# Digital Mapping & Spatial Analysis

Graduate Community of Learning
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# Workshop Agenda

1. Visualizing Spatial Data (Andrew)
2. Storytelling with Maps (Rachel)
3. Archaeological Application of GIS (Zach)

# CARTO

- Map, Interact, Analyze
- Example 1: Bryn Mawr dining options
- Example 2: Carpenter Carrel Project
- Example 3: Terracotta Altars from Morgantina

# Leaflet: A JavaScript Library

http://leafletjs.com

# Storytelling with maps #1: OdysseyJS (CartoDB)

Platform

Germany's way through the World Cup 2014

Tutorial

# Storytelling with maps #2: Story Maps (ArcGIS)

Platform

Indiana Limestone (example 1)

Ancient Wonders (example 2)

# Mapping Spatial Data with ArcGIS

- Mapping in GIS Basics
- Archaeological Applications
- Topographic Applications

# Mapping Spatial Data with ArcGIS

## What is GIS - Geographic Information System?

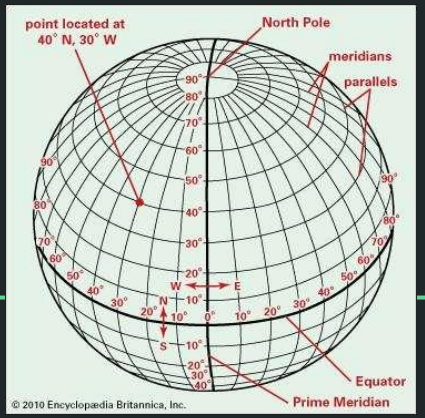
**A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into spatial data, such as patterns, relationships, and situations - helping users make smarter decisions.** - ESRI GIS dictionary.

- ArcGIS by ESRI - industry standard, expensive, intuitive functionality, PC
- Q-GIS - open source, industry standard, less than intuitive, Mac and PC
- GRASS - developed by the US military, open source
- AutoDESK - counterpart to AutoCAD for topography

# Types of Spatial Data in ArcGIS: Basics

**Every feature on the planet has its own unique latitude and longitude coordinates:**

**Houses, trees, streets, archaeological finds, you!**




## How do we collect this information?

- **Remote Sensing: Aerial photography, satellite imaging, LIDAR**

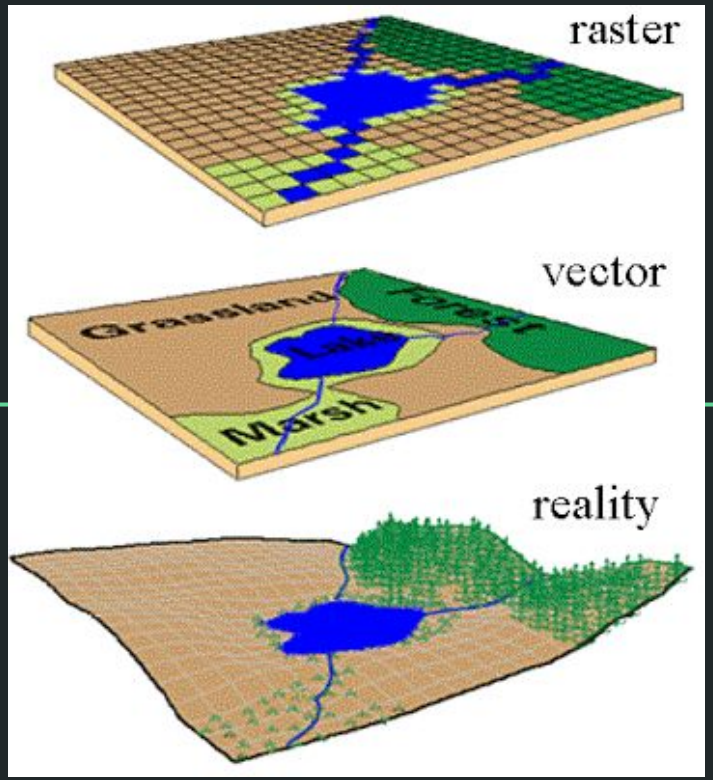
- **On-site Observation: total station data, ground penetrating radar, GPS**

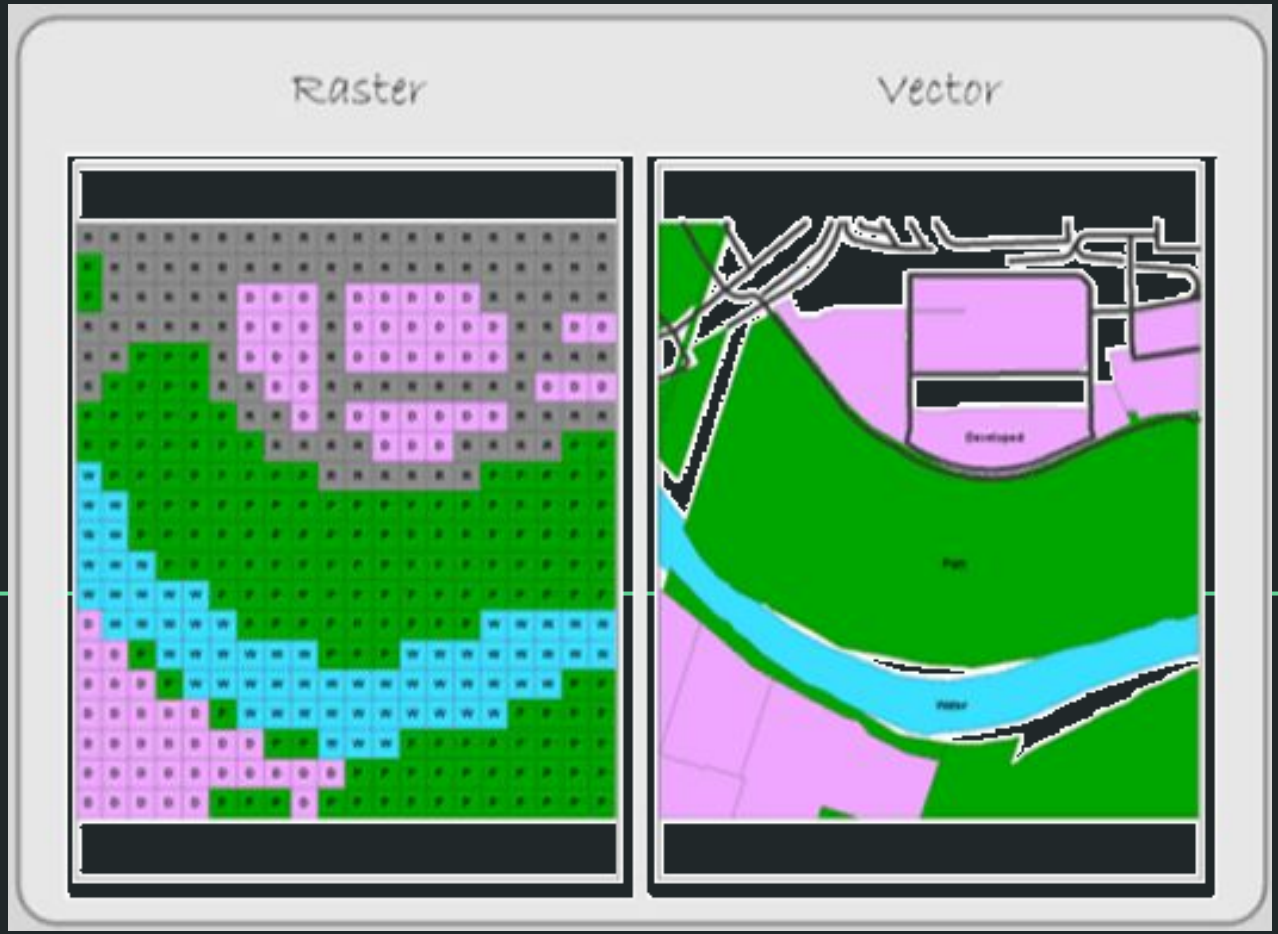
# Types of Spatial Data in ArcGIS: Basics

## Raster vs. Vector projections

**Raster Maps:** “a representation of the world as a surface divided into a regular grid of cells. Raster models are useful for storing data that varies continuously, as in an aerial photograph, a satellite image, a surface of chemical concentrations, or an elevation surface”

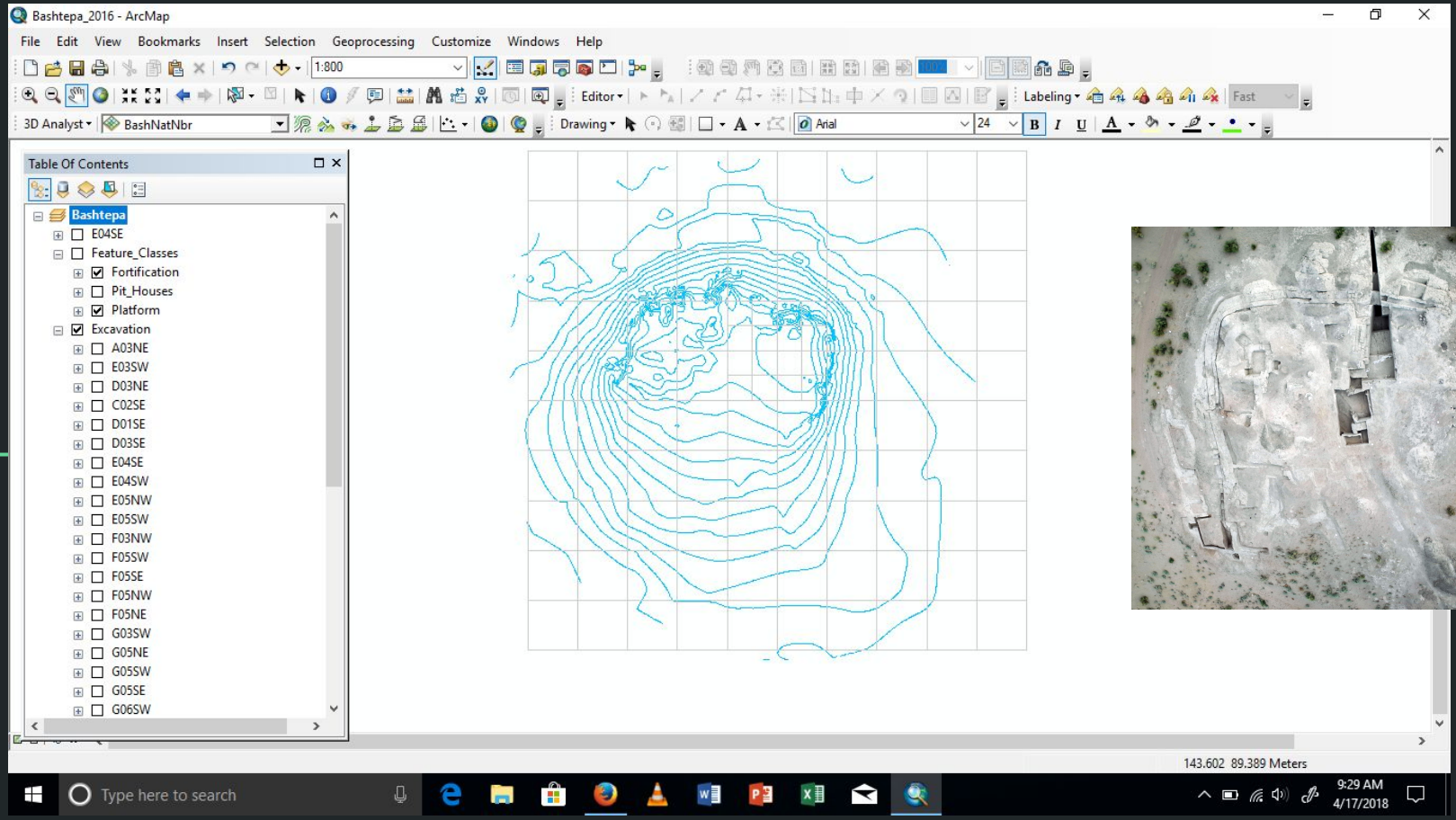
**Vector Maps:** a representation of the world using points, lines, and polygons. Vector models are useful for storing data that has discrete boundaries, such as country borders, land parcels, and streets.






Source: giscommons.org/introduction-concepts

# Vector topography vs. raster, aerial topography at Bashtepa, Uzbekistan



**The Ideal:**

**Map created in ArcGIS using raster and vector data imported into photoshop and illustrator for an aesthetic finish.**


**(We still have yet to do this for Bashtepa)**

# Archaeological Applications of ArcGIS

**ArcGIS is a powerful tool for projecting and querying mass amounts of archaeological spatial data. ArcGIS, or open source alternatives such as Q-GIS, alongside AutoCAD Civil are industry standard.**

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**Uses:**

- **Visualizing a site's "grid frame"**
- **Projecting spatial data about the excavation - architectural features, small finds, soil layers and transitions, height levels,**
- **Measuring distance at a small and large scales**
- **Calculating area of features**

# Archaeological Applications of ArcGIS

**Both raster and vector maps can (and should) be anchored to longitude And longitude coordinates. Longitude and Latitude coordinates are VECTOR points. They are conceptual and not real, converging at 0, 0 in the Gulf of Guinea off the west coast of Africa. All spatial references in lat./ long. are anchored to this point.**

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**This is ideal, but not necessary, and in some cases impractical for archaeological projects.**

- **Requires a GPS capable of >1cm accuracy (Trimble). NO HANDHELDS!**

# Archaeological Applications of ArcGIS

## Total Station

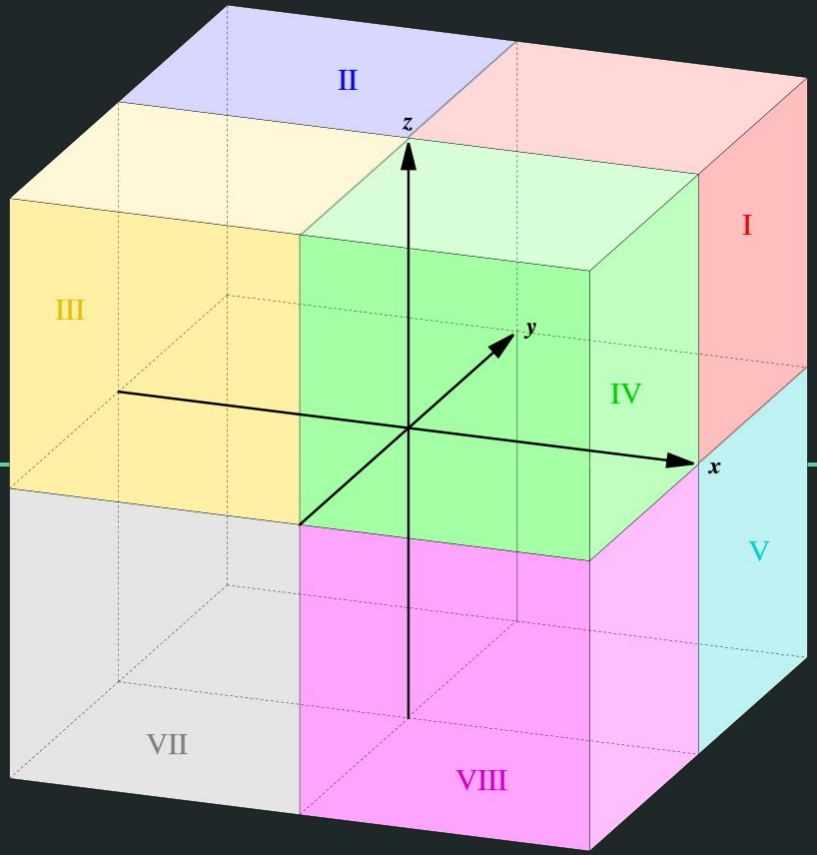
A scary looking, but simple piece of equipment that uses a laser and triangulation to establish points in space in relation to other points in space. Accuracy ~3mm!

- Not tied to long/lat, (more expensive models now do)
- Data must be internally coherent so the station “knows” where you are in relation to other points in space.
- This requires the establishment of an “internal” or “floating” grid.”

# Archaeological Applications of ArcGIS

## Floating Grids

Each archaeological site requires an internally coherent data frame, known as a grid, to which all points in space, i.e. your archaeological data, are spatially referenced. Without this your documentation is irreparably flawed.



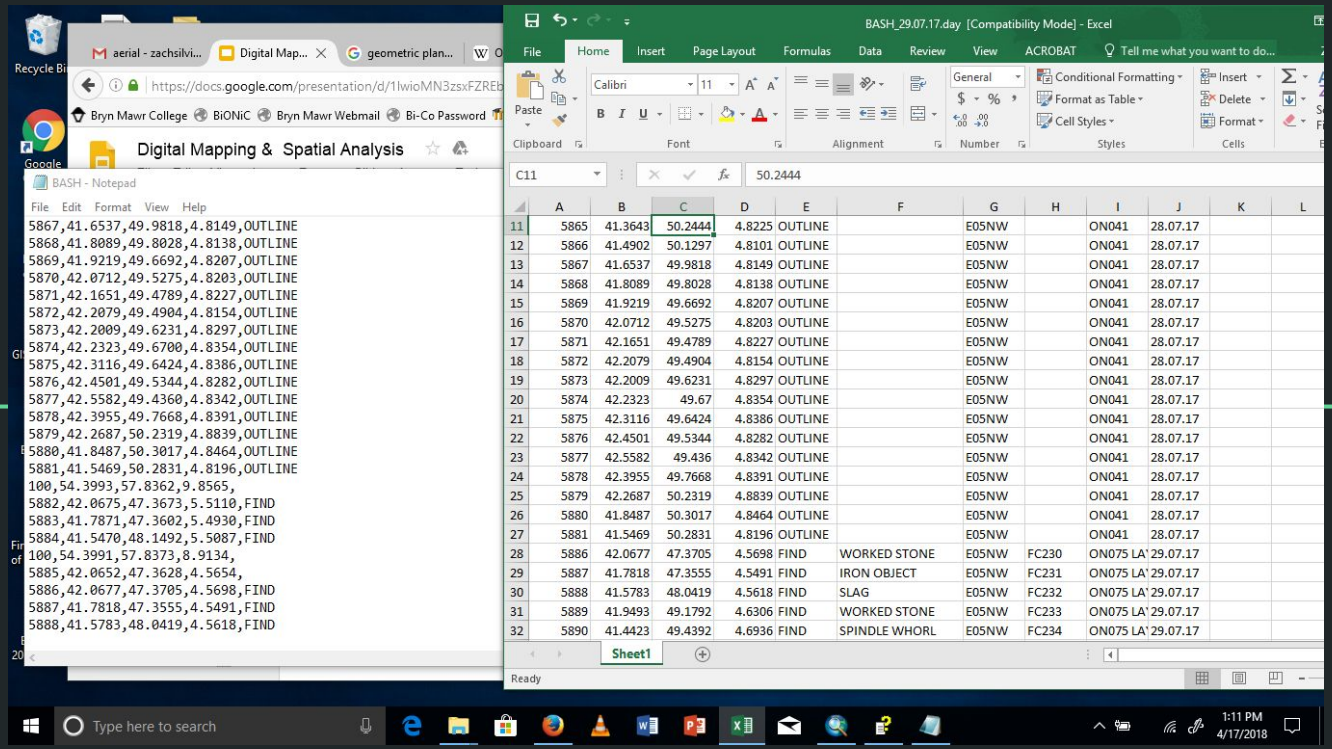

**It is nothing more than an x, y, z geometric plane to which all points are measured in meters rather than lat./long.**

# Archaeological Applications of ArcGIS

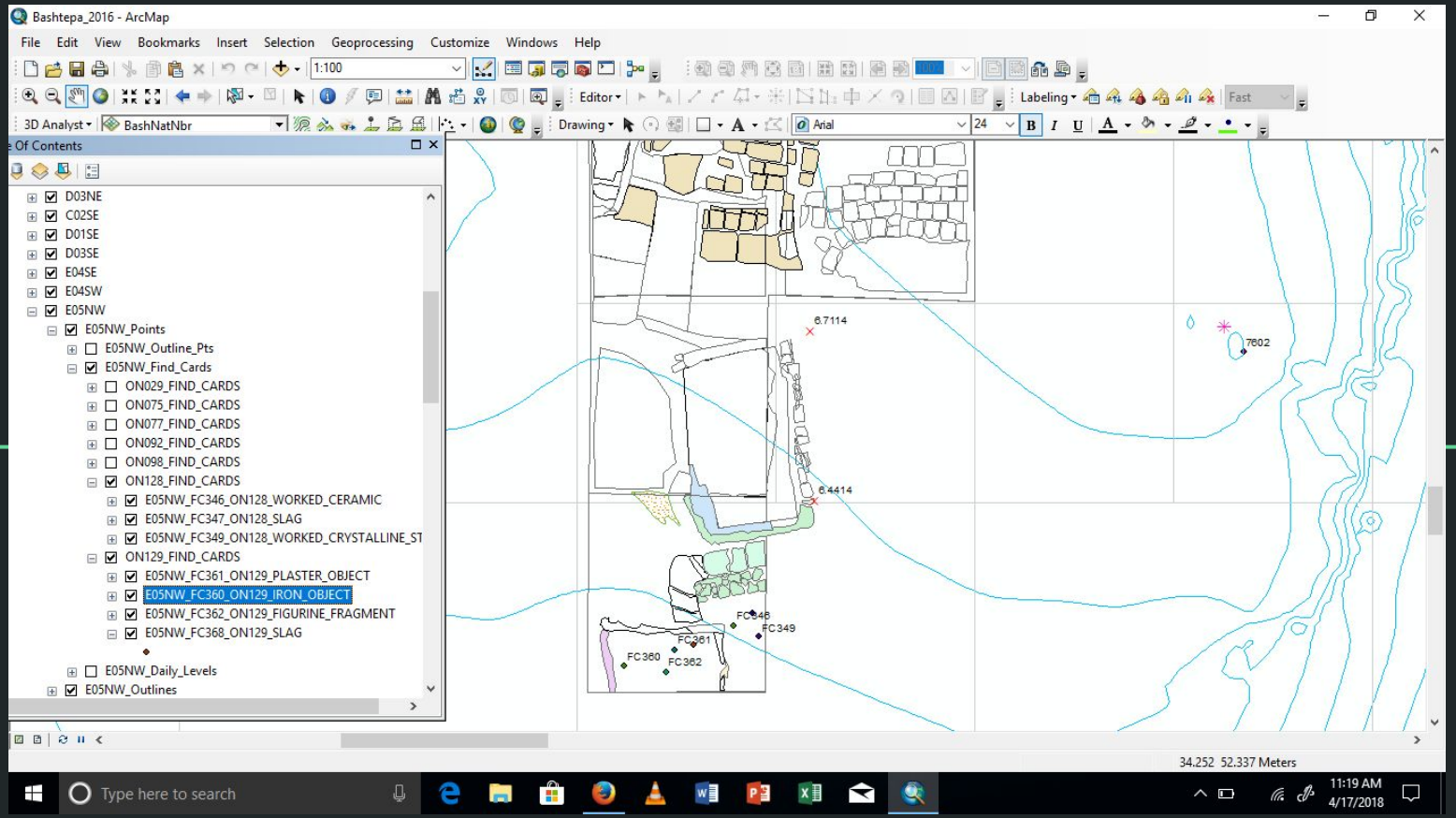
## X, Y, Z data

X = Easting
Y = Northing
Z = Height

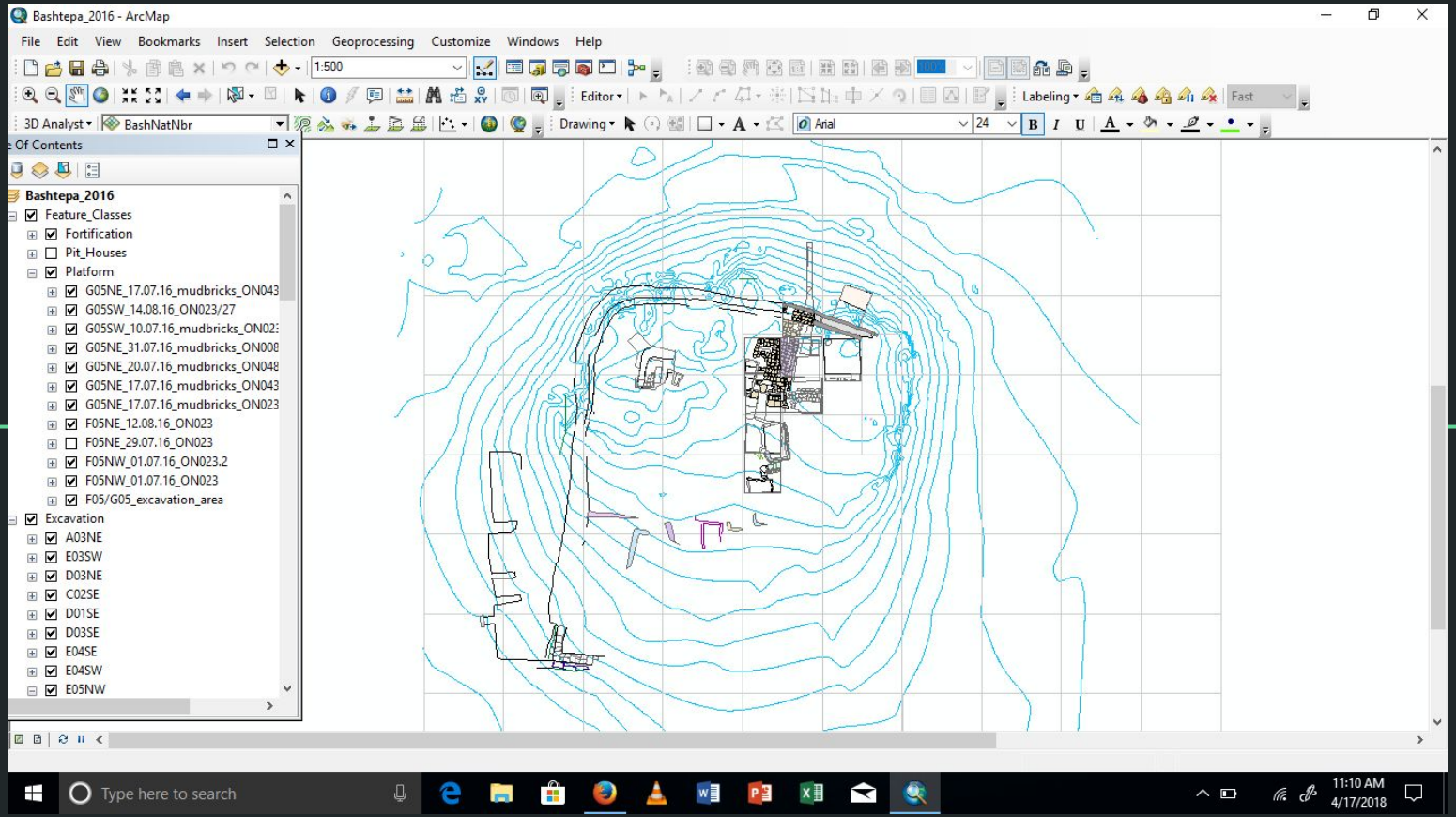
- Total Station: .txt file
- ArcGIS needs .xml
- Code point attributes in excel



# Archaeological Applications of ArcGIS



# Archaeological Applications of ArcGIS



# Topographic Mapping

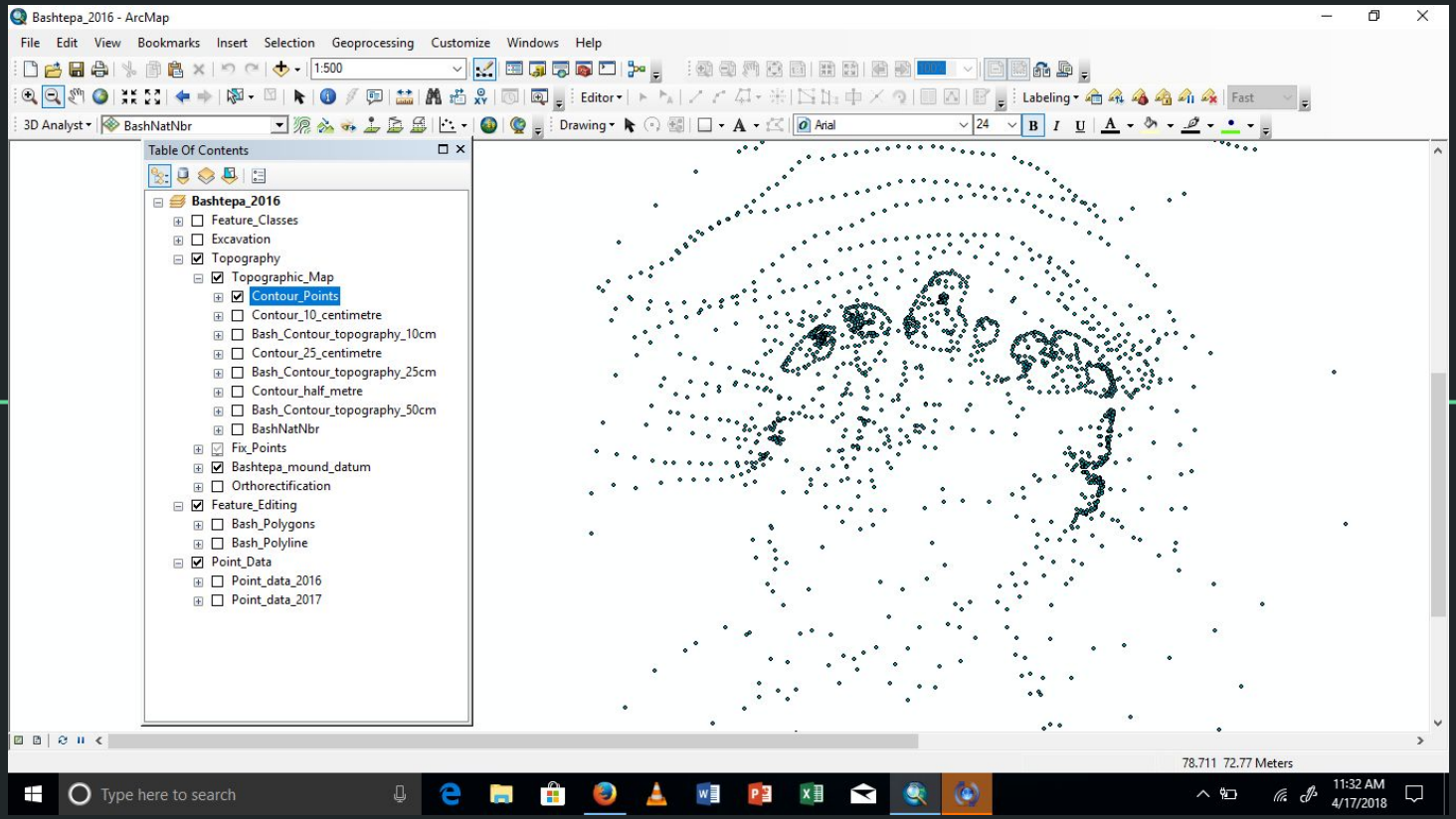
## TWO DAYS FOR COLLECTING DATA - TWO MINUTES TO PROJECT !!!

ArcGIS has several built in apps for the purpose of creating topo maps at the click of a button.

The hard work is taking the points! These number in the thousands and the work is boring.

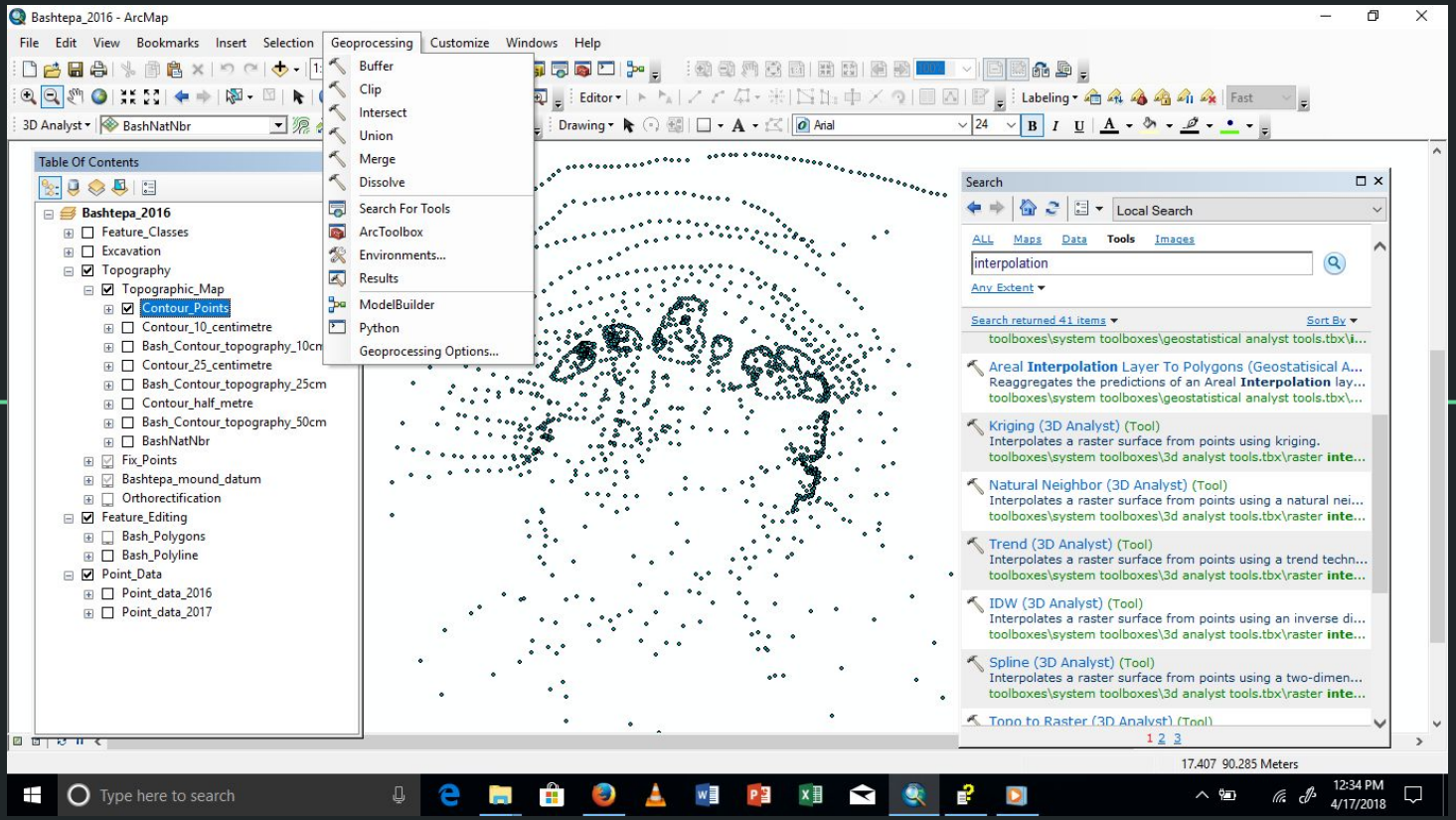
# Topographic Mapping

# Topographic Mapping

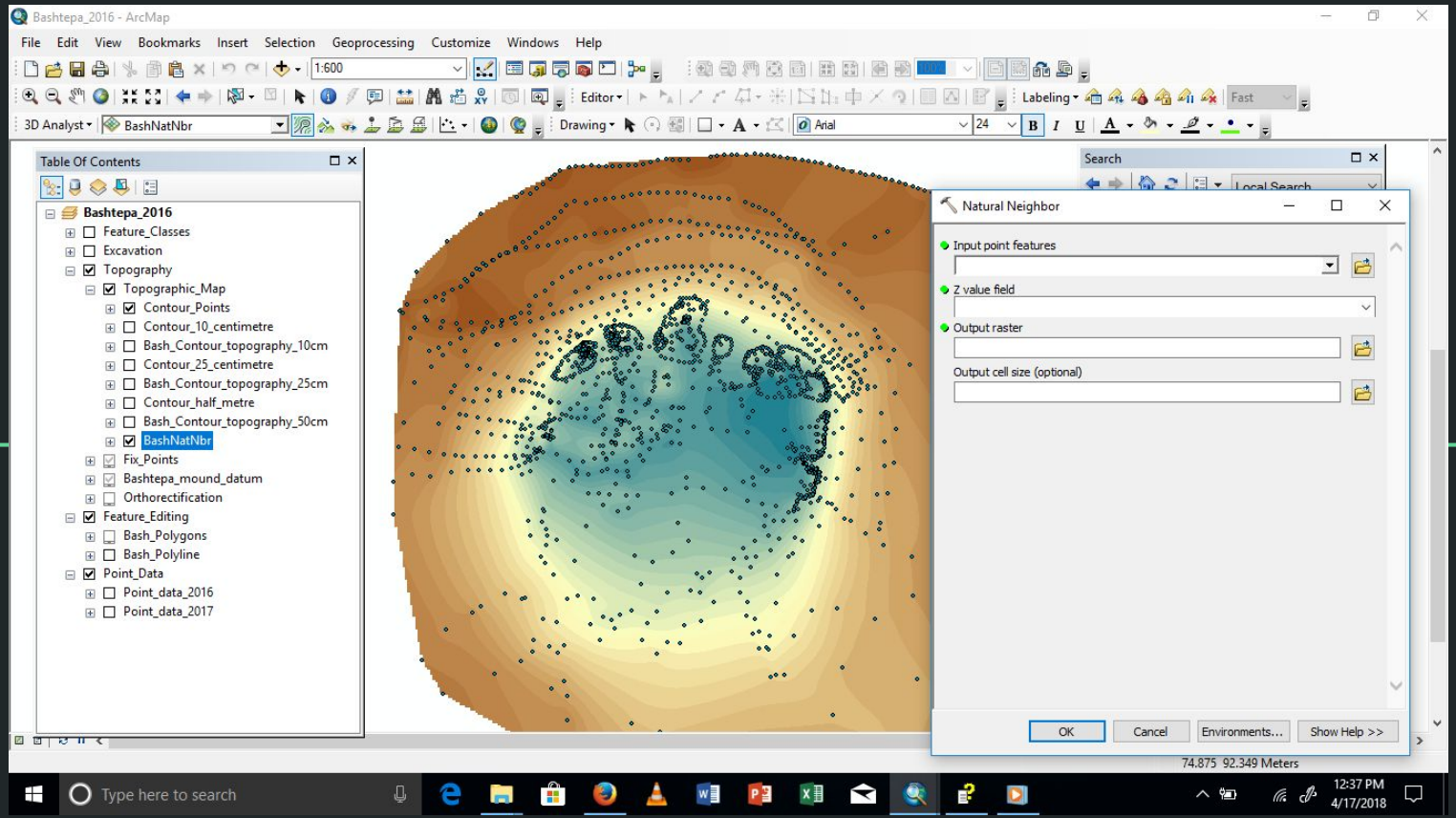


# Topographic Mapping

## Interpolation - visualizing the spatial relationship between 3D points.

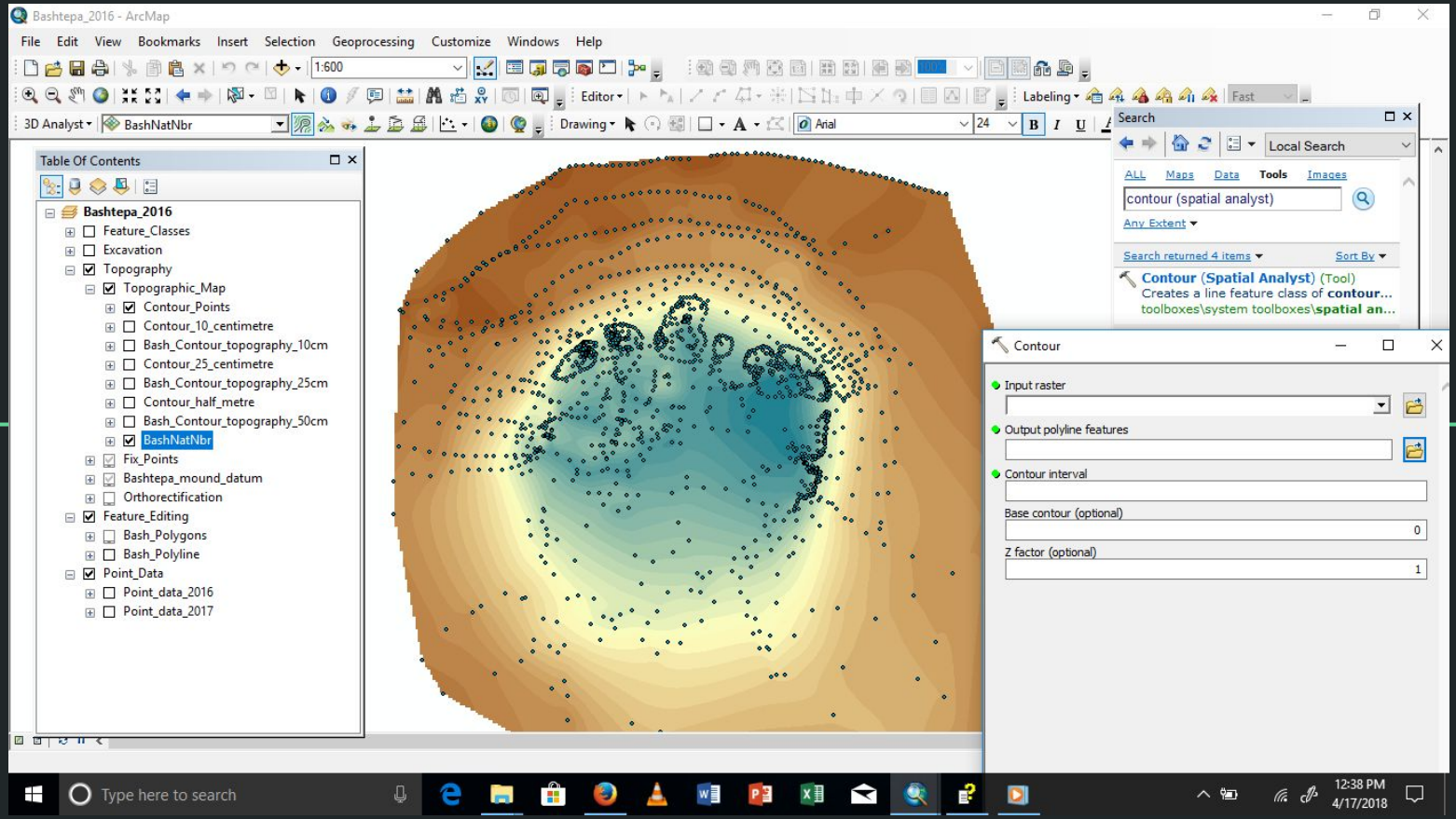


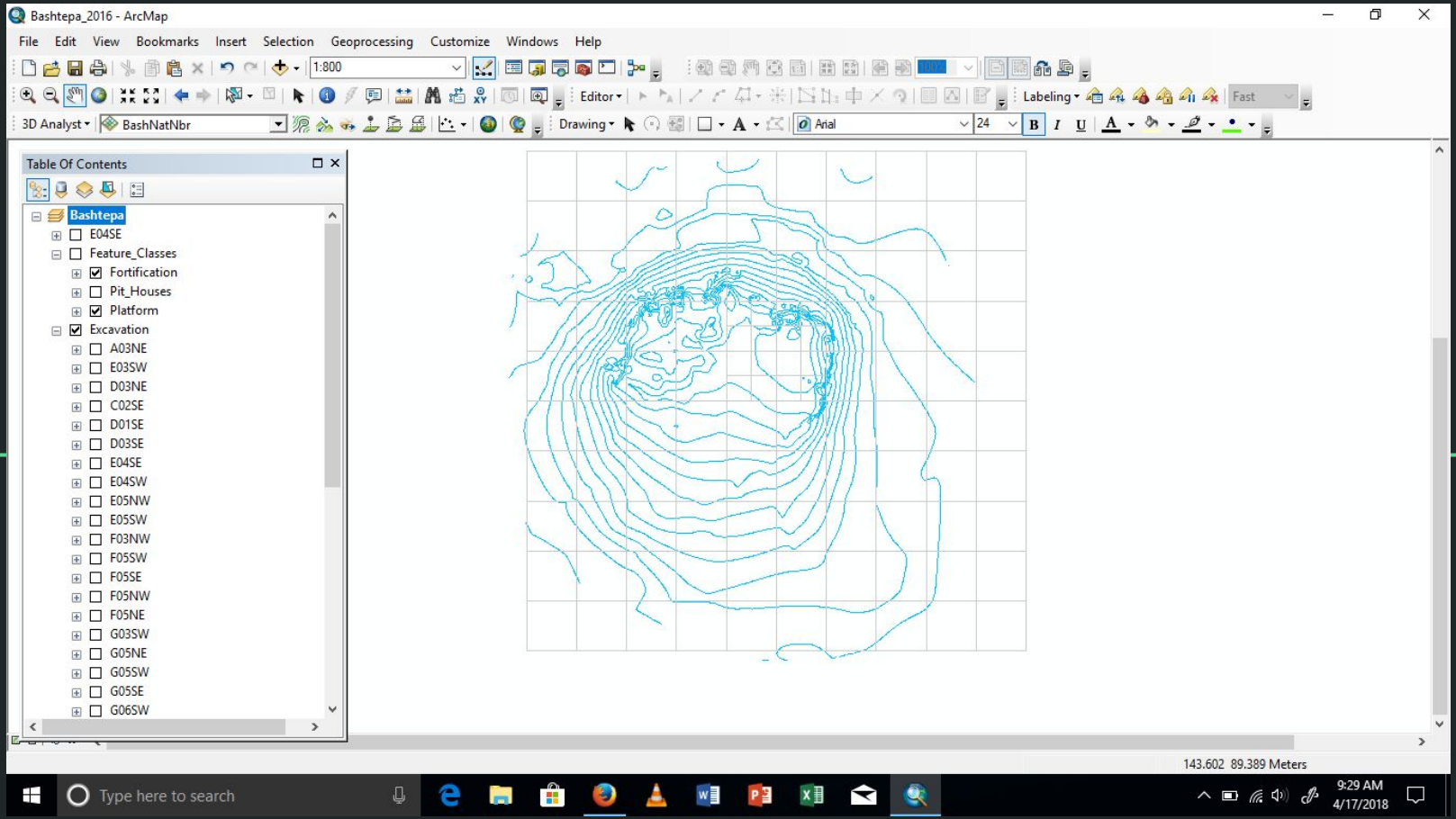
# Topographic Mapping



# Topographic Mapping

## Contour Topography

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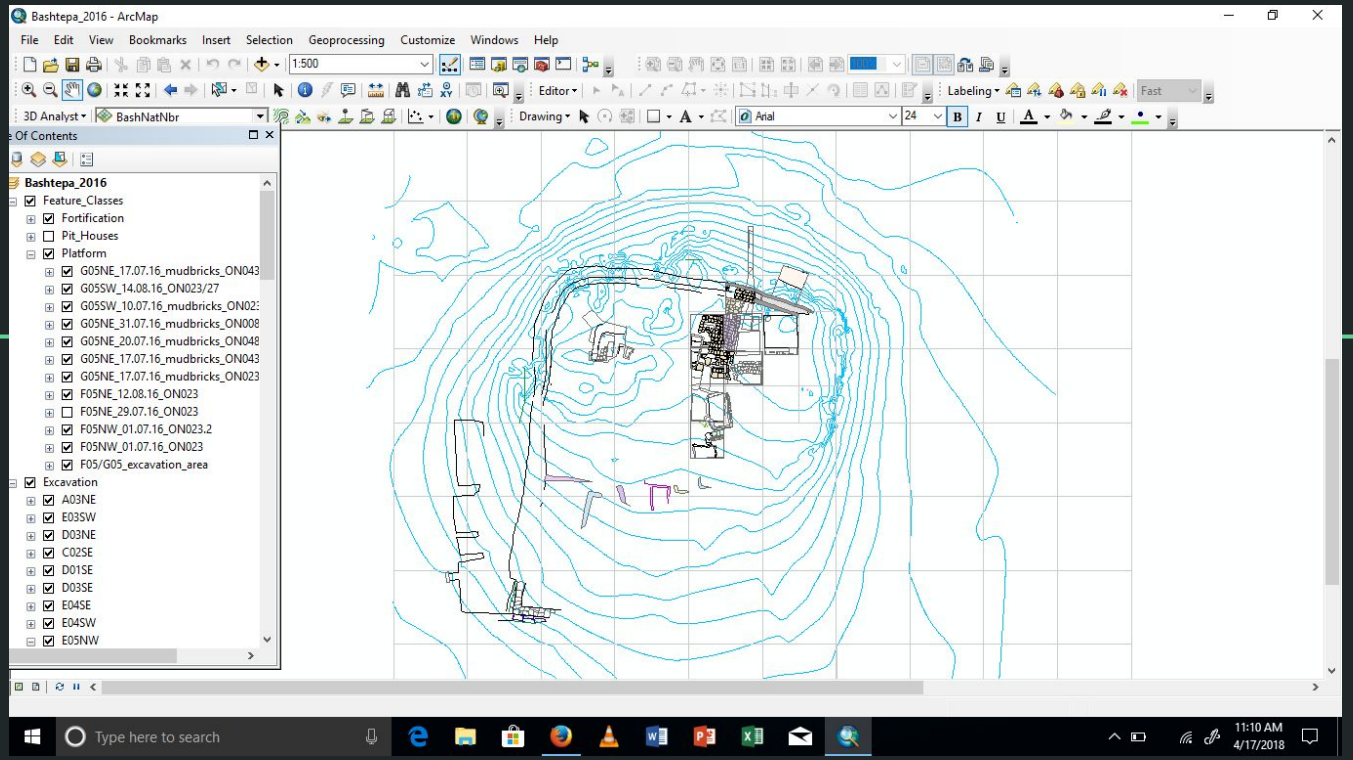
# Overlaying

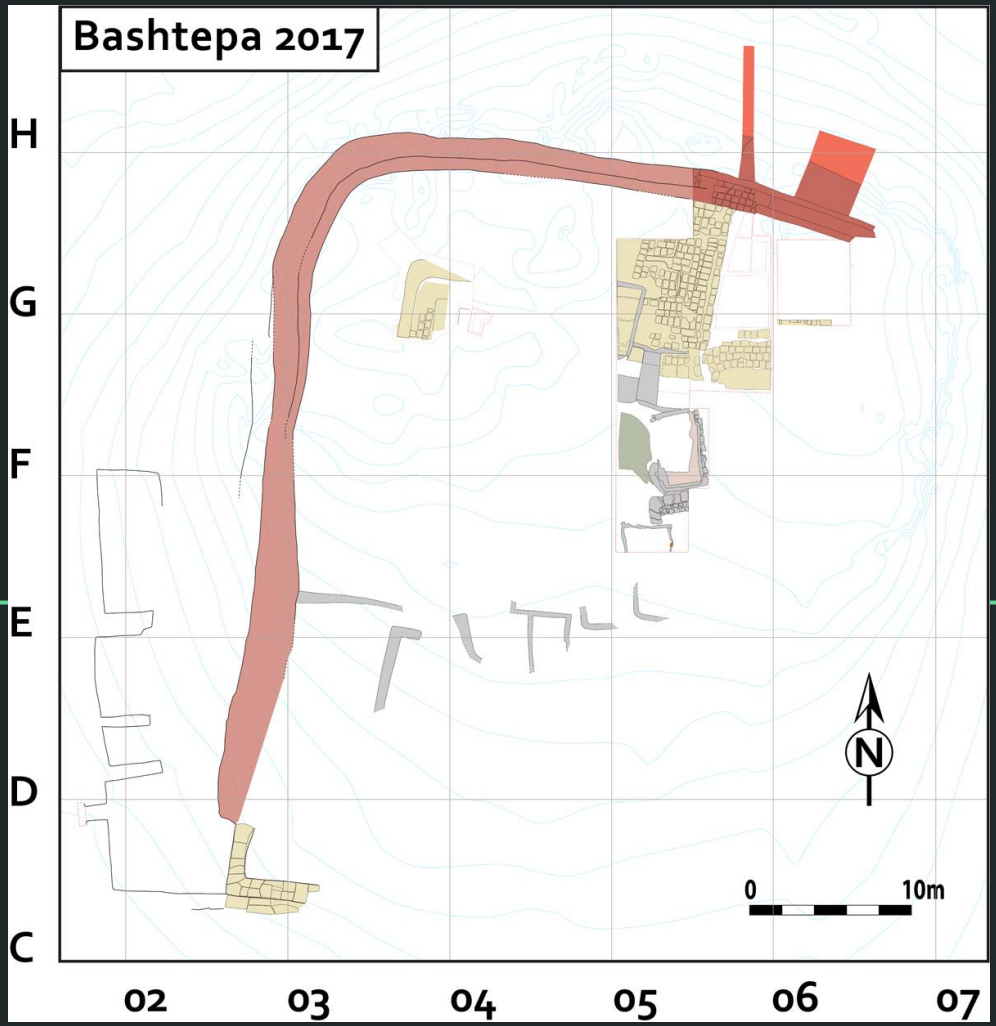
**All within the same data frame, anchored to the same grid. Just a click of a button!**



# Final Stage Making Your Map Publishable

**ArcGIS is horrible for making aesthetically pleasing, polished Maps. Major shortcoming.**

- Analytic tool, not graphic.
- Capability to import into Illustrator (vector) or Photoshop (raster).
- Many sites use AutoCAD Civil because the maps are publishable and spatially sound as you go.



# Google Maps APIs: Geocoding

https://developers.google.com/maps/documentation/

# Additional Resources

- Mapknitter.org - make maps from aerial photos
- Timeline.knightlab.com - make interactive timelines
- Worldmap.harvard.edu - open-source GIS mapping platform

- Ancient World Mapping Center (Antiquity À-la-carte)
- Pleiades - Gazeteer of Ancient Places
- Digital Atlas of Roman and Medieval Civilization (DARMC)
- Digital Atlas of the Roman Empire (DARE)
- ORBIS: The Stanford Geospatial Network Model of the Roman World