

A topographic map showing contour lines and a blue river. The map is rendered in shades of blue and green, with the river flowing through the center. The contour lines indicate elevation changes across the terrain.

Visualizing Groundwater Data in QGIS

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- **OsGeo Charter Member**
- Member of the Danish QGIS User Group



QGIS for Hydrological Applications

Recipes for Catchment Hydrology and Water Management

Hans van der Kwast
Kurt Menke

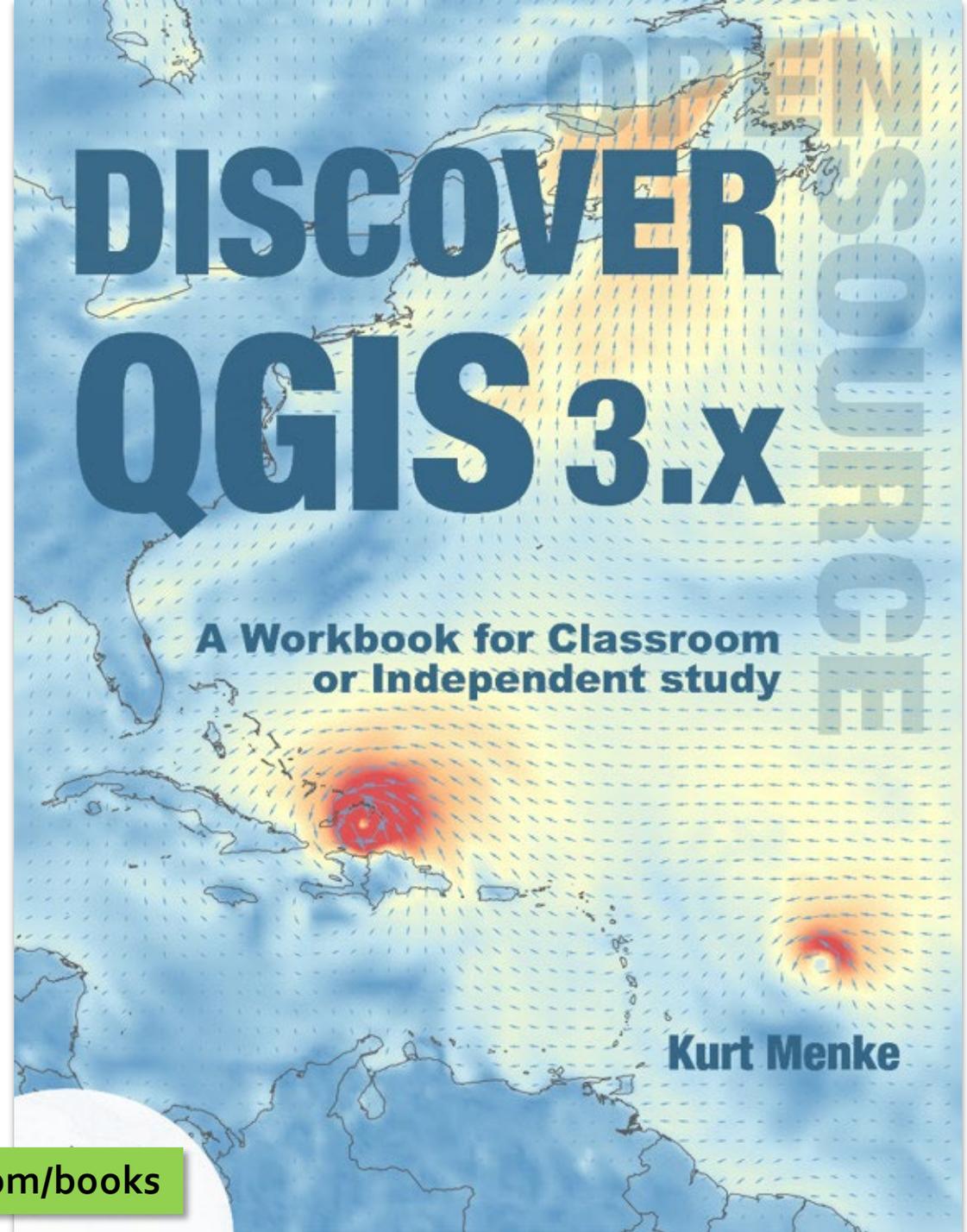


<https://locatepress.com/books>

DISCOVER QGIS 3.x

A Workbook for Classroom or Independent study

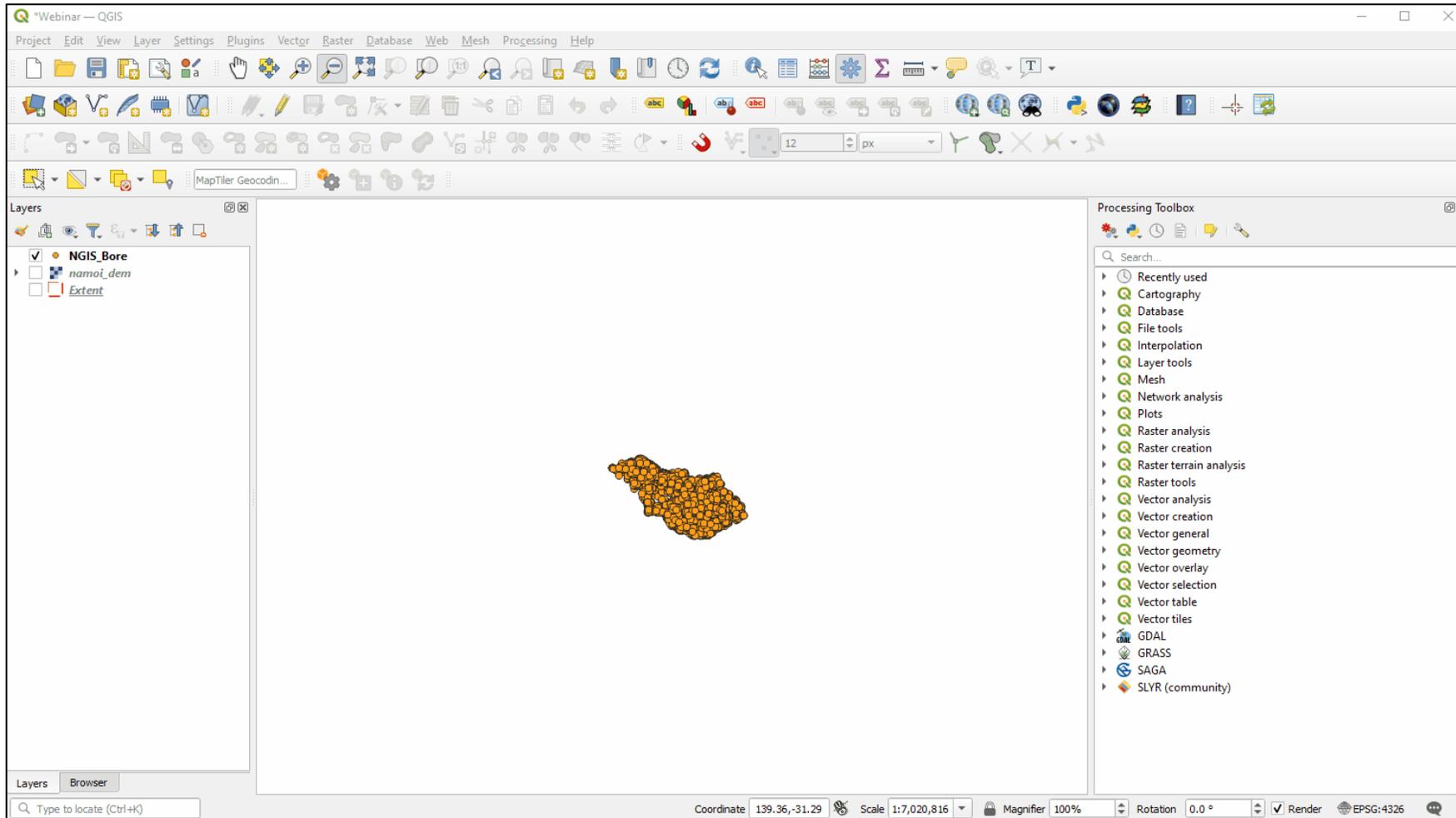
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QuickMapServices Plugin

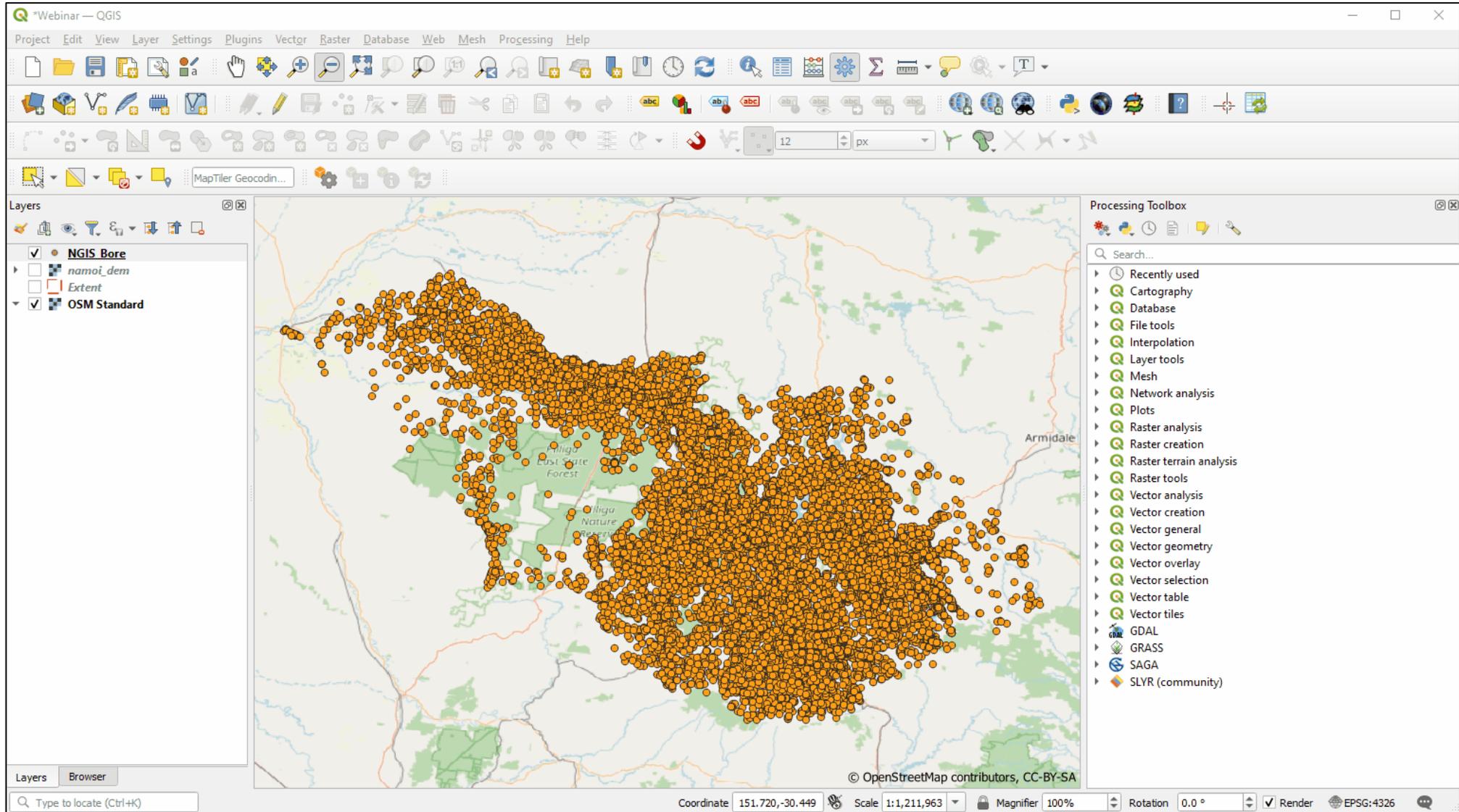
Over 150 basemaps

Ensure data is falling
in the correct place



QGIS Layer Styling Panel (F7)

Show bore holes by type



Visualizing the DEM

Put X, Y & Z values into the same units

*To generate an accurate hillshade image the DEM should be in a Cartesian coordinate system

Reproject by:

Right-click → Export → Save As...

Save Raster Layer as...

Output mode Raw data Rendered image

Format GeoTIFF Create VRT

File name C:\Users\kurtm\Documents\Geo\AWS\AWS_groundwater\namoi_dem.tif

Layer name

CRS **EPSG:3577 - GDA94 / Australian Albers**

▼ Extent (current: layer)

North -3,235,857.0851

West 1,401,567.7497 East 2,012,908.8041

South -3,648,629.1297

Current Layer Extent Calculate from Layer ▼ Map Canvas Extent

▼ Resolution (current: layer)

Horizontal 30.4939 Vertical 27.1064 Layer Resolution

Columns 20048 Rows 15228 Layer Size

Create Options

Pyramids

No data values

Add saved file to map OK Cancel Help

Coloring the DEM with a cpt-city Color Ramp

The screenshot shows the QGIS interface with a DEM map. The map is displaying a grayscale Digital Elevation Model (DEM) with a color ramp applied to the elevation values. The color ramp is categorized, and the legend shows the resulting color-coded values. The QGIS interface includes a menu bar, toolbar, and various panels like Layers, Layer Styling, and Processing Toolbox.

Layers Panel:

- NGIS_Bore
 - DRNG
 - EXPR
 - EXPR, MINE
 - EXPR, MNAS
 - HUSE
 - INDS
 - IRAG
 - MINE, MNAS
 - MON
 - RECN
 - STOK
 - UNK
 - WSUP
 - WSUP, INDS
- namoi_dem
- Extent
- OSM Standard

Layer Styling Panel:

NGIS_Bore

Categorized

Value: abc FType

Symbol: [Symbol]

Color ramp: Random colors

Symbol	Value	Legend
[Symbol]	DRNG	DRNG
[Symbol]	EXPR	EXPR
[Symbol]	EXPR, MINE	EXPR, MINE
[Symbol]	EXPR, MNAS	EXPR, MNAS
[Symbol]	HUSE	HUSE
[Symbol]	INDS	INDS
[Symbol]	IRAG	IRAG
[Symbol]	MINE, MNAS	MINE, MNAS
[Symbol]	MON	MON
[Symbol]	RECN	RECN
[Symbol]	STOK	STOK
[Symbol]	UNK	UNK
[Symbol]	WSUP	WSUP
[Symbol]	WSUP, INDS	WSUP, INDS
[Symbol]		all other values

Buttons: Classify, Delete All, Advanced

Layer Rendering:

Live update, Apply

Coordinate: 150.015,-32.127 | Scale: 1:1,211,963 | Magnifier: 100% | Rotation: 0.0° | Render | EPSG:4326

Creating a Color Hillshade with a Blending Mode

The screenshot displays the QGIS software interface. The main map area shows a color hillshade of a terrain, with colors ranging from green (low elevation) to yellow and orange (higher elevation). The interface includes a menu bar, a toolbar, a Layers panel on the left, and a Layer Styling panel on the right. The Resampling dialog box is open, showing settings for zoomed-in and zoomed-out views, both set to Bilinear, and an oversampling factor of 2.00. The Layer Styling panel shows the 'namoi_dem' layer with a singleband pseudocolor style, a linear interpolation, and a color ramp. A table in the Layer Styling panel shows the value-to-color mapping for the hillshade.

Value	Color	Label
17	Green	17
50	Green	50
83	Green	83
116	Green	116
149	Green	149

Rendering Elevation Contours

NOTE: There are also Contour algorithms in the Processing Toolbox

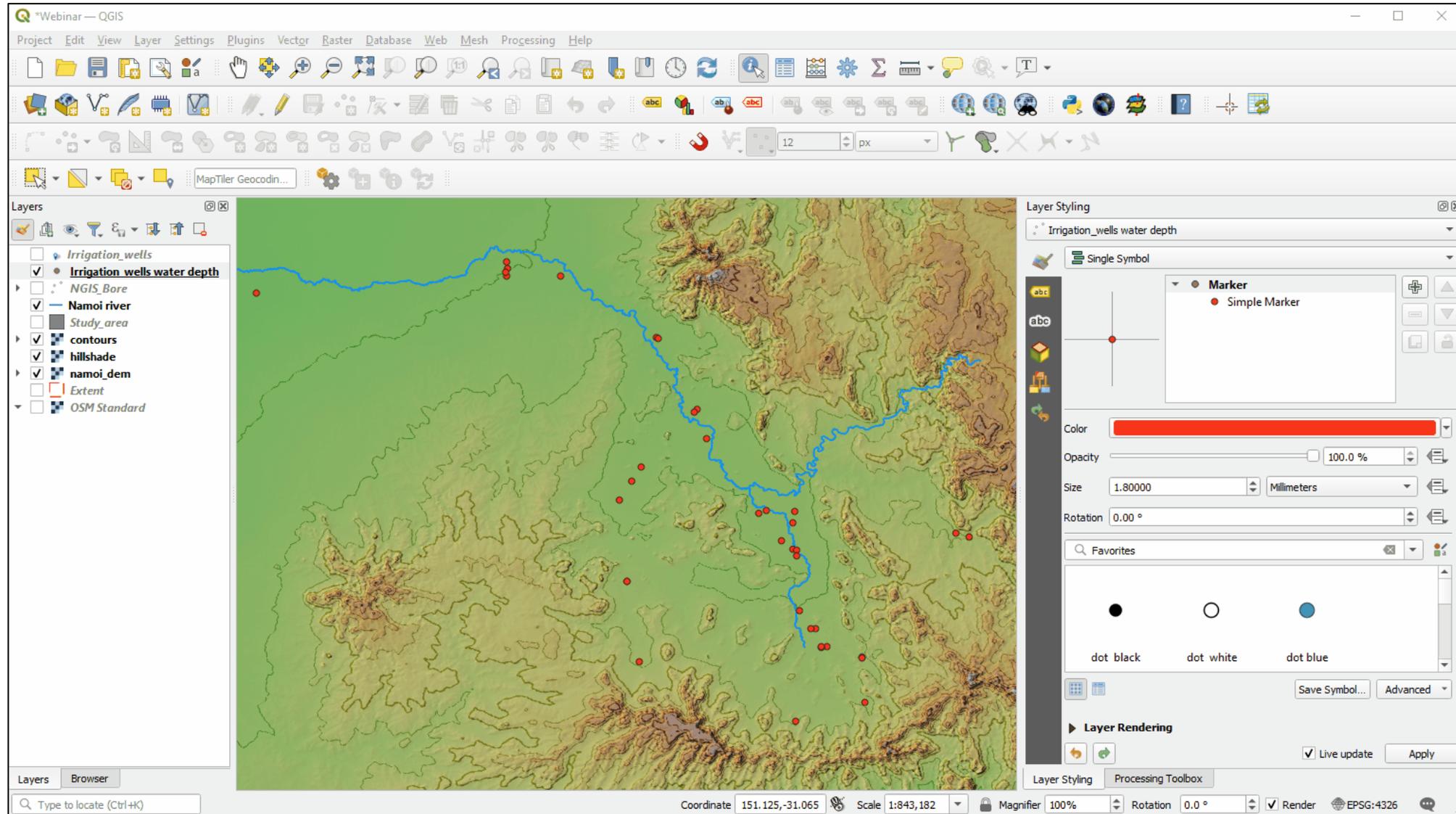
The screenshot displays the QGIS software interface. The main map area shows a terrain visualization with a hillshade effect, where higher elevations are rendered in brown and orange, and lower elevations are in green. The interface includes a menu bar at the top with options like Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, Processing, and Help. Below the menu bar is a toolbar with various icons for map navigation and processing. On the left side, there is a 'Layers' panel showing a list of layers: NGIS_Bore (expanded), DRNG, EXPR, EXPR, MINE, EXPR, MNAS, HUSE, INDS, IRAG, MINE, MNAS, MON, RECN, STOK, UNK, WSUP, WSUP, INDS, hillshade (selected), namoi_dem, Extent, and OSM Standard. On the right side, there is a 'Layer Styling' panel for the 'hillshade' layer. It shows settings for 'Z Factor' (315.00°), 'Multidirectional' (unchecked), 'Layer Rendering' (Blending mode: Multiply, Brightness: 0, Saturation: 0, Contrast: 0, Gamma: 1.00, Grayscale: Off, Hue: Colorize unchecked, Strength: 100%), and 'Resampling' (Zoomed in: Bilinear, Zoomed out: Bilinear, Oversampling: 2.00, Early resampling: unchecked). At the bottom of the interface, there is a status bar showing 'Coordinate: 151.761,-31.140', 'Scale: 1:1,278,876', 'Magnifier: 100%', 'Rotation: 0.0°', 'Render', and 'EPSG:4326'. The bottom left corner features the SEPTIMA logo.

Symbolizing Irrigation Wells with an SVG Icon



The screenshot displays the QGIS interface with the 'Layer Styling' dialog for the 'Irrigation_wells' layer. The dialog is set to 'Single Symbol' and 'Marker'. The 'Simple Marker' section is active, showing a blue dot symbol. The 'Color' is set to blue, 'Opacity' is 100.0%, 'Size' is 2.00000 Millimeters, and 'Rotation' is 0.00 degrees. The 'Favorites' section shows three options: 'dot black', 'dot white', and 'dot blue'. The 'Layer Rendering' section has 'Live update' checked and 'Apply' button visible. The main map area shows a topographic map with a blue river and several blue dots representing irrigation wells. The 'Layers' panel on the left lists various layers including 'Irrigation_wells', 'NGIS_Bore', 'Namoi river', 'Study_area', 'contours', 'hillshade', 'namoi_dem', 'Extent', and 'OSM Standard'. The status bar at the bottom shows the coordinate (151.703, -32.333), scale (1:1,382,066), magnification (100%), rotation (0.0 degrees), and projection (EPSG:4326).

Symbolizing Irrigation Wells by Depth to Water



Styling the Interpolated Surface

The screenshot displays the QGIS interface with the following components:

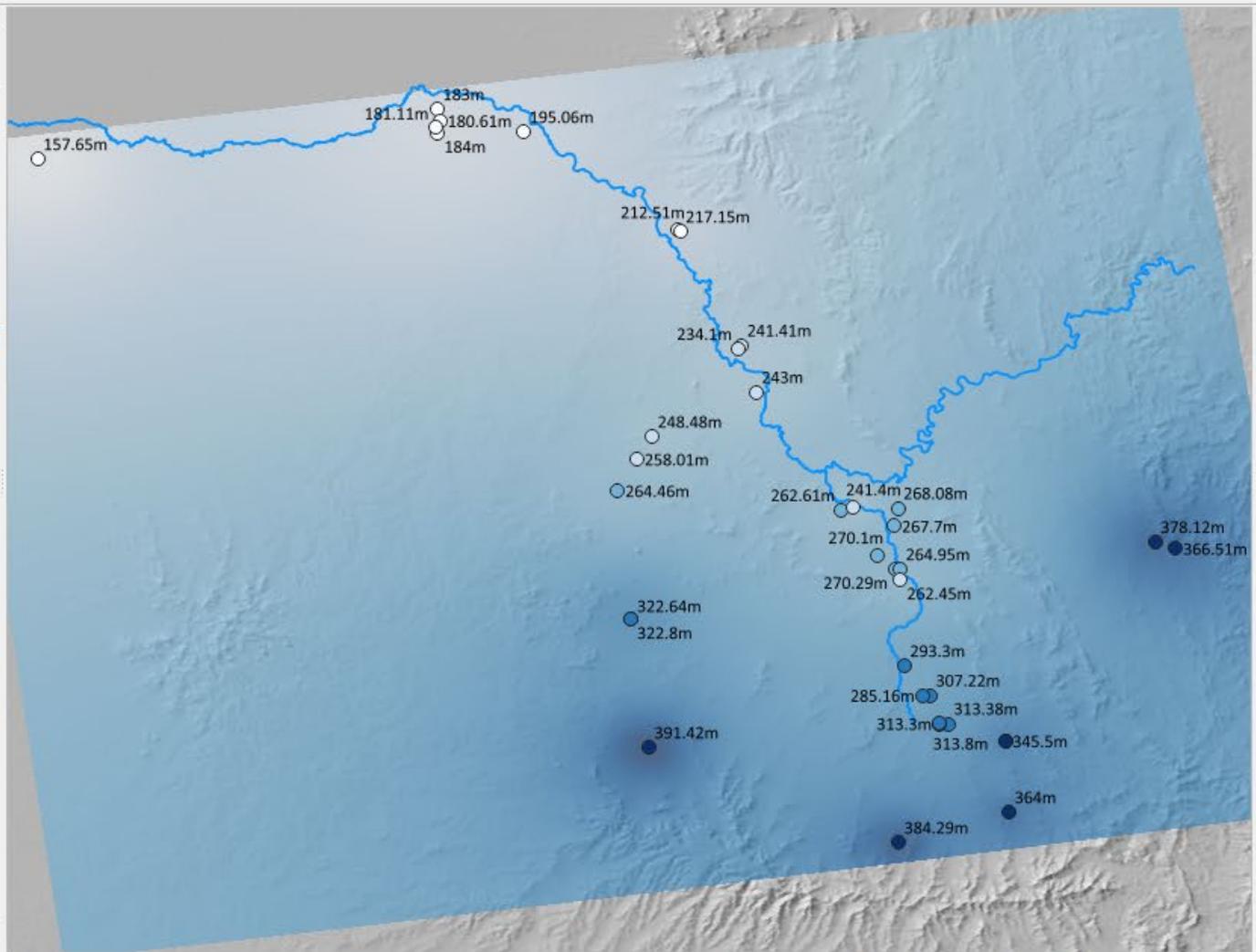
- Layers Panel:** Lists several layers including 'Irrigation_wells water depth', 'Waterlevel Fluvial IDW', 'Namoi river', 'NGIS_Bore', 'Study_area', 'contours', 'hillshade', 'namoi_dem', 'Extent', and 'OSM Standard'. The 'Waterlevel Fluvial IDW' layer is currently selected.
- Map View:** Shows a grayscale topographic map with numerous circular data points representing water levels, each labeled with a value such as 181.11m, 180.61m, 195.06m, 212.51m, 217.15m, 234.1m, 241.41m, 243m, 248.48m, 258.01m, 264.46m, 262.61m, 241.4m, 268.08m, 270.1m, 267.7m, 264.95m, 270.29m, 262.45m, 322.64m, 322.8m, 391.42m, 293.3m, 307.22m, 285.16m, 313.3m, 313.8m, 345.5m, 378.12m, 366.51m, 364m, and 384.29m.
- Layer Styling Panel:** Configured for the 'Waterlevel_Fluvial_IDW' layer. It shows a 'Singleband gray' style with 'Band 1' selected. The 'Color gradient' is set to 'Black to White' with a 'Min' value of 157.815 and a 'Max' value of 391.033. The 'Contrast enhancement' is set to 'Stretch to MinMax'. Under 'Layer Rendering', 'Blending mode' is 'Normal', 'Brightness', 'Saturation', and 'Contrast' are all set to 0, 'Gamma' is 1.00, and 'Grayscale' is 'Off'. The 'Hue' section has 'Colorize' checked and 'Strength' set to 100%. The 'Resampling' section has 'Live update' checked.
- Status Bar:** Shows the current coordinate as 151.061, -31.243, a scale of 1:843,182, a magnification of 100%, and a rotation of 0.0 degrees. It also indicates '1 legend entries removed' and 'Render' status.



Layers

- Irrigation_wells
- Irrigation_wells water depth
 - 158 - 221
 - 221 - 263
 - 263 - 279
 - 279 - 323
 - 323 - 391
- Namoi river
- WaterLevel Fluvial Thiessen**
- Waterlevel_Fluvial_IDW
 - Band 1
 - 391.03265
 - 157.81497
- NGIS_Bore
- Study_area
- contours
- hillshade
- namoi_dem
- Extent
- OSM Standard

SEPTIMA



Layer Styling

WaterLevel_Fluvial_Thiessen

Global Opacity

70.0 %

No Data Value

No data value 0

Additional no data value

Display no data as

Custom Transparency Options

Transparency band None

Transparent Pixel List

From	To	Percent Transparent
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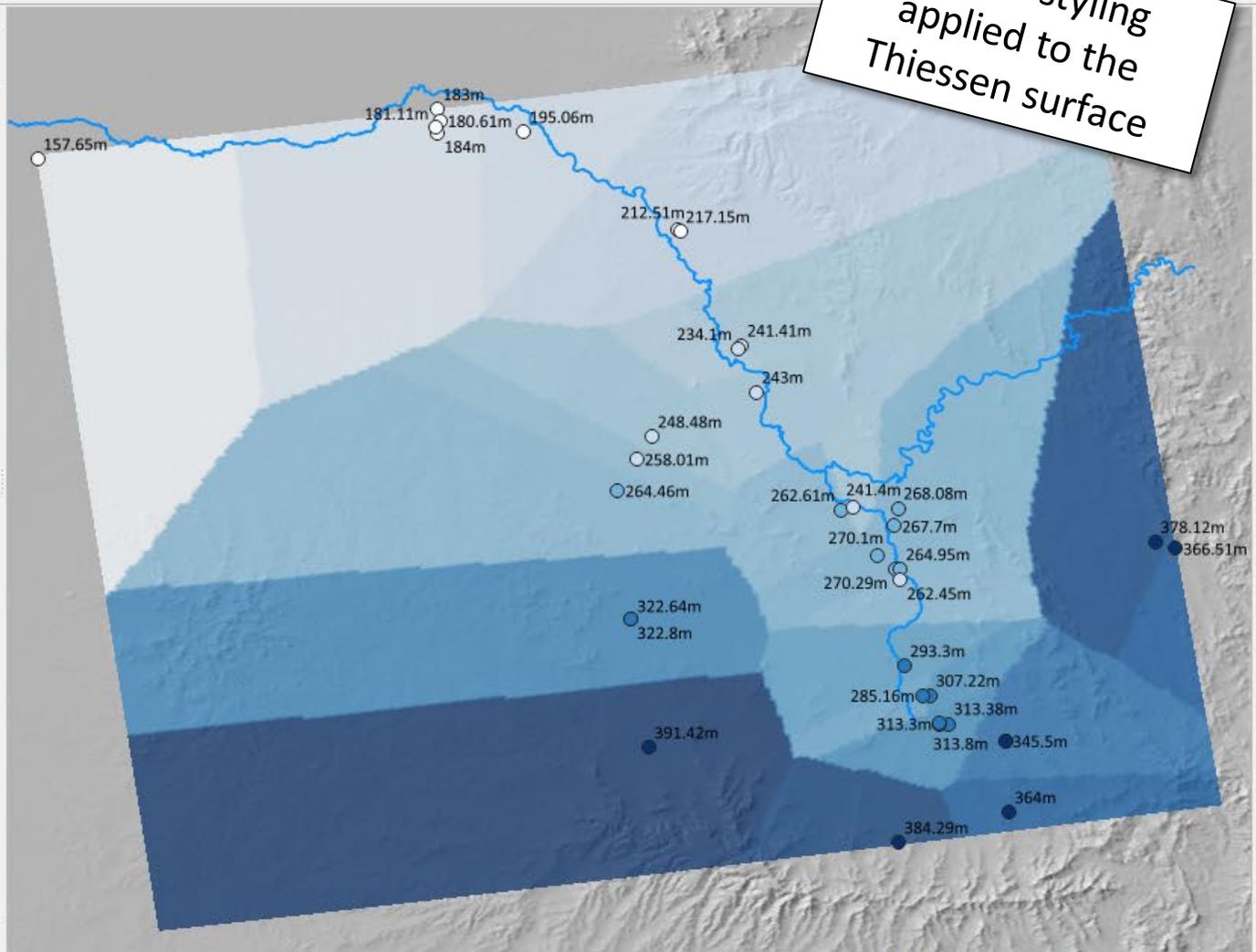
Live update Apply



MapTiler Geocodin...

Layers

- Irrigation_wells
- Irrigation_wells water depth
 - 158 - 221
 - 221 - 263
 - 263 - 279
 - 279 - 323
 - 323 - 391
- Namoi river
- WaterLevel Fluvial Thiessen
- Waterlevel_Fluvial_IDW
 - Band 1
 - 391.03265
 - 157.81497
- NGIS_Bore
- Study_area
- contours
- hillshade
- namoi_dem
- Extent
- OSM Standard



Similar styling applied to the Thiessen surface

Layer Styling

WaterLevel_Fluvial_Thiessen

Global Opacity: 70.0 %

No Data Value: No data value 0

Custom Transparency Options

From	To	Percent Transparent
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Live update Apply



Creating a Mask for the Study Area

The screenshot displays the QGIS interface with a map showing a purple study area mask overlaid on a topographic map. The mask is an irregular shape following a river and surrounding areas. The map includes elevation contours and several data points with elevation values such as 157.65m, 183m, 180.61m, 181.11m, 184m, 195.06m, 212.51m, 217.15m, 234.1m, 241.41m, 243m, 248.48m, 258.01m, 264.46m, 270.1m, 268.08m, 267.7m, 378.12m, 366.51m, 270.29m, 264.95m, 262.45m, 293.3m, 307.22m, 285.16m, 313.38m, 313.8m, 343.9m, 354m, 384.29m, 391.42m, and 322.64m.

The interface includes a menu bar (Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Mesh, Processing, Help), a toolbar with various icons, and a Layers panel on the left. The Layers panel shows the following layers:

- Study_area
- Irrigation_wells
- Irrigation_wells water depth
 - 158 - 221
 - 221 - 263
 - 263 - 279
 - 279 - 323
 - 323 - 391
- Namoi river
- WaterLevel_Fluvial_Thiessen
- Waterlevel_Fluvial_IDW
 - Band 1
 - 391.03265
 - 157.81497
- NGIS_Bore
- Study_area
- contours
- hillshade
- namoi_dem
- Extent
- OSM_Standard

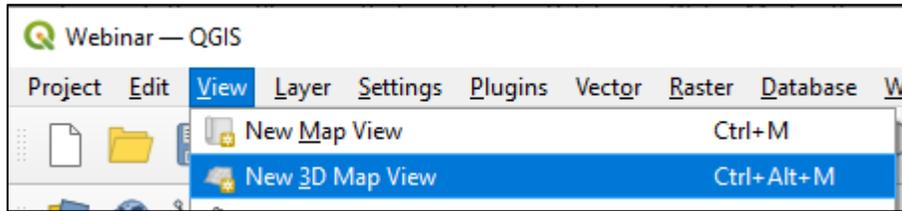
The Layer Styling panel on the right shows the 'Study_area' layer with a 'Single Symbol' type and a 'Fill' style. The fill color is purple. The Color and Opacity settings are visible, with Opacity set to 100.0%. The Unit is set to Millimeters. The Favorites panel shows three styles: BEV Pencil, Coastal Vignette, and gradient plasma. The Layer Rendering panel has 'Live update' checked and 'Apply' button.

A callout box in the top right corner contains the text: "Inverted Polygon Shapeburst Fill".

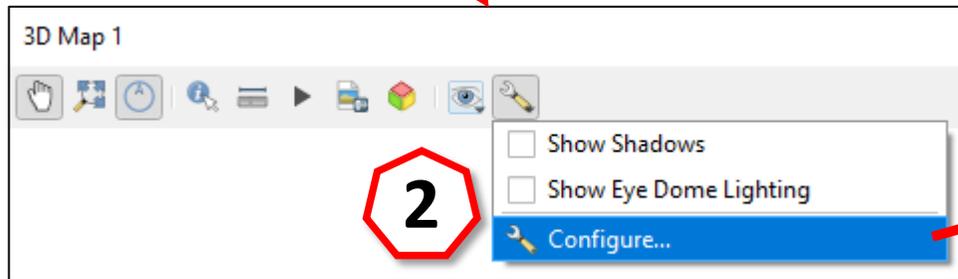
At the bottom of the QGIS window, the status bar shows: Coordinate 149,267,-30,400, Scale 1:1,168,292, Magnifier 100%, Rotation 0.0°, Render, and EPSG:4326.

Viewing a Surface in 3D (IDW)

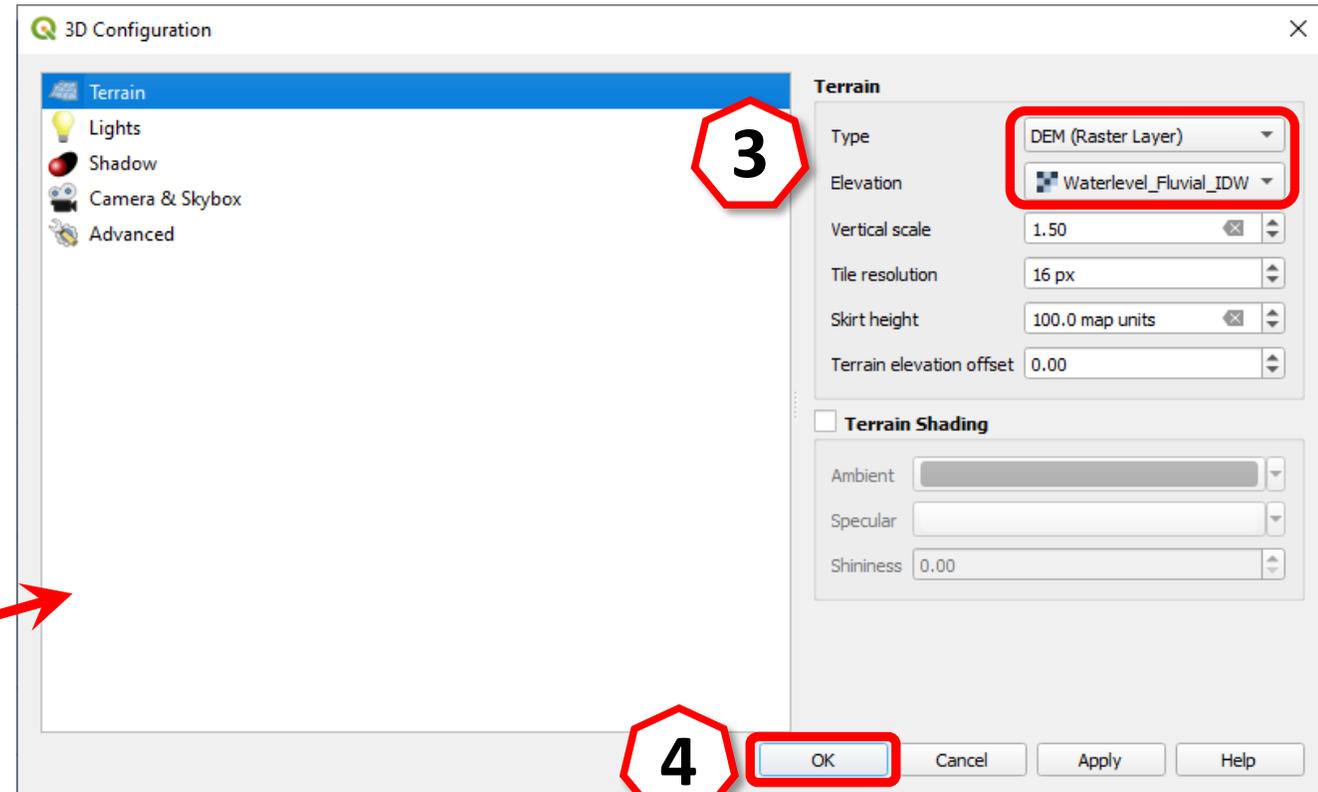
1



2

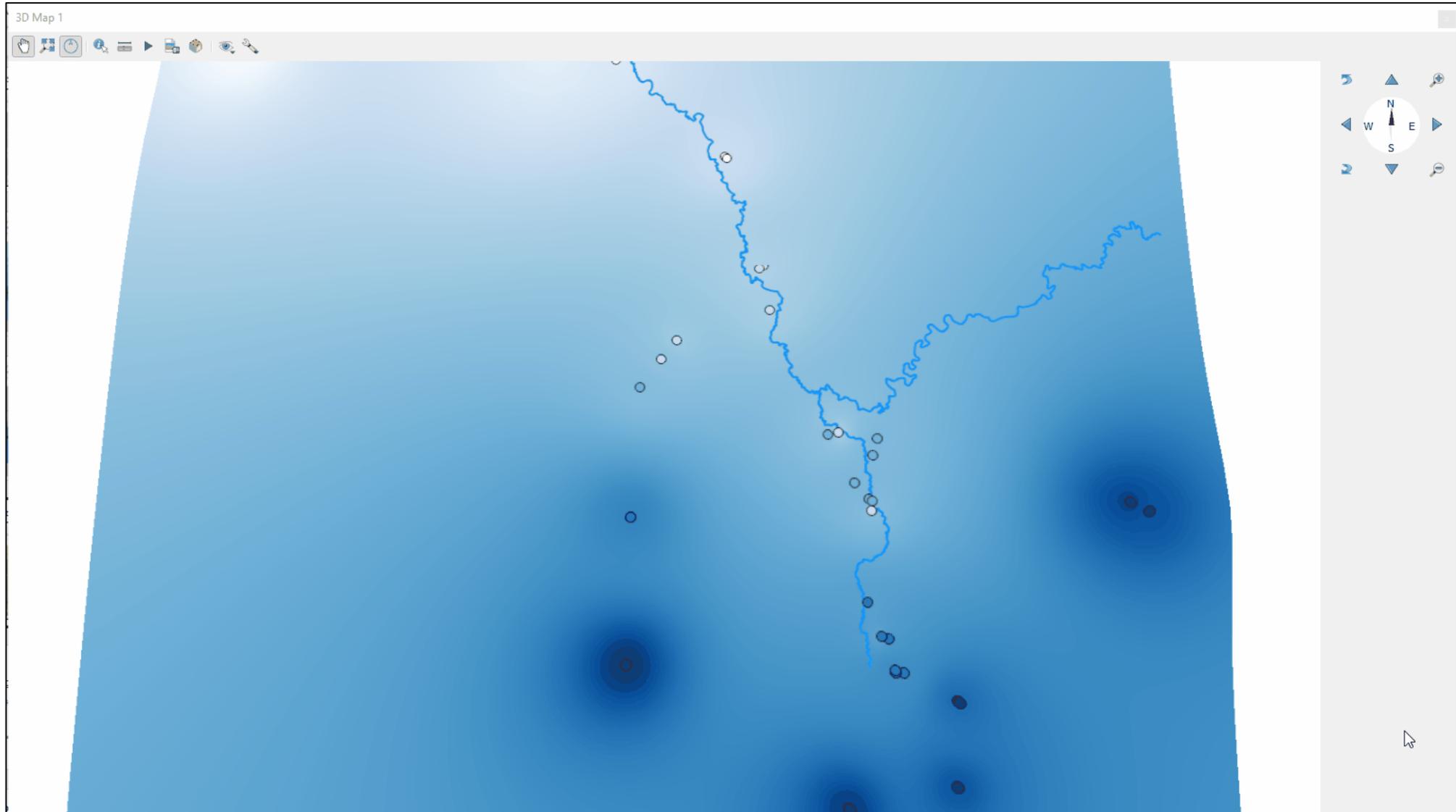


3

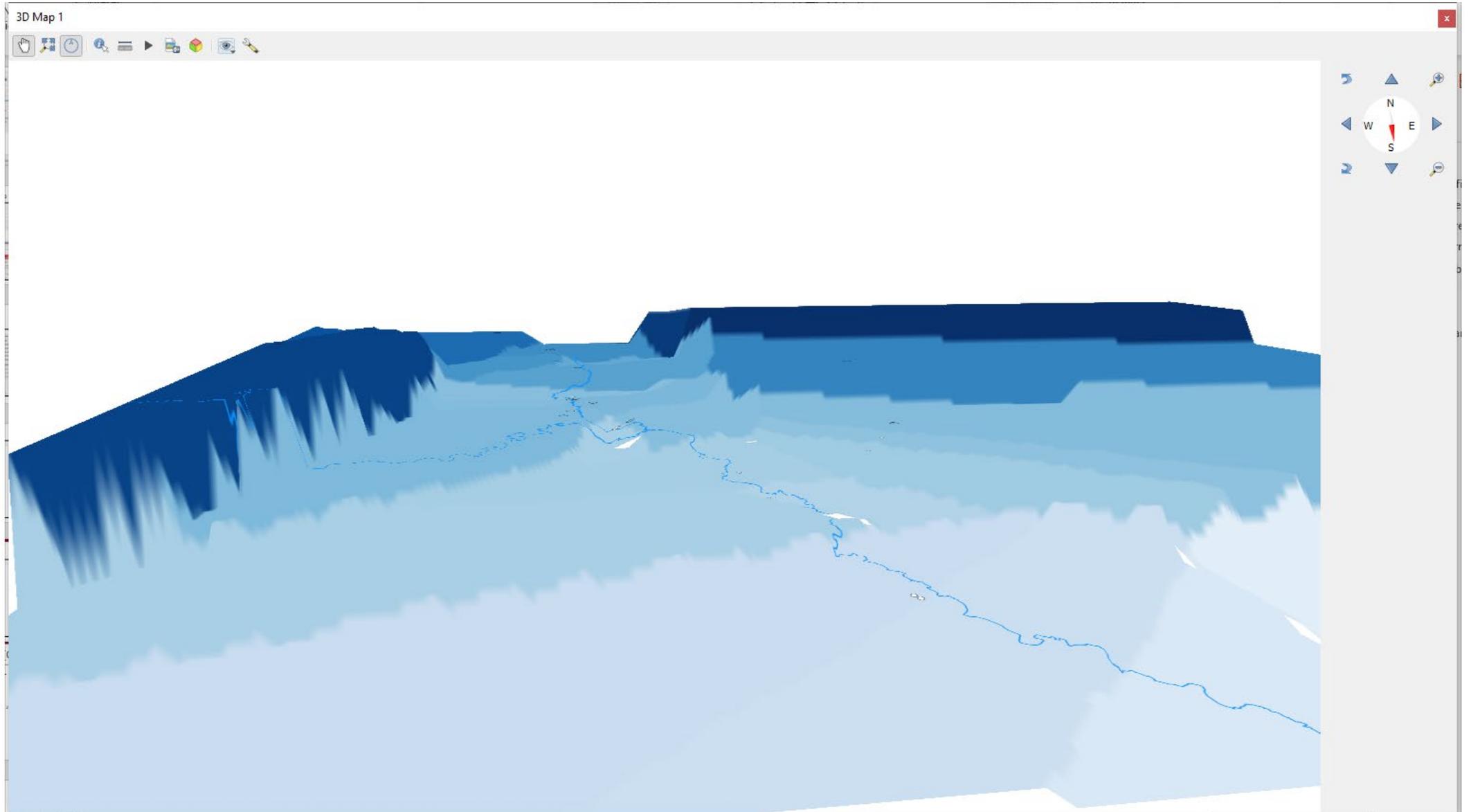


4

Viewing a Surface in 3D (IDW)



Viewing a Surface in 3D (Thiessen)



Generating Contours for an Interpolated Surface

The screenshot displays the QGIS interface with the 'Layer Styling' panel open for the 'Waterlevel_Fluvial_IDW' layer. The 'Contours' section is active, showing the following settings:

- Input band: Band 1
- Contour Interval: 5.0
- Contour Symbol: (Default line style)
- Index Contour Interval: 25.0
- Index Contour Symbol: (Default line style)
- Input Downscaling: 4.0

The 'Layer Rendering' section shows the following settings:

- Blending mode: Normal
- Brightness: 0
- Saturation: 0
- Contrast: 0
- Gamma: 1.00
- Grayscale: Off
- Hue: Off
- Strength: 100%

The 'Resampling' section shows the following settings:

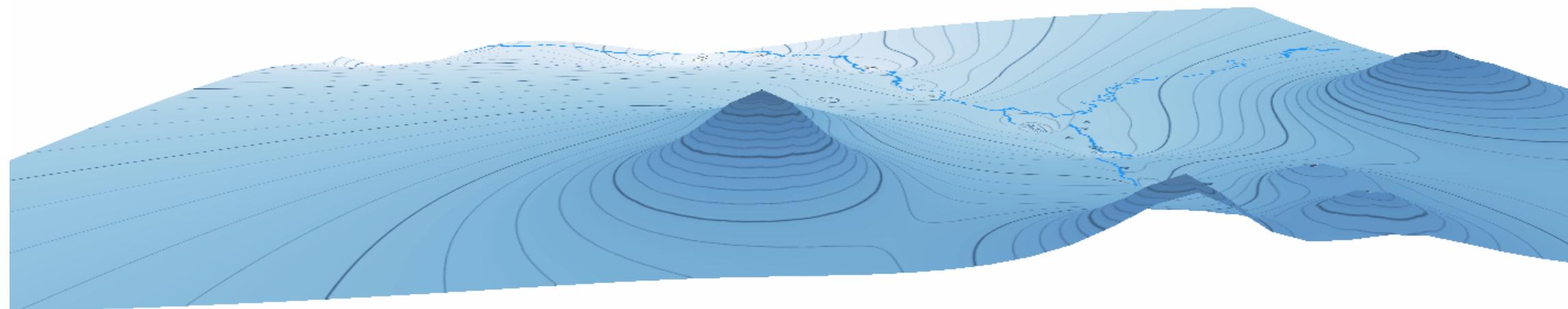
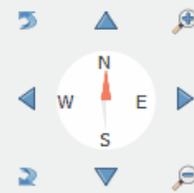
- Zoomed in: Bilinear
- Zoomed out: Bilinear
- Oversampling: 2.00
- Early resampling: (unchecked)

The main map area shows a topographic map with a blue river (Namoi river) and various contour lines. The 'Layers' panel on the left shows the following layers:

- Study_area
- Irrigation_wells
- Irrigation_wells water depth
- Namoi river
- Contours
- Waterlevel_Fluvial_IDW
- Waterlevel_Fluvial_IDW100
- WaterLevel_Fluvial_Thiessen
- WaterLevel_Fluvial_IDW_clipp
- WaterLevel_Fluvial_Thiessen
- NGIS_Bore
- Study_area
- contours
- hillshade
- namoi_dem
- Extent
- OSM Standard

The status bar at the bottom shows the following information:

- Coordinate: 1804246, -3477517
- Scale: 1:706,353
- Magnifier: 100%
- Rotation: 0.0 °
- Render: (checked)
- EPSG:3577



Viewing the IDW
surface with contours
in the 3D Viewer

Thanks! Questions?

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