



Earthquake Scenario Selection Tool

User Guide

About	2
How to use the tool?	3
Select Search Location	3
Search Results	4
Legend	6
Deaggregation – Spatial Location	7
Deaggregation – Magnitude Distance	8
Visualisation Styles	9
FAQ's?	10
How many scenarios are there?	10
What does NSHA18 mean and how does it relate to the selection tool?	10
How do these Earthquakes compare to historical events?	10
How realistic are these earthquakes?.....	10
How can I determine the impact from a scenario?	11
What are the limitations to the information?	11
When will the NSHA18 be updated?	11
How can I give feedback on the tool?.....	11
Where can I go for further information on Earthquakes?	11

About

The Earthquake Scenario Selection Tool is an interactive tool for querying, visualising and downloading earthquake scenarios, which are realistic and represent “worst-case” or hypothetical events that may impact population centres around Australia. Such scenarios may also support seismic risk assessments of critical infrastructure assets to inform remediation actions. The seismic scenarios use the underlying science and data of the 2018 National Seismic Hazard Assessment (NSHA18) to identify the magnitudes and epicentre locations of these hypothetical earthquakes.

There are 160 sites nationally with pre-generated scenarios available in the Earthquake Scenario Selection Tool. These represent plausible future scenarios that can be used for earthquake risk management and planning. There are two scenarios for each of the 160 selected localities across Australia. Output products include shaking contours for a range of intensity measures, including peak acceleration and velocity, as well as response spectral acceleration for 0.3, 1.0 and 3.0 seconds. The output also includes raster and contour images, and the associated metadata used for generating the scenarios.

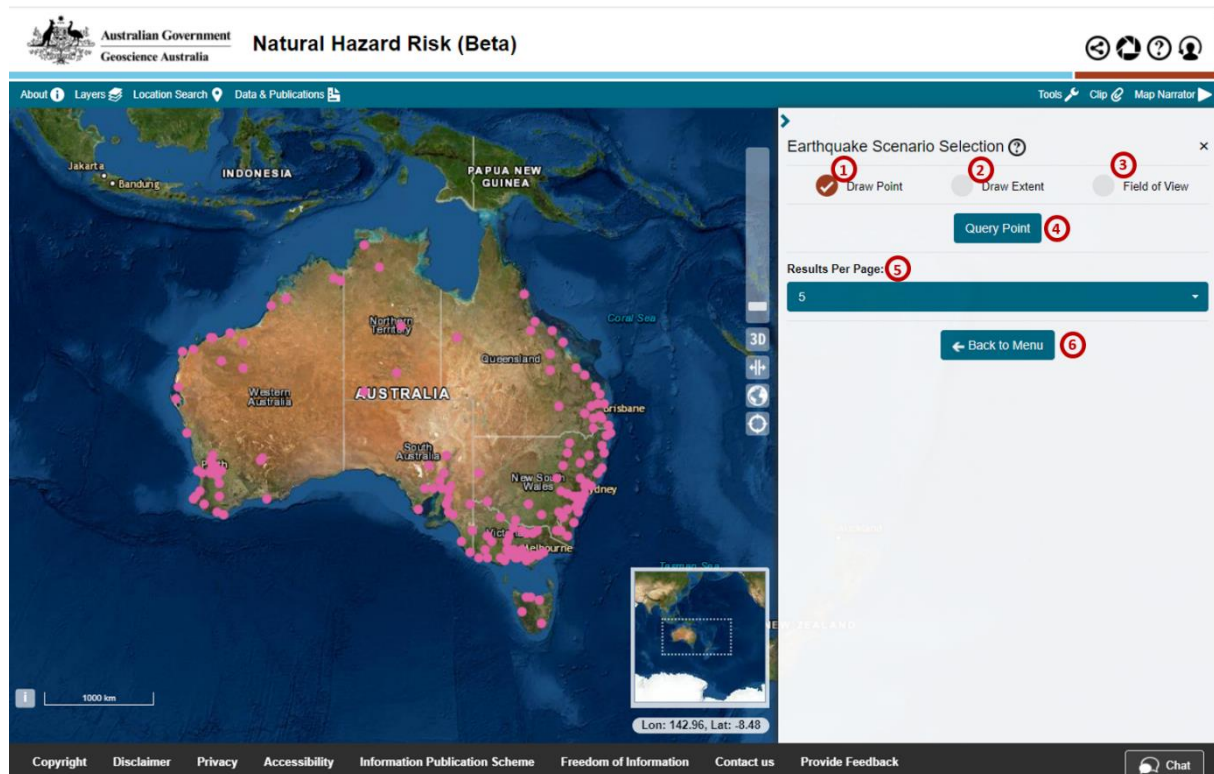
Use-cases include:

- Emergency management
 - In a planning context, I want to know what hazard events are possible in an area of interest and with what intensity. With this information, I can estimate what impact these events might have and develop necessary mitigation plans.
 - As part of the pre-disaster season briefing with my community, I want to identify hypothetical events that may impact a location so we can be better prepared.
- Education and Research
 - In educating public on historical events, I need to use a scenario to create GIS/Geoscience exercises for students to learn about earthquake hazards.
- Industry & Organisations (including NGO's)
 - In preparation for the Great Shakeout each year, I want to create a scenario to use to raise awareness of earthquake effects amongst critical infrastructure owners.
 - As an insurer, I want to create a scenario to evaluate risk for insurance estimates and to visualise a range of potential events for a location.
- Public
 - As a responsible community member, I want to use a scenario to inform the public of the risk in their area.
 - In supporting community education activities, I need to use a scenario that is similar or the same as a historical event so that I can produce material to show the risk, which has increased with expanding population/infrastructure.
- Government
 - As a local government, I want to use multiple scenarios for specific geographic locations that can inform planning and response activities, to convey potential risk and consequence based information to the community or guide Emergency management planning and resilience activities.

Disclaimer: The Earthquake scenario selector tool and information is not be used for safety of life decisions.

How to use the tool?

Select Search Location



1. **Draw Point:** Select a specific point location on the map panel to query.
2. **Draw Extent:** Draw a box, circle, polygon, or freehand, over an area of interest to query.
3. **Field of View:** Return all 160 locations with **Location ID** (Location Identifier), and the magnitude of **Scenario 1** and that of **Scenario 2** for the location.
4. **Query Point:** Return a location to query for the selected point.
5. **Results per Page:** Set the maximum number of results from the query location/area to display in the tool bar.
6. **Back to Main Menu:** Return to Natural Hazard Risk tool menu.

Additional Information

Draw Point: Draw Point option can be selected if there is a specific location to query on the map. If there is no locality data on the specific selection of point or within the search radius, then no data will be returned. Search radius is optional, 0 km is the default for search radius and 200 km is the maximum.

Draw Extent: Draw Extent option can be selected if there is an area of interest to query on the map. This option will return all locations within the selected area as Search results.

Select type of Draw: Select a type of Draw **Box, Circle, Polygon, or Freehand** radio button, if **Draw Extent** option is selected.

Draw: Click to draw a previously selected type of Draw (Box, Circle, Polygon or Freehand) on the map

Draw: Search results will return for the localities that are covered under the drawing boundaries. If there is no locality (that is, pink dot point on the map panel) covered within the drawing extent, no value will be returned as Search Results.

- For **Box** and **Circle** type of Draw, click a point on a preferred location of the map panel, and then release, then click again to specify the end location point on the map panel to complete the extent.
- For **Polygon** type of Draw, click a point on a preferred location, release and click again on multiple locations to cover all desired locations for search results, then click on a point to meet the first selected location point to complete the extent. Alternatively the double click can be actioned on the end location to allow the first selected location point meeting the end location point, to retrieve search results of the selected location/area. However, if the first selected point location appears to be diverted to the second selected location where the double click is actioned on the latter, no search results will be returned.
- For **Freehand** type of Draw, click and drag across all locations on the map panel and release to select the areas for search results.

Clear: Once **Draw** button is clicked, the button label changes to **Clear** and an instruction to “Click to start drawing, then click to complete drawing”. When **Clear** button is clicked on or different selection is made in one of the **type of Draw** radio buttons, the button label changes to **Draw** to enable drawing on the map panel.

Field of View: Field of View option can be selected to return 160 locations nationally as Search Results. When selected, type of Draw is made invisible and **Show Results** button will appear to retrieve search results for 160 locations across Australia.




Search Results

The screenshot displays the 'Earthquake Scenario Selection' interface for Albany. The map shows a drawing tool (a red star) and concentric circles representing the search extent. The sidebar on the right provides the following data:

Scenario Input: 2a	
Longitude:	117.90
Latitude:	-35.10
Magnitude:	5.3 MW
Depth:	5 km
RP (lower):	1200 yrs
RP (avg):	4500 yrs
RP (upper):	16000 yrs
Fault:	Point Source

Scenario Outputs: 2b	
Ground Motion	Maximum
MM:	7.33
SA(0.3):	0.57 g
SA(1.0):	0.10 g
SA(3.0):	0.01 g
PGV:	2.66 cm/s
PGA:	0.43 g

The sidebar also includes a 'Legend' section, a 'Download' button (2e), and navigation buttons: 'Back to Results' (7) and 'Back to Menu' (8). The map shows a scale bar of 50 km and coordinates: Lon: 116.84, Lat: -33.59.

1. **Search Results Location** – Query location name (coordinates and buffer distance if applied).
2. **Search Results Summary for Scenario 1:** Returned results of query location, based on the Scenario 1 calculation.
 - a. **Scenario Input:**
 - i. **Longitude:** Longitude of the query location.
 - ii. **Latitude:** Latitude of the query location.
 - iii. **Magnitude:** Magnitude of the query location.
 - iv. **Depth:** Devised (hypothetical) hypocentre depth input.
 - v. **RP (lower):** Estimate of lower bound return period based on recurrence information for magnitude events over a 10,000 km² area around the locality.
 - vi. **RP (avg):** Estimate of average return period based on recurrence information for magnitude events over a 10,000 km² area around the locality.
 - vii. **RP (upper):** Estimate of upper bound return period based on recurrence information for magnitude events over a 10,000 km² area around the locality.
 - viii. **Fault:** Fault source used (Point location or finite fault).
 - b. **Scenario Output:**
 - i. **MMI:** Likely maximum macroseismic intensity.
 - ii. **SA (0.3):** Likely maximum 0.3 second peak acceleration in units of g.
 - iii. **SA (1.0):** Likely maximum 1.0 second peak acceleration in units of g.
 - iv. **SA (3.0):** Likely maximum 3.0 second peak acceleration in units of g.
 - v. **PGV:** Likely maximum peak ground velocity in units of cm/s.
 - vi. **PGA:** Likely maximum peak ground acceleration in units of g.
 - c. **Image files:**
 - i.  **Add raster to map or Remove raster from map:** this icon can be turned on to add the raster layer, or turned off to remove the raster layer around the locality on the map.
 - ii.  **Add contour to map or Remove contour from map:** this icon can be turned on to add the contour lines, or turned off to remove the contour lines around the locality on the map.
 - iii.  **Open PDF:** Generate the map of ground motion type for the spatial location.
 - d. **Legend:** Expand to see the level of intensity for raster and contour in a colour-descriptive form.
 - e. **Download:** Download results in USGS ShakeMap Scenario Package, ShakeMap Raster (GEOTIFF), or Contours (Shapefile).
3. **Search Results Summary for Scenario 2:** Returned results of query location, based on the Scenario 2 calculation.
4. **Deaggregation – Spatial Location:** Longitude-Latitude Deaggregation showing the percentage contribution to Hazard of earthquake sources with a given longitude and latitude relative to the selected location.
5. **Deaggregation – Magnitude-Distance:** Magnitude-Distance Deaggregation showing the percentage contribution to Hazard of earthquakes with a given magnitude and distance to the selected location.
6. **Visualisation Styles:** Expand to change how the raster and contour are stylised on the map.
7. **Back to Results:** Navigate to go back to a previous search results screen.
8. **Back to Main Menu:** Return to Natural Hazard Risk tool menu.

Additional Information

Search Results Summary for Scenario 1: In Scenario 1, the location with the highest total contribution to the seismic hazard at the 1/10,000 Annual Exceedance Probability (AEP) is selected from the magnitude, longitude, latitude deaggregation by summing the probabilities in each location bin and picking the modal location.

Search Results Summary for Scenario 2: The location attributes in scenario 1 and scenario 2 are the same, but the returned data is different. Scenario 2 returns the scenario with the next largest contribution to the hazard under the condition that the magnitude at least ± 0.5 magnitude units different to Scenario 1.

Fault: Fault source used (Point location or finite fault)

- Point location or point source: Creates a seismic scenario with a location (selected by spatial deaggregation) and a hypocentre depth (assumed at 5 or 10 km).
- Finite fault: The scenario using the finite-source rupture generally shows a broader zone of high shaking intensity than the point-source scenario. The finite-rupture source allows for the rupture to extend closer to, or break the Earth's surface.

Visualisation Styles: The accordion menu will be visible if at least one of the raster and/or contour files is selected in either Scenario 1 or Scenario 2.

Legend

The screenshot displays the 'Natural Hazard Risk (Beta)' web application. The main map shows a seismic hazard visualization for Scenario 1, centered on a point source (marked with a red star). The visualization includes concentric circles and a color-coded intensity scale. The right-hand panel contains the following sections:

- Summary - Scenario 1:**
 - Scenario Input:**
 - Longitude: 117.90, RP (lower): 1200 yrs
 - Latitude: -35.10, RP (avg): 4500 yrs
 - Magnitude: 5.3 MW, RP (upper): 16000 yrs
 - Depth: 5 km, Fault: Point Source
 - Scenario Outputs:**
 - Ground Motion Maximum:**
 - MMI: 7.33
 - SA(0.3): 0.57 g
 - SA(1.0): 0.10 g
 - SA(3.0): 0.01 g
 - PGV: 2.66 cm/s
 - PGA: 0.43 g
- Legend:** A color-coded legend for the intensity scale, with red circles 2 and 3 highlighting the legend and the intensity table respectively.
- Level of Intensity Table:** A table showing the representation of color for each selected raster and/or contour image for Ground Motion type.

1. **Ground Motion Scenario Outputs:** Click to see the raster, contour files on the map panel and PDF of the map of selected Ground Motion type.
2. **Legend:** Expand to see the level of intensity for raster and contour in a colour-descriptive form.
3. **Level of Intensity Table:** Shows the representation of colour for each selected raster and/or contour image for Ground Motion type.

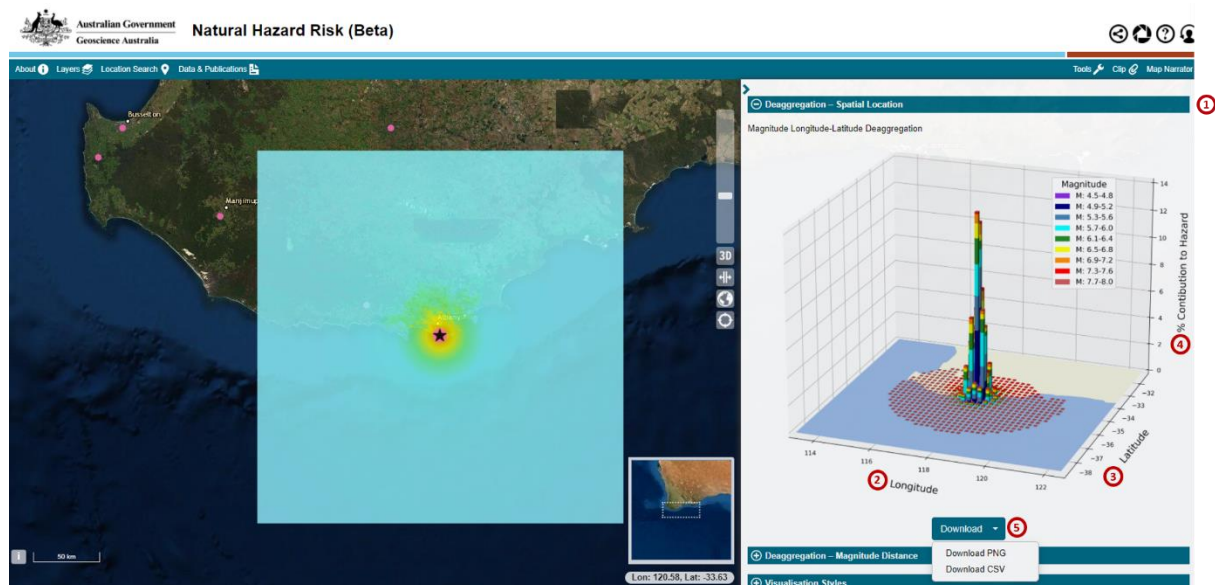
Additional Information

Ground motion Scenario Outputs: Only one raster and one contour image file can be selected from any Ground Motion type list at a time. For example, if a raster is selected to add the rectangle representation on the map for MMI, then a raster for PGV again is selected, the previous raster selection of MMI will become de-selected, and the second selection (raster for PGV) will remain selected.

Legend: Legend accordion menu is invisible unless the raster file or contour file or both files in Ground Motion type of either Scenario 1 or Scenario 2 are selected.

Level of Intensity Table: Raster is a rectangular pattern on the map panel, the colour on the raster rectangle indicates level of intensity of earthquake within the location. Contour is an illustration with contour lines on the map, the colour lines represent the difference in elevation between successive contour lines. Subject to the selection of “Default” or “Colour blind Safe” option and opacity in Visualisation Style, the colour may change accordingly.

Deaggregation – Spatial Location

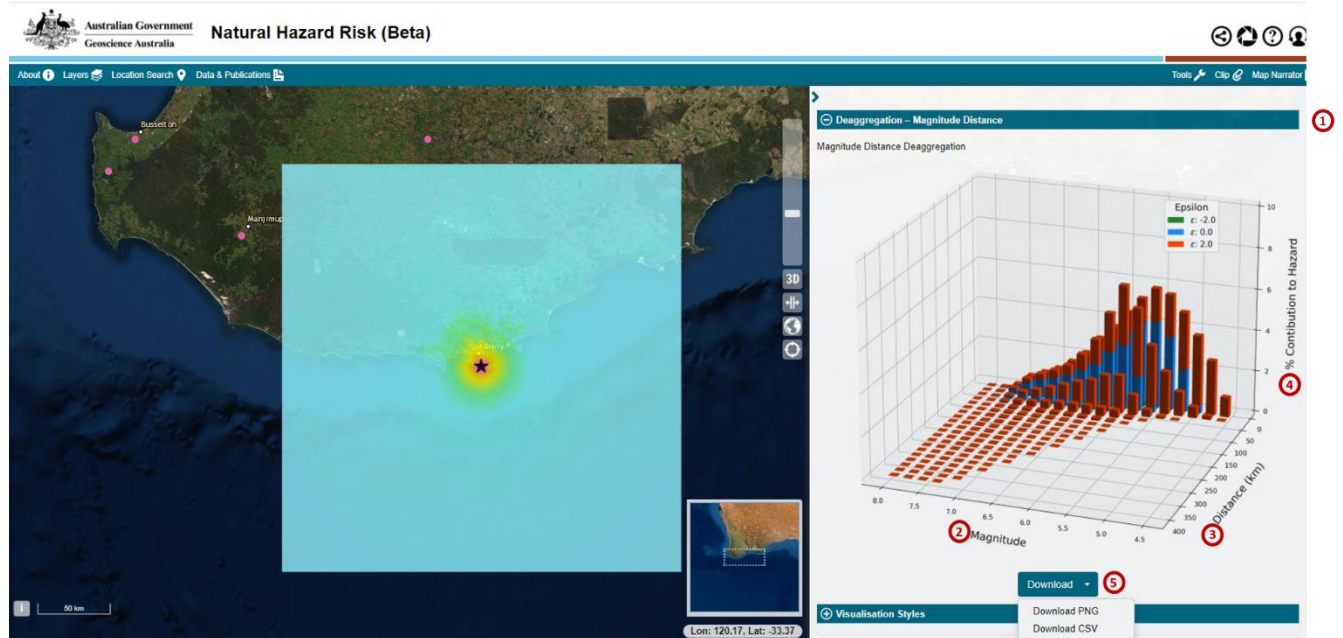


1. **Deaggregation – Spatial Information:** Expand to see the predominant earthquake sources, partitioned in terms of spatial location and magnitude, which contribute to the ground-motion hazard for locality.
2. **Longitude** – Longitude of the spatial location.
3. **Latitude** – Latitude of the spatial location.
4. **% Contribution to Hazard** – Contribution percentage of the magnitude of the ground-motion hazard for the spatial location (longitude and latitude).
5. **Download** – Download Portable Network Graphic (PNG) file, or Download Comma Separated Value (CSV) file.

Additional Information

Download: Click on PNG file to trigger a new window with auto-population of the Spatial Location Deaggregation image. Click on CSV file to download a spreadsheet, which contains the deaggregation of location metadata with magnitude.

Deaggregation – Magnitude Distance

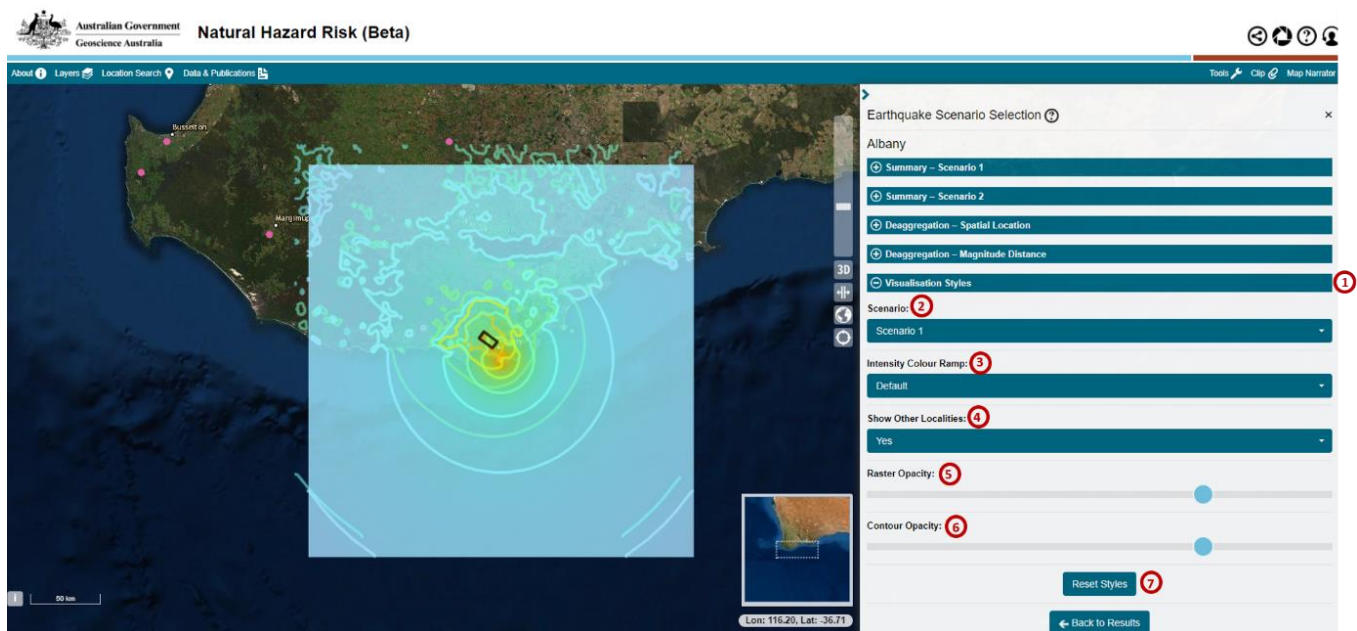


1. **Deaggregation – Magnitude Distance:** Expand to see the predominant earthquake sources, partitioned in terms of magnitude and distance, which contribute to the ground-motion hazard for locality.
2. **Magnitude** – Magnitude of the earthquake that contributes to the hazard.
3. **Distance (km)** – Distance (in kilometres) from the ground-motion hazard locality.
4. **% Contribution to Hazard** – Contribution percentage of the magnitude and distance of the ground-motion hazard for locality.
5. **Download** – Download Portable Network Graphic (PNG) file, or Download Comma Separated Value (CSV) file.

Additional Information

Download: Click on PNG file to trigger a new window with auto-population of the Magnitude Distance Deaggregation image. Click on CSV file to download a spreadsheet, which contains the deaggregation of magnitude and distance metadata.

Visualisation Styles



1. **Visualisation Styles:** Expand to see how the raster and contour are styled on the map.
2. **Scenario:** Select either Scenario 1 or Scenario 2 for the previously selected image file in the Summary accordion menu.
3. **Intensity Colour Ramp:** Change the raster and/or contour images from the Default to 'Colour Blind Safe' colours.
4. **Show Other Localities:** Show other location ID (pink dot point) on the map panel.
5. **Raster Opacity:** Change the opacity of the returned raster on the map panel.
6. **Contour Opacity:** Change the opacity of the returned contour on the map panel.
7. **Reset Styles:** Change to Default in Intensity Colour Ramp, 'Yes' in Show Other Localities, and both Raster Opacity and Contour Opacity return back to their original positions.

Additional Information

Visualisation Styles: De-selection to the image files in both scenario will make the Visualisation Style accordion invisible.

Scenario: Selection or De-Selection to the image file in Scenario 1 and/or Scenario 2 will drive the list to add or remove the scenario.

Raster Opacity: De-selection of raster files in both Scenario 1 and Scenario 2 will make the Raster Opacity invisible.

Contour Opacity: De-selection of contour files in both Scenario 1 and Scenario 2 will make the Contour Opacity invisible.

FAQ's?

How many scenarios are there?

The Earthquake Scenario Selector Tool holds two unique earthquake events that contribute most to the hazard for 160 locations within Australia.

What does NSHA18 mean and how does it relate to the selection tool?

The National Seismic Hazard Assessment (NSHA) characterises intensity and likelihood of earthquake ground shaking across Australia. The latest version of the assessment was released in 2018 and forms the basis for the Earthquakes scenarios stored within the ESST. These synthetic scenarios are retrieved by the Earthquake Scenario Selector Tool.

More information on the 2018 National Seismic Hazard Assessment (NSHA18) can be found at <https://www.ga.gov.au/about/projects/safety/nsha>

How do these Earthquakes compare to historical events?

The scenarios available in ESST are synthetic events which have been informed by the 2018 National Seismic Hazard Assessment (NSHA) for Australia. Oftentimes, the scenarios provided within the ESST are larger, and consequently, more severe than those experienced historically. However, these events are both realistic and represent a potential “worst-case” events that may impact population centres around Australia.

How realistic are these earthquakes?

The earthquakes available for discovery through ESST tool have been selected using the National Seismic Hazard Assessment (NSHA). All data and tools that have been used to develop the NSHA have been peer reviewed and are openly available, supporting the transparency and repeatability of the work. Based on our current knowledge of earthquake occurrence, the scenarios are both realistic and represent a potential “worst-case” events that may impact population centres around Australia. Given the natural randomness in the source characteristics of earthquakes, ground-shaking observations from event-to-event can vary significantly, even for earthquakes with the same magnitude. However, the scenarios use our current best understanding of the likely ground-shaking intensity across a spatial region for any given magnitude and distance from the earthquake source. This knowledge will improve through ongoing monitoring and observation of earthquakes across Australia, leading to improved estimates of seismic hazard risk in the future.

More information on the 2018 National Seismic Hazard Assessment (NSHA18) can be found at <https://www.ga.gov.au/about/projects/safety/nsha>.

How can I determine the impact from a scenario?

Estimating impact requires an understanding of the hazard (described by its shaking intensity), what is exposed to the hazard (e.g. residential buildings, infrastructure, etc.) and how vulnerable each of the exposed elements are to the intensity of the hazard. ESST tool only provides the potential earthquake shaking intensity at a given location for a given scenario. Further studies are required to estimate impact. Further information on the available cases studies is available at: [Earthquake Mitigation Case Study for Regional Town of York, WA](#) and [Earthquake Impact and Risk Assessment for Perth and Supporting Infrastructure \(EIRAPSI\)](#).

Please email hazards@ga.gov.au for more information.

What are the limitations to the information?

For uncertainties associated with ESST product please consult the [NSHA18 documentation](#) and relevant reports at <https://www.ga.gov.au/about/projects/safety/nsha>. Further limitations on the generation of ShakeMaps are documented in [here](#).

When will the NSHA18 be updated?

Geoscience Australia will continue to update the NSHA to incorporate advancements in the underlying earthquake-hazard science and utilise improvements in technology. Subsequent improvements to an ESST tool may be facilitated through these scientific and technological advances. There are no immediate plans to update the NSHA18.

How can I give feedback on the tool?

Feedback can be sent to hazards@ga.gov.au.

Where can I go for further information on Earthquakes?

For information on Earthquakes that are detected with the global seismic network, please visit [Earthquakes@GA](#), if you feel an earthquake, you can also submit a 'felt report'.
