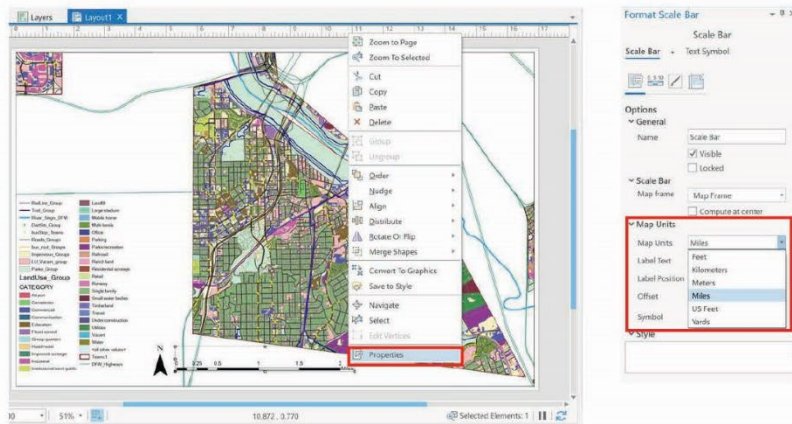
- The number of scale bar's scale numbers are also converted, and the numbers can be changed by increasing or decreasing the size of the scale bar



8

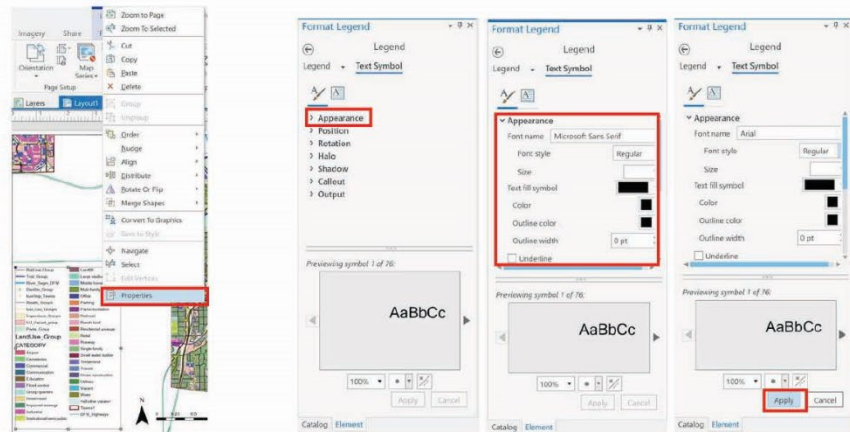
4

- If you want to change the map units, double-click on scale bar > Properties > Map Units



9

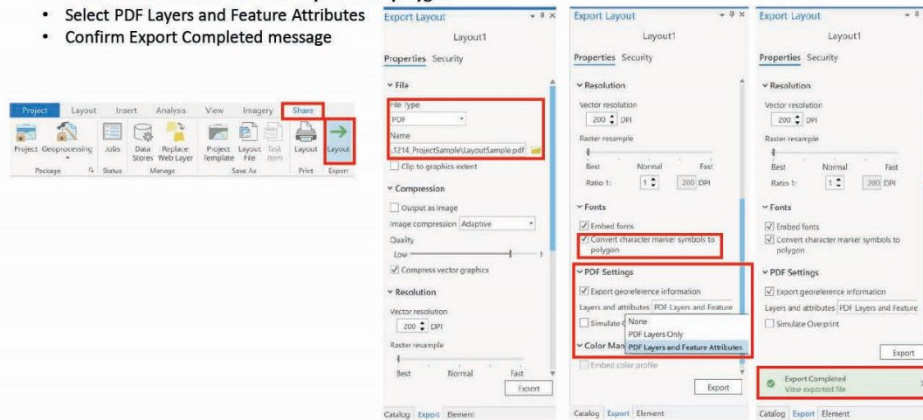
- If you want to change text properties, right-click on text(ex. Legend) > Text Symbol > Appearance...
 - You can change other properties under Text Symbol window, for example, Position, Rotation, Halo,...
 - When you finish setting the properties, click Apply



10

5

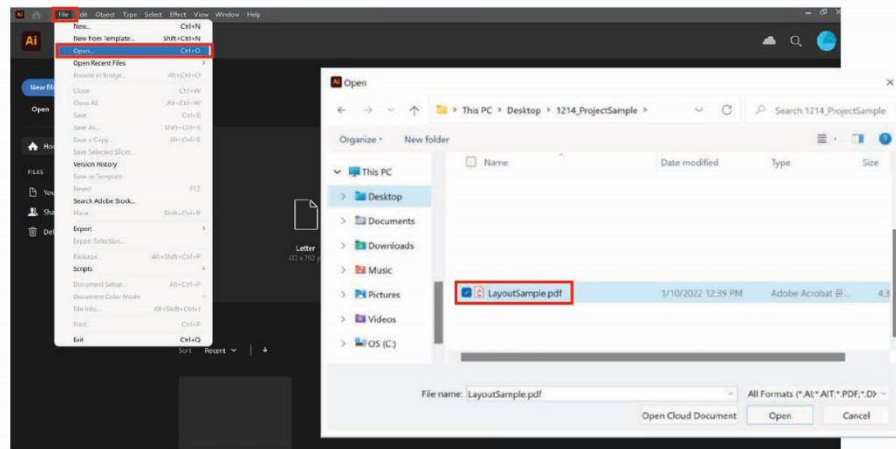
- To convert your layout to PDF file format, Click Layout icon under the Share tab
 - Set File Type PDF
 - Designate location
 - Select Convert character maker symbols to polygon
 - Select PDF Layers and Feature Attributes
 - Confirm Export Completed message



11

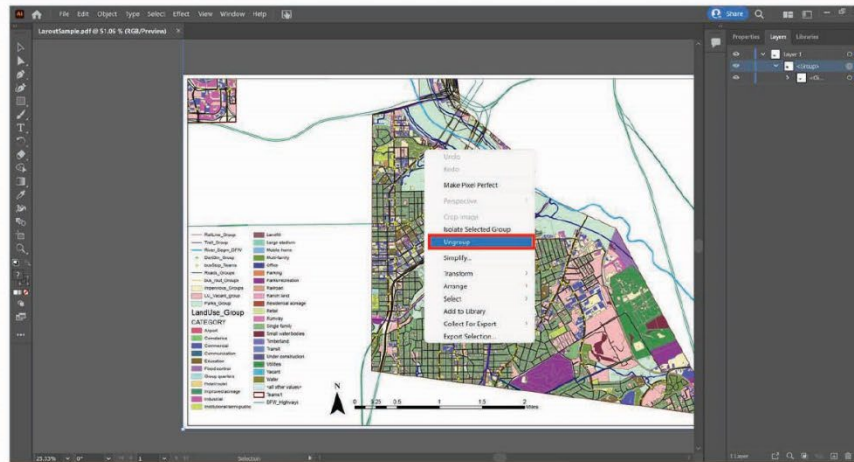
How to edit polygons in Adobe Illustrator

- Open file in Adobe Illustrator
 - Remember the saved location



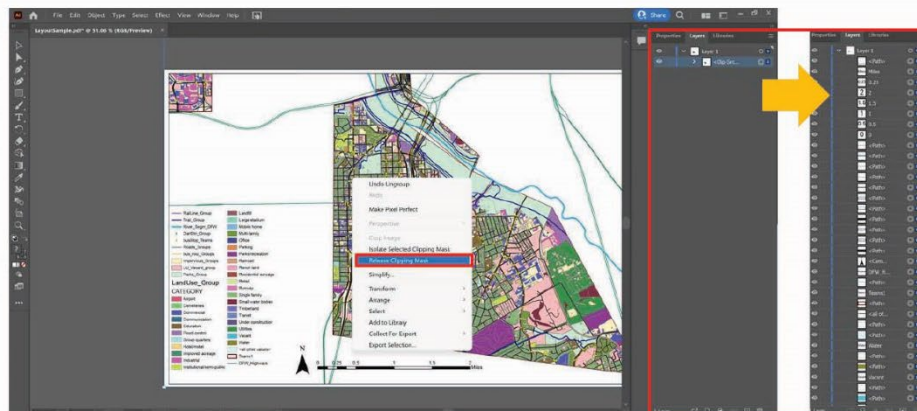
12

- Select all (Ctrl + A) and right-click on polygons, select Ungroup



13

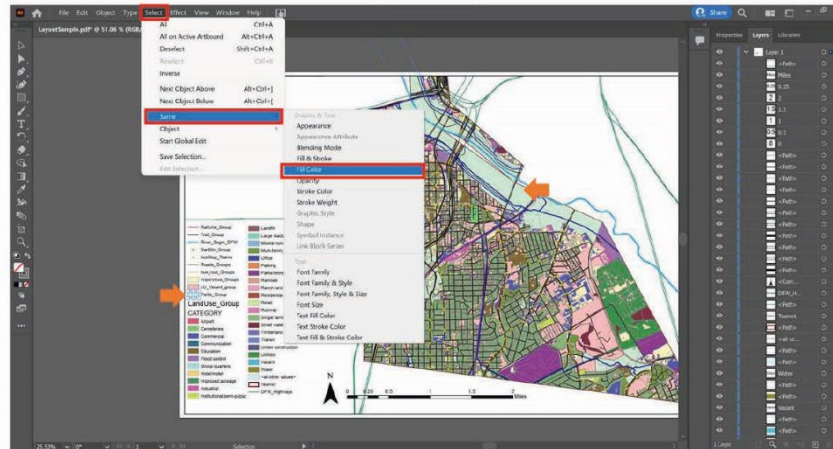
- Select all (Ctrl + A) again and right-click on polygons, select Release Clipping Mask
- See the changes in the layer



14

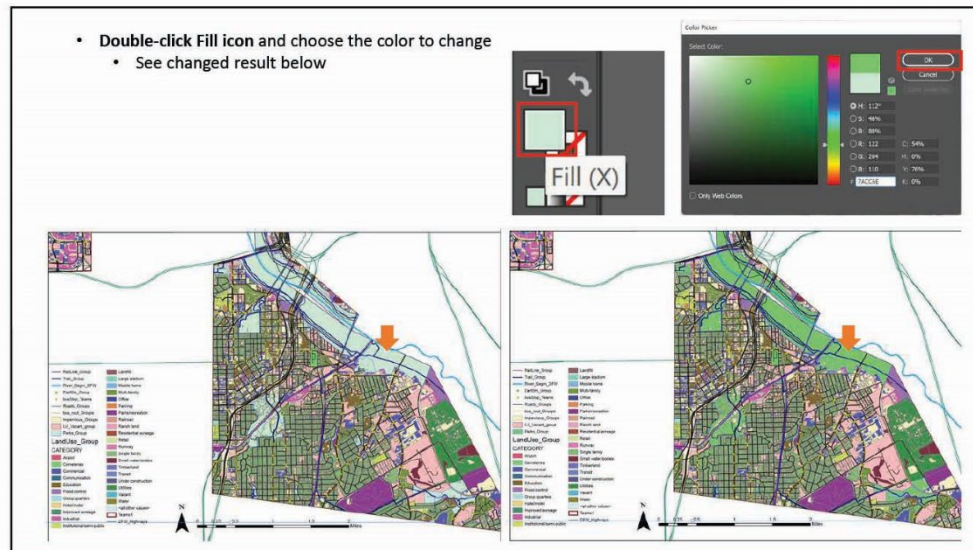
7

- Select specific polygon which you want to change the color.
- Click Select > Same > Fill Color. The marked color was selected



15

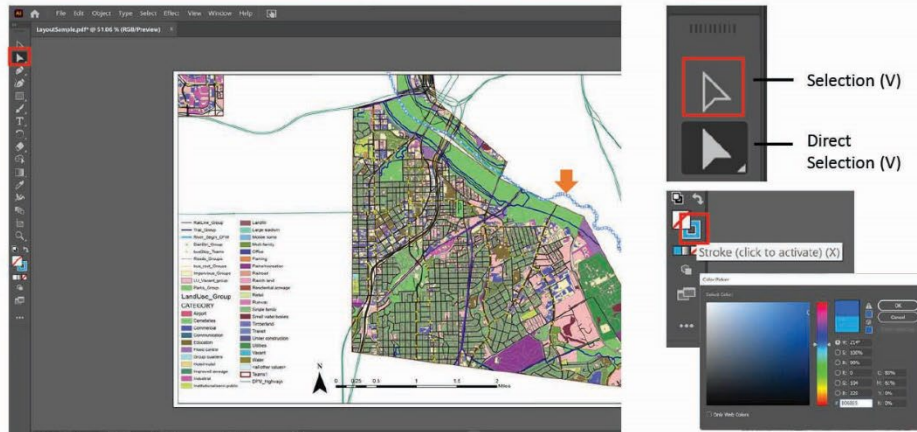
- Double-click Fill icon and choose the color to change
- See changed result below



16

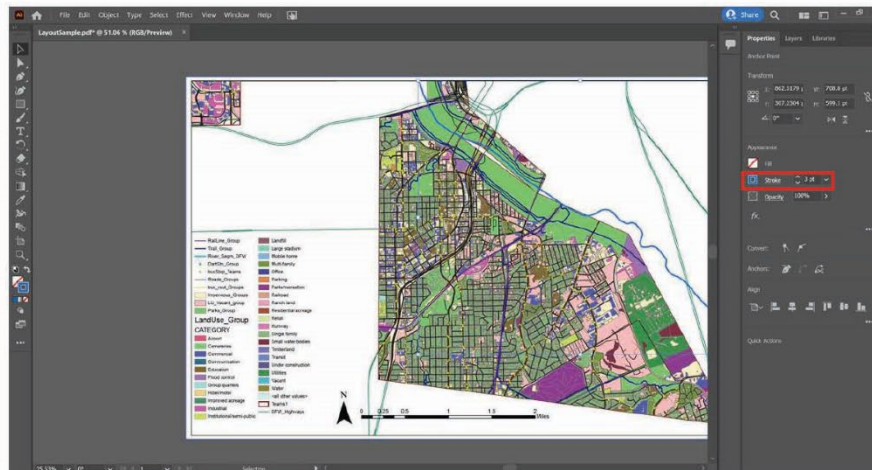
8

- To select the stroke, click the **Direct Selection** icon (A, white arrow) and move over to the desired location, and click.
- Click the **Selection** icon (V, black arrow) and double-click the stroke icon to change colors



17

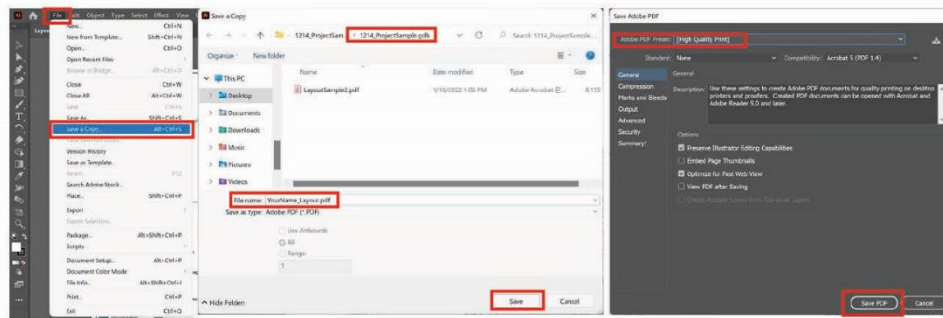
- You can change stroke width in the Properties tab



18

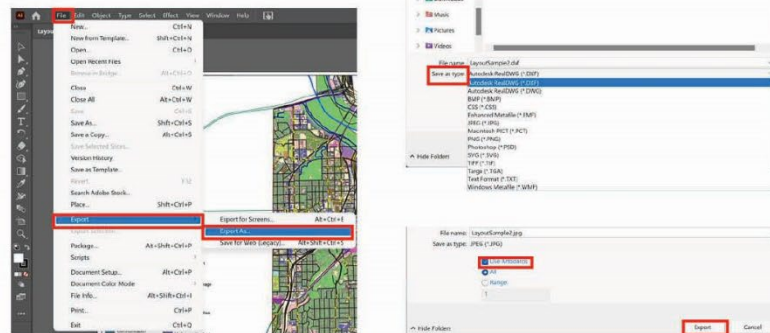
9

- To save the file as **PDF**, click File tab > Save a Copy...
 - Enter the file name and click Save
 - Set the Adobe PDF Preset and Save PDF



19

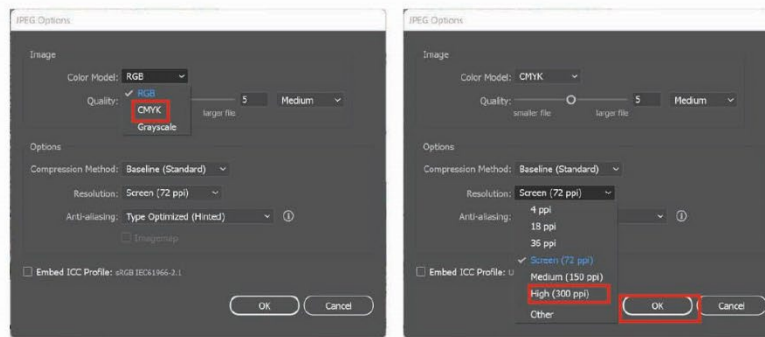
- To save file as **different types**, File tab > Export > Export As...
 - Select the **file type**, for example, JPEG(JPG)
 - Check the **Use Artboards** box
 - Click Export



20

10

- Set the Color Model to **CMYK** for printing
- Set **Resolution** High (higher than 200 ppi)
- Click **OK** to save the file



21

11

APPENDIX B

DEMONSTRATION OF GIS WORKSHOP

B-1. GIS Workshop: Preparation & Demonstration



Figure 10 Collaborative Curriculum Development



Figure 11 GIS Workshop at CityLab



Figure 12 Desk Crit at CityLab

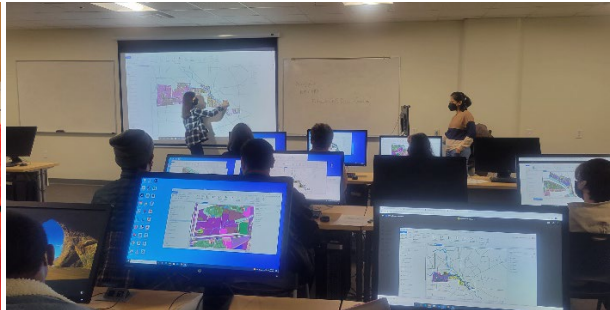


Figure 13 GIS Workshop at CAPPA, UTA

B-2. Field Trip



Figure 14 Exploring the River



Figure 15 Lecture During Lunch Break



Figure 16 North Texas Mater Naturalist



Figure 17 Walking along the River



Figure 18 Learning River Ecology



Figure 19 Drone Lesson

[Online Survey for Field Activities]

Field Trip to Moore Park

Document few of your observations about Trinity River and Moore Park with this survey

What is your first impression of the Trinity River today?

1000

2. How often do you visit the Trinity River or parks adjacent to the river? Which part of the river have you visited? What are the names of the parks you visited?

1000

3. Take a look at the conditions of the river and the river bank and take a picture of it.*

These pictures should help us understand the edge condition between the river and the land.

Select image file

4. Take another picture of the river conditions.

This picture will be more specific of the river itself

1000

10. What activities do you want to do at the river or around the river?

How did you get to the park today

Choose all that apply

☐ Car

☐ Public Transit

☐ walk

☐ Bike

What other transportation do you think you can use to get to this location? Choose all that applies.

Choose all that applies

☐ Car

☐ Bike trail

☐ walking

☐ public transit

5. Describe the conditions of the river and the river bank based on the following questions.

Is the water in the river clean? Do you see any trash? Is the river bank eroded? Is the river bank steep or gentle? Does it have trees/shrubs/prairies? Do you see any insects/fish/animals? Does the river look safe to get in? How much vegetation do you see along the river bank?

1000

Walk around a little bit and take a picture of something that you like.*

This can be a picture of any features (plants, trail, river, bridge, launch pad, others) that you were happy to see.

Select image file

Describe the picture you took and why you like it

1000

Walk around a little bit and take a picture of something that you don't like.**

This can be a picture of any features (plants, trail, river, bridge, launch pad, others) that you were not happy to see.

Select image file

Describe the picture you took and why you didn't like it

1000

How clean is the river and the edge at this location?

1 star would indicate a lot of trash, 5 star would indicate that it is very clean

☐ ☐ ☐ ☐ ☐

How would you rate this river edge location?

☐ ☐ ☐ ☐ ☐

Write your reflection about today's visit to the river and activities we did.

1000

Submit

B-3. Exhibition at AD EX, Dallas



Figure 20 Exhibition Title Board



Figure 21 Student Presentation Figure 22 Board Display



Figure 23 Architectural Models Created by Students



Figure 24 Installation in Progress

APPENDIX C

COLLABORATING PARTNERS

C-1. Participated Teachers from the Partner School, The CityLab

Oswaldo Rivera-Ortiz, Architecture, CityLab

Jennifer Sayed, Urban Planning, CityLab

Ashley Gardner, Environmental Sustainability, CityLab

Lynn Smith, Principal, CityLab

C-2. UTA Graduate Research Assistants

Kathleen Stanford, Graduate Research Assistant, Institute of Urban Studies, City and Regional Planning

Dasom Mun, Graduate Research Assistant, Landscape Architecture Program

Avery Deering-Frank, Graduate Research Assistant, Landscape Architecture Program

C-3. GIS Workshop Instructor

Ali Behseresht is a Ph.D. student of Urban Planning and Public Policy at the University of Texas at Arlington (UTA). He was teaching ArcGIS introduction, intermediate and advanced level classes to students at UTA's Urban Planning and Public Policy program. Also, Ali is a public transit Project Manager at Dallas Area Rapid Transit (DART). He manages public transit facilities, oversees Automatic Passenger Counter (APC) in collecting ridership, and analyzes ridership for further changes/improvements in public transit infrastructure.

His experience in teaching and research interests in Geographic Information Systems (GIS), Quantitative Modeling, land-use modeling, and public transit provided significant inputs in creating most impactful teaching material for students, using real-world data. For example, Ali acquired bus stop amenities, and user count data from DART. This data was immensely helpful in determining the best locations for bus stop interventions.

C-4. Guest Speakers

W.J. “Bud” Melton engages with Special Projects in Halff's Planning and Landscape Architecture practice. During his nearly-30 years of consulting, he has had key roles in alignment feasibility studies, and fostering inter-jurisdictional and interagency partnerships for a variety of urban bikeways and trails which are included in the planned Regional Veloweb network. Bud is a member of the American Planning Association and its Texas Chapter; the Association of Pedestrian & Bicycle Professionals; the Urban

Land Institute's TOD Product Council; a board director of the Greater Dallas Planning Council. He serves on advisory councils for University of Texas at Arlington's master's in landscape architecture Program as well as for Dallas Independent School District's CityLab High School Foundation.

Steve Smith's early career as a rocket scientist in the Neil Armstrong lunar landing program equipped him well to found Smith Group Asset Management, specializing in finding companies that will grow faster than expected and capturing the reward for clients when that happens. Steve has always loved the outdoors. He attained the highest honor awarded, an Eagle Scout, in Boy Scouts of America and spent five summers volunteering in BSA camps. In recent years, his love of the outdoors has led him to volunteer for a number of nature-oriented non-profits, including recent board seats for Groundwork Dallas, Friends of Reverchon Park, Audubon Texas, and the Trinity Coalition, where he currently serves as Board Chairman.

Teresa Patterson, aka "River Mom" is a certified ACA (American Canoe Association) instructor, and co-owner of Adventures Unlimited Paddling Company. She worked as an event planner/decorator and author before turning her talents to growing the Trinity River Paddling Trail. She has been guiding groups of paddlers on adventures throughout the rivers and lakes of the DFW Metroplex for over 6 years. She currently serves as an officer in the North Texas River Runners and is an active member of the Dallas Downriver Club. Originally a scuba diver, Teresa took up kayaking as a way to stay close to the water when she couldn't dive. Now kayaking, sailing, and horseback riding are her passions. The only thing she loves more is helping others discover the joys of nature on the river.

Kristi Kerr Leonard possesses a lifelong love of the natural world, starting with her childhood in the woods and creeks of Oak Cliff, and now merges that with her MBA and business acumen. Utilizing her MBA from Thunderbird School of Global Management, Kristi began her career as an account supervisor at The Richards Group and later operated her own advertising company, Head Bank Freelance Advertising. Most recently, she served as a consultant to high-net worth individuals in their estate management and legacy building. Kristi found her niche in 2014 as a certified North Texas Master Naturalist. A natural explorer, Kristi's primary volunteer activity is leading hikes in the Great Trinity Forest. Her research focus includes local history, medicinal and edible plants, forest ecology, and Native American lore.

Rachel Jenkins joined the North Central Texas Council of Governments (NCTCOG) as a Transportation Planner in 2019. As part of the Transit Management and Planning team she plans, implements, and supports transit projects and mobility management activities throughout the region. Together with regional transportation partners, she works to identify and address transportation gaps and opportunities. Prior to joining the team at NCTCOG, Rachel managed the group visit program as part of the University Recruitment team at the University of Texas at Arlington, assisting students on their journey to higher education. Rachel received her Bachelor of Arts Degree in Geography and Anthropology from Texas Christian University in 2014 and a Master of City and

Regional Planning with a Certificate in Geographic Information Systems from the University of Texas at Arlington in 2020. In 2019, she was named an Eisenhower Transportation Fellow by the U.S. Department of Transportation for her research and professional contributions to the field of transportation. She is also a steadfast advocate for public transportation and mobility access within her own community in Fort Worth, Texas.

C-5. Field Trip Volunteers

Teresa Patterson, Trinity River Paddling Trail Manager, Trinity coalition, Adventures Unlimited Paddling Company

Kristi Kerr Leonard, MBA, Trinity Coalition

Ginger Greatens, North Texas Master Naturalists

Imelda Haley, North Texas Master Naturalists

C-6. Project Partners

The CityLab High School Foundation is an independent nonprofit organization that supports the mission of CityLab High School. The Foundation promotes community involvement and secures funding support for the High School. Foundation programs include Dallas Mayoral Forums, annual Summits, and webinars. The Foundation also helps connect CityLab with potential project and funding partners.

The Trinity Coalition is dedicated to improving the Trinity River, its parks, and forests, as one of the most valued natural assets in Texas. In 2020 they were rewarded with the official designation of the Upper Trinity River Corridor as a National Water Trail, creating a national paddling destination for our 7.4 million Dallas-Ft Worth Metroplex residents and the nation. It is a 501(c)3 non-profit corporation.

The Institute of Urban Studies (IUS) was founded in 1967 to conduct research on urban issues, provide the fruits of that research to municipal government organizations, educational institutions, and community non-profits, and to train future generations of urban planners, city officials, and academic leaders. Over the past 50+ years, the Institute has assisted over 300 Texas communities from small general law cities, to neighborhoods, to major cities like Dallas and Fort Worth. IUS has generated millions of dollars of sponsored research and community-based projects and helped to train hundreds of planning professionals and city leaders who have applied their skills to assist communities and educational institutions across the nation. IUS is housed with UT Arlington, a Carnegie Tier 1 research institution based in the Dallas Fort Worth Metroplex.