La Jolla Bathymetry Demo

Download bathymetry grid from NGDC

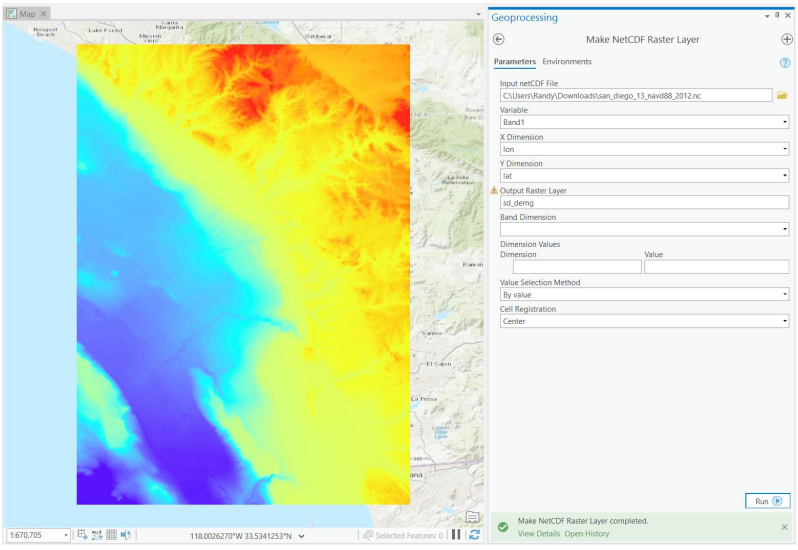
- Coastal Elevation Models > Search San Diego

San Diego	2012	North American Vertical Datum of 1988	WGS84	1/3 arc-second	Complete	Data / Details

- San Diego, CA ⅓ Arc-second NAVD8 Coastal Digital Elevation Model
    - Download NetCDF file (425 MB)

Convert NetCDF File to Raster

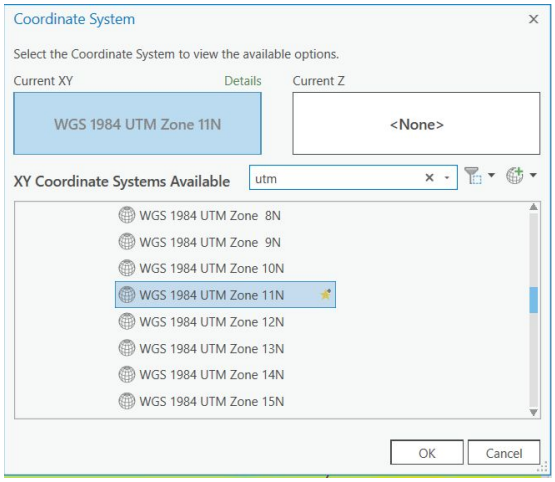
- ArcGIS Pro tool: Make NetCDF Raster Layer
  Input: san_diego_13_navd88_2012.nc
  Variable: Band 1
  X Dimension: lon
  Y Dimension: lat
  Output Raster Layer: sd_demg

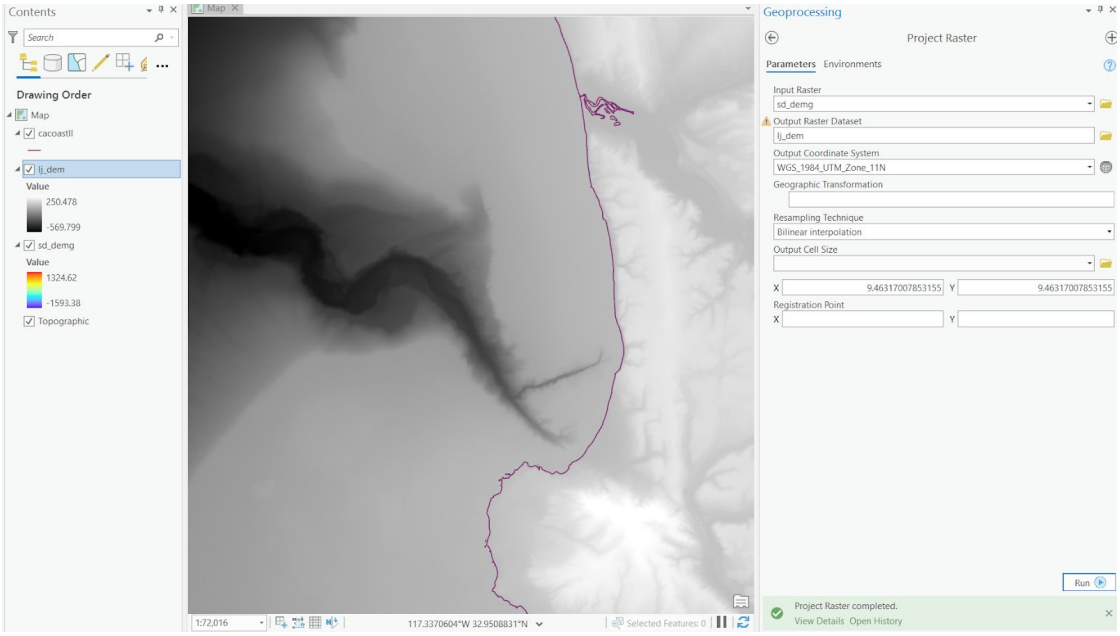


Extract Subset and Project to UTM Zone 11 meters

- Zoom into La Jolla region
- Use Project Raster Tool
    - Set Environments:
      Extent: Current Display Extent

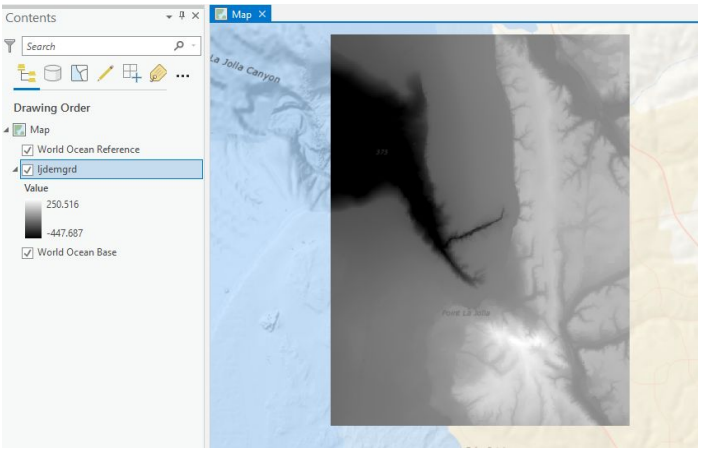
  Parameters:
  Input Raster: sd_demg
  Output Raster Dataset: lj_dem
  Output Coordinate System: WGS 1984 UTM Zone 11N





Add DEM Data to ArcGIS Pro

Add raster data: ljdemgrd



Here is elevation data for La Jolla region symbolized as graduated gray-shaded colors. Looking at the contents pane, we see the raster data range from -447 meters depth (dark) to +250 meters (light) (Layer Properties > Source > Data Source > Vertical Units: Meters).

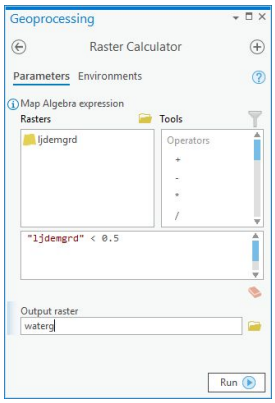
Extract bathymetry and topography as separate raster layers

There are at least 2 ways we will do this:

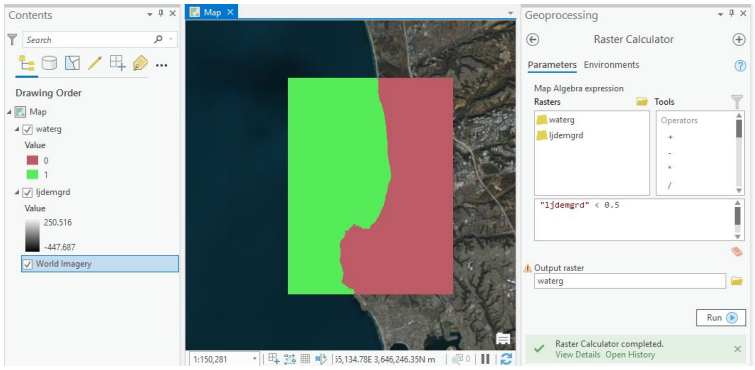
1. Calculate a mask grid → Extract data using mask
2. Utilize raster function: Con

1. Use Raster Calculator to create a water mask.

- Search for Raster Calculator tool

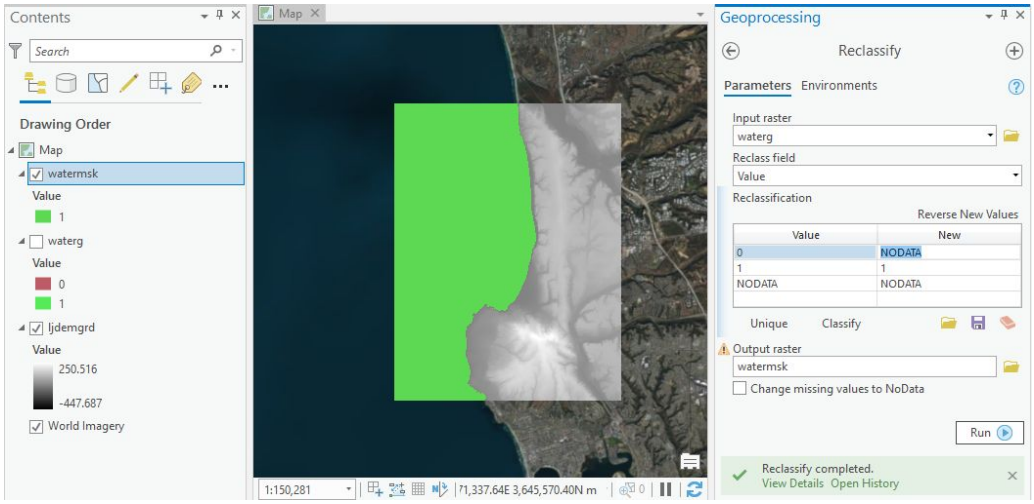


- Enter in the following in Raster Calculator:
  “ljdemgrd” < 0.5

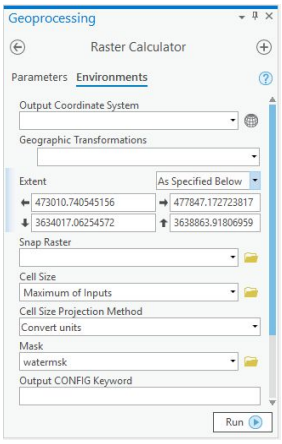


The raster is green where the statement evaluates to TRUE (1) and red where statement evaluates to FALSE (0). For now, we are only interested in Water

- Reclassify to create water mask (use Reclassify or IsNull tool)
  Search for Reclassify tool (Spatial Analysis Tools > Reclass > Reclassify)

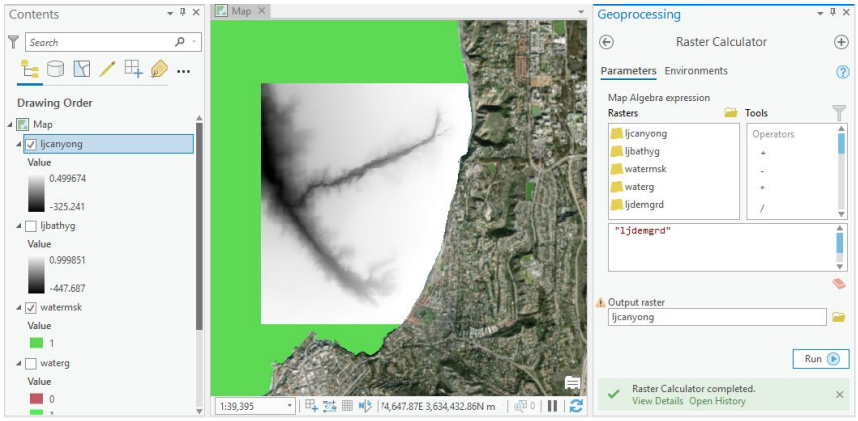


- Use Raster Calculator a final time applying mask grid (could also use Extract by Mask)
  Zoom in closer to la jolla canyons
  Select Environments option in Raster Calculator to set extent and extract by mask
  Environments:
    Extent: Current Display Extent
    Mask: watermsk



Parameters:

"ljdemgrd"

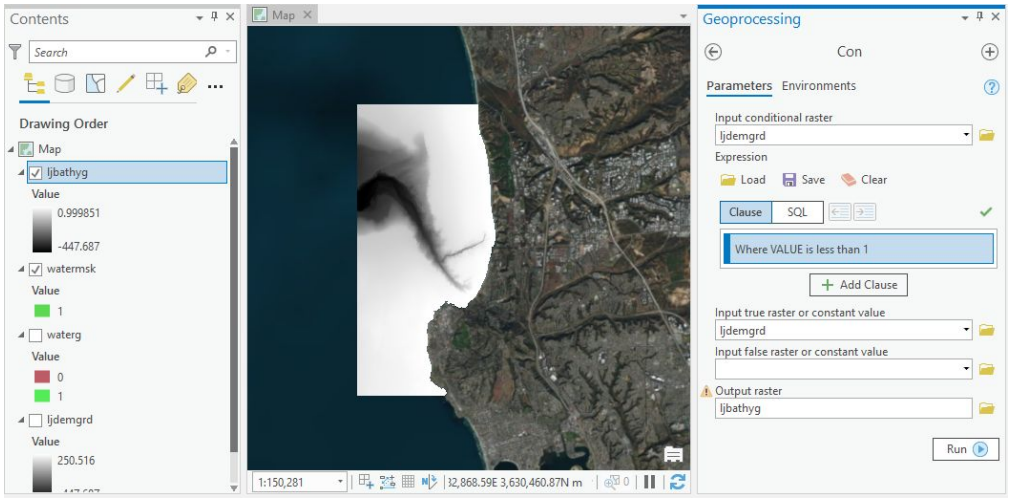


The new DEM is clipped to water values less than 1 meter and covers the extent of wherever you were zoomed into.

2) Simply use the Conditional statement (aka "Con")

Open the Conditional tool (Spatial Analysis Tools > Reclass > Reclassify)
Input conditional raster: ljdemgrd
Expression → Clause: Where VALUE is less than 1.0
Input true raster or constant value: ljdemgrd
Input false raster or constant value:
Output raster: ljbathyg

We now have the bathymetry data extracted into a new layer. You are looking at the seafloor bottom where depth range from -447 m to 0.999 m. We want to contour the 0 meter depth line - this is why we kept in data < 1.



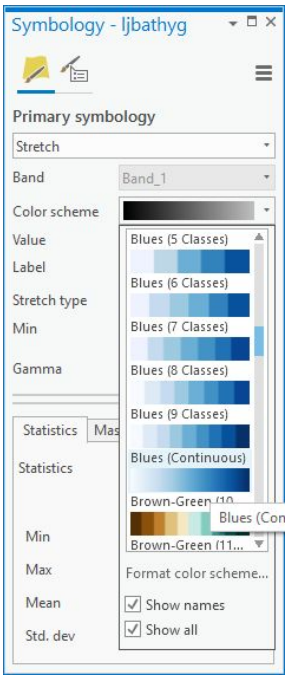
Clean up Contents Pane

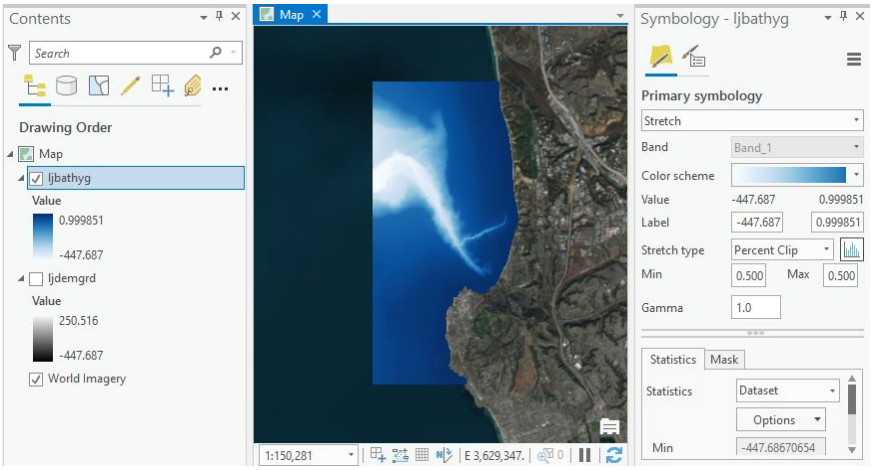
Can remove masks and intermediary layers. Can even remove the bathymetry grid and re-add from Geodatabase to see where software puts these files.

Symbolize bathymetry data

Let's symbolize the depths with dark to light blue color scheme:

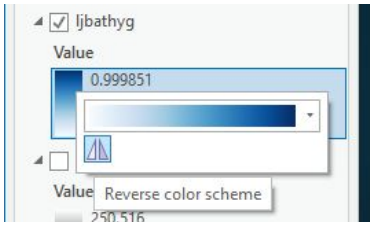
- Right-click ljbathyg > Symbology
- Primary symbology > Stretch
- Select Color scheme
    - Check "Show names"
    - Check "Show all"
    - Find Blues Continuous





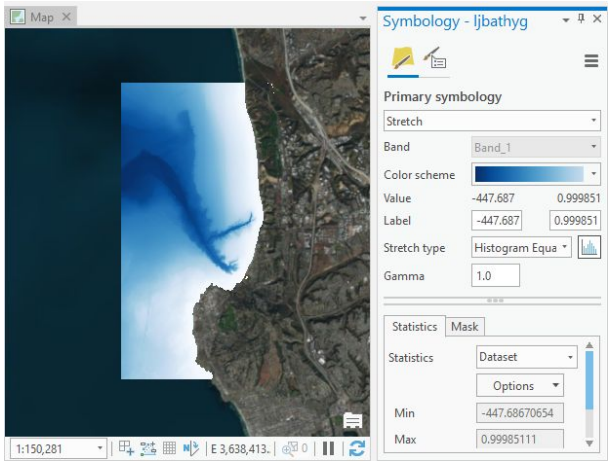
The data are symbolized just as color scheme shows where light colors are for deep water and dark colors for shallow areas. Let's reverse the scheme, where darker colors represent deeper water:

- Right click the blue color bar in the Contents Pane
- Select the Reverse color scheme option



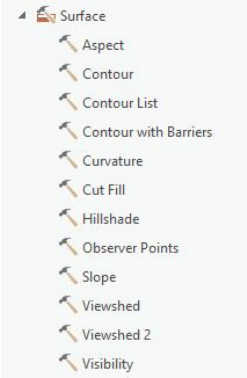
This will reverse the color scheme. Play around with the different Stretch types:

- Histogram Equalize (my favorite)
- Minimum Maximum (can edit the min/max values manually)
- Percent clip



Check out the Spatial Analyst Surface Toolbox

Analysis > Geoprocessing Pane > Tools > Toolboxes > Spatial Analyst Tools > Surface

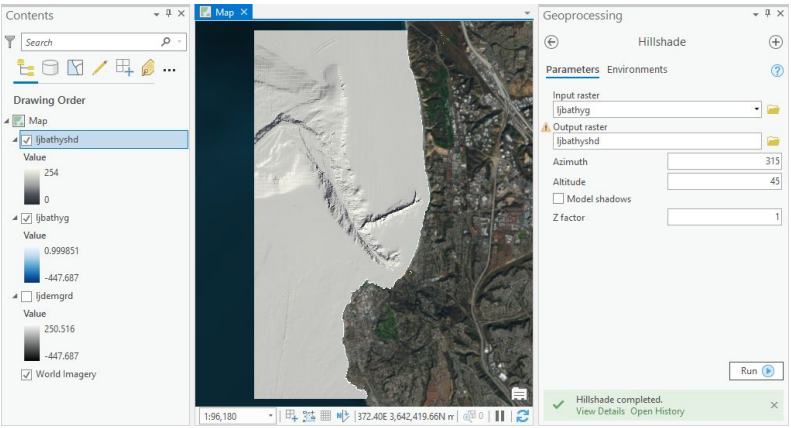


Create a hillshade

Use the Hillshade tool to generate a sun-shaded surface to help display. You enter input/output rasters and the azimuth (compass direction) and altitude of the artificial light. So the default value of 315 degrees simulates a light source from the NW direction at 45 degrees above the horizon.

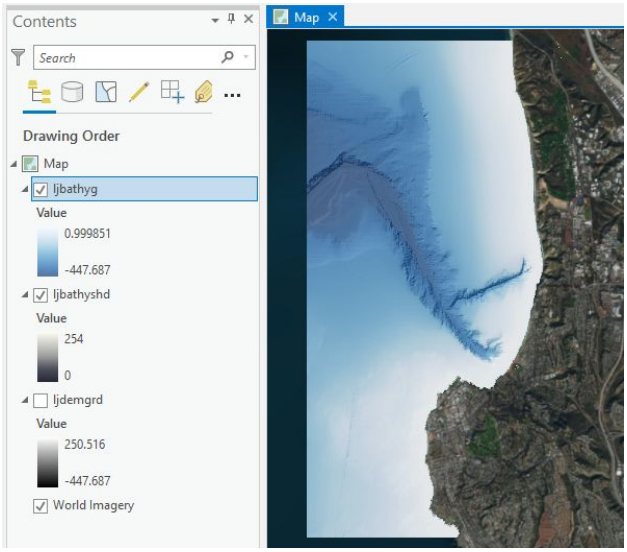
Select Surface > Hillshade (or search for “hillshade” in Find tools)

- Input raster: ljbathyg
- Output raster: ljbathyshd
- Azimuth: 315 (default)
- Altitude: 45 (default)
- Model shadows: unchecked (default)
- Z factor: 1 (default)



The hillshade should show up in the Contents pane - it is essentially a raster with integer brightness values (0-254).

Change the display ordering in the Contents pane so the hillshade lies beneath the bathymetry grid (ljbathyg).
Adjust the transparency of the bathymetry grid: Appearance > Transparency 35 %

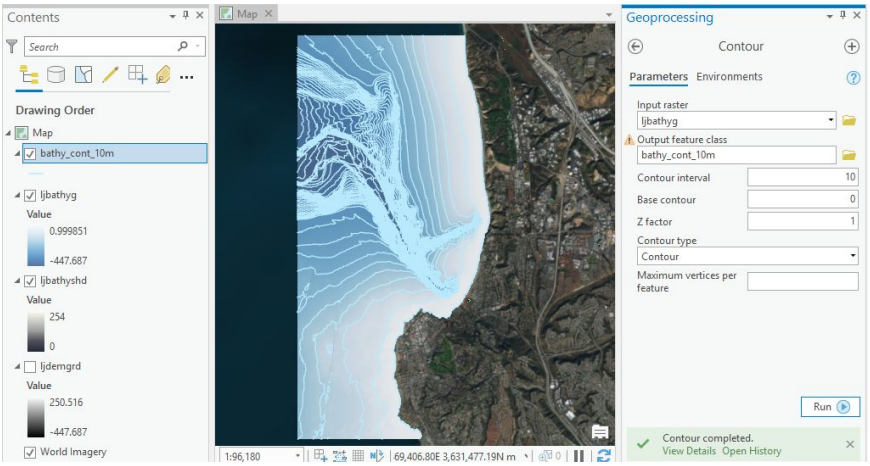


Getting closer to a good looking plot!

Create contours

Use the Contour tool to generate contour line features at set intervals. Before using the tool, look at the range of values in the bathymetry grid (-447 to 0.9). A contour interval of 10 m, will give us about 44 contour lines on the map - this seems pretty good. The higher the interval the longer the tool will take, so choose wisely.

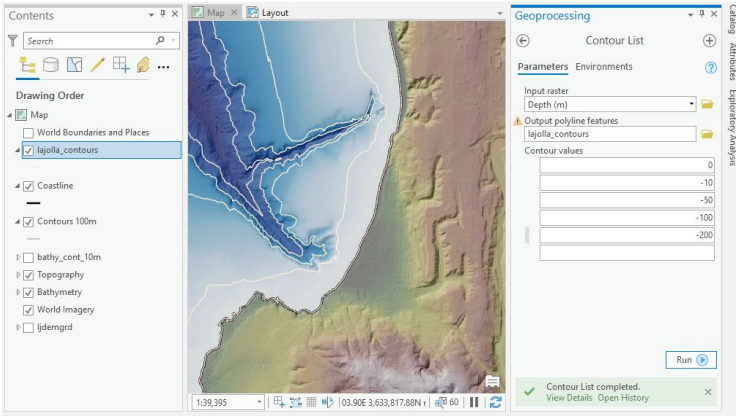
- Input raster: ljbathyg
- Output feature class: bathy_cont_10m
- Contour interval: 10 (units are whatever the units of Input raster are)
- Base contour: 0



The contours are added on top of the depth grids. These lines represent changes in depths every 10 m (or 30 ft). The map looks kind of crowded. We could use the contour tool again using an interval like 50m. Or we can make some crafty selection queries to get the data we want. What we want:
Zero contour (shoreline) as thick black line (2 pt thickness)
100 m contours as solid gray line (0.5 pt thickness)

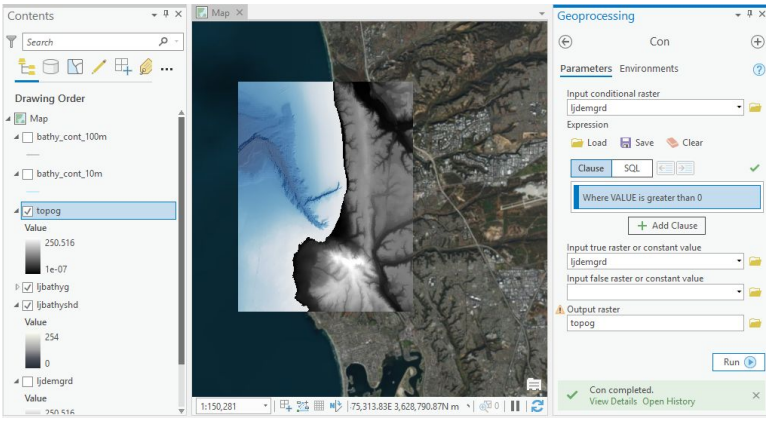
Question: My bosses ask me all the time to see the contours in feet or fathoms, how would we do this?
Answer: 2 ways:
I. Calculate a new raster where values are in feet (feet_grd = meter_grid * 3.28084)
II. The Contour Tool has an option z factor, where conversion can take place

Using Contour List tool, we can select discrete contour values we want. For instance, we can limit the contour values to this list: 0, -10, -50, -100, -200.

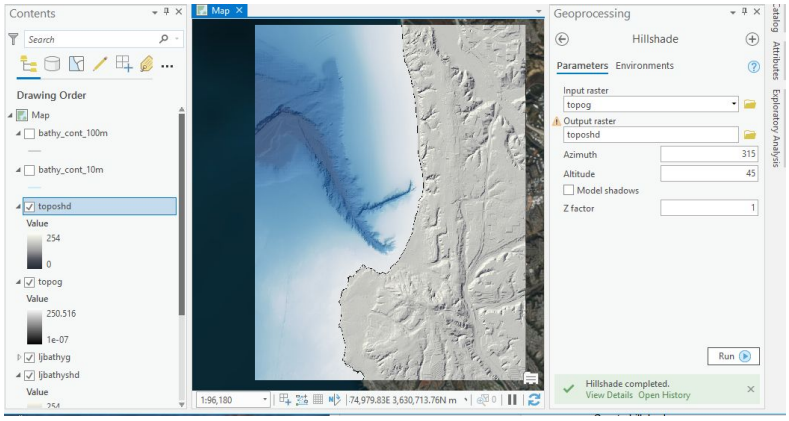


Repeat for topography

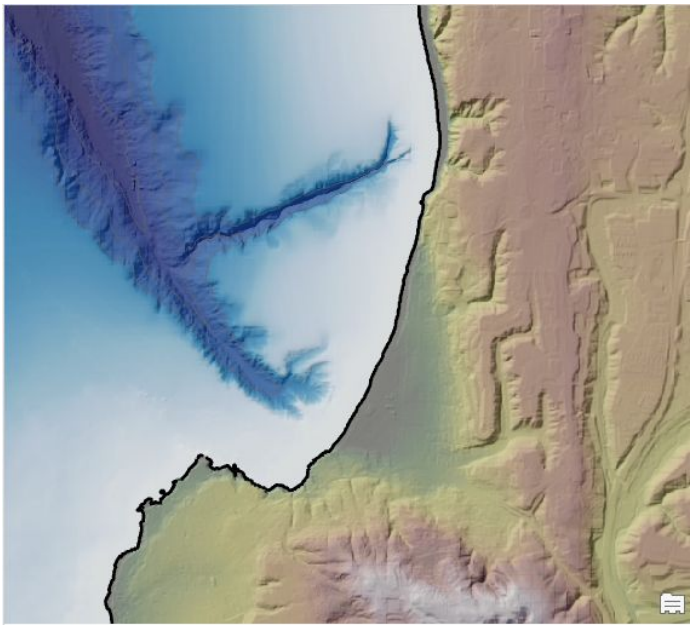
Use Con tool and extract land elevations from DEM: ljdemgrd



Create hillshade

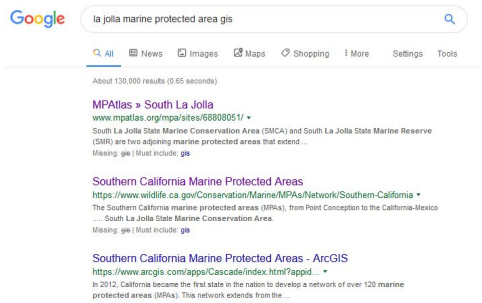


Change symbology for land topography

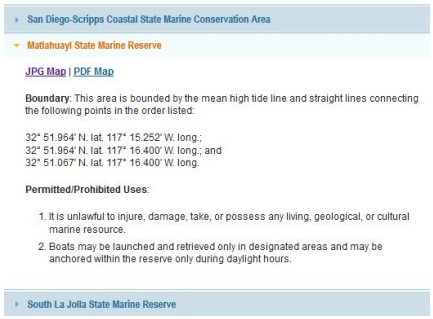


Download Marine MPA areas

A web search for La Jolla Marine Protected Areas GIS gives the following:



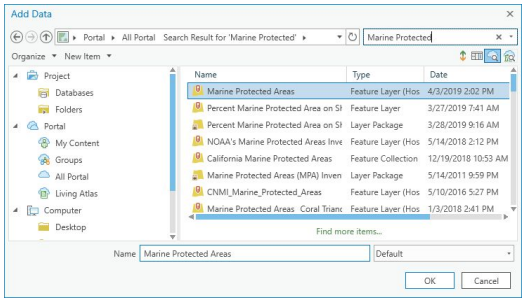
The 2nd link brings us here



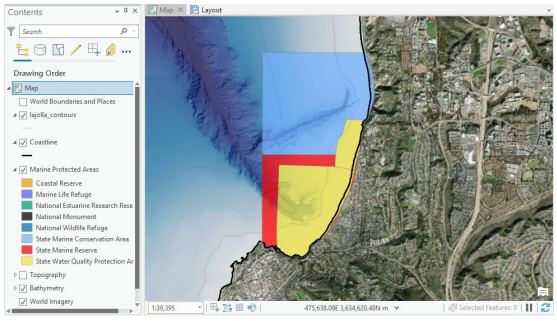
So, we could create a polygon by using the coordinates listed and the “Mean High Tide Line”. This is definitely doable - we have a digital elevation model and can find the mean high tide (MHT) value to contour by looking at the NOAA Tides and Currents website.

However, the 3rd link in internet search is an arcgis web service, so let’s try that. It brings us to a Story Map: Southern California Marine Protected Areas

So, we know it is a web service somewhere, let’s Add Data and search the portal:



Selecting the first one, gives us what we are looking for:



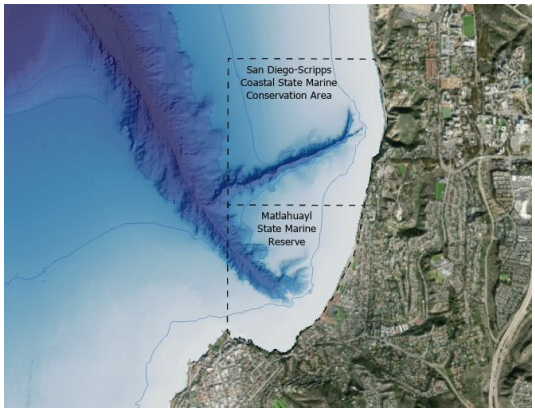
Select the 2 features we are interested, and either Right-click Marine Protected Areas:

I. Selection > Make Layer From Selected Features
II. Data > Export To New Feature (This will bring up the Copy Tool.)

Save as La Jolla MPA

Note: Making a layer relies upon the source data connection. Looks like it is from a reliable source, but you never know if service will remain active. Thus, sometimes it is better to make local copy. Advantage of (I) over (II) is the symbology is saved to new layer. (II) requires an additional step of importing symbology.

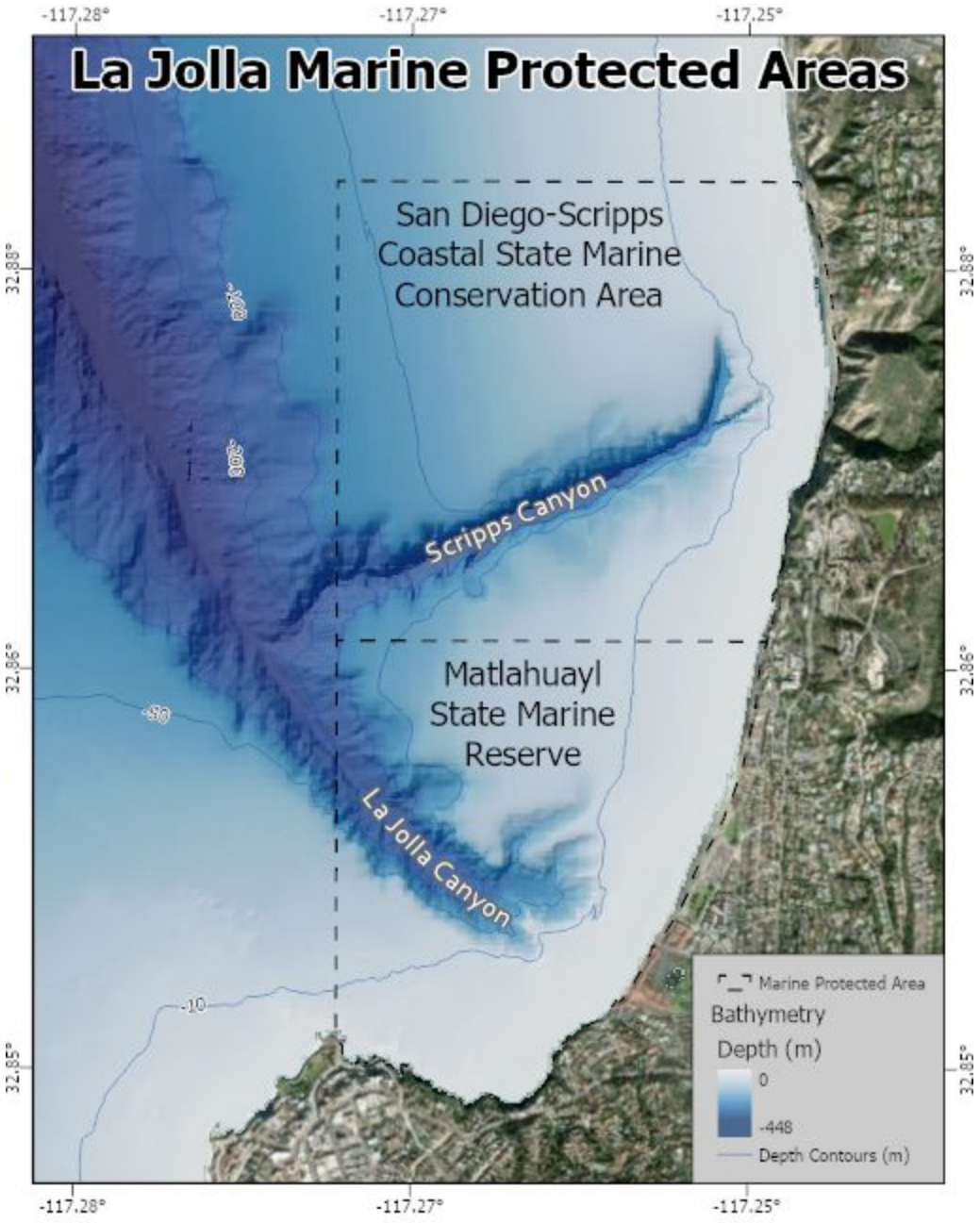
Symbolize as Single Symbol with black dashed outline (0.5 pt) and no fill.



So, this looks pretty close to what we want, time to make a Layout, put on some finishing touches, and export!

Insert Layout and Make a Map

Insert Map Frame
Insert Graticule
Insert Legend
Insert Scale
Move the Source attribution


La Jolla Marine Protected Areas
-117.28°
-117.27°
-117.25°
32.88°
32.86°
32.85°
San Diego-Scripps
Coastal State Marine
Conservation Area
Scripps Canyon
Matlahuayl
State Marine
Reserve
La Jolla Canyon
-100
-200
-90
-10
Marine Protected Area
Bathymetry
Depth (m)
0
-448
Depth Contours (m)