GIS-3: VECTOR ANALYSIS

GOALS

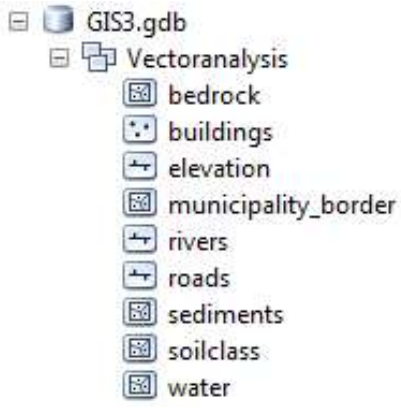
- Make a selection of data with defined properties from a larger dataset.
- Cut out parts of a dataset.
- Handle logical operations for simple queries.
- Calculate area size and area relationship
- Look at simple neighborhood relations
- Merge two datasets to generate new information, and visualize these with a map.

DATA

Create a new folder named "GIS3" in \\hypatia.uio.no\lh-mn-geofag-felles\kurs\GEO3460 *\"your username".* The data we are going to use for this assignment are saved in a geodatabase called GIS3.gdb in the folder \\hypatia.uio.no\lh-mn-geofag-felles\kurs\GEO3460\Data/GIS3. Copy **GIS3.gdb** to your working folder.

The geodatabase (gdb) is a collection of geographic datasets of various types, but in this case we only have vector datasets. To work with datasets saved in a geodatabase are similar to work with shapefiles. However, geodatabases have some advantages. Read more here: http://resources.arcgis.com/en/help/main/10.2/index.html#/Essential_readings_about_the_geodatabase/003n00000003000000/

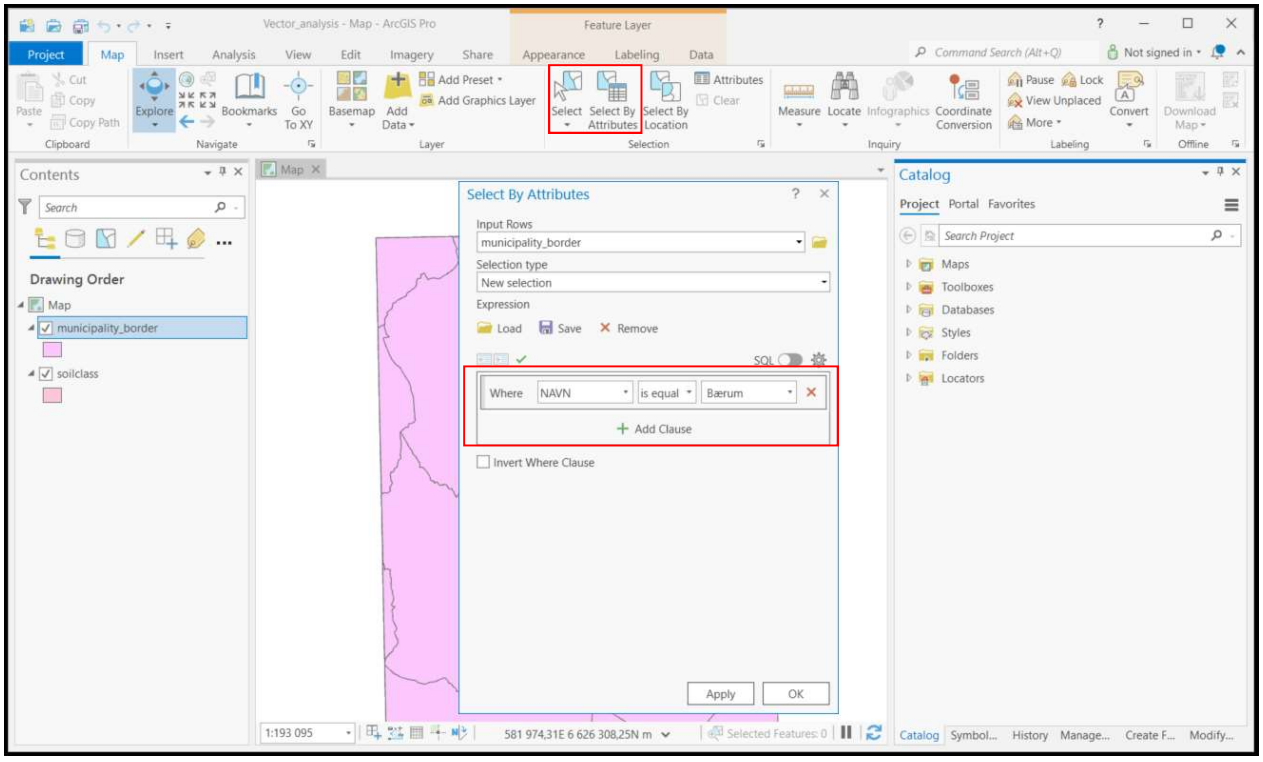
The data we are going to use is: Soil classes, bedrock, sediments, administrative boarders, elevation, roads etc. (see illustration of the geodatabase)



1: CUT INFORMATION FROM DATA SETS AND MAKE A THEMATIC MAP

Cut out the information for Bærum municipality from the soilclass map, the sediment map and the bedrock map.

1) Add the datasets **”municipality_border”** and **“soilclass”**(polygons). Open Add Data , find “GIS.gdb” in your folder, double-click on “GIS.gdb”, then double-click on “Vectoranalysis” and add the datasets.
2) Make sure the “municipality_boarder”-dataset is active and above the “soilclass”-dataset in the table of contents. Create a layer containing only **one** municipality by selecting Bærum either by selecting it interactive with the "select feature" tool , or by selecting from the attribute table of the ”municipality_boarder” layer by using “Select by attributes” . Use the latter if you don’t know the location of Bærum.



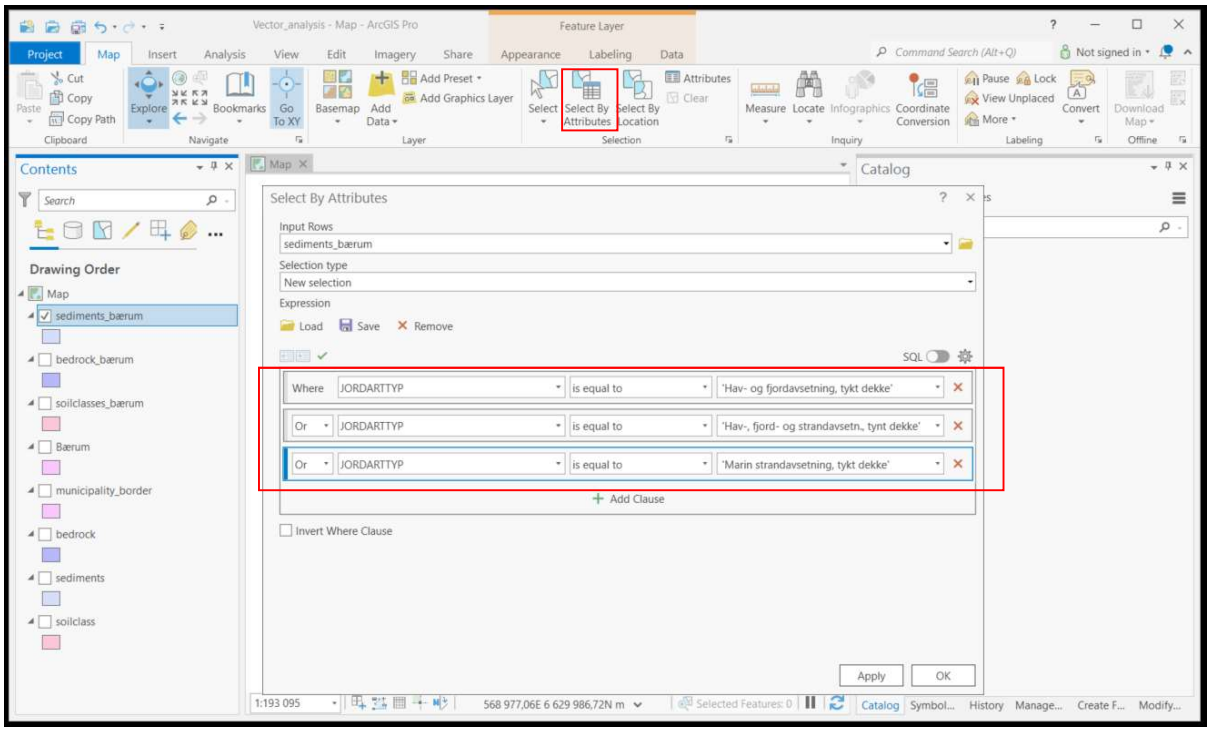
3) Right-click on ”municipality_boarder” layer in the table of contents and select “Selection” → “Make layer from selected features”. You will then get a new layer containing only Bærum municipality. Rename this layer to "Bærum".

   Remove the selection: Press Clear , or right-click on

"municipality_boarder" again, select Selection → Clear Selection.

4) From Toolboxes (View → Geoprocessing → Toolboxes) you select Analysis Tools → Extract → Clip. You can also just search "Clip" in the Geoprocessing tab and choose Clip from Analysis Toolbox.
5) The dataset to be cut (Soil classes) will be in the first field, and the cutting layer (Bærum) in the second. Save the results in the project folder and call it "soilclasses_bærum" (the third parameter).
6) Do the same procedure for "**sediment** and **bedrock"**, which means to import these datasets from the geodatabase to ArcGIS Pro and clip these layers on Bærum municipality.
7) Find the highest marine limit in Bærum based on the sediment data set. Explain how you found the answer.

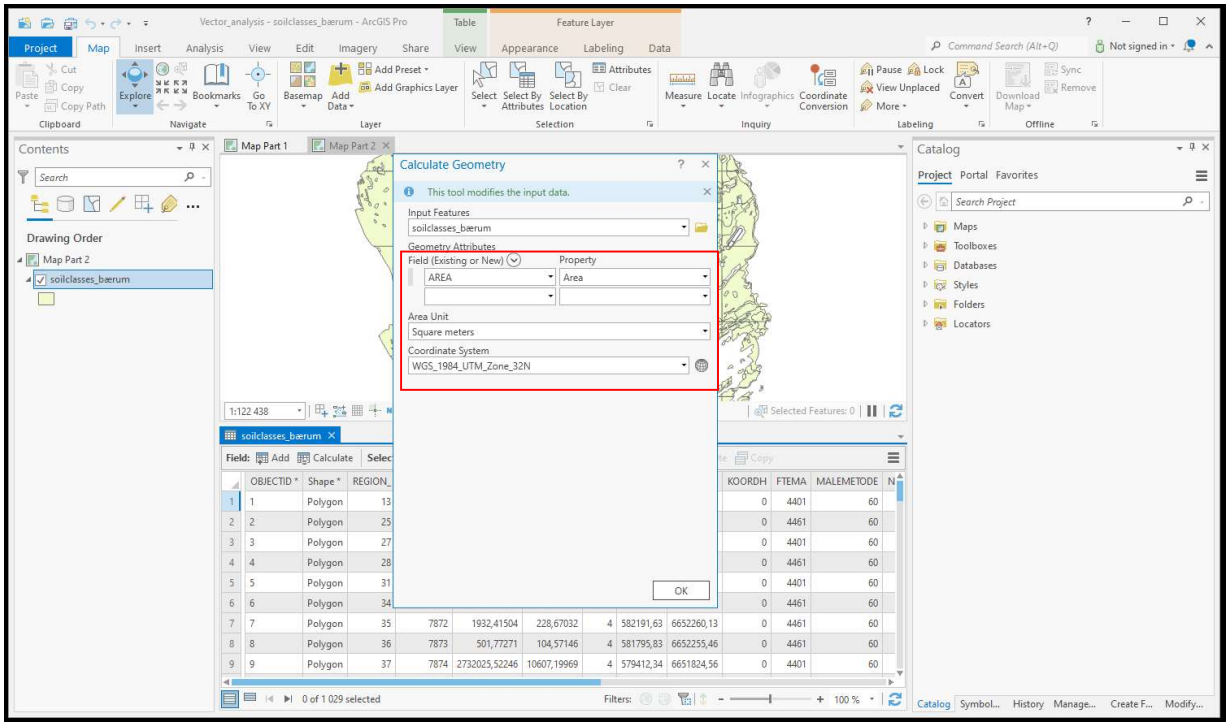
Hint: Find out which types of sediment layers that was previously marine under JORDARTTYP in the attribute table. Use "Select By Attributes" to pick out these sediment layers, and compare these with elevation contour lines (there is also "elevation" data in GIS3.gdb; HOEYDE in the attribute table means elevation).



2: FIND THE DISTRIBUTION OF LAND COVER TYPES IN BÆRUM MUNICIPALITY

We will now create statistics showing the area distribution of land cover types in Bærum municipality using the “soil classes” dataset.

1) Open the attribute table of the newly cut soil classes (right-click the layer and select "Attribute Table"; you can also use shortcut Crtl+T). Notice that there is a field called “Area” giving the area of each polygon. The values in the area field are not necessarily correct anymore because some of the polygons have been cut in two. To update the area, mark the column you want to edit (area), right-click and select ”Calculate geometry”. Make sure “Area” is defined under “Property” and “Square meters” under “Area Unit”. Press OK.



2) Are there other fields that change with the cutting, and needs to be updated?
3) Finding the area distribution is a way of aggregation, where all the areas that have similar codes are added together, like "forest", "swamp" etc. There is a tool for this in the Toolboxes under Analysis Tools → Statistics → Summary Statistics
4) In the menu that appears, select the Input table (the newly cut layer),

Output table (a new name that you create in your home area), Statistics field (Field: “AREA”, Statistic Type: “Sum” and Case field; “OBJTYPE”)

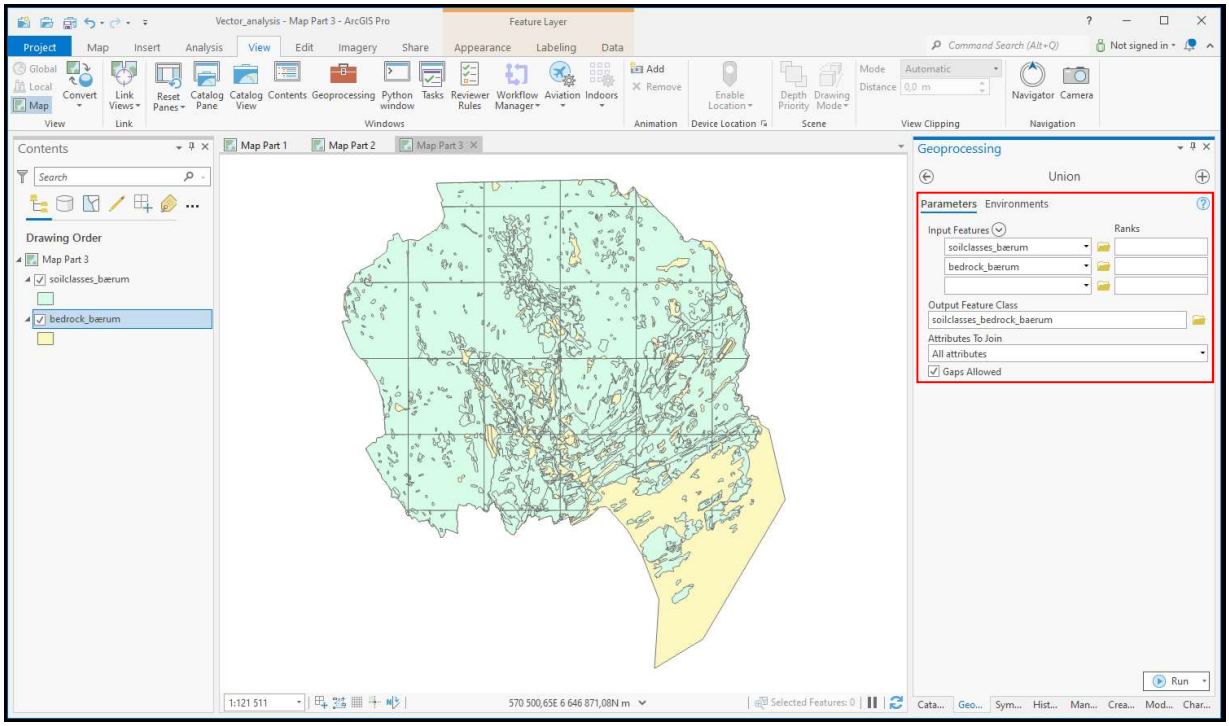
5) The result is a new table where the area (which is now updated) is summed over the categories in OBJTYPE. The table is added to the list in the left bar. To export the table, go to Toolboxes → Conversion Tools → Table To Excel.
6) The resulting table (.xlsx format) can be opened in Excel if you want to have a look at the data and make illustrations.

Norwegian	English
BymessigBebyggelse	City area
DyrketMark	Agricultural land
Gravplass	Graveyard
IndustriOmråde	Industrial area
Myr	Bogland
Skog	Forest land
SportIdrettPlass	Pitch/Sports field
Steinbrudd	Quarry
TettBebyggelse	Urban area

3: HOW IS THE DISTRIBUTION OF CULTIVATED FIELDS IN BÆRUM MUNICIPALITY?

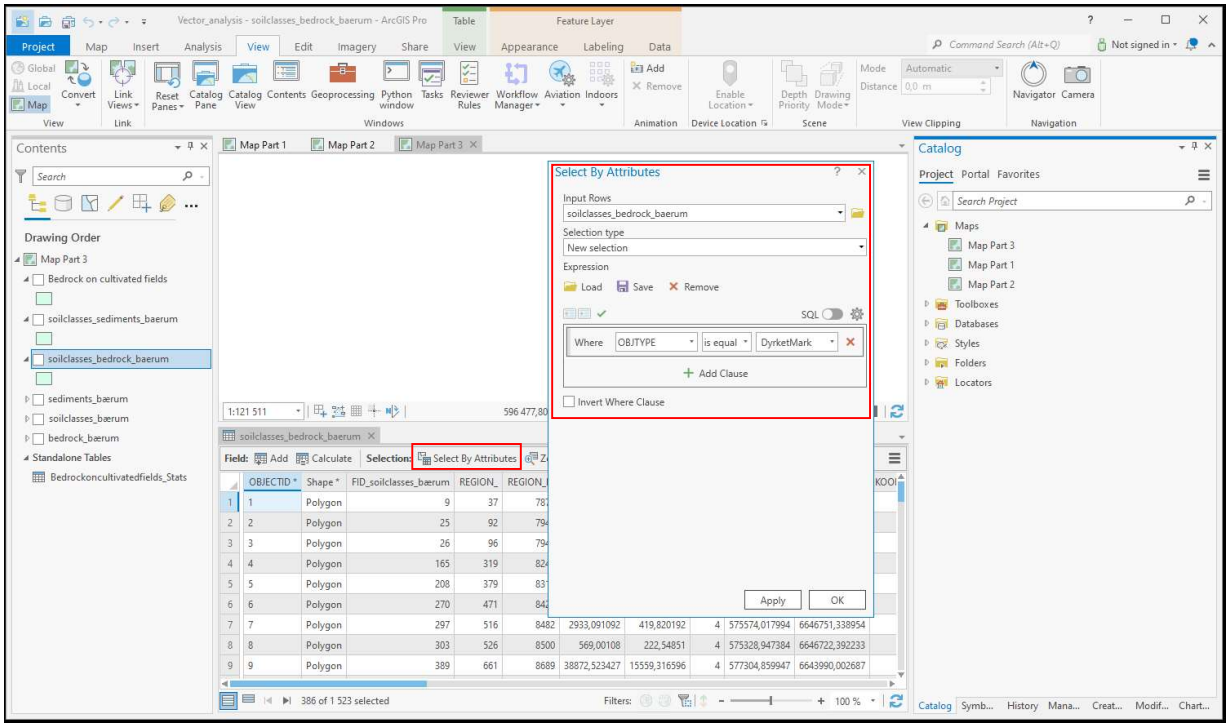
Study the location of cultivated fields in Bærum. Is it random, or is it maybe related to bedrock geology? Certain rocks provide better soil, and therefore it is conceivable that the cultivated fields follow bedrock boundaries. Or maybe the sediment cover (i.e. the sediments that are on top of the bedrock) is more important? The sediments are often from the last ice age or from the last deglaciation period. To examine this you have to connect the areas of cultivated fields to sediment and bedrock.

1. Open the tool “Union” from the Toolboxes (under Analysis Tools → Overlay). Here, both the geometry and features from the two data sets can be connected. Firstly, connect the soil classes and bedrock (already cut for Bærum). The process may take a while. Then do this for soil class and the sediment data set for Bærum.



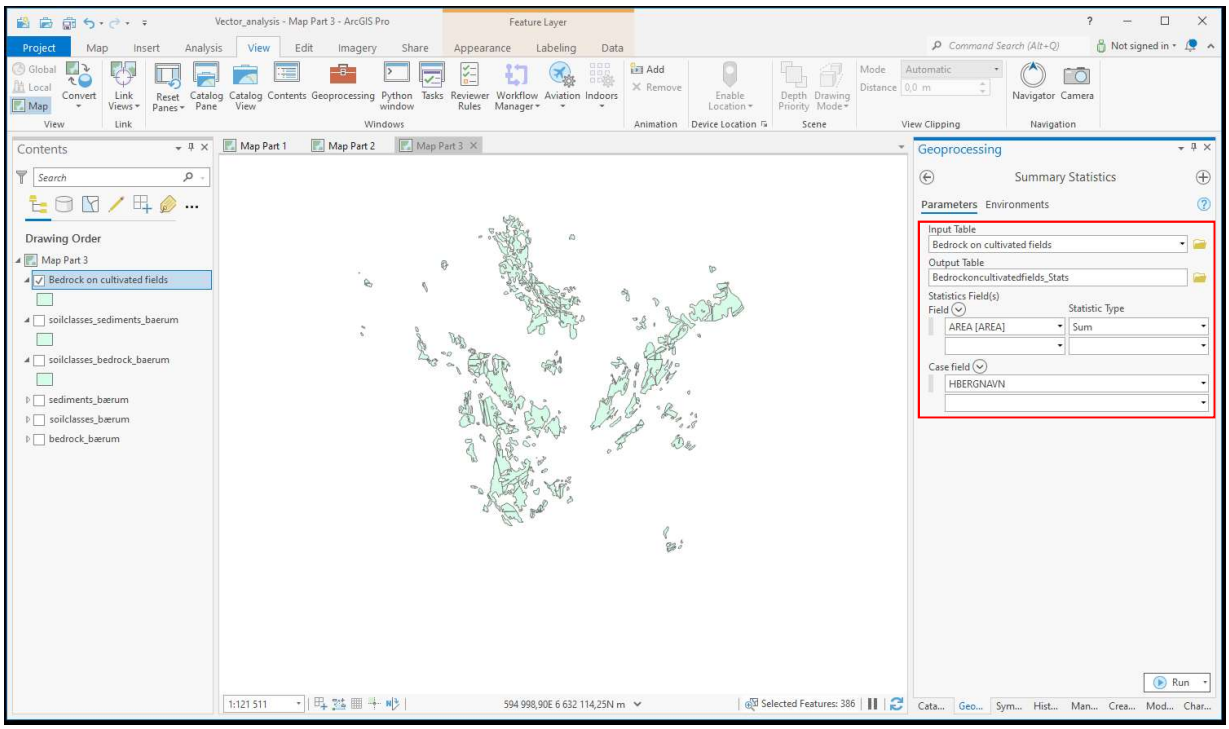
2. The new data sets have more polygons than the original. In the attribute table you will see that each polygon has inherited all the fields from both of the two original data sets.

3. **Note: In the new dataset's attribute table there is now a field called Area and another field called Area_1. These might not be correct because these are only joined from the original data sets.** To get the correct area you must recalculate the geometry on both Union datasets using same procedure as in ex. 2: Mark the column Area/Area_1 in the attribute table, right-click and select "Calculate Geometry". Area and Area_1 should have the same values.
4. Select all polygons, which are cultivated fields ("Dyrket mark" in Norwegian) and check that they are selected in the map (use e.g. the "Select by attributes" in the top row of the attribute table).



5. Create a new layer of this (Bedrock on cultivated fields), right-click on the union layer and choose Selection → Make layer from selected features.

6. If you now summarize all the areas in this layer with respect to bedrock types (HBERGNAVN), you get an overview of the bedrock that is related to the cultivated areas in Bærum municipality. You can export the table to Excel using Toolboxes → Conversion Tools → Table To Excel. Do you see any correlation here? Illustrate and explain which bedrock dominates cultivated areas.



Norwegian	**English**
Breksje	Breccia
Kalkstein, skifer, mergelstein	Limestone, slate, marlstone
Metabasalt	Metabasalt
Rombeporfyr	Rhomb porphyry
Sandstein	Sandstone
Skifer, sandstein, kalkstein	Slate, sandstone, limestone
Syenitt, kvartssyenit	Syenite, Quartz-syenite
Vulkanske bergarter (uspesifisert)	Volcanics (unspecified)

7. Now you will perform the same analysis using the Union between surface sediments and soil classes. Find out the relationship between the two data sets (use the field “JORDARTTYP”). Explain which sediments dominate cultivated areas. You can export the table to Excel using Toolboxes → Conversion Tools → Table To Excel.

Norwegian	**English**
Bart fjell	Bedrock
Breelvavsetning	Glacio-fluvial deposits
Elve- og bekkeavsetning, uspesifisert	Fluvial deposits
Forvitringsmateriale, uspesifisert	Regolith, unspecified
Fyllmasse (antropogent matr.), uspesifisert	Anthropogenic material deposits
Hav- og fjordavsetning, tykt dekke	Marine and fjord sediments, thick
Hav-, fjord- og strandavsetn., tynt dekke	Marine, fjord and strand sediments, thin
Humusdekke/tynt torvdekke over berggrunn	Thin organic cover over bedrock
Marin strandavsetning, tykt dekke	Marine strand sediments
Morenemateriale, tykt dekke	Till, thick
Morenemateriale, tynt dekke	Till, thin
Skredmateriale, tykt dekke	Colluvium, thick
Skredmateriale, tynt dekke	Colluvium, thin
Randmorene	Terminal moraine deposits
Torv og myr (organisk materiale)	Organic accumulations (bogs and mires)

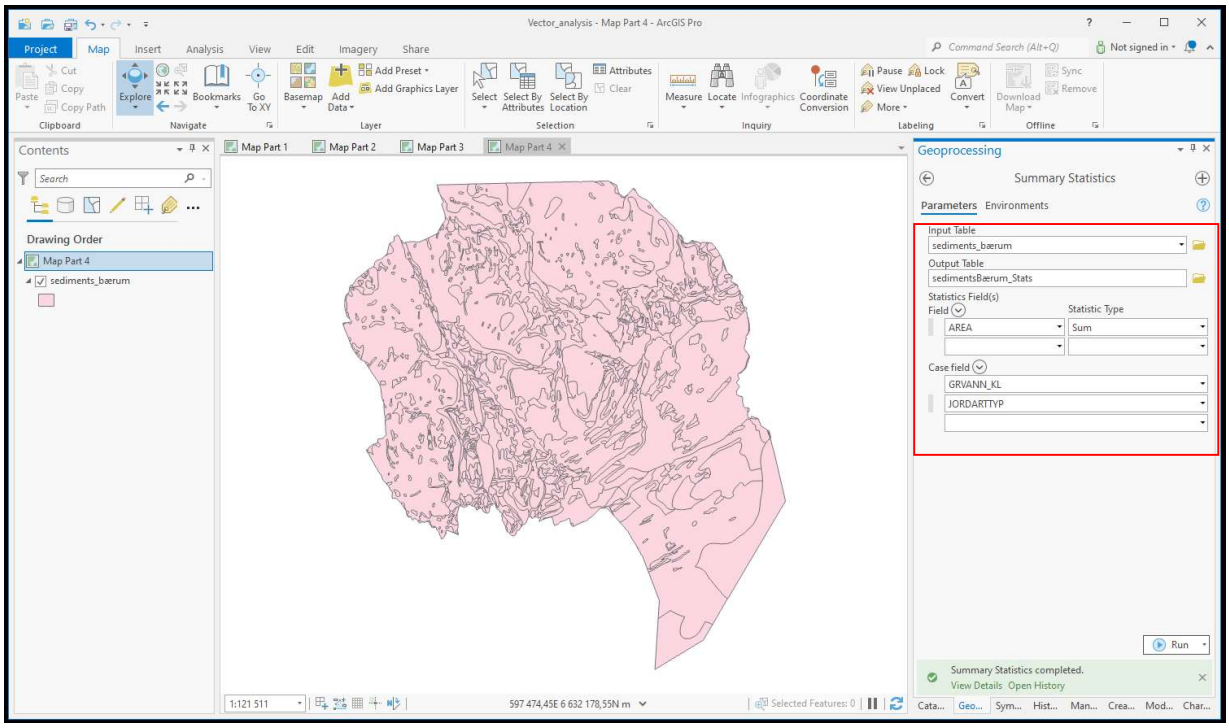
4: SEDIMENTS AND GROUNDWATER RESOURCES

Groundwater is an important resource for drinking water. In Norway, surface water is mostly used, but groundwater is considered as an important back up. How well suited different sediments types are as groundwater resource is widely studied. This is given in the fields “Grvann-ko” and “Grcann-kl” as follows:

Grvann-ko	Grvann-kl	English translation
0	Not classified	Not classified
2	Mulig betydelig grunnvannsressurs	Significant groundwater resource
3	Begrenset grunnvannsressurs	Limited ground water resource
4	Løsmassene dårlig egnet	Sediments are not suitable

Simplified, we can say that if the sediments are too fine (lots of clay) they are poorly suited as groundwater aquifer; the best is sand and gravel. It is often a conflict between land use and groundwater exploitation. It is important to prevent the ground water from being polluted, and there should therefore be restrictions on the use of areas that are exploited for groundwater. Examples can be conflicts between agriculture and groundwater, or between buildings and the groundwater deposits (e.g. Gardermoen).

- How are the different sediment types suitable as groundwater resource? Hint: Select each of the groundwater classes (Grvann-kl) and use summary statistics to sum up the area for the sediment types.



- Pretend you work in a consulting firm with area planning, and you will protect the areas of "significant groundwater resource" (in Norwegian: “mulig betydelig grunnvannsressurs”) or at least protect them against greater intervention. In what soil classes do we find "significant groundwater resource"? Are there potential conflicts between groundwater and cultivated areas (or buildings)? Hint: Earlier we made a layer with “sediments on cultivated fields” including both the soil classes and the sediment types. This layer can be used to select the “significant groundwater resource”.

HAND-IN

This should be included in the hand-in:

1. Source a similar dataset for another coastal location
2. Make a flowchart that describes the process of finding the distribution of cultivated fields in your chosen location (Part 3). If you do not know how to create a flowchart, you can find descriptions and examples on the Internet. Flowchart should be software-independent, so avoid any software-specific words, and should be relatively simple, using only a few words in each shape. It is a good idea to have e.g. three shape types or shapes with different colours for: (1) input data (e.g. "Sediments in Bærum"), (2) processes (e.g. "Union"), and (3) output.
3. Create a map that clearly illustrates the conflicting parts between areas with significant groundwater resource and cultivated land/buildings/rivers etc. (Part 4). The map should include a north arrow, scale, legend, title and a coordinate grid. Note: When you create your map in this assignment, you can also use the GIS-services like WMS's introduced in exercise GIS-2.
4. ½ - 1 page of text where you answer the questions below:
   a) On which elevation is the marine limit and describe with words how did you found the answer? (NOTE: Not necessary to explain with ArcGIS Pro commands)
   b) Which land cover type (in the soil classes) is dominating in your chosen location, and how large area is it covering (in km^2)?
   c) Explain which sediments that dominate cultivated areas. Shortly describe why these sediments are preferable for cultivation.
   d) From your analysis, which specific sediment types are preferable as ground water resources? As already mentioned, we pretend you are working for a consulting company that is interested to protect the "significant potential groundwater" resources. Together with the map, describe the risk of potential conflicts between groundwater and cultivated areas/infrastructure.

Submit your assignment on Canvas as GEO3460_GIS3_<your name>.pdf