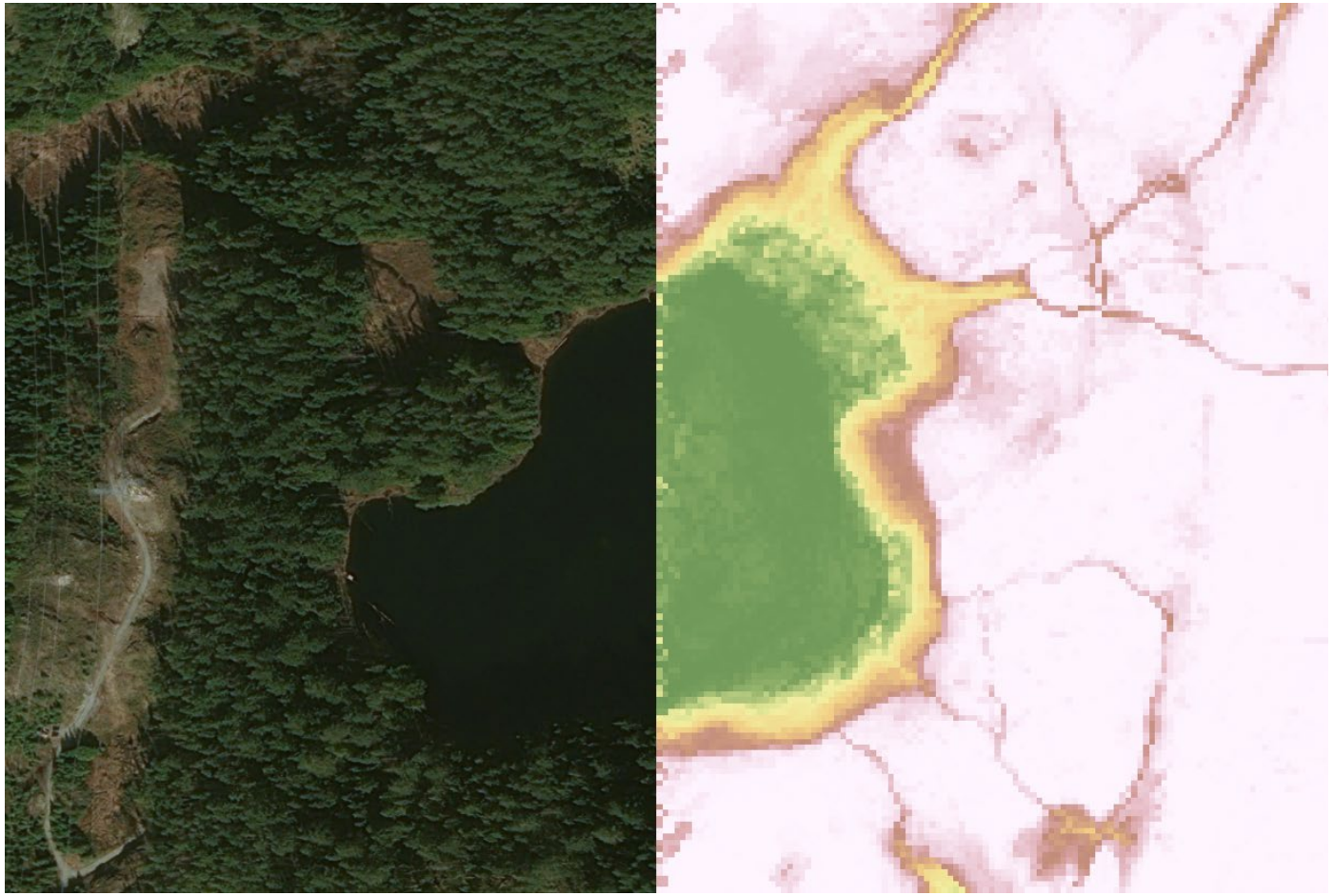


Wetland Intrinsic Potential tool Guide

Table of Contents

Preliminary Requirements

The Wetland Intrinsic Potential (WIP) tool is computationally intensive. It is advised to have the following prerequisites when running the tools:

- RAM of 16GB or higher (dependent on the extent of your area and resolution)

- Locally installed ArcGIS Pro software

- R

- Rstudio (recommended but optional)

- ArcHydro (Optional)

Getting started

Python and R languages are required to run the tool. Python is already integrated into ArcGIS Pro, however R is required to be downloaded.

Step 1: Follow the link to R CRAN selection

Step 2: Select the CRAN mirror link closest to your location

If you are located in Vancouver BC, you would select this link

Canada

https://mirror.rcg.sfu.ca/mirror/CRAN/	Simon Fraser University, Burnaby
https://muug.ca/mirror/cran/	Manitoba Unix User Group
https://cran.utstat.utoronto.ca/	University of Toronto
https://cran.pacha.dev/	DigitalOcean
https://mirror.csclub.uwaterloo.ca/CRAN/	University of Waterloo

Step 3: Select the appropriate download based off of your computer's operating system link

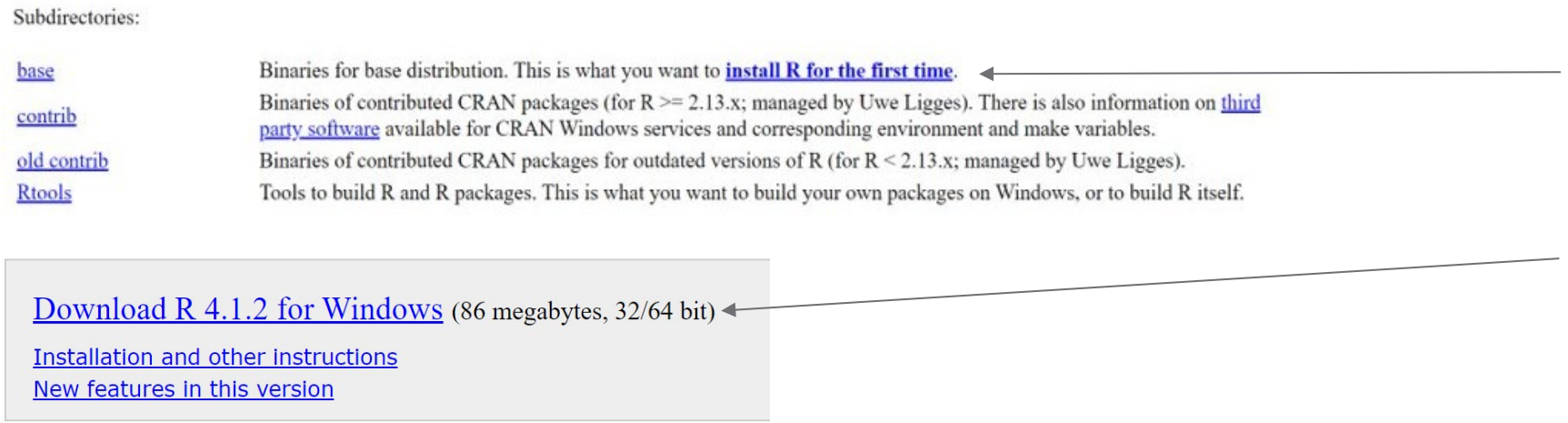
Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- Download R for Linux (Debian, Fedora/Redhat, Ubuntu)
- Download R for macOS
- Download R for Windows

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

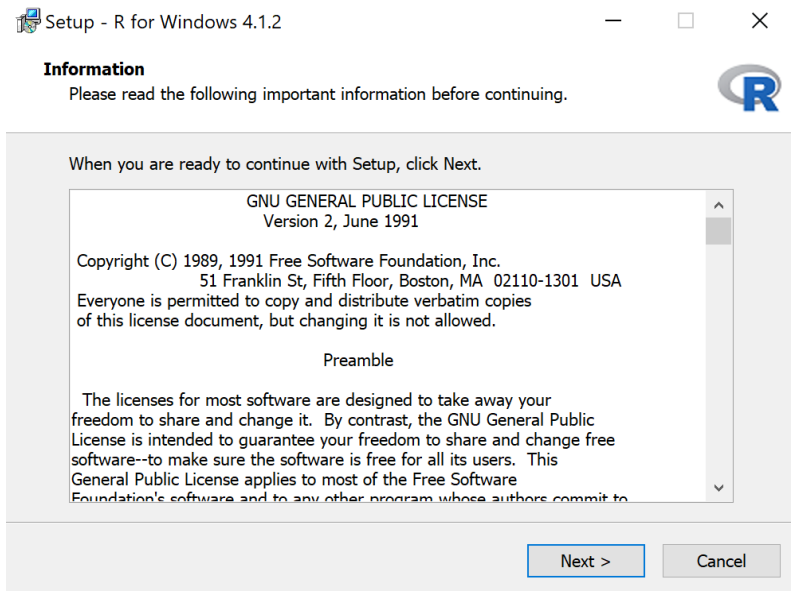
Step 4: Install R

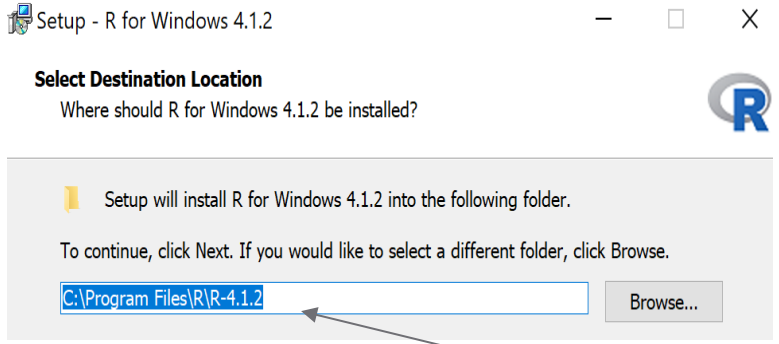


Follow the link

Click link to download

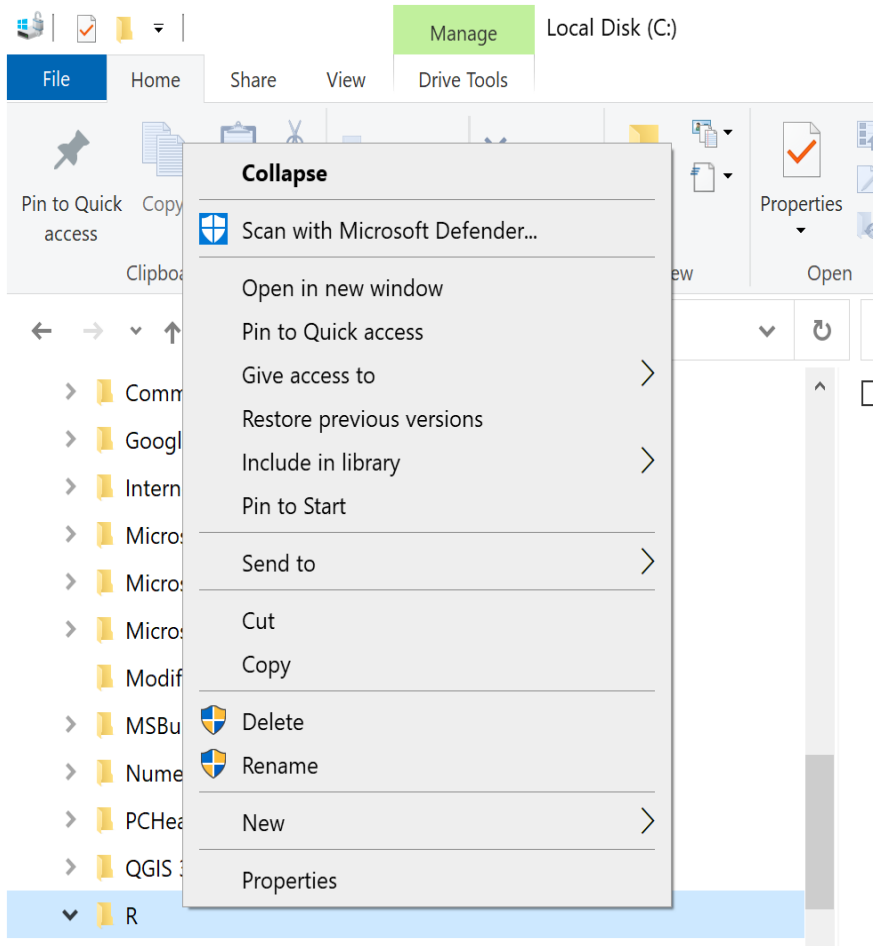
Step 5: Click next on each step of the download and finish. Leave the preset selections the same.

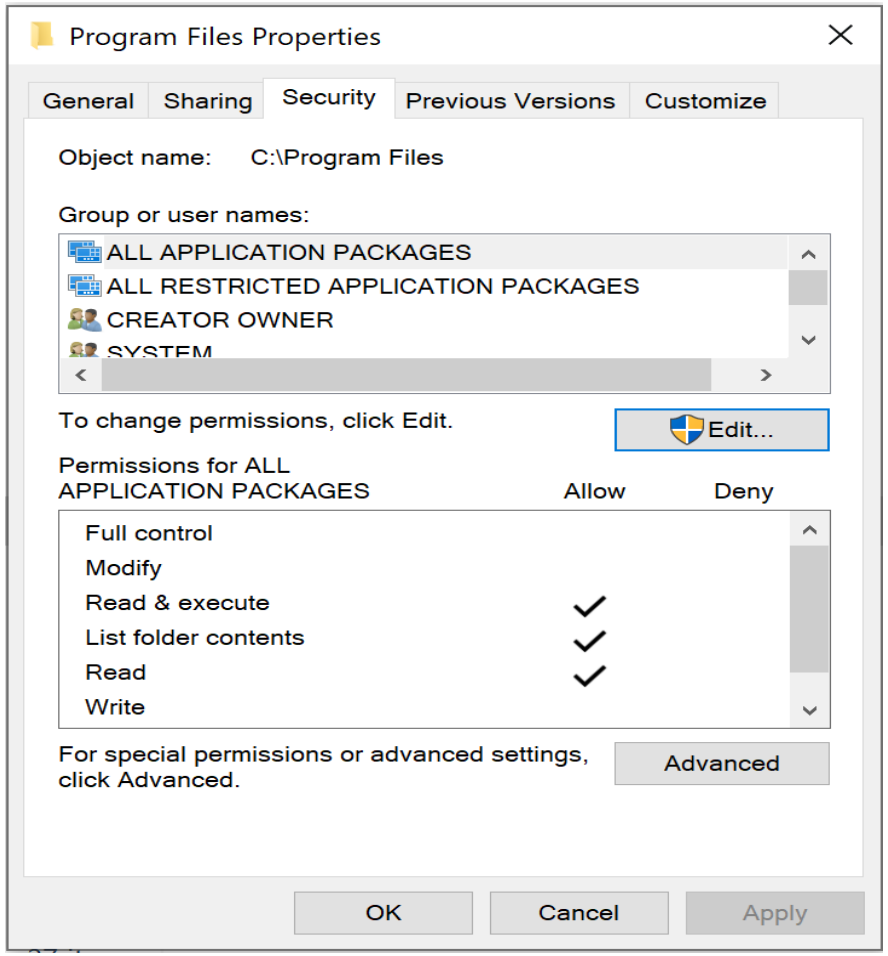




Note: R will want to download in the Programs Files area of your computer. This is not an issue, however it is recommended to check the permissions of the file location. Errors may be incurred when running the Build Random Forest script, if certain permissions are not enabled. See next slide for clarification.

- Step 6: Check permissions. Locate where the R folder is saved. Right click on the folder and select properties. Select security. View the permissions for the program. If the permissions are limited and cannot be changed, move the R folder file location into the computer's documents folder. This should fix most permissions issues when running the Build Random Forest script.

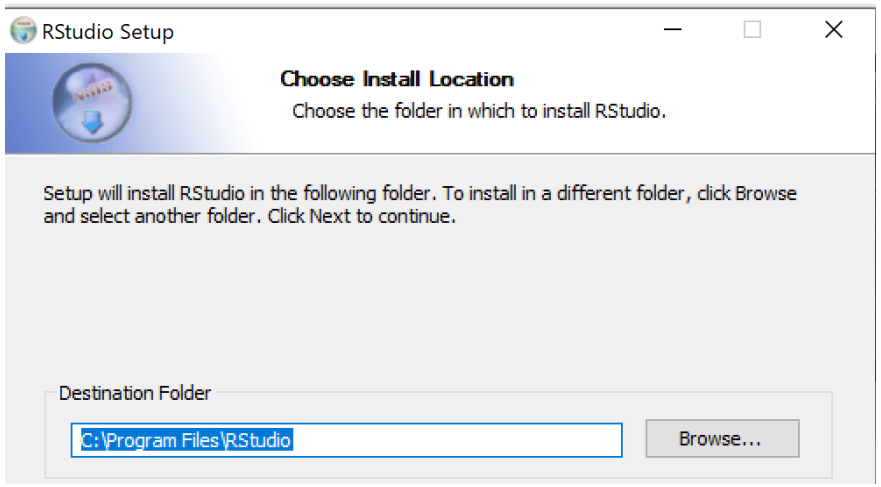




Step 7: download Rstudio. [Rstudio download]

Click to download recommended file

Leave the preset selections the same and finish. R and Rstudio are now downloaded.



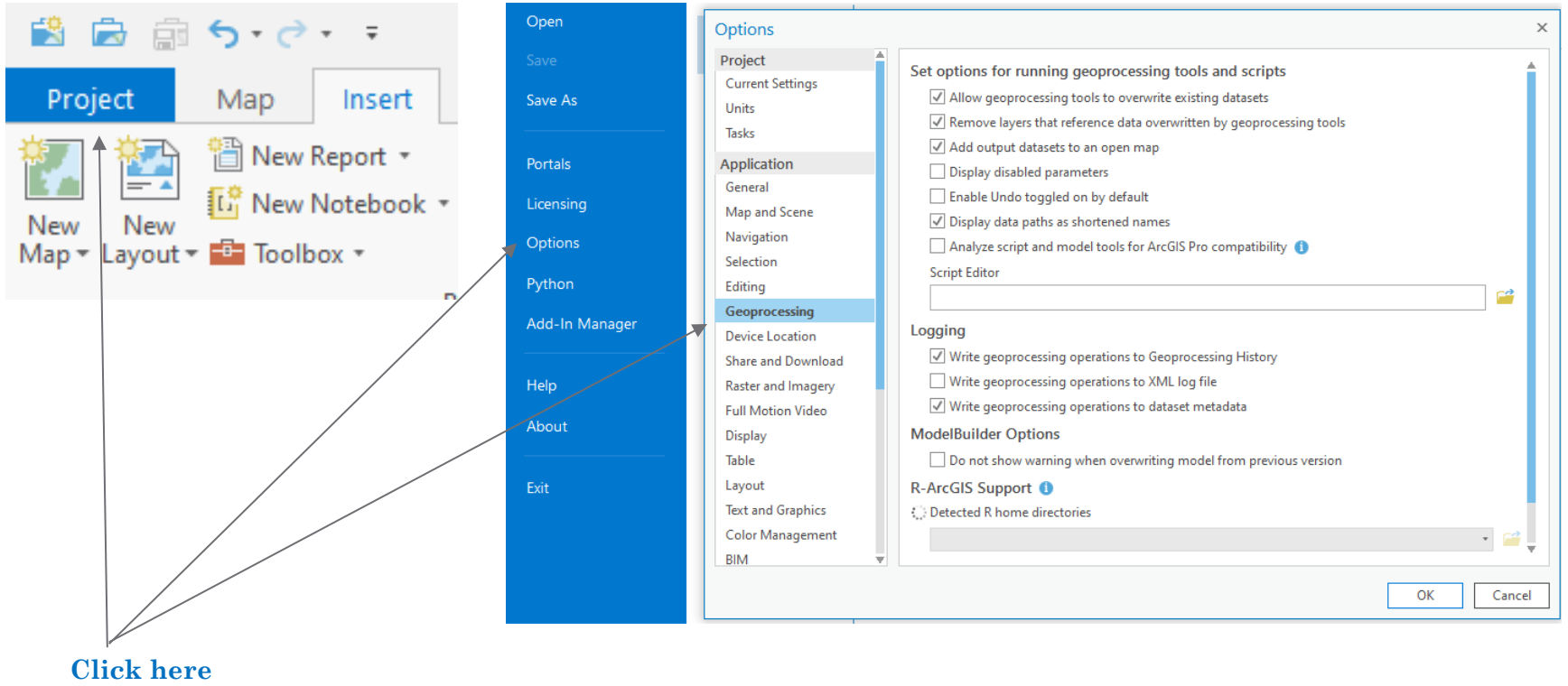
Locate where R was downloaded to and save in the same location

Installing ArcGIS bridge

The arcgisbinding package is required in order to create the ArcGIS-bridge. The following link provided in depth instructions if required, otherwise follow these steps. (Link if necessary) [Github R-bridge tutorial]

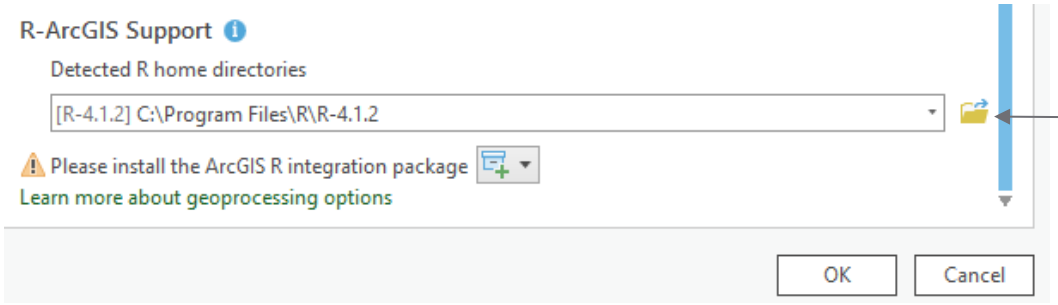
Step 1: Open ArcGIS Pro up

Step 2: click on Project in the left corner. Click on Options, then Geoprocessing.



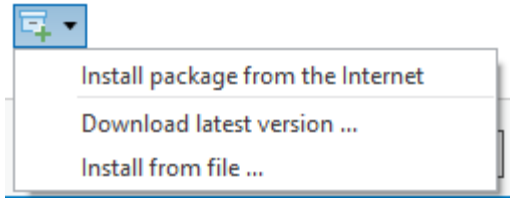
Click here

Step 3: Locate R-ArcGIS Support section within the geoprocessing tab. ArcGIS should detect a home directory and if it does not, click on the folder location and manually locate the R folder and select.

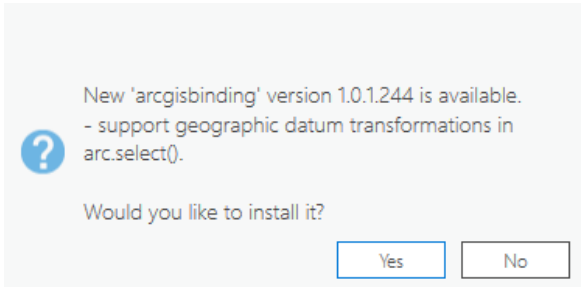


Folder icon for manual selection

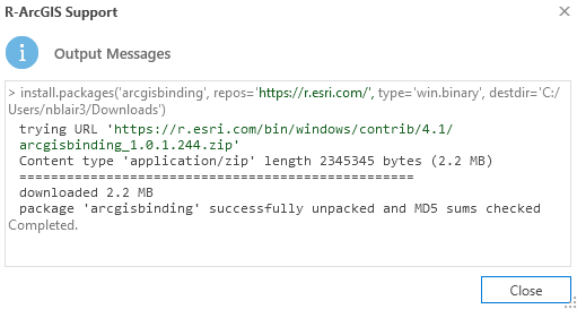
Step 4: click on this icon  and select "install package from the internet".

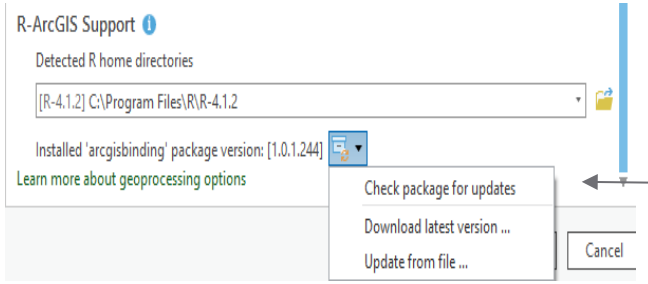


Step 5: Click Yes and install. A successful installation will show the following code. The arcgisbinding package can be updated from here in the future if needed. The ArcGIS-bridge should now be successfully installed.



Click yes





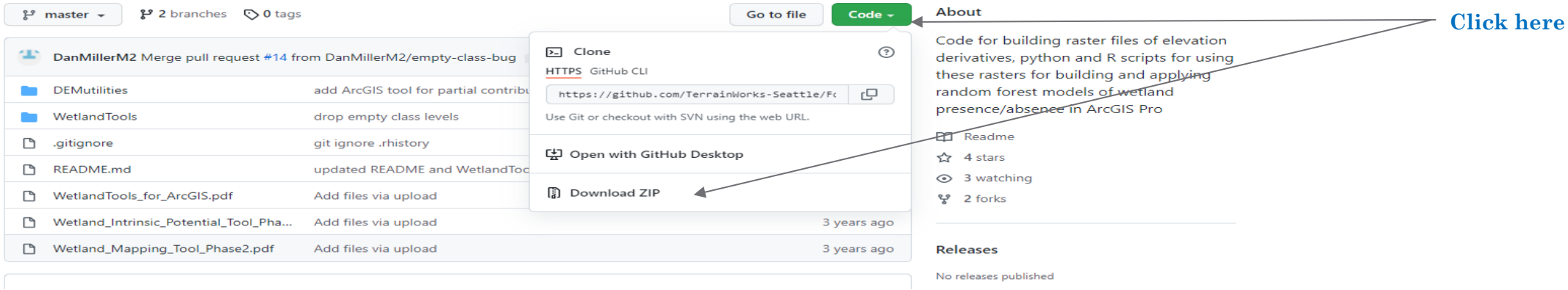
Update from here if necessary

WIP tool required files

The WIP tool requires various files in order to run. The following link will take you to the github page, which has alternative instructions, reports on the creation and use of the tool, and the required files for download. Link: Github WIP tool setup and files

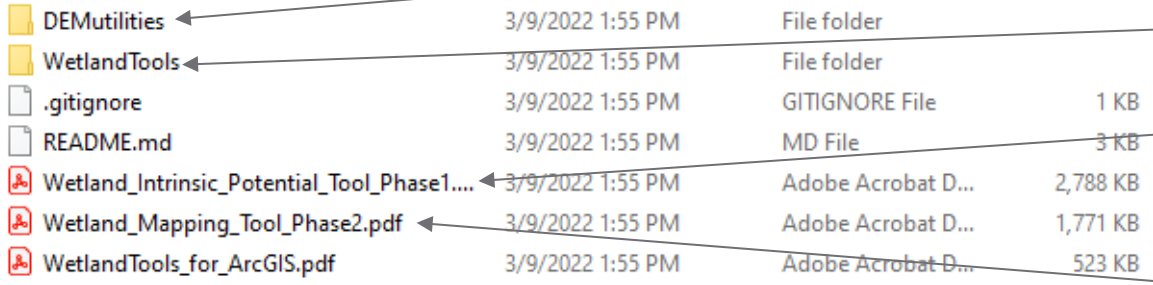
The following steps were pulled directly from these instructions. WIP tool instructions

Step 1: download appropriate files. Click on code and the Download ZIP. It will save as "ForestedWetlands-Master.zip".



Click here

Step 2: unzip the folder.



DEMutilities is a folder containing the files needed to install the DEMutilities toolbox in ArcGIS Pro.

WetlandTools is a folder containing the files needed to install the WetlandTools toolbox in ArcGIS Pro.

"Wetland_Intrinsic_Potential_Tool_Phase1.pdf" is the final report for Phase 1 of the project, and includes the user manual for the Phase 1 Wetland Intrinsic Potential Tool.

"Wetland_Mapping_Tool_Phase2.pdf" is the report for Phase 2.

Step 3: Unzip the DEMutilities and WetlandTools folders to where you want them on your computer. Within the DEMutilities folder is another zip file, ExecutableFiles.zip. It contains 3 files:

i. MakeGrids.exe

ii. LocalRelief.exe.

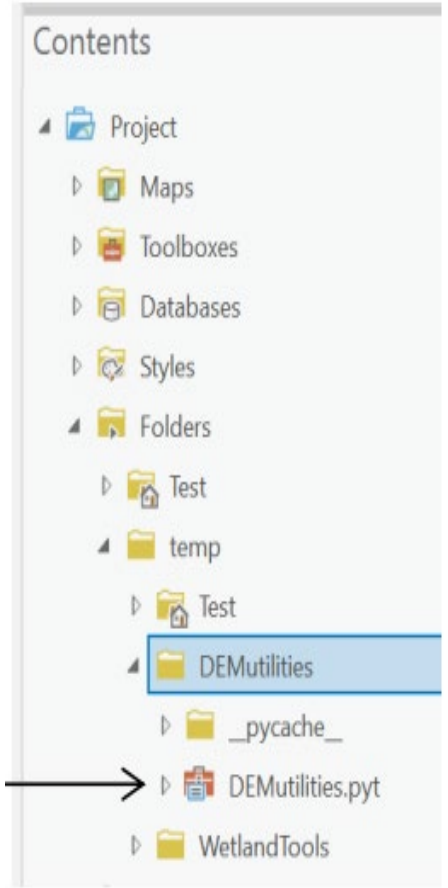
iii. Libiomp5mp.dll

Unzip these into the DEMutilities folder.

In ArcGIS Pro, go to the “View” tab and click “Catalog Pane”.

In the table of contents, go to “Folders” and right-click to “Add Folder Connection”. Navigate to the location of the DEMutilities and WetlandTools folders and add that folder to the table of contents.

Click on the folder you just added to expand it in the table of contents, then click on the DEMutilities folder. You should see a python-tool icon for DEMutilities.pyt



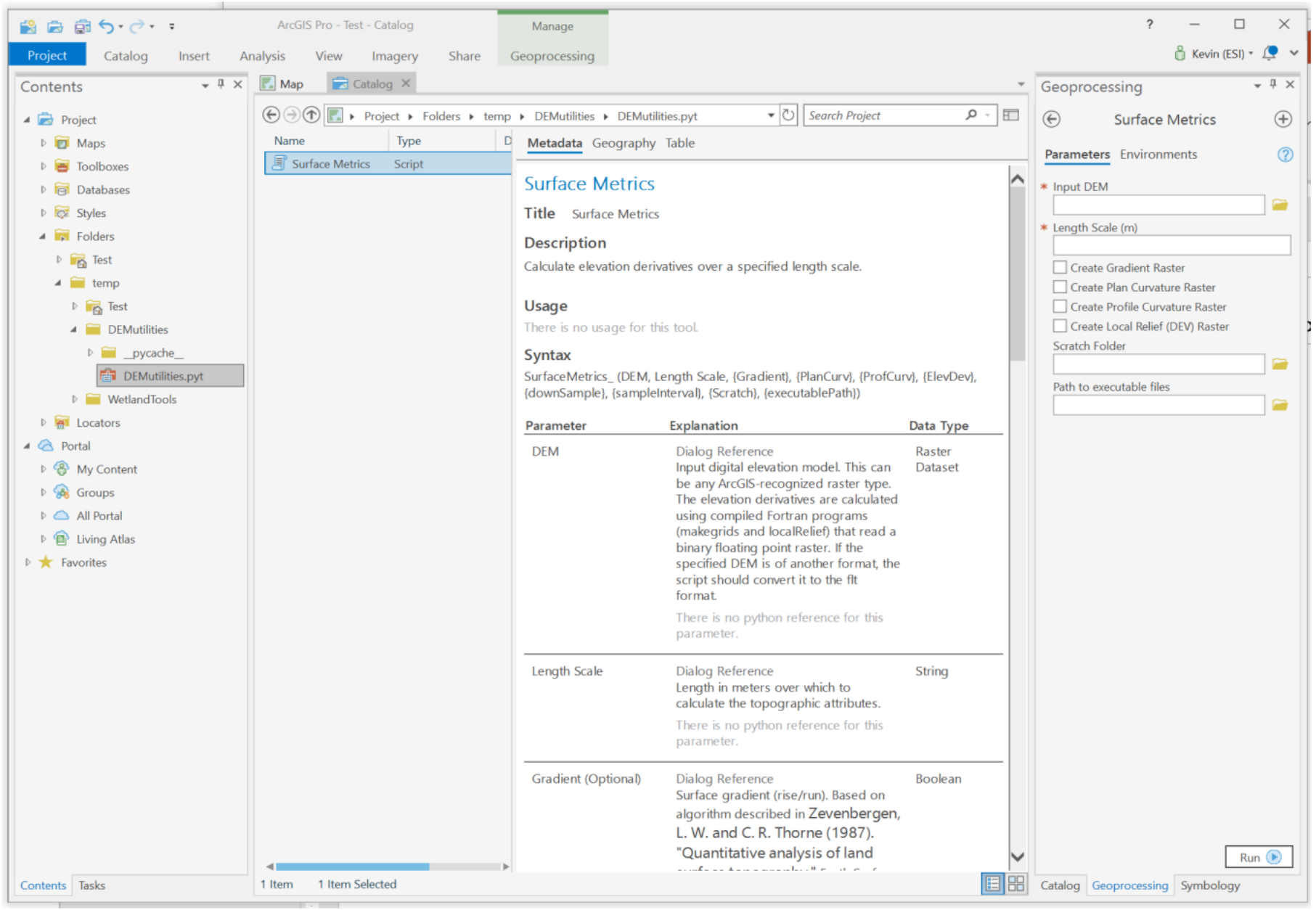
Note: This slide is a brief summary describing the inputs for the Surface Metrics script. Instructions for running the tool will be provided in the upcoming slides.

Within the DEMutilities.pyt toolbox is a single script: Surface Metrics.

Click on it to open the script in the Geoprocessing window and to show a description of the tool in the Metadata window.

Follow instructions in the metadata.

This tool creates new raster files of topographic attributes stored in binary floating point format. These raster files provide the input explanatory variables for the random forest model.



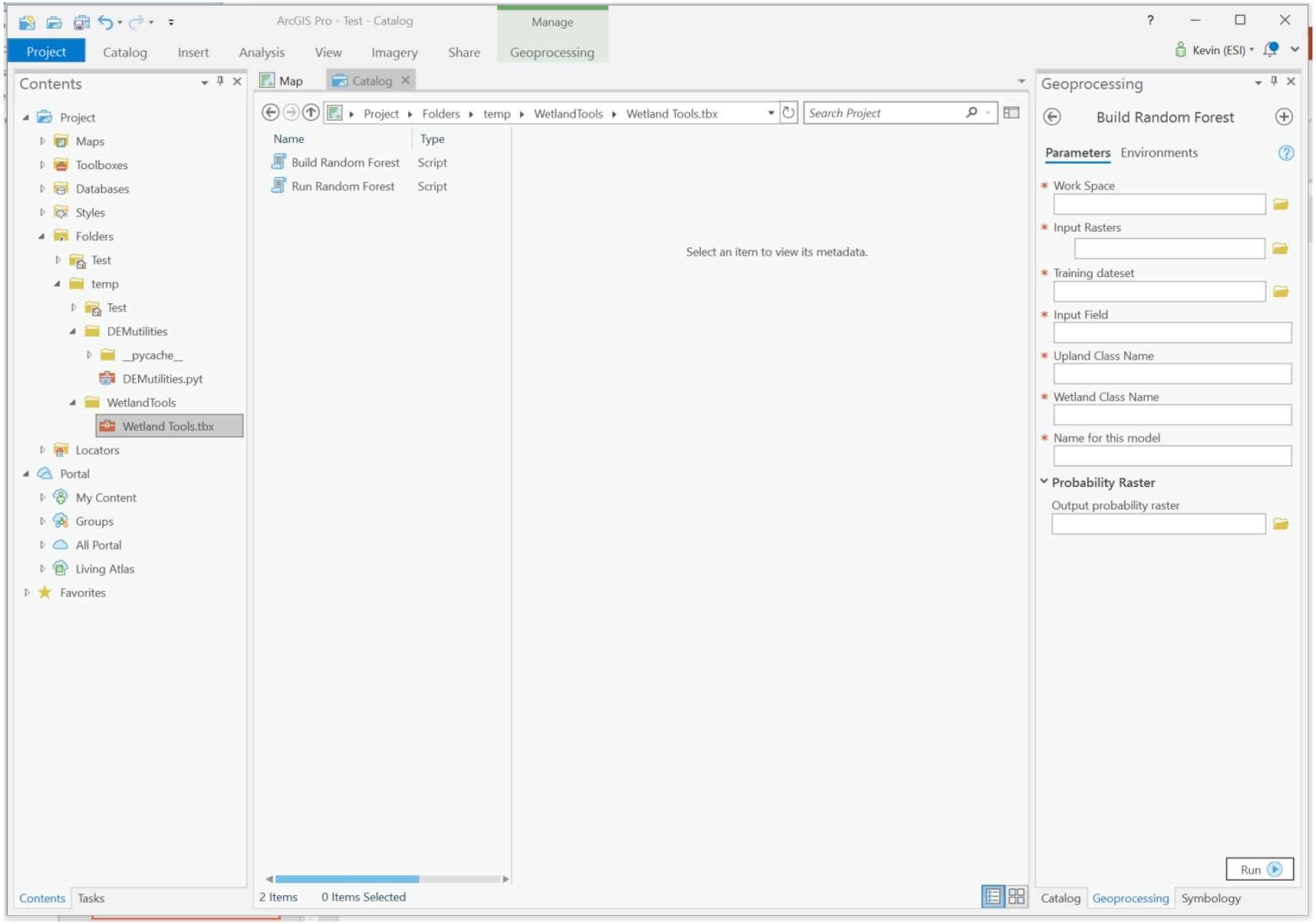
Note: This slide is a brief summary describing the inputs for the Build Random Forest and Run Random Forest scripts. Instructions for running the tool will be provided in the upcoming slides.

Similarly for the WetlandTools toolbox.

It contains two scripts:
- Build Random Forest
- Run Random Forest

Use the Build Random Forest script to train a model using point locations classified as wetland or upland (not wetland).

Use the Run Random Forest script to apply an existing random forest model – built with the Build Random Forest script – at new locations or to see how well the model works when compared to new field data.



Running the Surface Metrics script

After familiarizing what each data input requires in the meta data description of the Surface Metrics script, it is now time to input the appropriate data. The script will run as long as the following parameters are followed:

- Avoid running files in the script that are located in a geodatabase (.gdb). The script will stop running and create an error message.

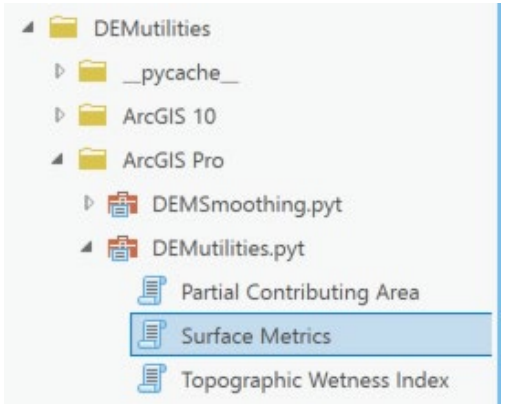
-All folders and file names should not contain special characters ($,%,& etc.), periods, or spaces. The script will not run and will output an error, make sure to double check all folders and file names if there are issues. Example: "demo 1" will not work but "demo_1" will work.

- Run all programs (R, RStudio, ArcGIS Pro) from the local drive on the computer. There may be some issues caused by running the programs from a virtual desktop or software.

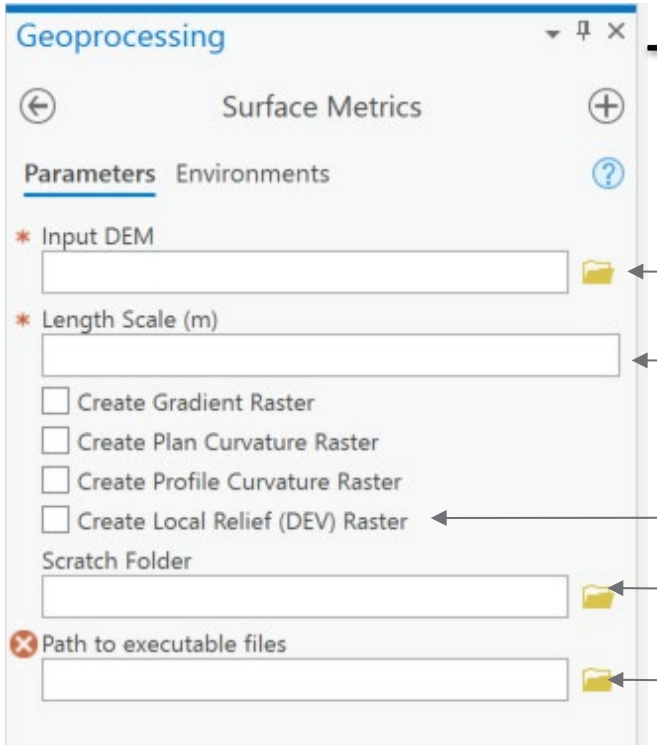
- The script will only run certain file types. Use .tif/.tiff files when running the script. If the file is not in a .tiff format, it can be converted into one using a conversion tool located in the ArcGIS Pro toolbox.

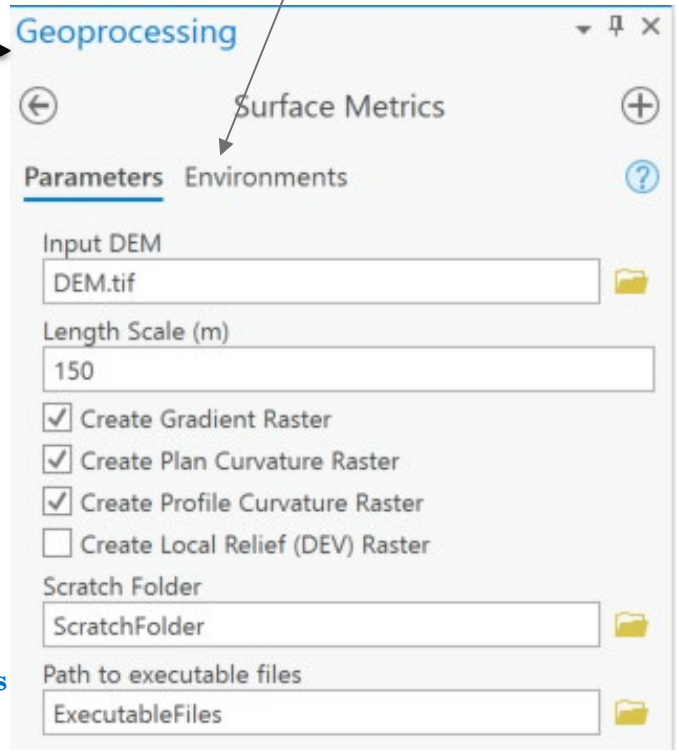
-Ensure all input files are using the same projected coordinate system. This is important for the final map that is output, as a different projection will cause points not to overlay properly. Projections can be checked by right clicking the file < properties < general < Spatial reference < Projected Coordinate system. Coordinate systems can be changed by using an ArcGIS pro tool.

Step 1: Go to the Catalog pane and open up the Surface Metrics script. This can be found by opening the DEMutilites folder < ArcGIS Pro folder < DEMutilities.pyt < Surface Metrics.



Step 2: Input the appropriate data and run the script





Don't forget to selected the projection you desire. Click on the Environment tab.

Input a raster dataset (Does this need to be smoothed?)

Select a desired length scale. (Note: a smaller scale will be more detailed than a large scale. It is best to try a variety of scales depending on the study area. (50, 150, 500, 1000 etc.)

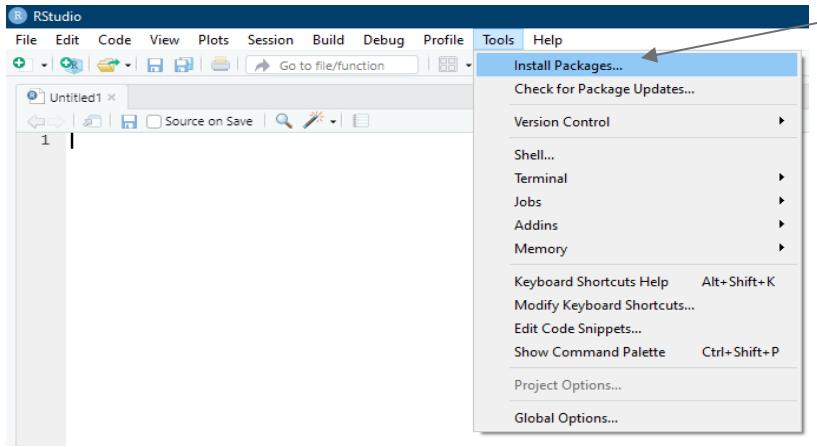
Check the desired outputs

Create an empty folder, name it ScratchFolder

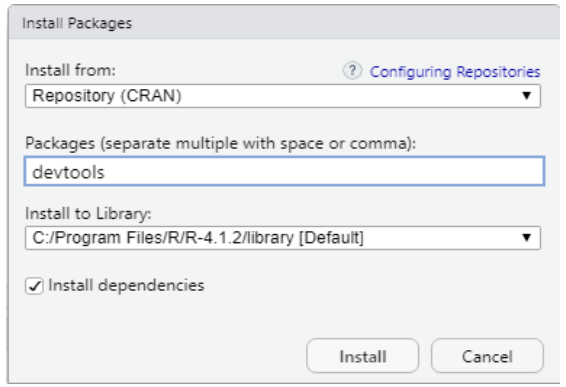
Executable files are found by selecting the following pathway: DEMutilities < ExecutableFiles < ExecutableFiles

Step 3: The script may take some time to run. Once the process is complete, the output .tif files will be found in the same folder the DEM input came from. These files can be dragged over into the Contents pane, displaying the map output layers.

(Note: If the tool does not run, open Rstudio. Open tools < Install packages..., Type devtools into Packages and click install, once loaded type library(devtools). Rerun the tool in ArcGIS pro.



Click here



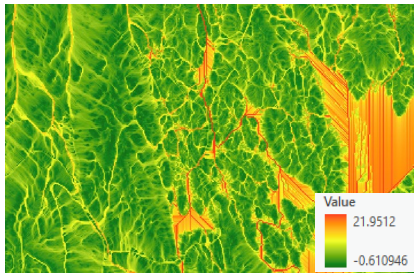

```
1  library(devtools)
2
```

Step 4

After creating a variety of outputs at different scales, there are other rasters, models, and shapefiles that could be created for the Build Random Forest tool. Here is a list of the following that would be useful for the preliminary map:

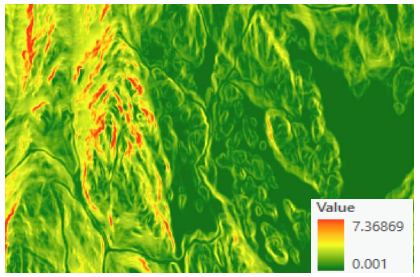
- Topographic Wetness Index (TWI)

Estimates where water will accumulate. This can be created using the Topographic Wetness Index tool found in the DEMutilities folder. Alternatively, the TWI can be created using ArcHydro.



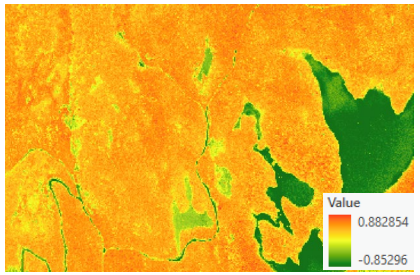
- Depth to Water (DTW)

Calculated depth measurement to wet soil. This can be created using ArcHydro. If you plan on using Arc Hydro its import to note that the DTW tool works best with areas HUC 12 or smaller. Moreover, merging DTW tiffs to create a raster of your entire study area can create artifacts on seam lines given that DTW uses least coast paths.



- Normalized Difference Vegetations Index (NDVI)

Measure vegetation light reflectance using RGB and NIR to determine vegetation coverage. This can be created in ArcGIS pro.



Note: Many other inputs can be used in the Build Random Forest tool.

Create a point classification dataset

A point classification dataset will need to be created using your .gdb. The .shp file can be moved later when running the points in the Build Random Forest script.

Option 1

Step 1

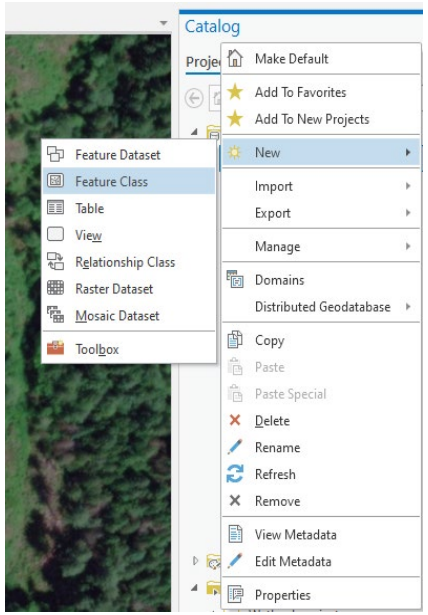
Right click on your personal .gdb in the contents pane. Select New, then select Feature class.

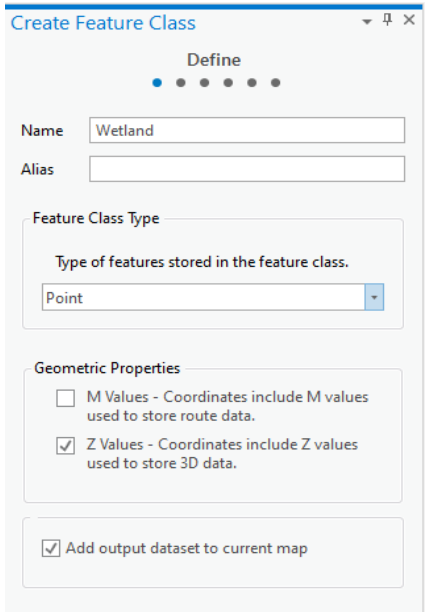
Step 2

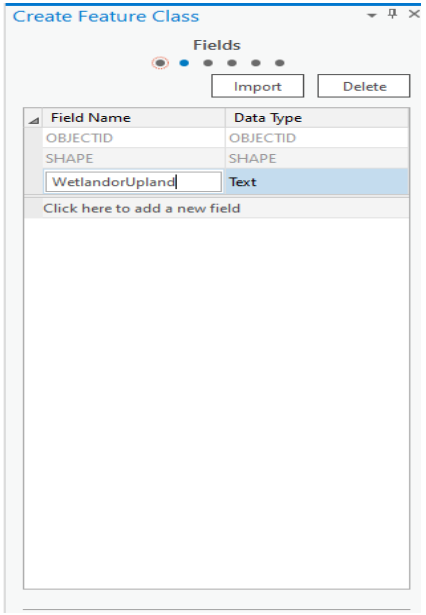
Create a name. Change "Type of features stored in the feature class." To point. Click next.

Step 3

Click "click here to add new field". Name the field (can be any name)







Step 4

Select Edit in the top toolbar. Select Create.

Step 5

Select point feature.

Step 6

Select an area of interest.

Step 7

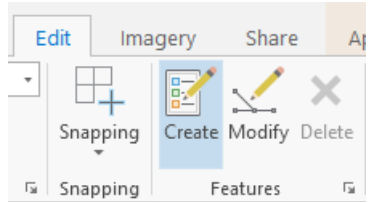
Select Edit in the top toolbar. Select Attributes.

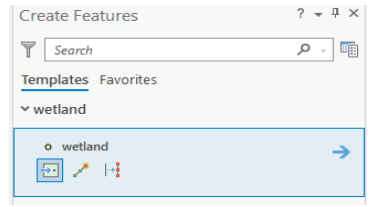
Step 8

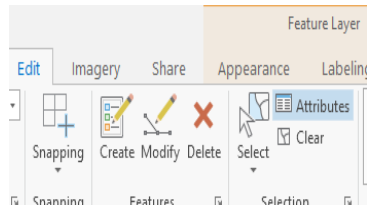
Enter a name in the attributes section. ("Wetland" or "Upland". Names can be shortened for simplicity as long as they are the same.

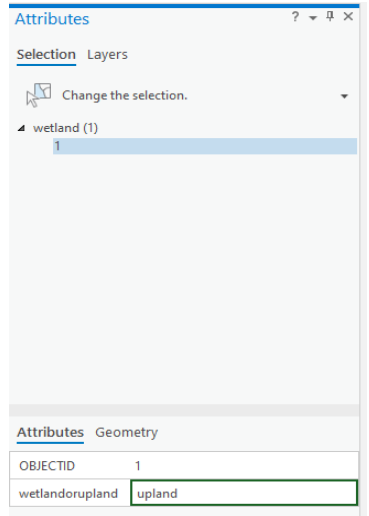
Step 9

Save all edits when complete. Move the created feature class out of the .gdb when running the Build Random forest Script.







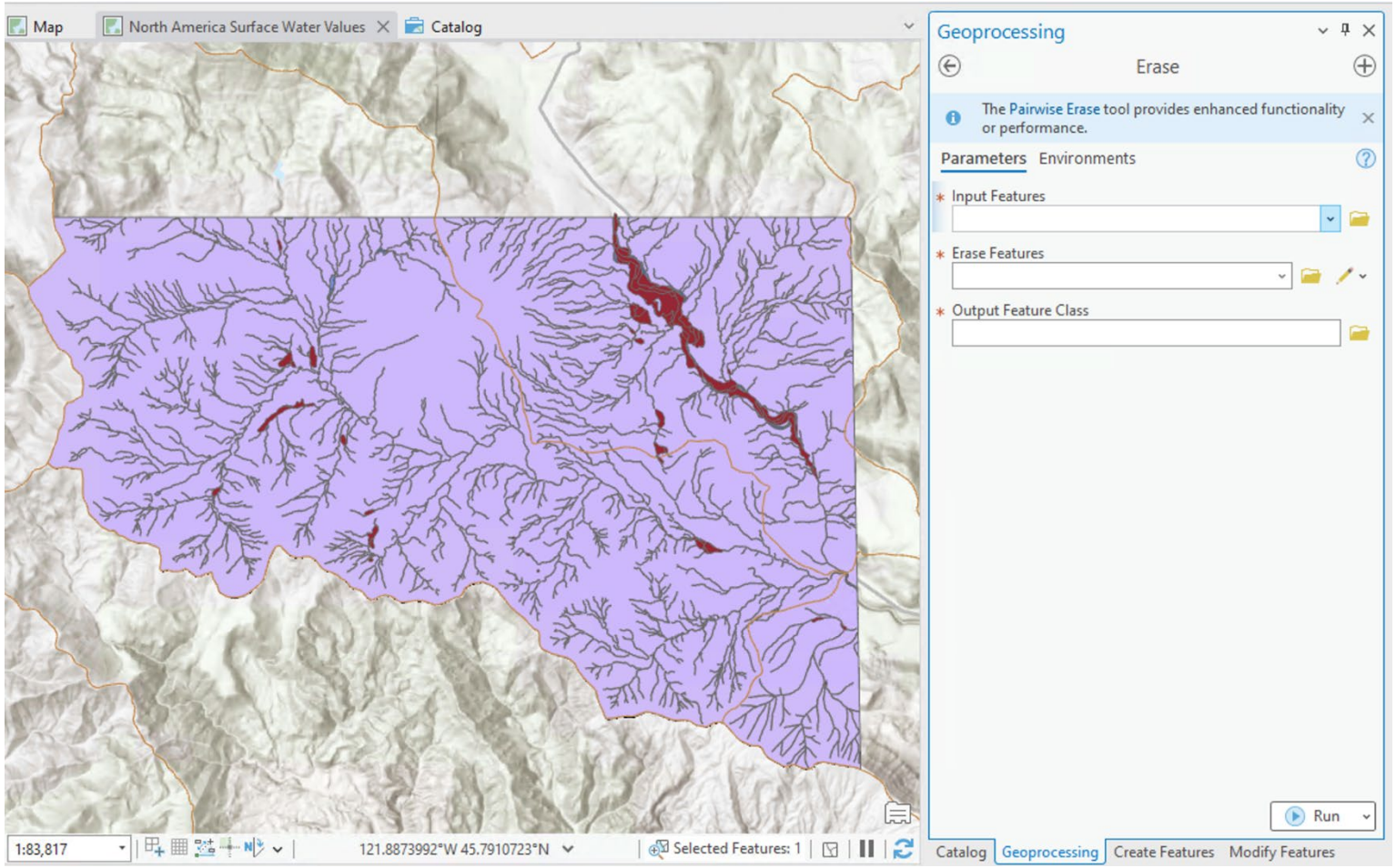


Option 2 (preferred)

For this method you will need a shapefile of your area of interest, surface water, and wetland polygons (I used data from the National Wetland Inventory).

Step 1: Locate the Erase tool found in Geoprocessing tab. We will use this tool to remove surface water features and wetlands form the study area polygon, to great a layer of points in the “uplands”.

Step 2: Remove surface water from the polygon. Your “input feature” will be the study area, and the surface water will be the “Erase feature”. Select our output location and environment then hit Run



Step 3: Now remove wetland features from the shapefile. Now you should have a polygon containing only upland area.

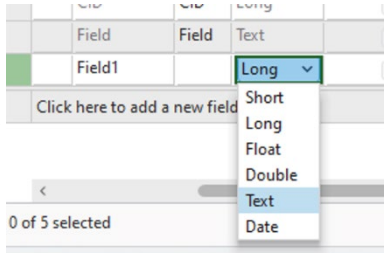
Creating random points

Step 1: Locate the Create Random Points Tool

Step 2: Create a set of random points from the upland polygon and the wetland polygon (You can use NWI polygon here). Note that the “Number of points” value will create that umber of points in each polygon. For example, say my wetland data is 5 wetlands (5 polygons) if I put 2 into the number of points field, I will get a total of 10 points (2 points in each polygon aka wetland). Adjust the number of points accordingly. And Run the tool in both wet and up areas.

Step 3: Now you should have 2 layers of random points. Now we need to add the appropriate names into the attribute table.

Step 4: Open the attributed table for the wet points. In the top left corner of the attribute table clip Add to create a new field.

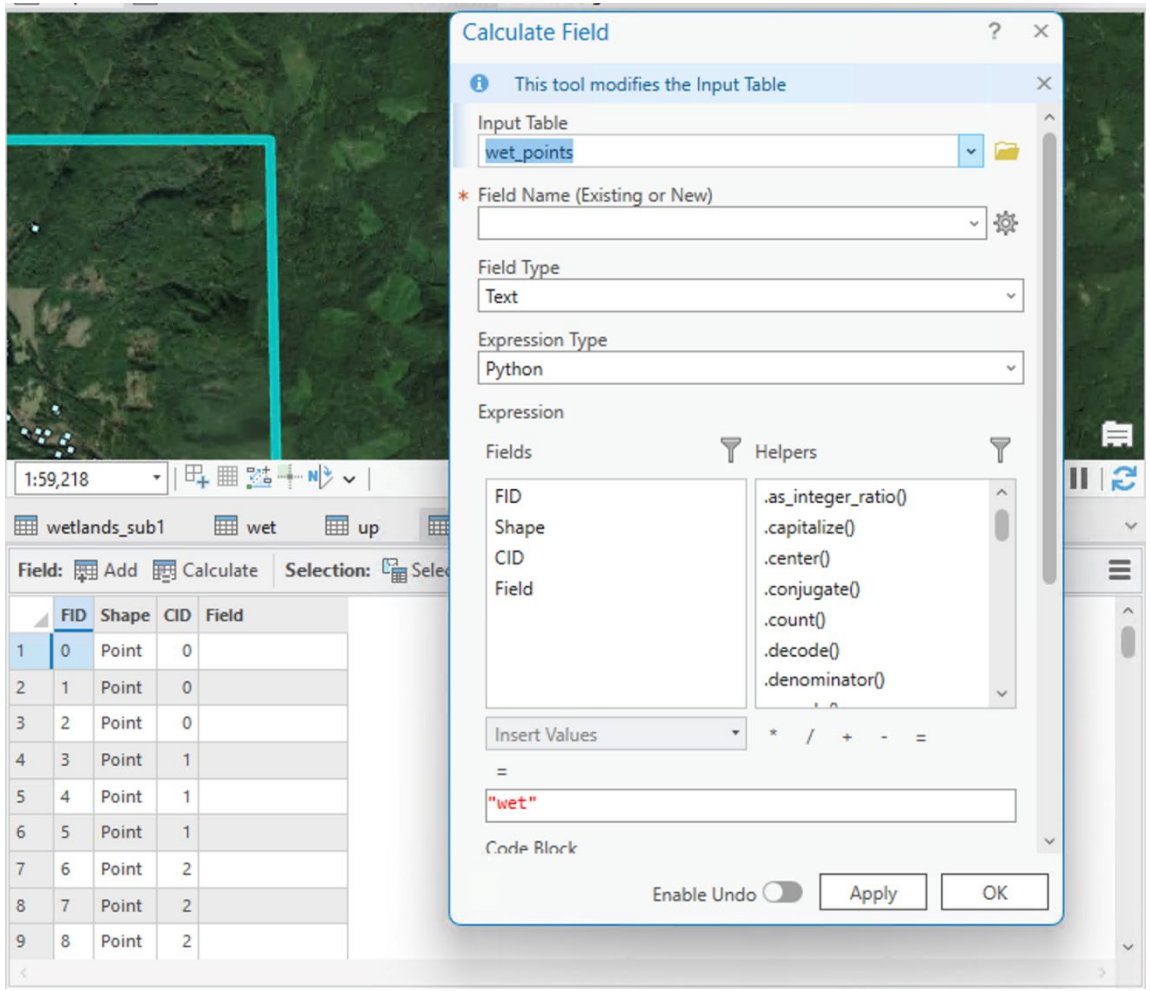


Step 5: Select text in Data Type. And set the length to 10.

Step 6: Left click and hit save. Now back in the attribute table left click the new field and hit calculate field.

Step 7: You should see something similar to the image on the right. In the bottom box use “” you add the word wet to the attribute table.

Step 8: repeat these streps for the Up layer



Step 9: Now we will marge to 2 layers together to have a single layer with both wet and up points. Locate the merge tool.

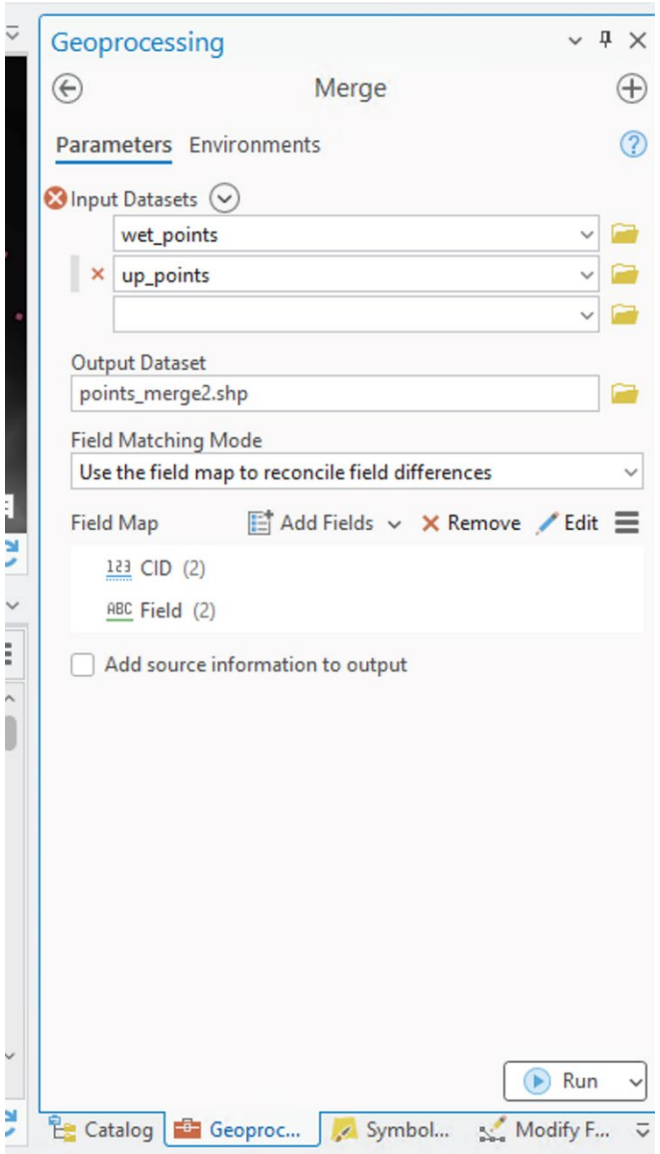
Step 3: In the Merge tool input both layers into ”Input Datasets”

Step 4: Name your output and ensure its not being saved in the

Geodatabase, and set your Environment

Step 5: Now run the tool

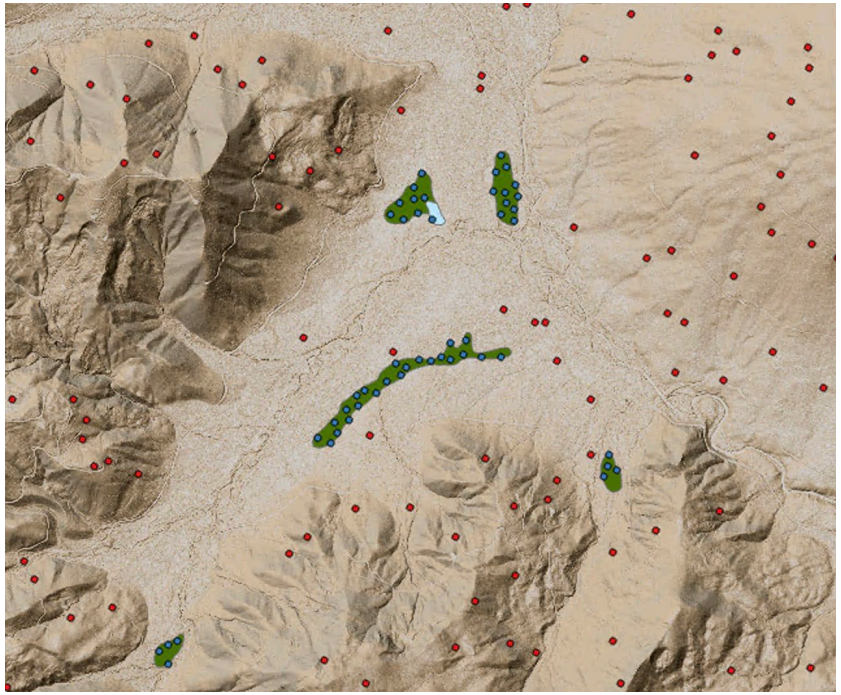
You're done! And now you should be ready to run the random forest



Example Points and Distribution Considerations

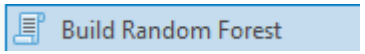
When creating your training data, it’s important to think about the quality of the data you are working with. It might be worthwhile to buffer stream flow lines before removing them and look closely at points near rivers and other bodies of water.

On the right, you can see an example of upland and wetland points (upland = red, wet = blue). In this example, you can see that all the wet points fall within NWI polygons. The points are overlaid on a hillshade to emphasize the topographic distribution of the mapped wetlands.

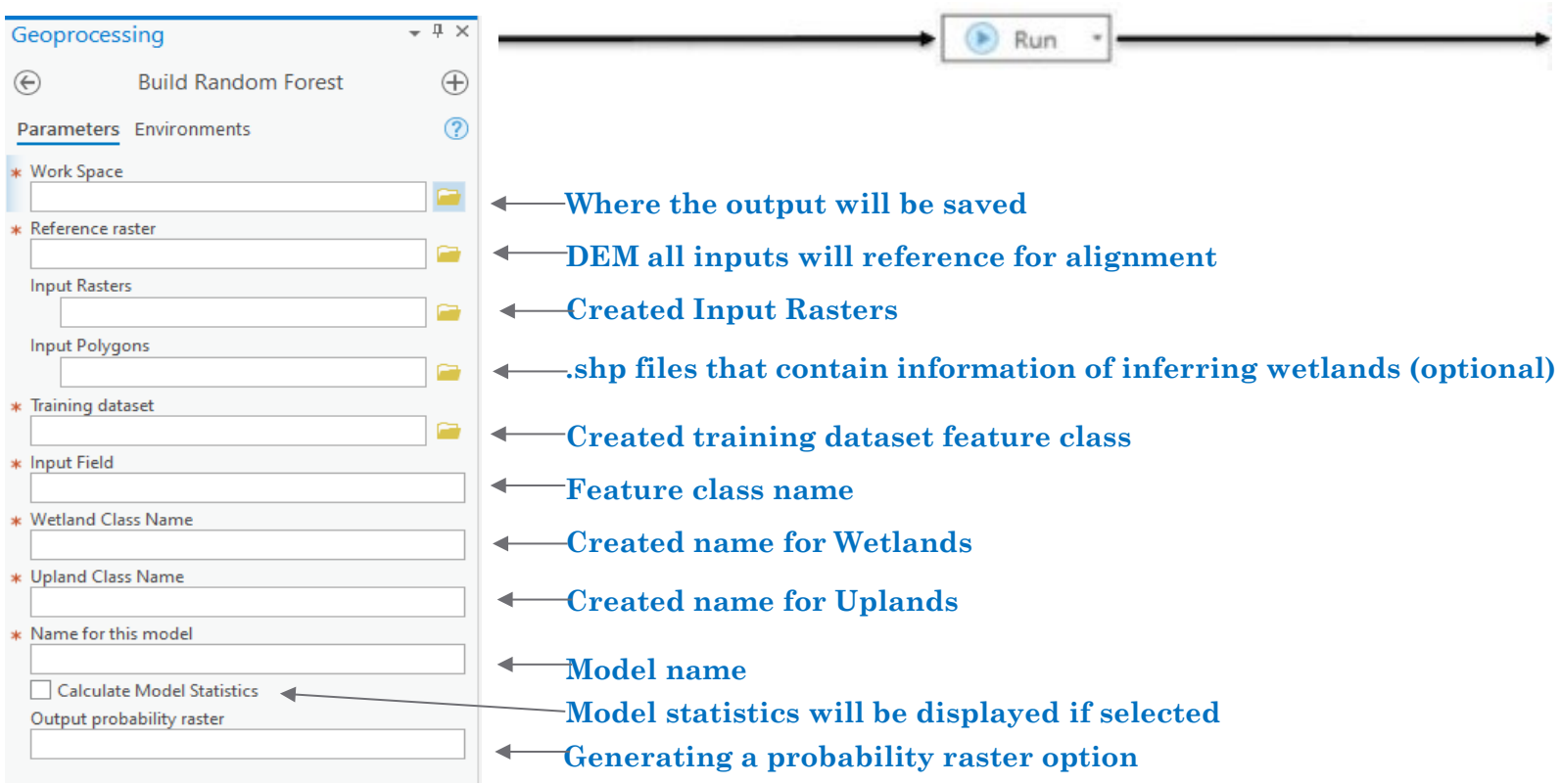


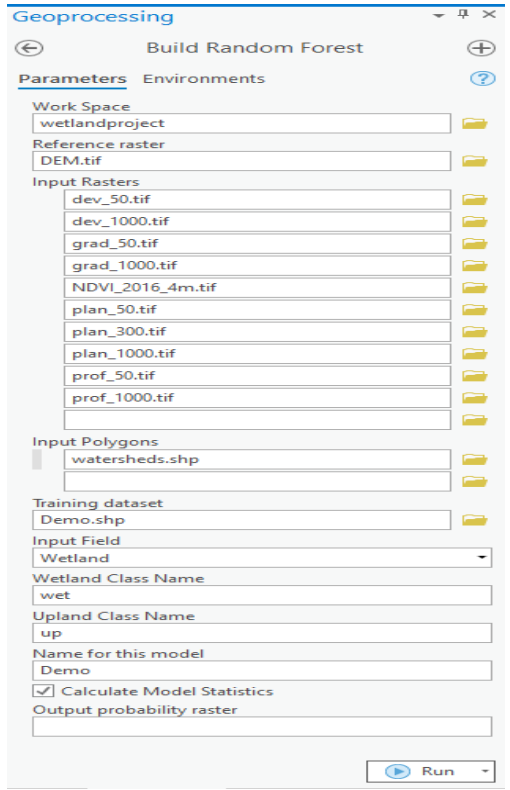
Run Random Forest script

Before running the scrip check that all your layers are in the same projection and have the same extent. This can be done in layer properties. Additionally, the model will run faster if your projection is in meters not feet.

Step 1) Locate the Run Random Forest script. Wetland tools < Wetlandtoolspro.tbx < Build Random Forest. Click on the script 

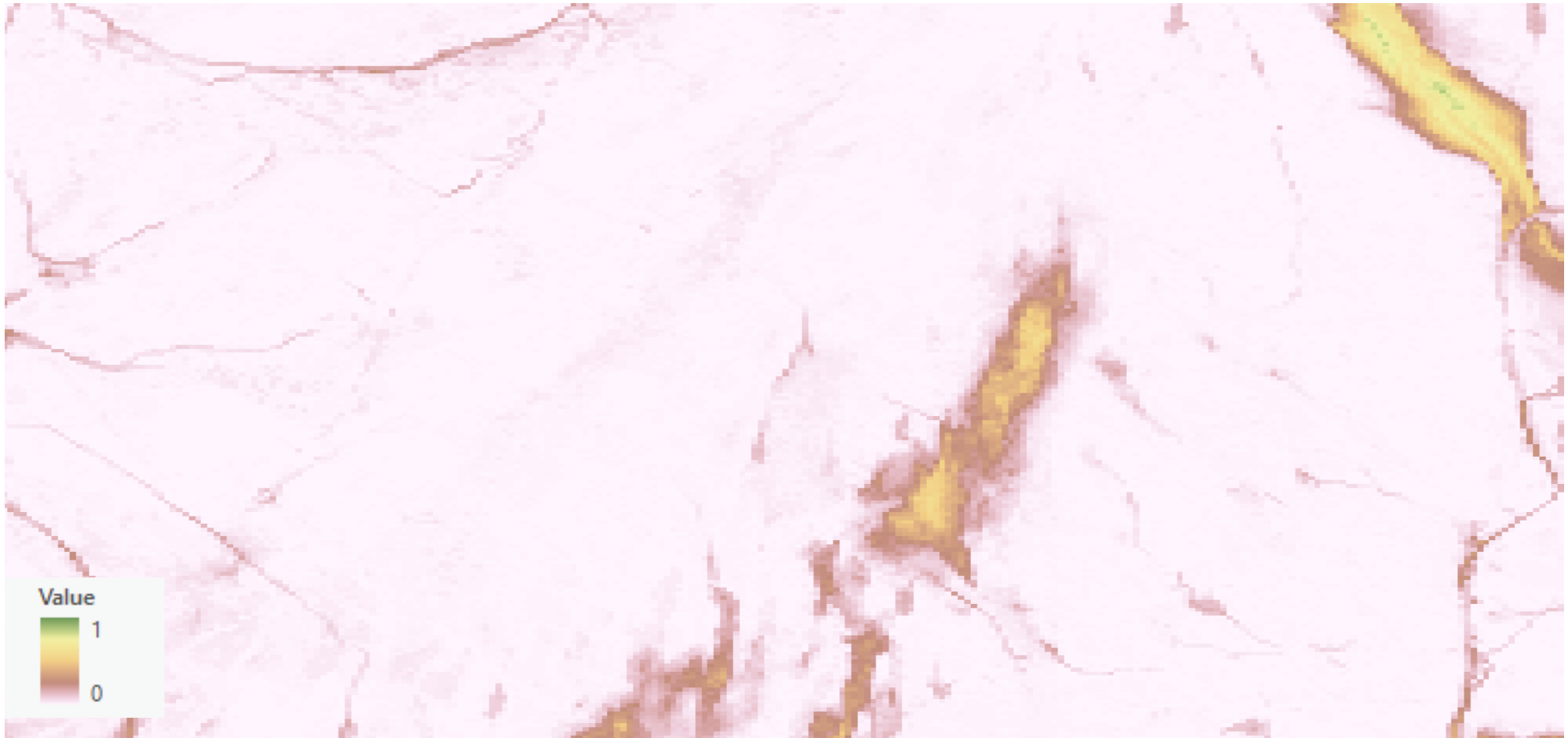
Step 2) Input the appropriate data





Random Forest Output

Once the tool has ran, you should now have a map with a probability index ranging from 0 (upland) to 1 (wetland). Click on a specific area to identify the pixel value. The value given is the probability of a wetland occurring in that area. Points can be adjusted as needed based off of field data or other methods if the map output is not accurate. The statistics will provide some insight into the error of the tool.



Trouble Shooting

- If you're getting an error when building the random forest regarding missing libraries, you might need to install the libraries in RStudio prior to building the random forest.
  - This can be done by opening RStudio and navigating to tools> install package. More details on how to install packages can be found on slide 16. Make sure to install all the package called out in the error, its possible it could be more then one. Installation of some packages may also require that you have a recent version of Rtools installed.

- Smoothing DEM and DTM errors
  - A smoothed DEM or DTM can be utilized to reduce noise in surface matrix outputs and hydrology indicators such as the DTW index. There are several ways to smooth your DEM, including scrips in the DEMutilities folder found within the ForestedWetlands-master folder. Like the other tools these are in python toolbox formats (.pty). Additionally, you can find tools for smoothing within Arc Hydro. If your having errors with either of these options, you can also use the focal statistics tool found in the geoprocessing tab.

- Merging Polyline and polygon water features for DTW
  - You can get surface water data from the National Hydrology Dataset. These data will come as line features (polylines) and area features (polygons) files. To use them to calculate the DTW, you will need to merge these features into one file. A quick way to do this is to use the Buffer tool to convert the polylines to polygons and then use the Merge tool to create one feature. Alternatively, you could rasterize both features and use a single raster as the DTW input. In this case, all non-water cells need to be null if using the Arc Hydro tool.