

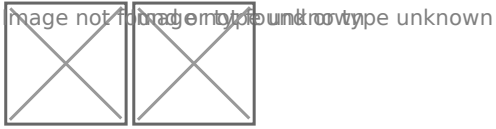
# Stepwise Process Flow

## Details

Step-by-step instructions in paragraph form for identifying natural drainage network and catchment areas from DEM using QGIS Hydrology tools:

- **Step 1:** Load the DEM for the Study Area
  - o Open QGIS and add the DEM layer to your project by navigating to 'Layer' > 'Add Layer' > 'Add Raster Layer'. Browse and select your DEM file.
- **Step 2:** Clip the DEM
  - o To clip the DEM to a region larger than the study area, go to 'Raster' > 'Extraction' > 'Clip Raster by Extent'.
  - o Select your input DEM layer and define the extent to cover an area larger than your study region.
    - o Set the output file and click 'Run'.
- **Step 3:** Fill and Interpolate Gaps in the DEM and generate Flow Direction Raster
  - o Install the 'SAGA' processing provider if you haven't already. Go to 'Processing' > 'Toolbox'.
  - o In the processing toolbox, search for 'Fill Sinks (Wang & Liu)' and run the tool.
  - o Select the clipped DEM as the input, set the 'Output corrected DEM' file, and run the tool.
    - o This will generate both Filled DEM and Flow direction raster files
- **Step 5:** Generate the Stream Network
  - o In the processing toolbox, search for 'Flow Accumulation' and run the tool.
  - o Choose the flow direction grid (generated in the previous step) as the input and set the 'Flow accumulation grid' as the output.
- **Step 6:** Use the Raster Calculator Tool
  - o In the processing toolbox, search for 'Raster Calculator' and run the tool.
  - o Enter the expression to select pixels greater than a certain threshold (e.g., 5% of the maximum flow accumulation value). o Example: "flow\_accumulation@1 > 0.05 \* max\_flow\_accumulation\_value" (Replace 'max\_flow\_accumulation\_value' with the actual maximum value).
  - o Set the output raster file and run the tool.
- **Step 7:** Define the Stream Order
  - o In the processing toolbox, search for 'Strahler Stream Order' and run the tool.
  - o Choose the flow direction grid and the stream network raster (generated in the previous step) as inputs.
  - o Set the output file and run the tool.
- **Step 8:** Convert to Polygon
  - o In the processing toolbox, search for 'Raster to Polygon' and run the tool.
  - o Select the stream order raster (generated in the previous step) as the input and set the output file.
- **Step 9:** Generate the Drainage Network
  - o The stream polygons obtained from the previous step represent the drainage network classified according to stream order.
- **Step 10:** Create a New Shapefile
  - o To delineate catchment areas and outfall locations, you can use a combination of 'Raster Calculator' and 'Raster to Polygon' tools to extract catchment boundaries from the flow accumulation raster. Then, manually digitize outfall points as new vector points in a new shapefile.

With these steps, you will be able to identify the natural drainage network and catchment areas from the DEM data using QGIS.



**Figure 9 Illustrations of watershed regions at Dhanbad (India)**

*Source – CWIS spatial analysis, Innpact Solutions and GWSC*

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Revision #2

Created 21 May 2024 09:06:48

Updated 28 January 2025 06:17:37