User's Guide for Model to Predict Post-Mining Water Levels

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Rebecca Steinberg, Nora Sullivan, Natalie Kruse, Dina Lopez, Jen Bowman

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1 BACKGROUND

There is a need for an improved method for predicting post-mining water levels in underground coal mining. The Surface Mining Control and Reclamation Act (SMCRA) permitting requirements include estimating water levels post mining as part of characterizing the area hydrology. The use of 'top of coal' has been proven, by flooded mines and recent hydrologic research, to be an insufficient estimate of post-mining water level. As mine companies are required by SMCRA to mitigate/remediate environmental impacts of flooded mines, this insufficient estimation may cost companies money. More reliable prediction can save money on post-mining reclamation by preventing the environmental impacts from happening to begin with.

The goal of this project was to develop an empirical predictive model of post-mining water level, implemented in ArcGIS Pro. Using data from the proposed underground coal mine permit, the model returns points of predicted post-mining water levels and can be compared to a Digital Elevation Model (DEM) to identify areas at risk of surface discharge from mine pools.

1.1 ORIGINAL DATA SOURCES

The project team requested public permit data from 28 permitted underground coal mines in Ohio. Spatial, hydrologic, and geologic measurements were gleaned from the permits, yielding usable data from 15 mines. Additional data and/or GIS layers were downloaded from Ohio Department of Natural Resources, Division of Mineral Resource Management (ODNR-DMRM), Geological Survey (ODNR-GS), and Water Resources (ODNR-WR), US Department of Labor Mine Safety and Health Administration (MSHA), National Oceanographic and Atmospheric Agency (NOAA), and Ohio Geographically Referenced Information Program (OGRIP).

1.2 STATISTICAL ANALYSIS

Once gathered, multivariate data analyses were run using The Unscrambler X and Neuroshell 2 to develop a prediction algorithm for post-mining water levels. The resulting algorithm with the resulting error was included in the tool. Table 1 displays the selected algorithm, with each variable transformation. Each of the variables required in the inputs for running the tool are required due to their use in running the prediction algorithm. More details on the analyses are provided in the three theses linked on the Mine Pool Study webpage of watershedadata.com (http://watersheddata.com/MinePool_Study.aspx).

Table 1 – Selected prediction algorithm

Polynomial Net (GMDH) Test 'K'	
Best formula:	Y=0.1*X7-4.9E-002*X11+9.2E-002-2.1E-002*X4+1.9E-002*X9+0.41*X1-1.1E-002*X3+6.5E-002*X6-0.1*X10+4.3E-002*X5+0.56*X2-0.37*X1^2-0.38*X2^2+2.5E-002*X11^2-0.14*X2^3-6.5E-002*X11^3+0.84*X1*X2-0.24*X1*X11+0.36*X2*X11+3.2E-002*X1*X2*X11-1.9E-004*X6^2+4.1E-002*X5*X6+4.3E-002*X7^2+4.E-002*X10^2-2.6E-002*X7^3+5.E-002*X10^3-0.14*X7*X10-1.1E-002*X9^2-1.6E-002*X9^3-2.5E-002*X2*X9+1.3E-002*X5^2-2.5E-002*X6^3-1.4E-002*X1^3+2.E-002*X1*X7+3.1E-002*X6*X10+2.7E-002*X1*X3+1.4E-002*X9*X11+2.9E-002*X2*X4+1.3E-002*X8^3-1.6E-002*X8*X11+6.7E-003*X4^2+4.5E-003*X1*X6
Variable Transformations:	X1=2.0*(Surface Elevation (msl) -545.0)/835.0-1.0
	X2=2.0*(Bottom Coal Elevation (msl) - 244.04)/1055.96-1.0
	X3=2.0*(Overburden Thickness (ft) -65.0)/638.1-1.0
	X4=2.0*(Mined Coal Thickness (ft) - 0.07)/11.69-1.0
	X5=2.0*(Shale/Clay Thickness (ft) - 0.35)/552.55-1.0
	X6=2.0*Sandstone Thickness (ft)/262.3-1.0
	X7=2.0*Limestone Thickness (ft)/204.97-1.0
	X8=2.0*Total Coal Thickness (ft)/33.23-1.0
	X9=2.0*Accumulative Coal to Extract (Mm^3)/138.61-1.0
	X10=2.0*(Underground Mining in 4-Mile Buffer (acres)-2061.0)/108987.5-1.0
	X11=2.0*(Average Annual Precipitation (in) - 37.5)/3.7-1.0
	Y=2.0*(Potentiometric Head (msl) - 400.0)/932.0-1.0
R squared:	0.9906
Mean squared error:	324.8997
Mean absolute error:	12.3227
Min. absolute error:	0.0014
Max. absolute error:	147.93
Correlation coefficient r:	0.9953

2 TOOL STRUCTURE

2.1 DATA FORMATS

For the tool to function smoothly, the completeness and formatting of the input data is most important. The provided pre-formatted Excel Spreadsheets allow for inputting raw data from proposed mine permit applications as specified and allow the tool to run correctly. Data formats for each column must be followed exactly to ensure accurate data extraction when imported to ArcGIS. All columns must be filled out with data and may not be left blank or calculation errors will occur when the tool applies the prediction algorithm.

Consistent coordinate projections in collection of data is also necessary, or at least clear recording of the projection used in collecting XY coordinates so the correct projection can be selected when running the tool.

2.2 REQUIRED INPUTS

It is necessary for the user to gather and prepare site specific data for analysis of the proposed mine. (See Section 4 for instructions on formatting.) The five required files are as follows:

1) **Well Excel spreadsheet**: Permit/Mine ID, well ID, XY coordinates, potentiometric head (ft msl), surface elevation (ft msl), bottom of coal elevation (ft msl), average annual precipitation (in). *Note: All elevations are in reference to mean sea level.*
2) **Borehole Excel spreadsheet:** Permit/Mine ID, XY coordinates, overburden thickness (ft), mined coal seam thickness (ft), shale/clay thickness (ft), limestone thickness (ft), total coal thickness (ft), accumulative coal extracted (Mm^3).
3) **Study mine:** Shapefile of proposed new mine extent.
4) **Abandoned Underground Mines (AUM):** Shapefile of pre-SMCRA mined out extents.
5) **Underground Mine Extents (UG):** Shapefile of post-SMCRA mined out extents.

2.3 TOOL FUNCTIONS

Figure 1 displays the general flow of the ArcGIS Pro model built to extract variables and apply to prediction algorithm to produce points of predicted post-mining water level. The model runs these tools automatically. This graphic is provided for those interested in how the model functions. The box on the left (START) displays the required user inputs, and the final box on the right (END) displays the final output of the tool. In between the START and END boxes are the tools used and the layers created by the model while extracting variables and applying the prediction algorithm.

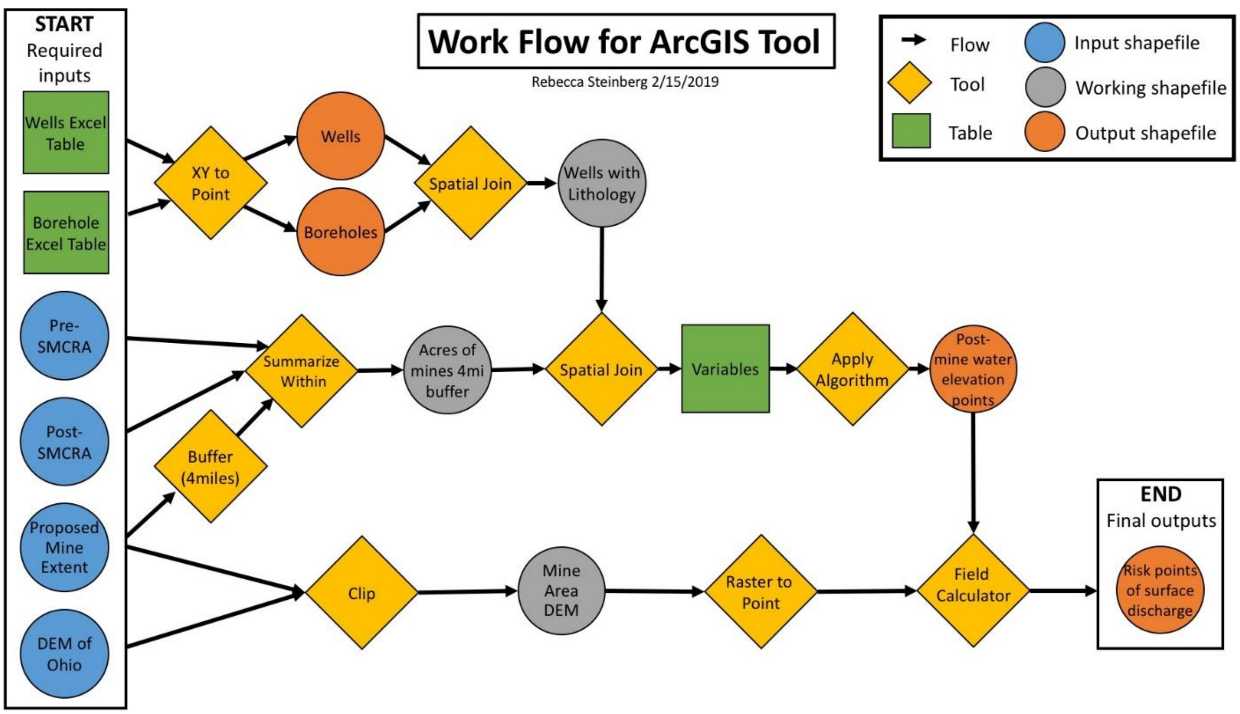

Figure 1 – Work flow diagram that describes the layers and tools used in the construction of the tool in ArcGIS Pro Model Builder.

2.4 DIRECT OUTPUTS

The tool produces four shapefiles that are automatically added to the map once the tool is run: 1) well shapefiles, 2) borehole shapefiles, 3) calculated points, and 4) points of predicted head compared to the area DEM. These outputs are further described in Section 5.

3 DOWNLOADING FILES

3.1 ZIPPED FOLDER

The ArcGIS Pro map package that hosts the prediction tool and the Excel data sheets are available for download at http://www.watersheddata.com/MinePool_Study.aspx as a zipped folder. The "Mine Pool GIS Tool Package" folder (Figure 2) is a folder containing the download links for the Map Package (Mine_Pool_Prediction_Model_Map.aptx), the Well Excel Spreadsheet, and Borehole Excel Spreadsheet. Prepare the Well and Borehole Excel data sheets prior to opening the tool in ArcGIS Pro (Section 4). The map package contains the prediction tool, script that runs the prediction algorithm, shapefiles of surrounding underground mines, DEM, and default required layers as examples.

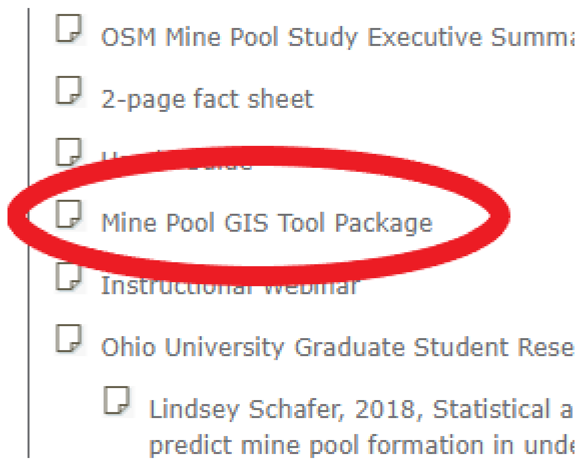

Figure 2 - Screenshot displaying the location of the download link to click on Watersheddata.com to download the prediction tool.

Once the zipped folder is downloaded, navigate to the 'Downloads' folder, right click on the zipped folder and select 'Extract All…' (Figure 3). When the window opens, select a local folder for saving the map package and data sheets. We recommend that you save all materials related to the Mine Pool Tool in this same folder.

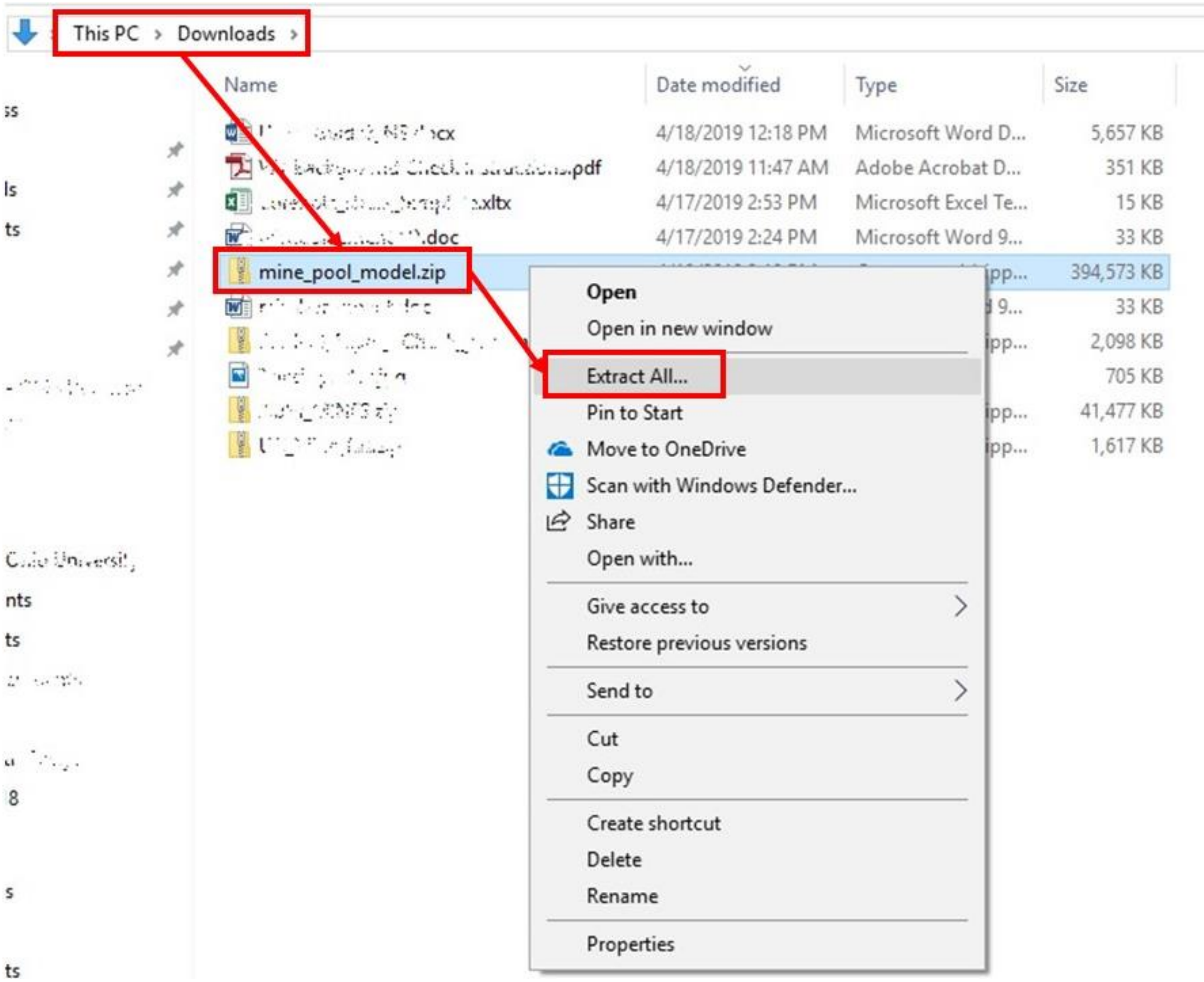

Figure 3 - Screenshot displaying how to unzip the folder containing the project files

4 PREPARE DATA

Proper data preparation is essential for successful execution of the model. The user should carefully read through the descriptions of the layers required to adequately prepare their data for running the prediction model.

4.1 SHAPEFILES

Three GIS polygon shapefiles are required:

1) **Abandoned Underground Mines (AUM):** Ohio abandoned coal mines (Pre-SMCRA).
   This layer is included in the tool Template, however, it is only current to the end of 2018, when the layers were downloaded. This layer is created and maintained by ODNR - DMRM. Tool users may want to verify that the layer has not been updated, or re-download and replace the included shapefiles with the most current versions from the ODNR Mines of Ohio interactive map (https://gis.ohiodnr.gov/MapViewer/?config=OhioMines). Click the "?" icon in the mine viewer application, then click the DATA tab to access downloads.
2) **Underground Mine Extents (UG):** Permitted mine extents (Post-SMCRA).
   This layer is included in the tool Template, however, it is only current to the end of 2018, when the layers were downloaded. This layer is created and maintained by ODNR - DMRM. Tool users may want to verify that the layer has not been updated, or re-download and replace the included shapefiles with the most current versions from the ODNR Mines of Ohio interactive map (https://gis.ohiodnr.gov/MapViewer/?config=OhioMines). Click the "?" icon in the mine viewer application, then click the DATA tab to access downloads.
3) **Extent of the proposed new mine**: Shapefile of proposed mine extent, created from maps and information in the permit application. The user may have to create this shape if the shapefile layer is not already created or accessible from the data for the permit application.

Also required is a raster file **Digital Elevation Model** (**DEM)**. For users in Ohio, the model package comes with preloaded, State of Ohio 30M DEM.

4.2 Data Sheets

The tool also requires two data tables that must be compiled from permit data or calculated from the data provided with the permit application, or other sources. Data used in developing this model were hand-entered from PDF copies of paper mine permit files. Due to the recent changes of the permitting process, (changing to an online, digital application) locating the required data may vary from the paper-based method used in this project. The digital permit application requires that same data as the paper application. The digital application process may make it easier for the user to compile the necessary data.

The formatted Excel Spreadsheets are provided in the download folder at http://watersheddata.com/MinePool_Study.aspx (Download instructions in Section 3).

Special attention must be paid to units of entered data to assure that all values are properly converted to the units specified in the provided formatted Excel spreadsheet files. Likewise, consider the coordinate systems used in collection of XY data, and make sure all final shapefiles and XY data are aligned in the same projection, as these tables will be plotted to point shapefiles in the model process. All columns must have data for the tool to function, no null or zero values. If the data collected does not have all values for variable in Excel spreadsheets, do not include that point in the analysis.

1.) **Well Excel Spreadsheet**: sheet containing hydrologic data extracted from mine permits used to predict post-mining water level by the ArcGIS tool
    a. Permit/Mine ID, Well ID, XY coordinates, potentiometric head (ft msl), surface elevation (ft msl), bottom elevation (ft msl): extracted from well logs and materials submitted with the permit application. *Note: Potentiometric head values are input for the user to compare and validate to the output prediction.*
    b. Average annual precipitation (in): retrieved from various sources. The user can check NOAA or other weather data collection entities to arrive at the best

number for their location. If local rainfall values are not available, enter the Ohio state annual average precipitation of 37.57 inches as a default.

2.) **Borehole Excel Spreadsheet**: sheet containing geologic data extracted from mine permits used to predict post-mining water level by the ArcGIS tool

   a. Permit/Mine ID, Borehole ID, XY coordinates, overburden thickness (ft), mined coal seam thickness (ft): data directly derived from the borehole logs required for the permit application.

   b. Shale/clay thickness (ft), limestone thickness (ft), sandstone thickness (ft), and total coal thickness (ft): calculated by adding together the associated layers from the overburden to get a total thickness stratigraphic record. Only layers within the overburden above the mined coal seam are considered.

   c. Accumulative coal extracted (Mm^3): the volume of coal the mine is expected to produce, which is a required value for the permit application.

When data collection for the formatted Excel well and borehole spreadsheets are complete for the proposed mine, each spreadsheet must be saved as a comma separated value (.csv) file (Figure 4). Save the .csv sheets to a local folder.

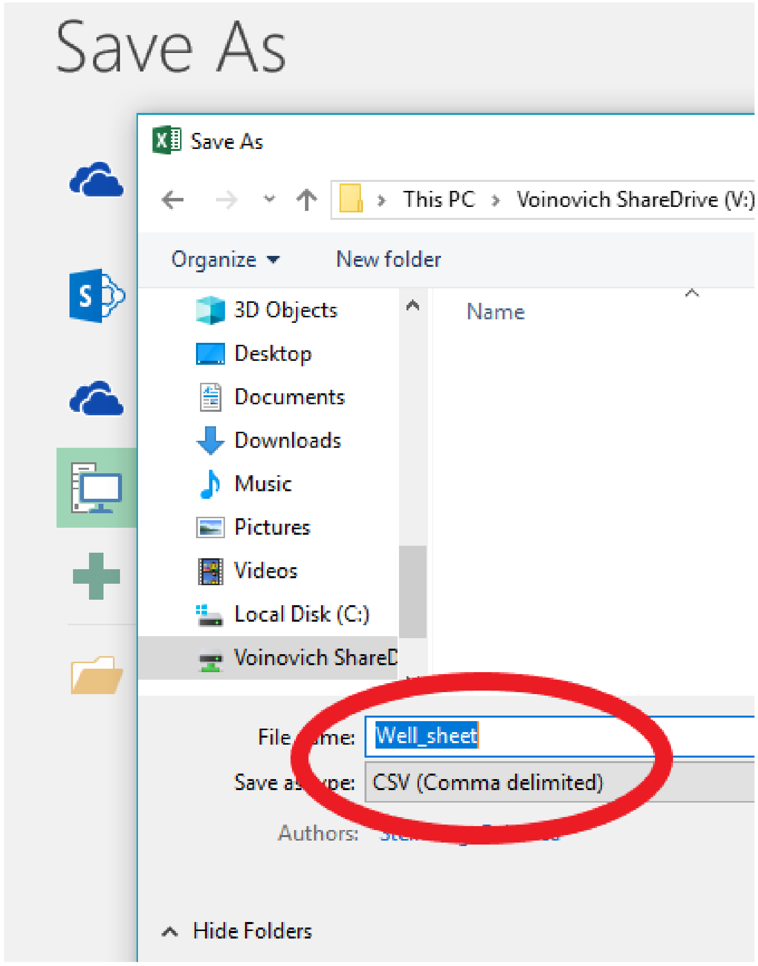

Figure 4 – Screenshot to show saving the data Excel sheets as the correct file format: .csv (Comma delimited)

5 Steps for Running the Tool

5.1 Setting Up Project Data

When data detailed in Section 4 is compiled into the spreadsheets and saved in the local folder, open the .aptx file in ArcGIS Pro by double clicking on the file, or by selecting “Open Project” from the front screen of ArcGIS Pro. The map may take a bit of time to load the template map and included layers.

Once the map package is opened and the project has been created, users can customize their required data within the map. For Ohio Coal Fields users, The Underground Mine Extents (UG) shapefile, Abandoned Underground Mines (AUM**)** shapefile, and the DEM for the state of Ohio raster are already included in the table of contents, so the user will only need to add: 1) the proposed mine shapefile; 2) the borehole .csv table; and 3) the well .csv table.

The “add data’ function in ArcGIS Pro (Figure 5) allows the user to locate the local folder where files are saved and add them to the project.

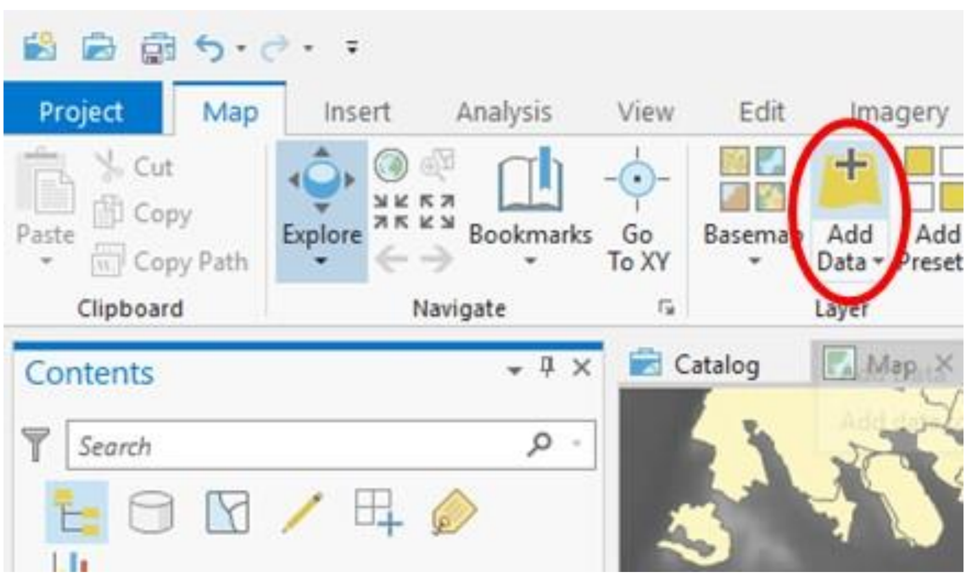

Figure 5 – Screenshot displaying the location of the ‘add data’ function in ArcGIS Pro to locate and add user input files.

First the user needs to add the shapefile of the proposed mine from the local folder using the 'add data' function. Click 'add data', navigate to the local folder in the window that appears, then select the shapefile and click 'ok' (Figure 6).

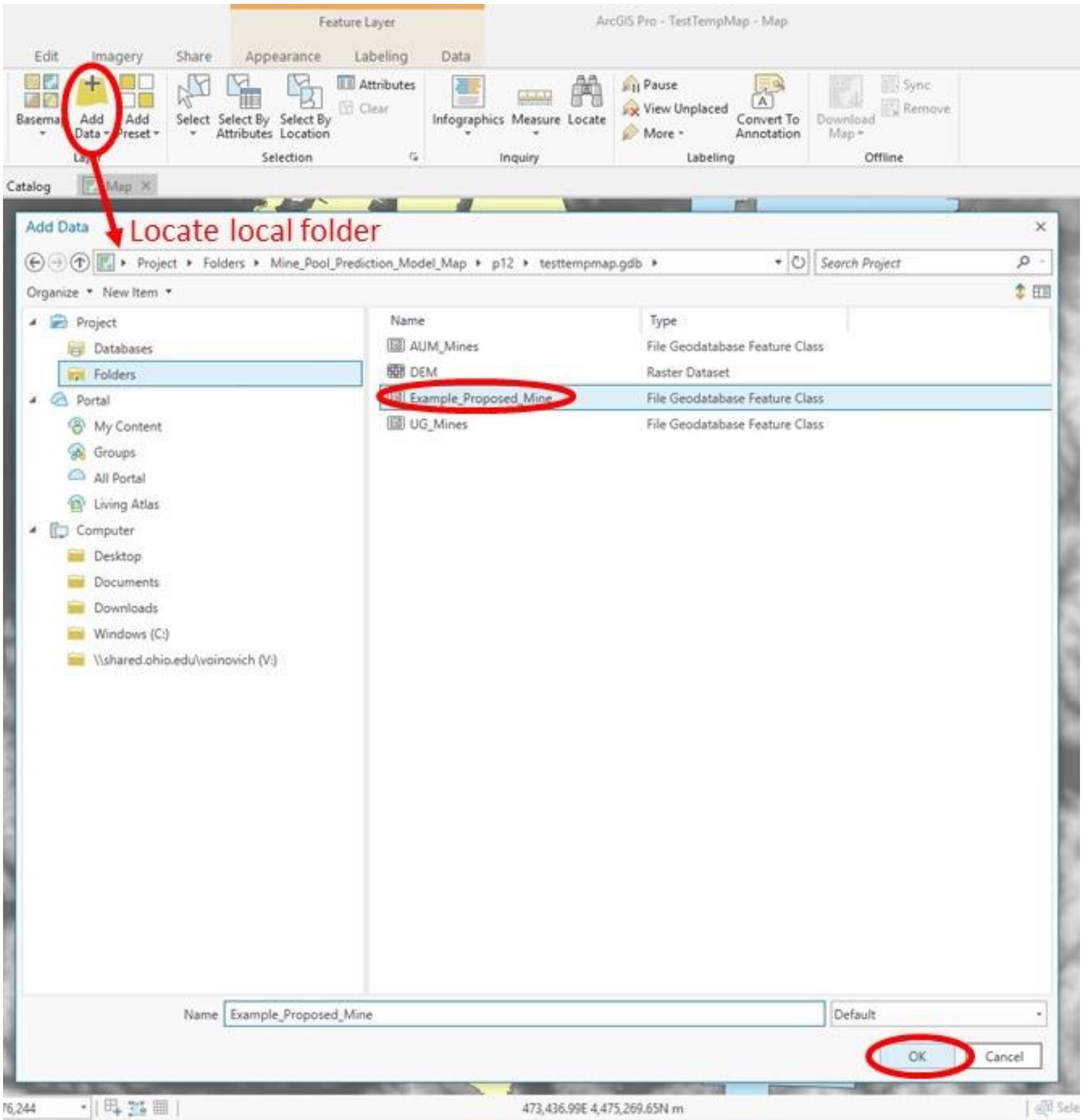

Figure 6 – Screenshot displaying how to add a shapefile to the project map, example here showing the Example Proposed Mine shapefile being added.

Once added, the user shapefiles must be saved to the project geodatabase created by the template project. Right click on the proposed mine shapefile (and any other shapefiles added) in the table of contents and select “Export features” (Figures 7).

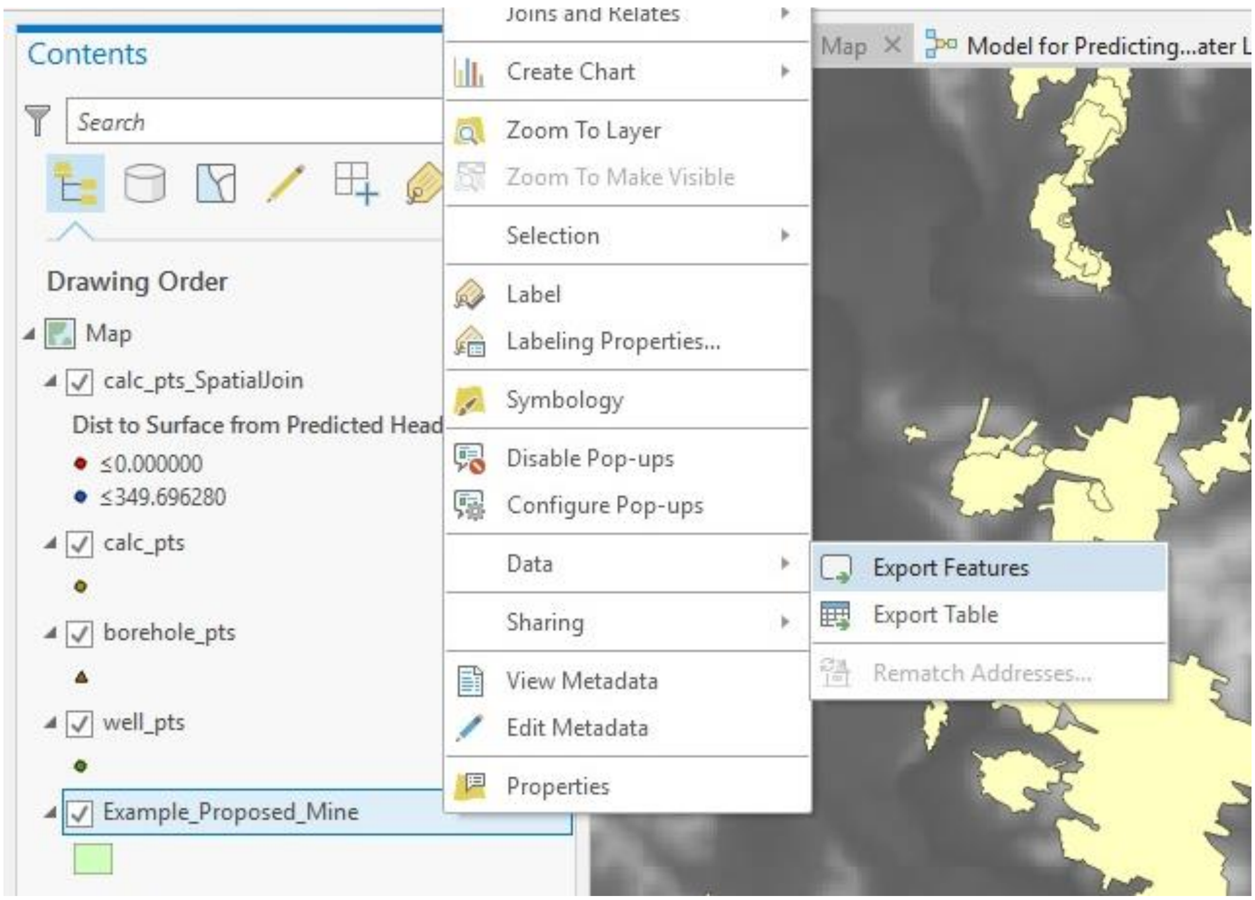

Figure 7 – Screenshot displaying how to find ‘Export features’ function so that user added layers can be saved to the Project database or in the working Project folder.

Navigate to the project geodatabase in the window that opens, name the shapefile, and save the shapefile in that location by hitting ‘run’ in the ‘copy features’ geoprocessing window (Figure 8).

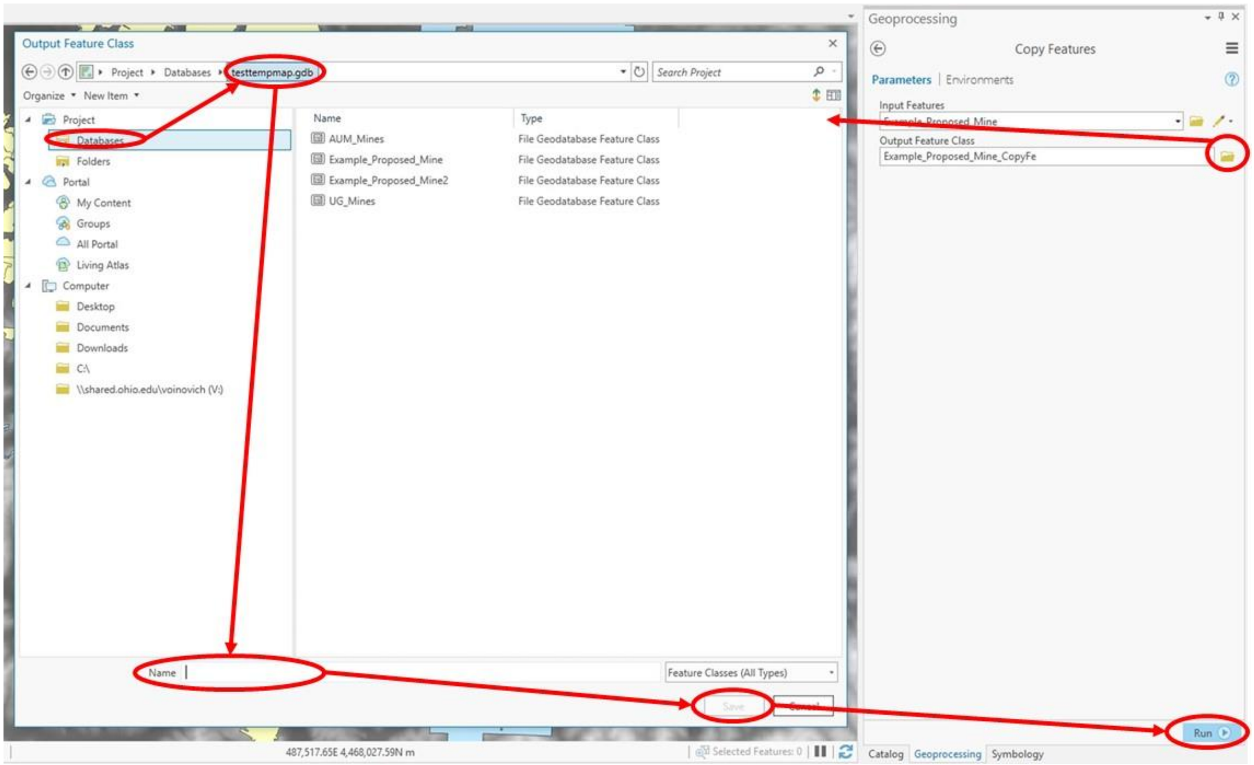

Figure 8 – Screenshot displaying how to save the user's shapefiles to the project's geodatabase. 'Export features' in Figure 7 opens, 'copy features' in the geoprocessing window. Open the window for the 'Output feature class' to navigate to the project geodatabase, provide a name in the window, click 'save', then make sure to click 'run' in the geoprocessing window.

Next the user needs to add the data sheets to the map, also using the 'add data' function and steps outlined above (Figures 5 & 6). Once added, the user data sheets must be saved to the project folder created by the template project. Right click on the .csv sheets in the table of contents and select "Export table" (Figure 9).

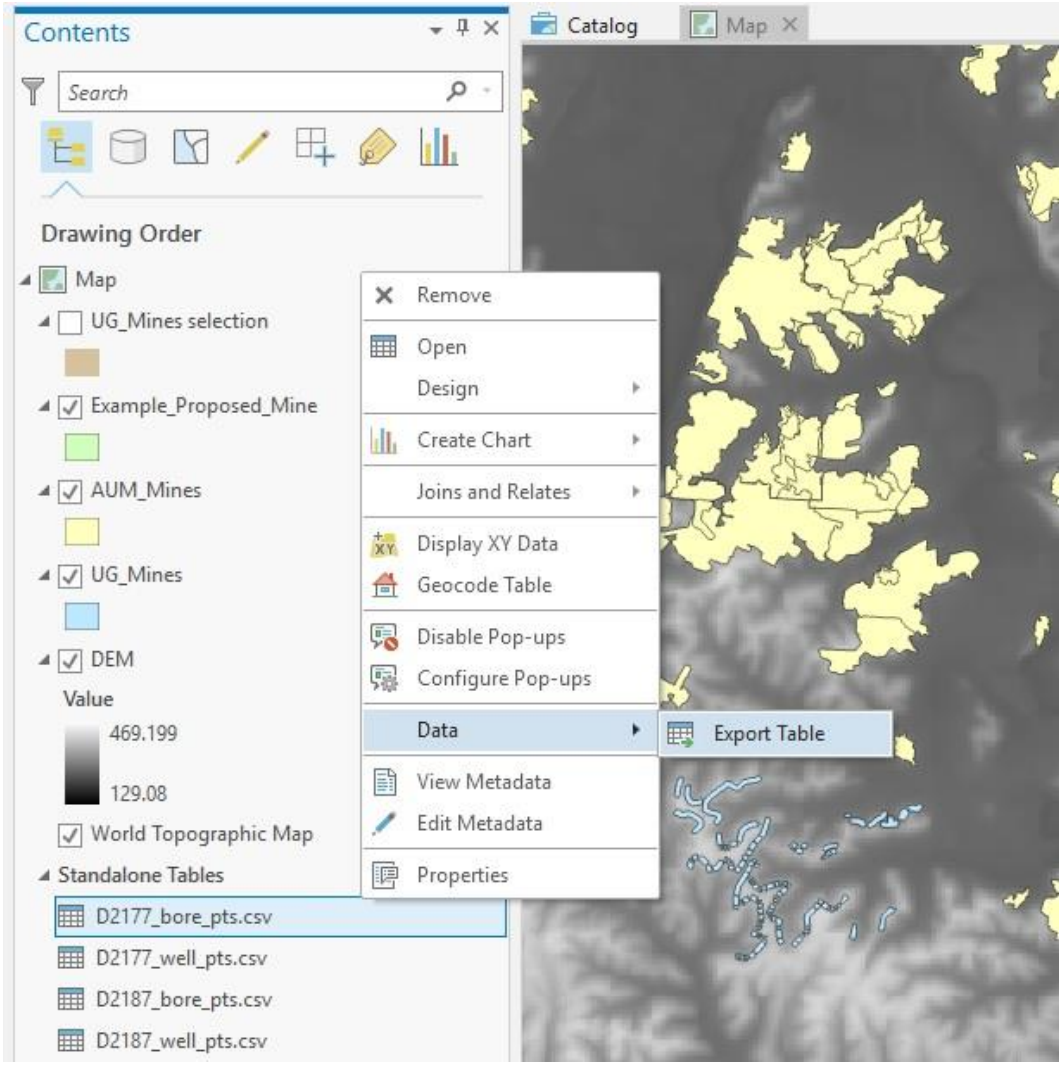

Figure 9 – Screenshot displaying how to export data tables after they are added to the project map.

‘Export table’ opens ‘copy rows’ in the geoprocessing window. Navigate to the project folder, enter a name in the format of “name.csv”, click ‘save’ and then click ‘run’ in the geoprocessing window (Figure 10).

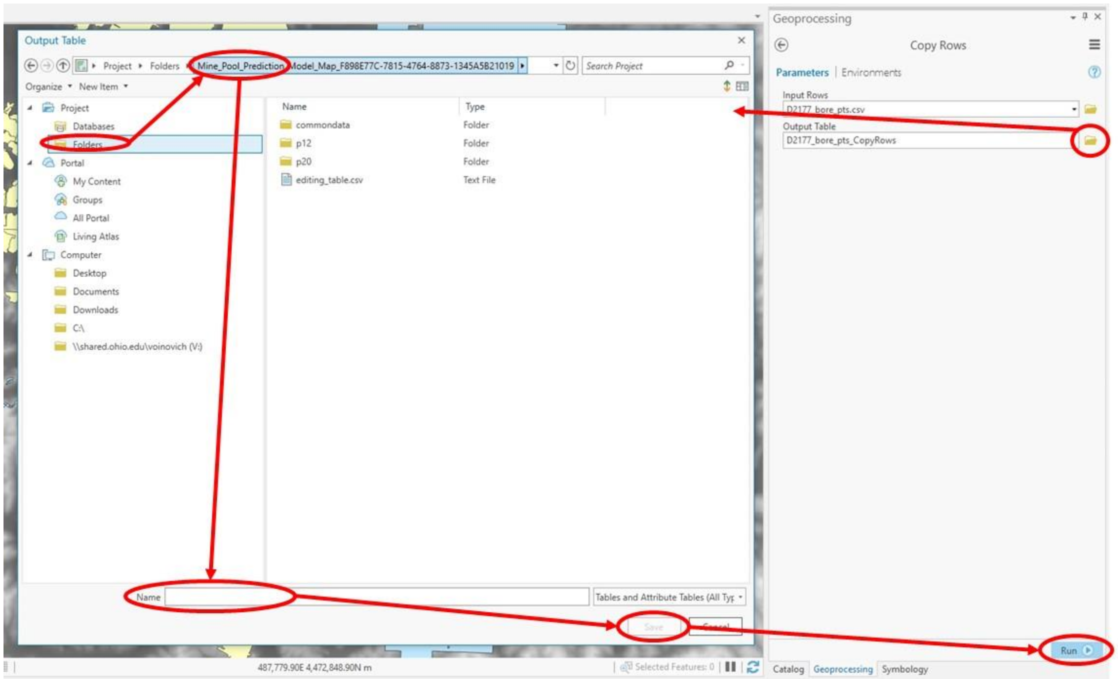

Figure 10 - Screenshot displaying how to save the user's data tables to the project folder. 'Export table' in Figure 9 opens, 'copy rows' in the geoprocessing window. Open the window for the 'Output table' to navigate to the project folder, provide a name in the window, click 'save', then make sure to click 'run' in the geoprocessing window.

5.2 Opening the Tool

Once the required inputs are added to the table of contents and saved to the project locations, the prediction model can be opened from the project's toolbox. The project's toolbox can be found in the Catalog tab several ways (Figure 11). If closed the Catalog tab can be reopened from the "View" tab in the main ribbon at the top of the screen. The template toolbox contains:

1) "Model for Predicting Points of Post-Mining Water Level in Ohio": the prediction tool
2) "Application Prediction Algorithm": Python script for applying the algorithm. No interaction required by the user, included for the model to reference and if the user wishes to adapt the tool with a new algorithm.

Double click, or right click and select ‘open’, on the prediction tool to open it in the Geoprocessing tab, also shown in the screen shots of Figure 11.

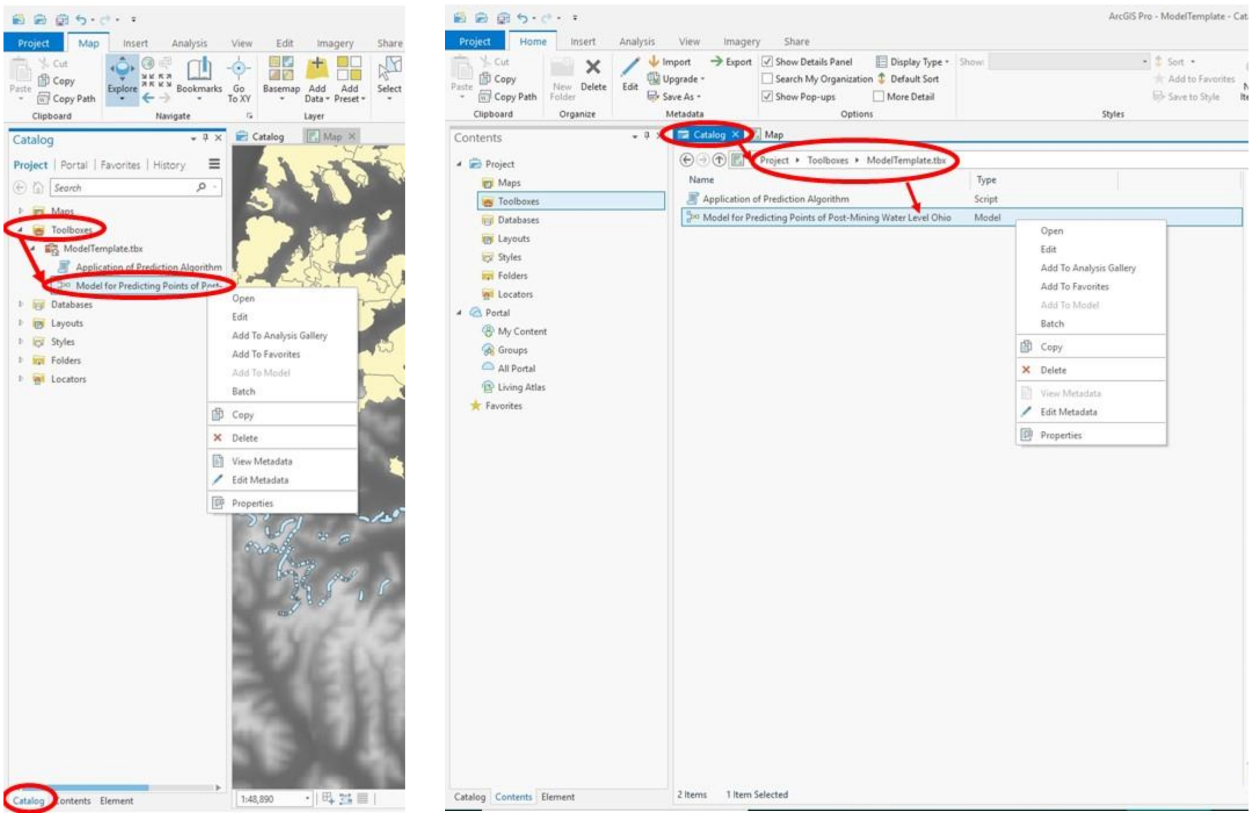

Figure 11 – Screenshots displaying how to locate the prediction tool within the Project toolbox. Both screenshots are different ways of finding the toolbox within the Catalog window.

5.3 Running the Tool

With the tool open, options for inputs and model-generated outputs are displayed with the defaults. Figure 12 shows the layout of the tool when opened in the Geoprocessing window. See previous [Section 3](#) for more details.

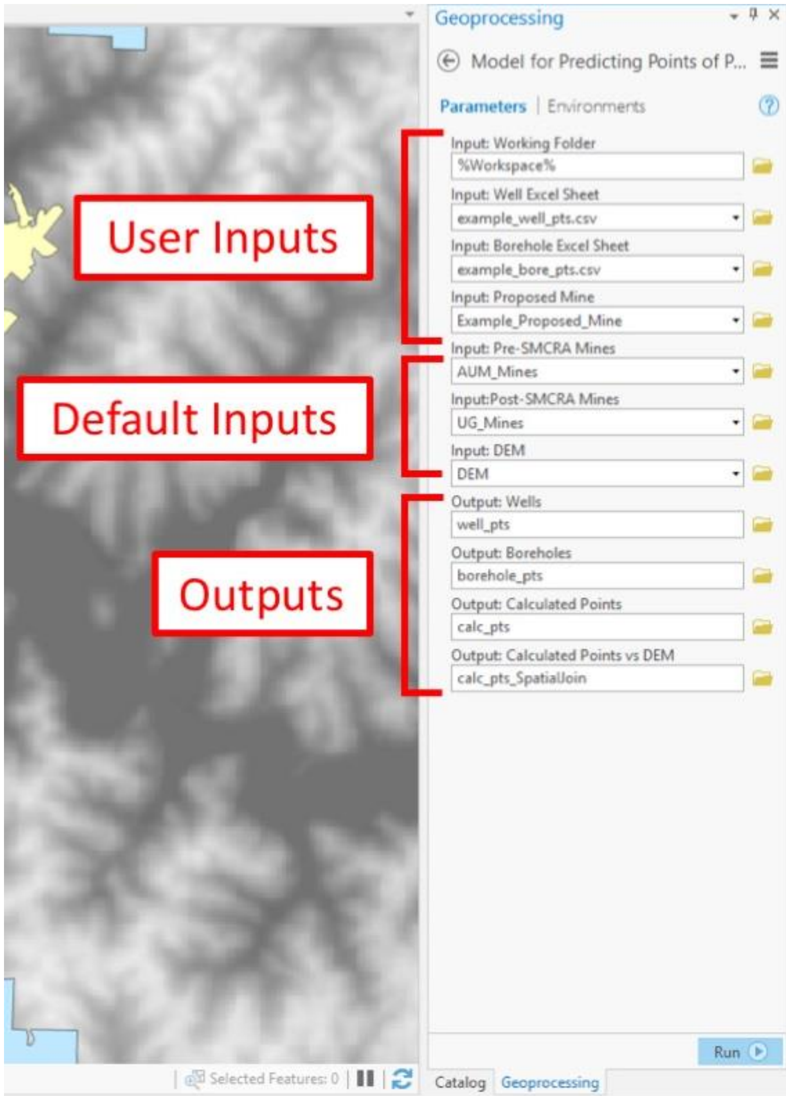

Figure 12 – Screenshot displaying how the tool looks when opened in the geoprocessing window, with the user required inputs labeled at the top, final required inputs with defaults, and outputs labeled at the bottom.

The User Inputs are items that need to be changed by the user before running the tool. 'User Inputs' from the user are:

1.) **Working Folder**: user MUST select the project folder where the toolbox and geodatabase are stored for the tool to run (Figure 13).

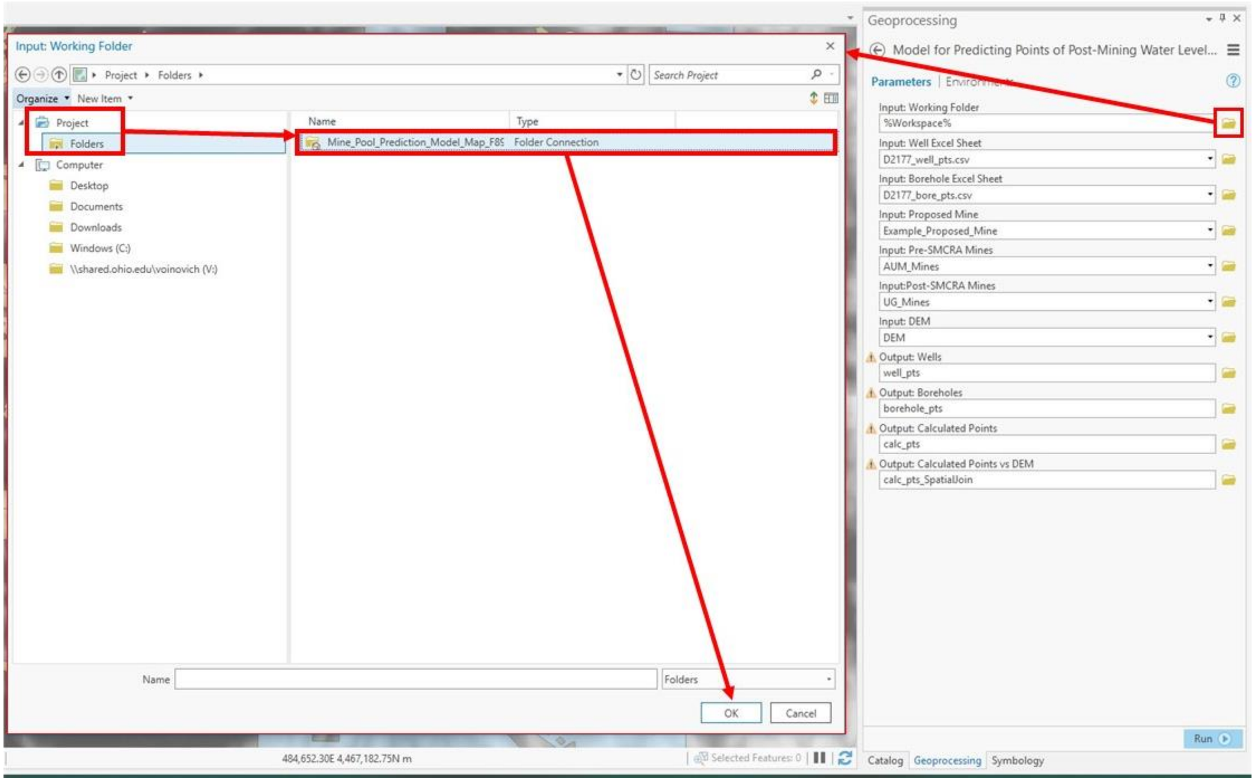

Figure 13 – Screenshot showing how to select the project folder for the User Input "Working Folder". The folder only needs to be clicked on once to highlight/select it but not open it. Once highlighted, hit 'OK'.

2.) **Well Excel Sheet**: .csv formatted sheet that user has added to the map (Figure 14)

3.) **Borehole Excel Sheet**: .csv formatted sheet that user has added to the map (Figure 14)

4.) **Proposed Mine**: shapefile of proposed mine extent that user has added to the map (Figure 14)

Figure 14 – Screenshot of the prediction tool open in the geoprocessing window. To select the files for each user input, files already on the map can be seen in the drop down menu when clicking on the small arrow on the right of the input row. Select the appropriate file for each 'Input:'

‘Included Default’ inputs are pre-loaded and Ohio Coal field users need not change unless these files have been updated by ODNR (Figure 12). They can also be changed as displayed in Figure 14 if shapefiles have been added to the project map:

5.) **Pre-SMCRA Mines**: recent underground mines layer from ODNR
6.) **Post-MSCRA Mines:** abandoned underground mines layer from ODNR
7.) **DEM:** digital elevation model in meters for area of proposed mine, state of Ohio DEM

'Outputs’ are pre-set with default names and a default location of the scratch geodatabase. The user *should* change the names and locations of the outputs to the project geodatabase so that the outputs can be easily located and identified. If not changed, re-running the model will replace the previous results. Changing the name allows for identifying between runs results. The main outputs will be added to the map once the tool is run even if the user does not change the name. Figure 15 shows how to select the geodatabase location to save user outputs of the model.

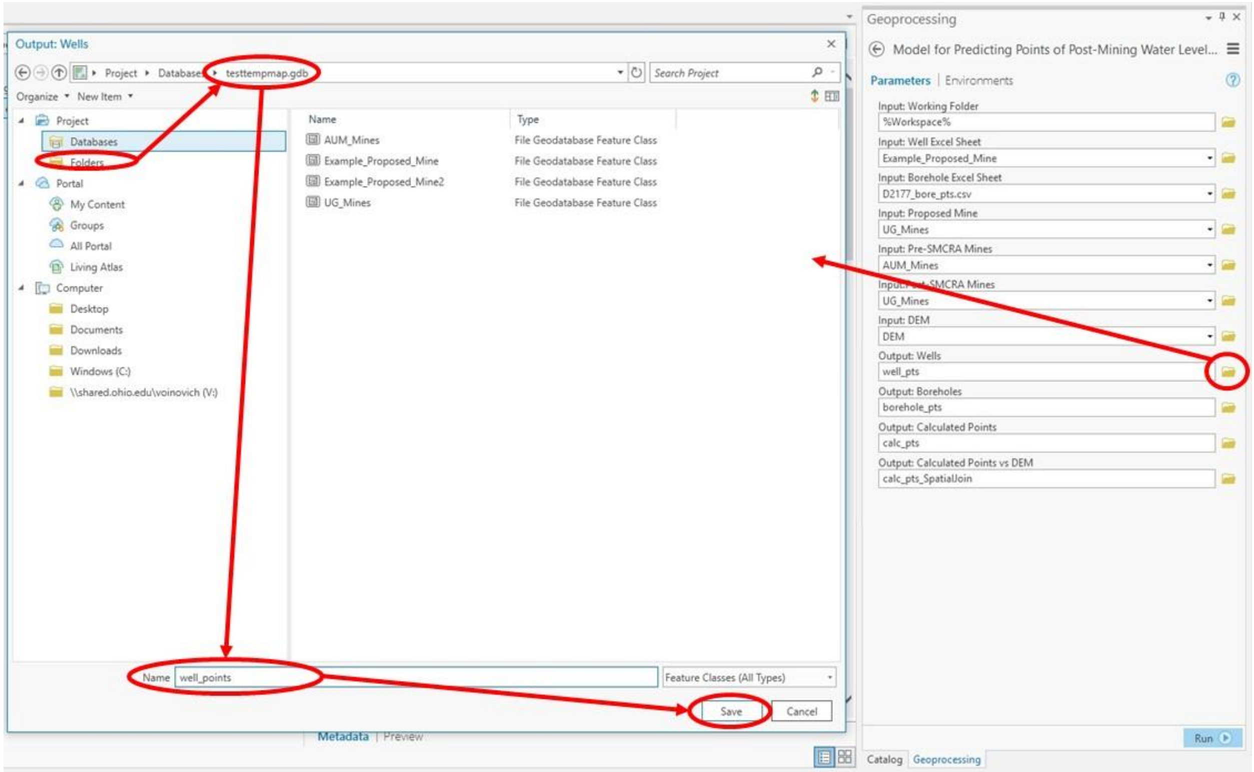

Figure 15 – Screenshot displaying where to save output shapefiles of model. Open the window to navigate to the project geodatabase, enter a name for the shapefile, and hit 'save' at the bottom. This example is for the output well points shapefile, but should be done for the next three output shapefiles.

Once all the data is correctly entered in the geoprocessing window of the model, hit 'run' at the bottom of the window to start the model. Allow ArcPro time to run through the model, it will add layers to the map and display a successful run (Figure 18).

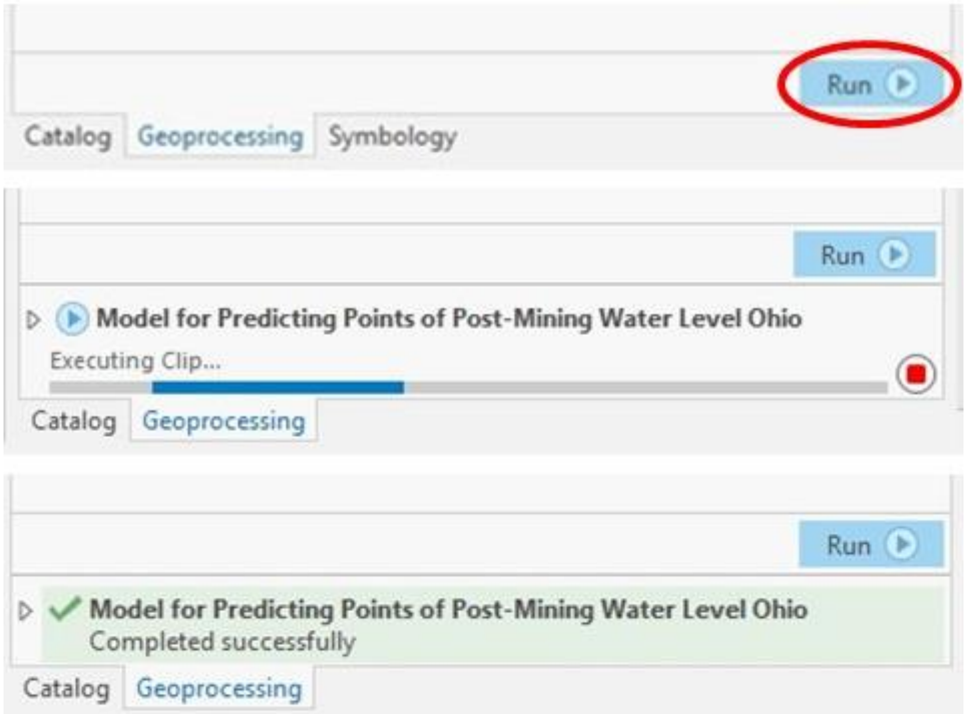

Figure 16 - Screenshots displaying running the model. At the top start with clicking run once all data is entered, next screenshot displays the tool running, the bottom screenshot displaying that the model has run successfully.

5.3.1 Metadata

Descriptions for each input and output can be seen in the metadata when viewing the tool in the toolbox (Figure 17).

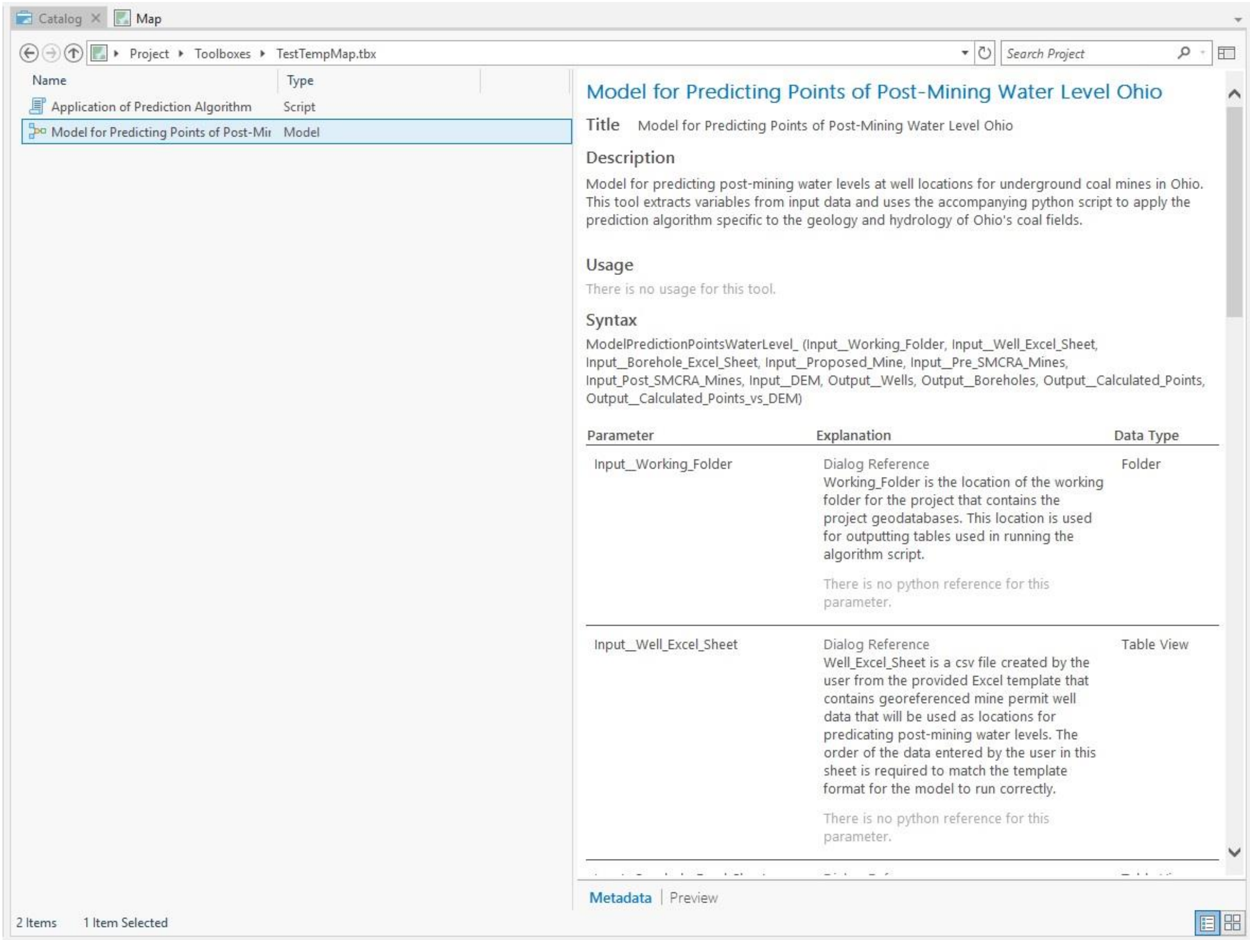

Figure 17 – Screenshot displaying how to view metadata of the tool when viewing the tool in the catalog window. Figure 11 shows how to navigate to this window.

The metadata can also be seen by clicking on the question mark when viewing the tool in the geoprocessing window (Figure 18).

Figure 18 – Screenshot of how to locate the 'question mark' in the geoprocessing window of the model. Clicking on the question mark opens another window displaying the metadata of the model.

5.4 Interpreting Tool Outputs

The final outputs of the tool are automatically added to the map when the model successfully runs, but are also saved to the location specified by the User in the set up for running the tool (Section 5.3). The shapefiles added (and default names) to the map by the tool are:

1) Projected well points (well_pts.shp)
2) Projected borehole points (borehole_pts.shp)
3) Calculation points with all variables extracted (cal_pts.shp)
    a. All variables required to run the prediction algorithm are displayed in the attribute table, along with the final column providing the predicted post-mining water level
4) Calculation points with comparison to the area DEM (calc_pts_SpatialJoin.shp)
    a. Resulting attribute table displays values for the initial measured potentiometric head, calculated coal seam elevation, value of predicted head, DEM points converted to feet, and the final value comparing the surface elevation to the predicted head (Figure 10). *Note: The elevation used for comparison is the DEM elevation, not the reported surface elevation from the initial well input data.*

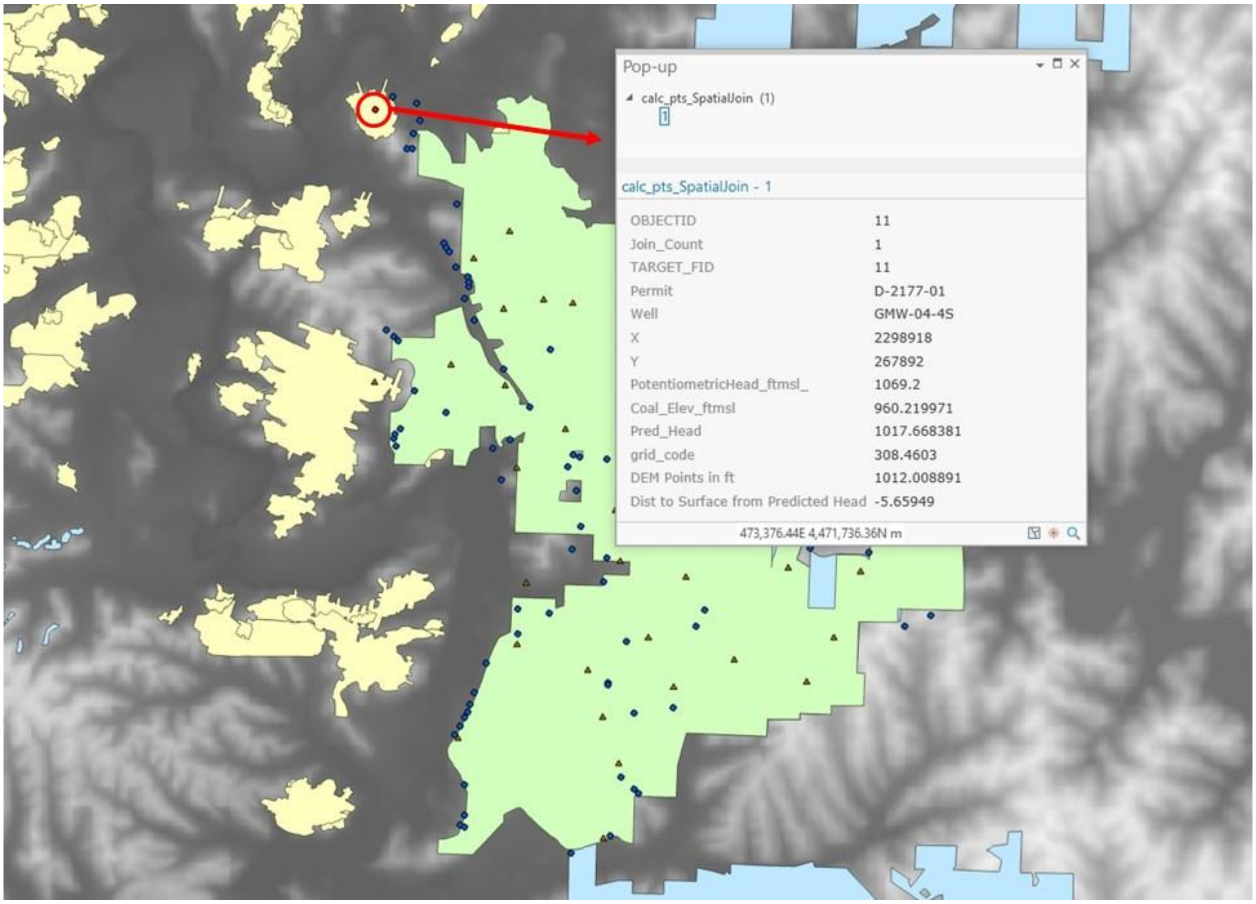

Figure 19 – Screenshot of final outputs from running the prediction tool, highlighting a point of risk that when clicked displays the data results in a pop up window.

5.4.1 Changing Symbology for Output Layers

Once the tool has been run and layers are added to the map, symbology for interpreting the layers can be edited to easily identify which well points of predicted post-mining water level indicate areas at risk for surface discharge.

This can be done by right clicking on the 'calc_pts_SpatialJoin' layer and selecting 'Symbology' to open the symbology tab, or by clicking on the layer to highlight it and the symbology tab appears in the header tab of ArcGIS Pro (Figure 20).

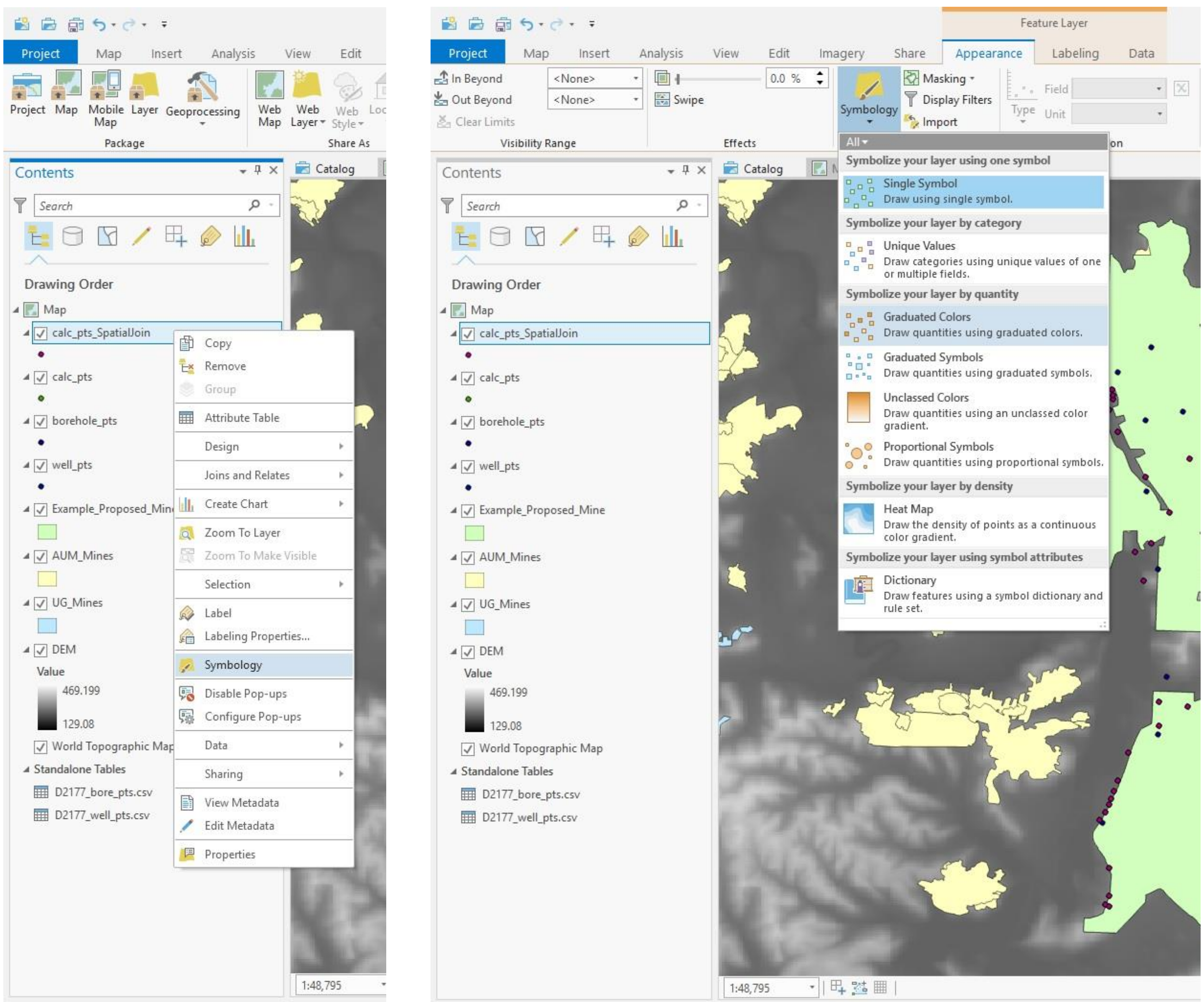

Figure 20 – Screenshots to display how to locate the symbology function for the final output layer. The left image shows right clicking on the layer in the table of contents. The right image shows when the layer is highlighted (one click) in the table of contents the main ribbon tab for 'Feature Layer' > 'Appearance' > 'Symbology'> 'Graduated colors'.

Once editing the symbology, there are various ways to display the point data but the suggestion for tool users is to define symbology for value ranges of points below the DEM (positive “Dist to Surface from Predicted Head” values) and above the DEM (negative “Dist to Surface from Predicted Head” values), by following the steps below.

At the top of the symbology tab, select ‘Graduated Colors’ as the type of symbology (Figure 21 [#1]). Then select the “Dist to Surface from Predicted Head” as the value to be symbolized by and pick 2 for number of ranges (Figure 21 [#2-3]). Ranges will be automatically assigned but can be edited by double clicking in the range box. Enter ‘0’ in the first box to indicate points that have a negative value indicating water level above the DEM (Figure 21 [#4]). The second box should already be the highest value, thus representing the values below the DEM. The symbol on the left can then be double clicked to change the size and color of the points to indicate on the map areas of risk for surface discharge (Figure 21).

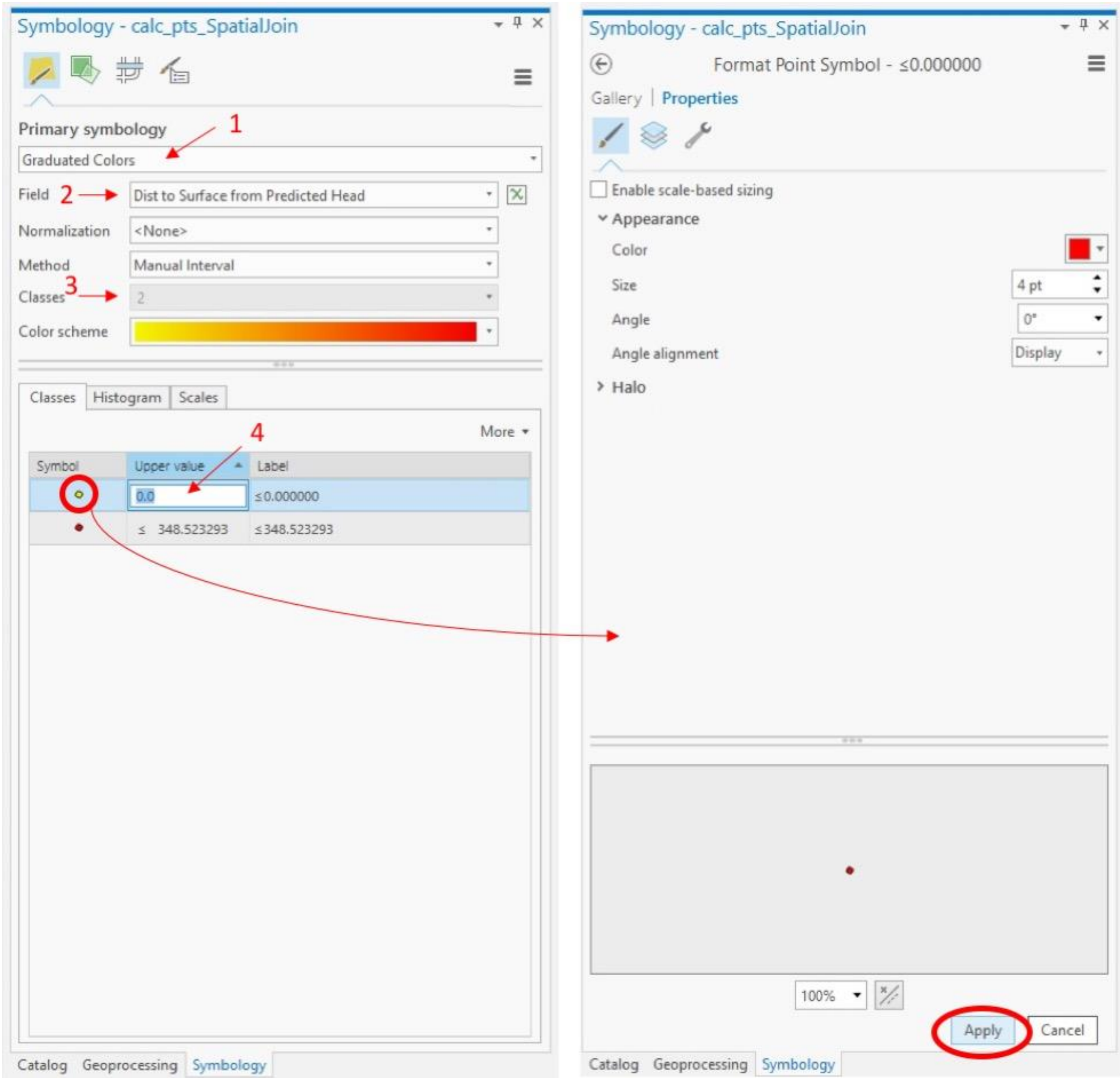

Figure 21 – Screenshots displaying how to adjust the symbology for the final output layer. 1. Selecting the 'Graduated colors' for symbology type. 2. Select field to symbolize by, the final value that compares the predicted head to the DEM: 'Dist to Surface from Predicted Head'. 3. Select 2 for the number of classes. 4. Manually change the upper value for the lower of the ranges to 0. Finally, double clicking on the actual symbol will allow the next window to appear where the user can select shape, size, and color for each of the different ranges. Make sure to 'Apply' the symbology.

6 Trouble Shooting

6.1 Points not projecting correctly

If the model runs well but the resulting points are not in the area of the proposed mine as they should be, it is likely the default projection of the tool does not match the projection of the input data's XY coordinates. This may be fixed by setting a projection in the Environment of the tool prior to running (Figure 22). If the data is in a latitude longitude format the data will need to be converted to XY coordinates.

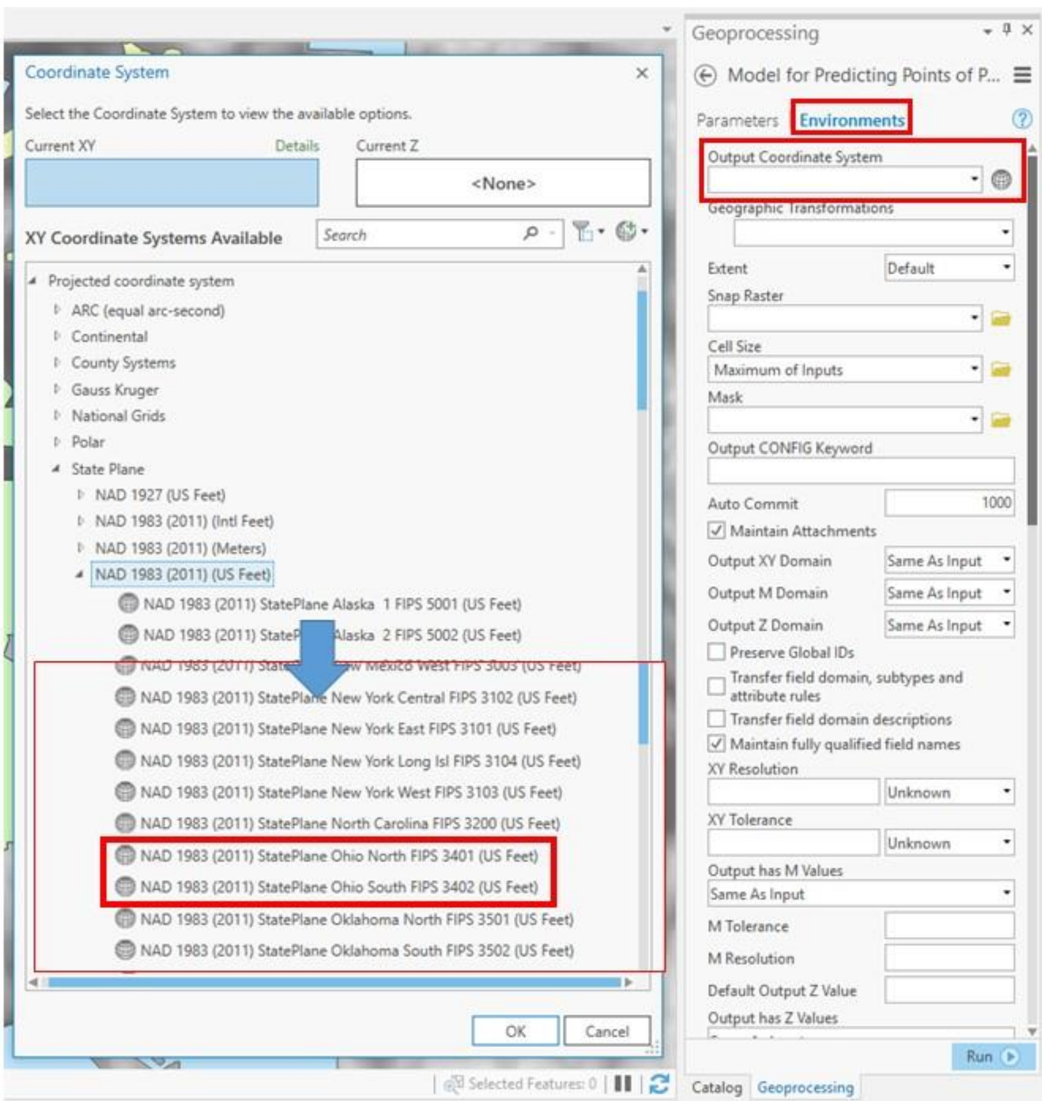

Figure 22 – Screenshots showing how to set the coordinate system in the environments settings for the prediction tool so that it matches the user's data. The most common ones used in the applicable area of the tool are highlighted on the left.

6.2 Model Failure

The most likely error to occur is that user data was not input correctly and has caused the tool to fail. The first suggestion is to re-check the data entered in the Excel spreadsheets. None of the values should be zero or null values. The units of the entered data should also be checked so that they match the required units for the tool, as indicated in the Excel templates and in the previous descriptions in this User's Guide. Another possibility is that the 'Working Folder', the first input required when viewing the tool in the geoprocessing, was not changed from the default value; the tool cannot run without this section.

6.3 Model output values unreasonable

If the results from running the tool provided highly unreasonable values, the first suggestion is to re-check the data entered in the Excel spreadsheets. None of the values should be zero or null values. The units of the entered data should also be checked so that they match the required units for the tool, as indicated in the Excel templates and in the previous descriptions in this User's Guide. If the units are correct and the data has no nulls or incorrect zeros, it may be that the users' data is not accurate, or the algorithm is not applicable to the area the data was collected for.

6.4 Model Invalid when opened

If when opening the tool in the geoprocessing tab, it initially displays a red x and states the 'model is invalid', it is likely there is a connection lost in the model builder structure of the tool. There is the possibility with inconsistencies of Model Builder that the tool itself may break down. One common issue in testing the tool was losing the connection to the tool that runs the prediction algorithm that is included in the flow of Model Builder. The Python script that runs the variable transformations and applies the prediction algorithm is included in the project toolbox, as described in Section 5.1.

To fix this issue, simple editing will have to be done directly to the tool in Model Builder. To open this, view the tool in the Catalog view of the toolbox, right click and select 'edit' (Figure 23).

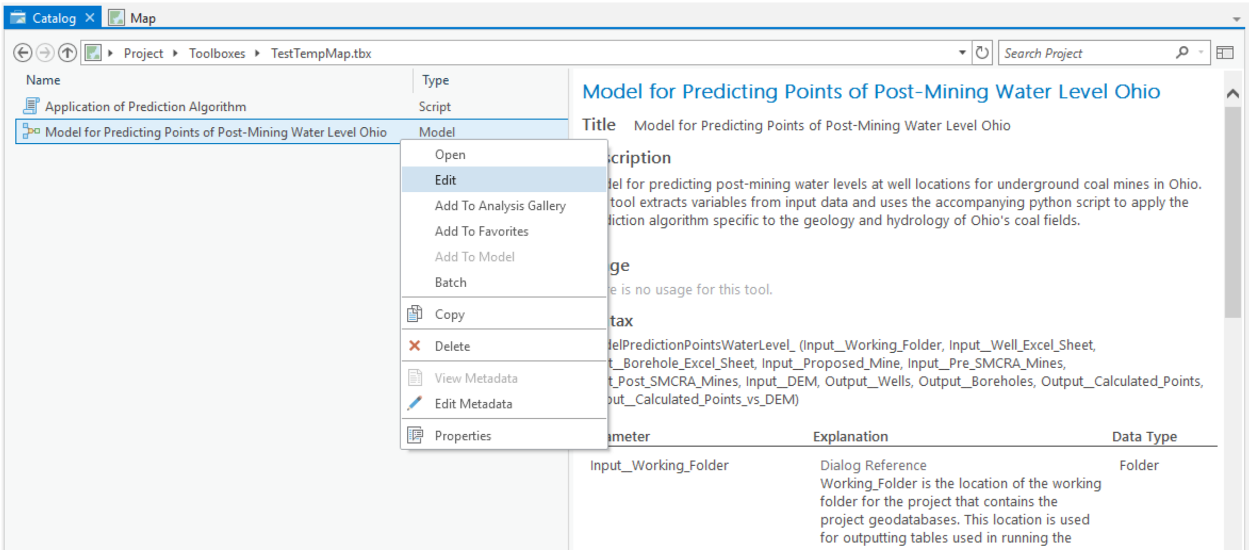

Figure 23 – Screenshot showing how to open the editing window for Model Builder.

This will open an editing window of Model Builder that may look like the screen shot in Figure 24.

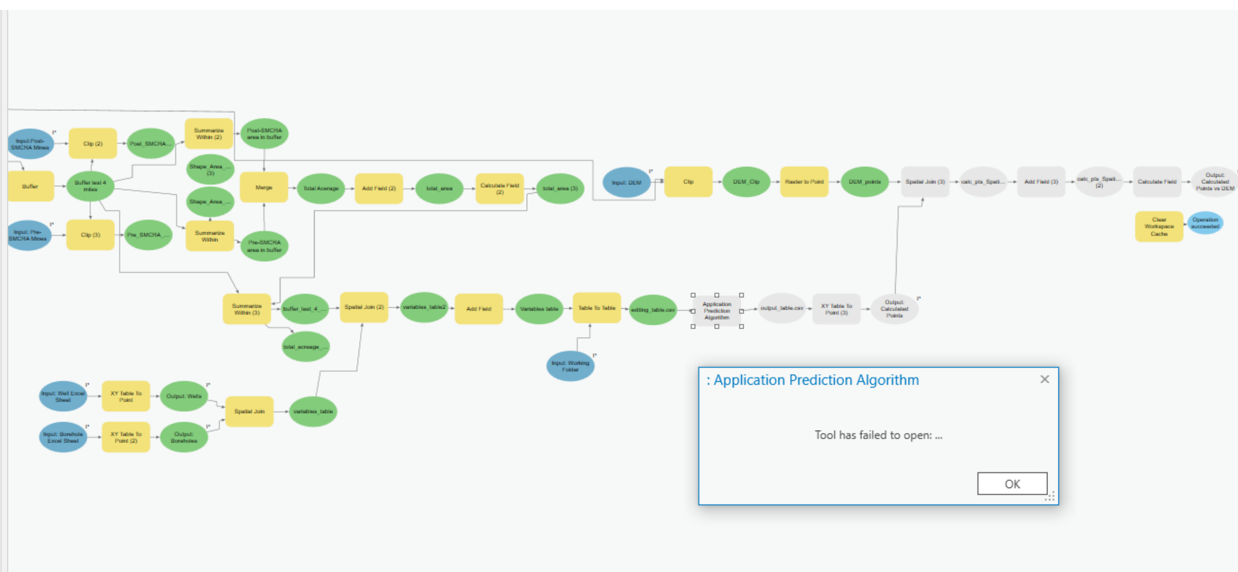

Figure 24 – Screenshot showing what the tool looks like in Model Builder if the connection to the algorithm tool is lost.

Once open, if the model looks like Figure 15, select the 'Application Prediction Algorithm' and hit delete (Figure 25).

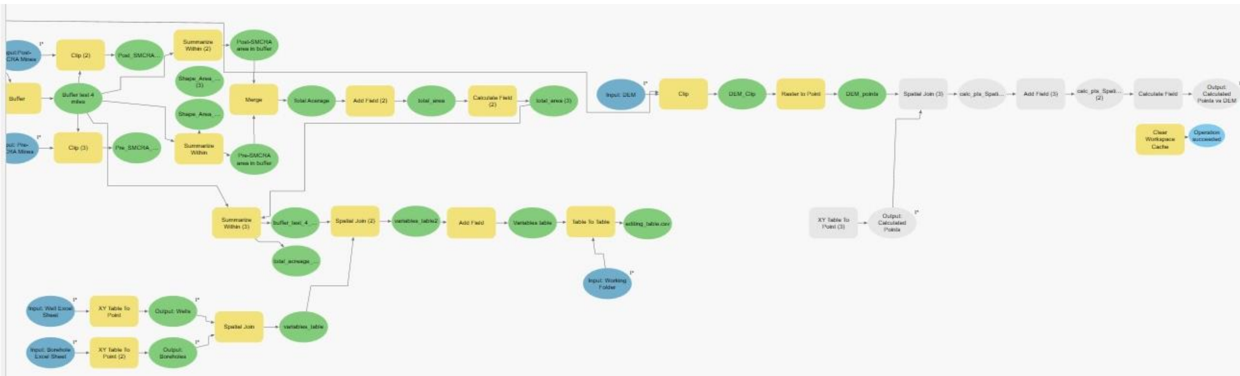

Figure 25 – Screenshot showing how the tool looks once the lost connection is deleted, done by highlighting the 'Application Prediction Algorithm' and hitting delete.

From the Catalog window, open the toolbox and drag the script tool 'Application Prediction Algorithm' into the open Model Builder window (Figure 26).

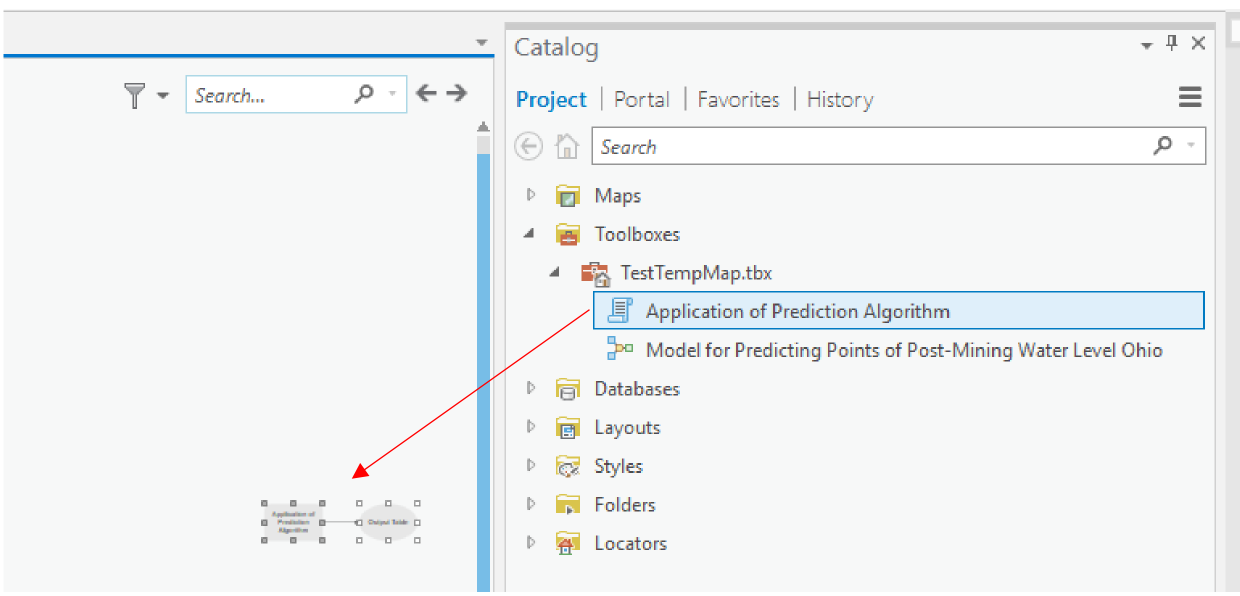

Figure 26 – Screenshot displaying dragging the 'Application of Prediction Algorithm' from the toolbox viewed in the Catalog window in to the open editing Model Builder screen.

Next, the connections to the model and the script tool must be repaired (Figure 27). Click and drag from the 'editing_table.csv' variable to the 'Application Prediction Algorithm' and select the option for Input Table. Next click and drag from the ‘Input Working Folder’ and select the option for ‘Working Folder’. Finally connect the ‘output.csv’ variable to the rest of the model ‘XY Table to Point’ and select the option for ‘Input Table’.

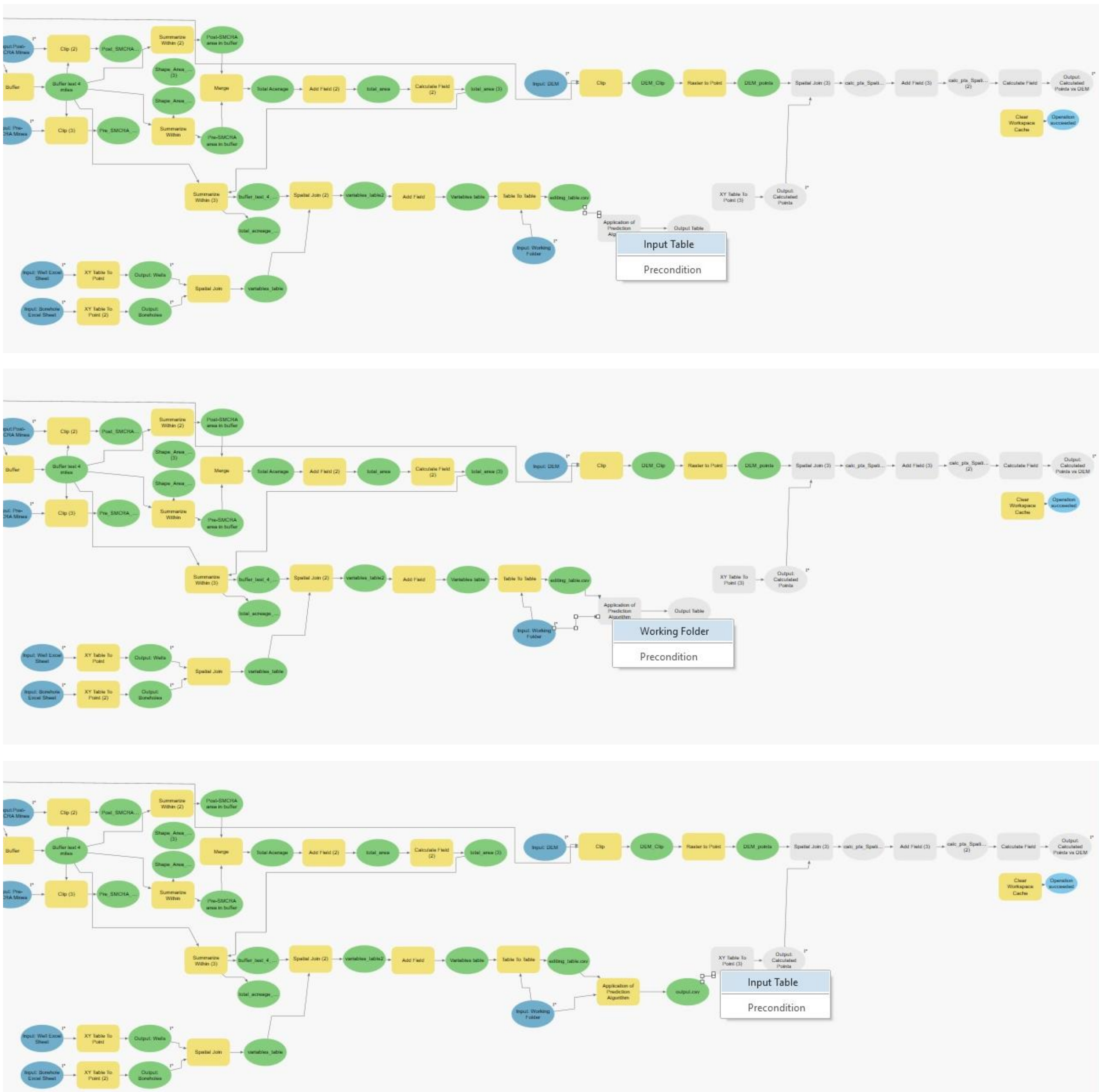

Figure 27 – Screenshots displaying how to repair the connections of the model to the ‘Application Prediction Algorithm’. Click and drag from the ‘editing_table.csv’ to the ‘Application Prediction Algorithm’ and select the option for Input Table. Next click and drag from the ‘Input Working Folder’ and select the option for ‘Working Folder’. Finally connect the ‘output.csv’ variable to the rest of the model ‘XY Table to Point’ and select the option for ‘Input Table’.

Once the connections are repaired, the final fix is to open the ‘Application Prediction Algorithm’ and change the output table name and location (Figure 28). The output table MUST be a .csv file format. The default name can be left but add .csv at the end and select the project folder location (NOT a geodatabase).

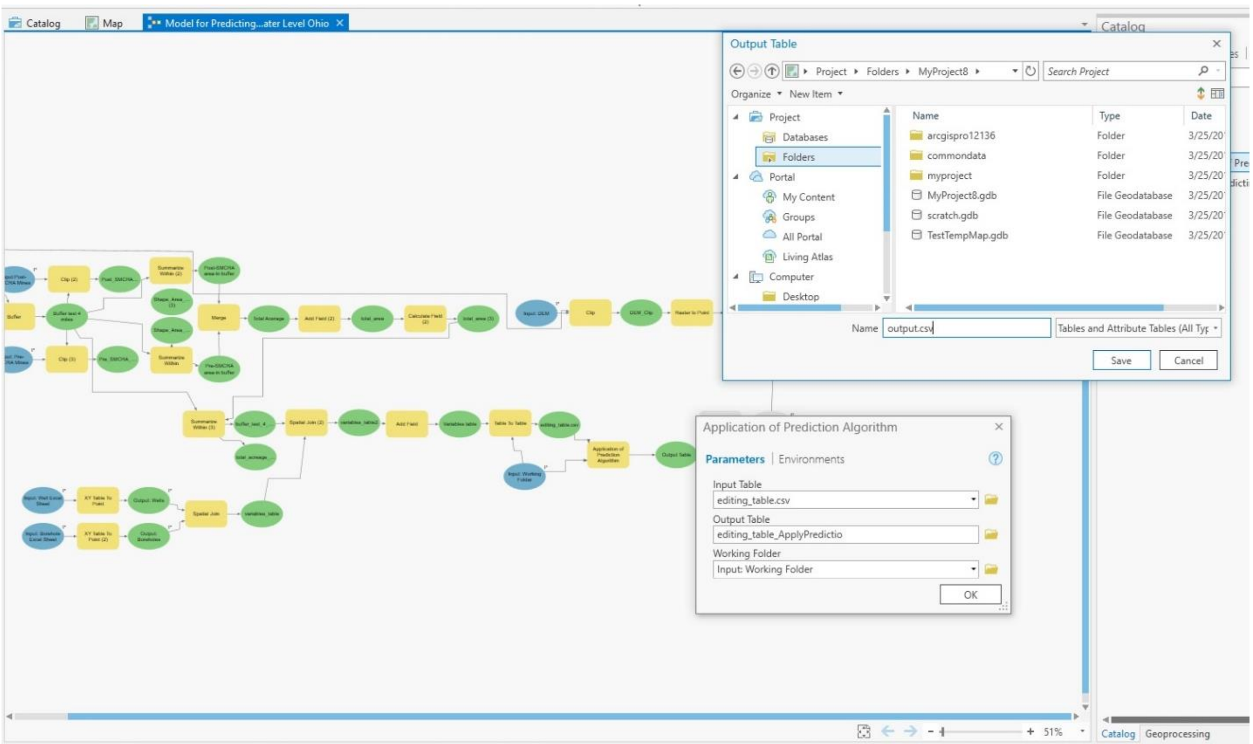

Figure 28 – Screenshot showing final repairs to the model. Once the tool is reconnected, double click to open ‘Application Prediction Algorithm’ to edit the output table name and location. The output table MUST be a .csv file format. The default name can be left but add .csv at the end and select the project folder location (NOT a geodatabase).

Once this is done the model should look like Figure 29. Save the model before closing the Model Builder edit window and re-run the model.

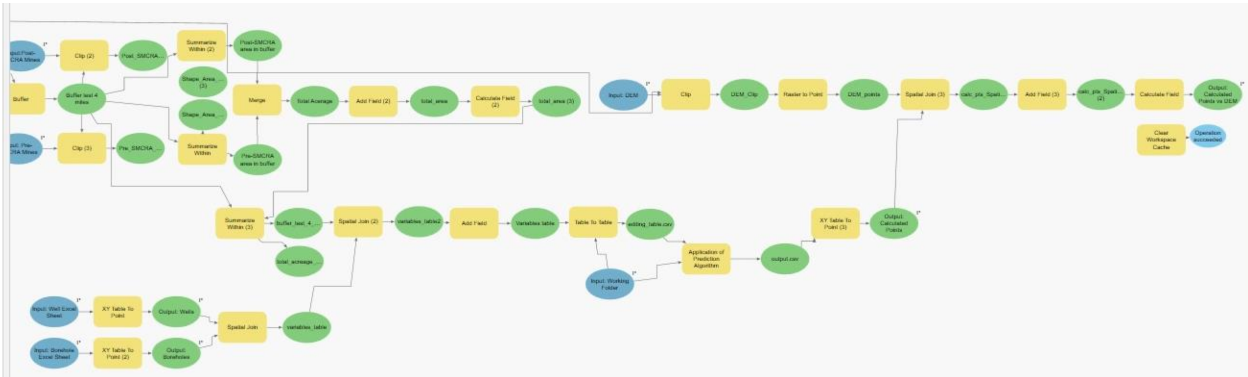

Figure 29 – Screenshot of the final repaired model for the prediction tool. Make sure to save the model before closing and re-running.