Federal Geospatial Platform Training

Improving Map Data and Web Service Performance in the FGP

03/23/2022

Canada

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Part 1:
Techniques to Improving Map Data and Web Service Performance
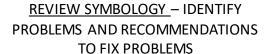
Methods and Best Practices

Methods to Improve Web Services

REVIEW SYMBOLOGY – IDENTIFY PROBLEMS AND RECOMMENDATIONS TO FIX PROBLEMS

REVIEW GEOMETRY – APPLY TECHNIQUES AND FUNCTIONS TO HELP IMPROVE PERFORMANCE

EVALUATE DISPLAY SCALES – OPTIMAL DISPLAY SCALES TO HELP IMPROVE PERFORMANCE

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1a. FGP Viewer Spatial Reference Systems:

- The recommended coordinate reference systems for the FGP viewer are:
    - **EPSG:3978 -** NAD83 / Canada Atlas Lambert – Default when opening the FGP viewer
    - **EPSG:3857** (or EPSG:102100 for ESRI) - WGS84 Web Mercator (Auxiliary Sphere)

- All other reference systems are available and will be projected on-the-fly by the viewer.

NOTE: **Reprojection** on-the-fly has **considerable** **impact on web service performance**

1b. Data Extraction
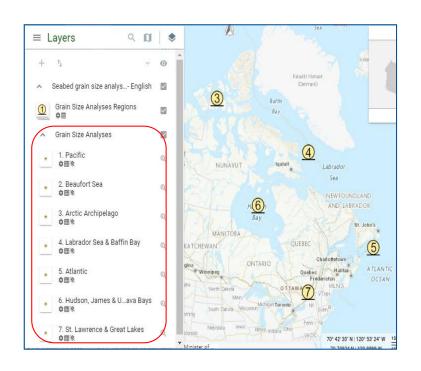
Export selected features (*feature classes*)

- Exporting features and creating layer groups based on attribution type allows users to turn on/off each layer and efficiently view data.

- Select features in a layer and export them as a stand-alone feature class.

- Once the layer is exported, it can be grouped to better represent data

Example from FGP : Species at Risk Range Extents

1c. Group-Layers in FGP Viewer

- **Organize data efficiently** - create user-friendly symbology that reflects purpose of layer
- **Activation and deactivation** of layers
- Feature classes can have their **own scale range**
- A **single metadata record** describes all layers of the resource

 Keep in mind:
- Too many layers can slow down web services
- **Test** your web service in FGP viewer
- List layers represented in your Group Layer in the Abstract
- **Group Layers from an "OGC Web Map Service (WMS)" hosted on an ArcGIS Server are not currently supported**

EXAMPLE: Seabed grain size analysis, offshore Canada

For more information please click here for Group Layers training

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1d. Symbology

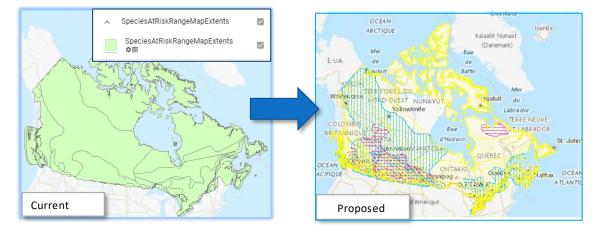" Doesn't the good have to be beautiful?"
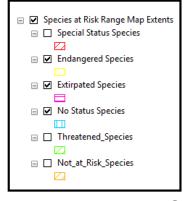
Philippe de Rothschild

1d. Symbology: Optimization

- Creation of **attribute layers** and **sublayers** allow users to activate and deactivate different sublayers according to their display needs and requirements:
  - Sends a clear message much more effectively
  - Improved display performance
  - Avoids unwanted overlapping of information over the field used for the symbology
  - Increases usability and decreases confusion

Example in FGP: Species at Risk Range Extents

Classification and symbology
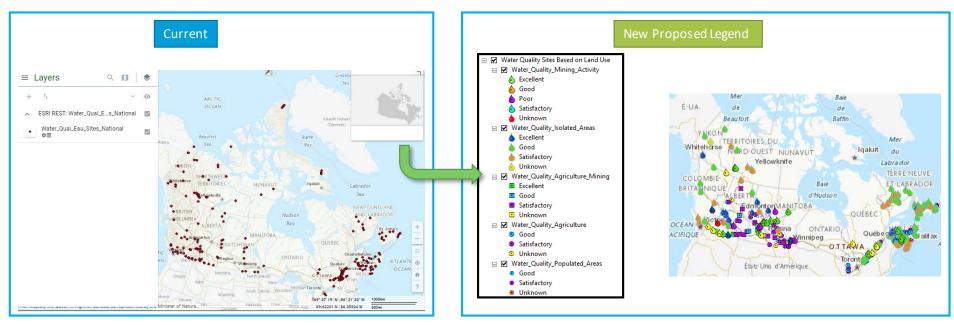Sub-layers from the SAR Status field

Current

Proposed

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1d. Symbology Optimization

Combination of different symbologies in the legend

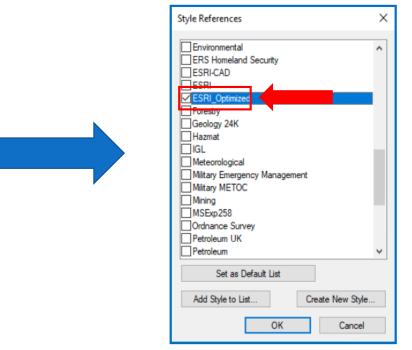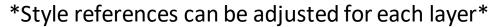**Example in FGP: National Long-term Water Quality Monitoring Data**

1d. Symbology Optimization

ESRI's ArcGIS optimized styles of symbology similar to their default equivalents – prove to be 60% more efficient loading data

Style references can be adjusted for each layer

1d. Symbology Optimization
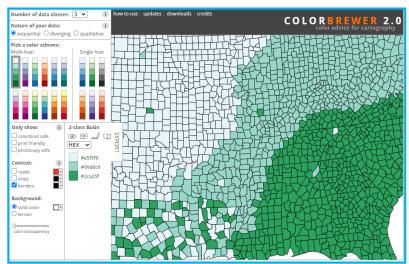
Use of this tool will benefit your map designs because:

1. Allows for the creation of various color scheme pallets to help visualize data accordingly.

2. Users can export a high range of colors and download the color specifications.

3. Certain color schemes can be paired to give a more meaningful representation of your data:
- Sequential – Ordered data, high to low
- Diverging – Critical values and extremes
- Qualitative – Primary visual differences

ColorBrewer developed by **Axis Maps** allows users to create color schemes for maps and other graphics in order to show data that is readily readable.

ColorBrewer 2.0

Seven-class map where the green band has six outliers that can easily be seen.

1e. Geometry Generalization

Generalization is a method used in GIS to reduce the detail of data. Sometimes GIS data contains excess detail or more spatial information than what is required for the scale of the map being prepared.

There are several tools in ArcGIS and QGIS that allow you to generalize geometries and thus improve the performance of map data and web services. Here are a few:
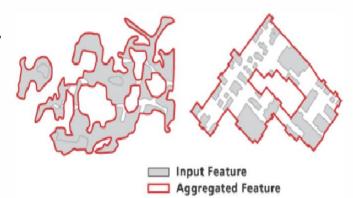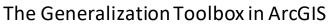
Aggregation

Merge (*Dissolve*)

Simplification

Smoothing

1e. Geometry Generalization: AGGREGATION

- Consider moderate downscaling when the input features can no longer be represented individually due to data size, limited map space or required data resolution.

- Aggregation only occurs where two polygon boundaries are within a specified distance from each other

- Useful for cartographic representation.

Input Feature
Aggregated Feature

The Generalization Toolbox in ArcGIS

The output feature class will not contain any attributes of the input features.

Processing Toolbox in QGIS

1e. Geometry Generalization: MERGE / DISSOLVE POLYGONS
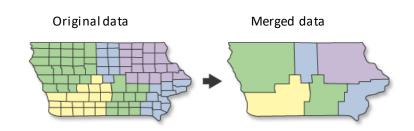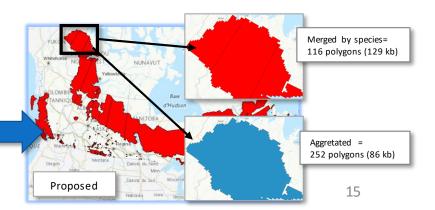
- This tool aggregates features based on one or more specified attribute(s) called 'Merge field(s)'.

- Features with the same value will be combined to form a single attribute

- Merged fields are created in the resulting feature layer

- NOTE: Can create multipart features. These non-continuous features are represented in a single row in the attribute table.

Original data   Merged data

Example in FGP: Critical Habitat National – Species at Risk Canada (ECCC)

32 295 polygons (9.7 mb)

Current

Proposed

Merged by species= 116 polygons (129 kb)

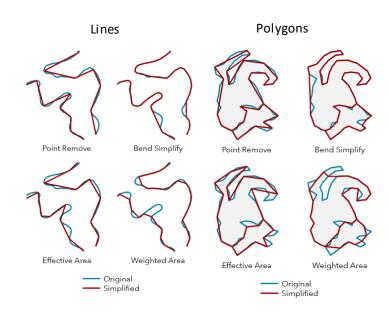Aggretated = 252 polygons (86 kb)

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1e. Geometry Generalization: Simplify lines / polygons

- Simplify lines/polygons by removing extraneous vertices or curves, while maintaining the overall shape.

- Uses 4 simplification algorithms: POINT_REMOVE, BEND_SIMPLIFY, WEIGHTED_AREA, EFFECTIVE AREA.

Simplification can cause loss of data and precision

* Requires an ArcGIS Desktop **Standard** or **Advanced License**

Lines   Polygons

Point Remove   Bend Simplify   Point Remove   Bend Simplify

Effective Area   Weighted Area   Effective Area   Weighted Area

— Original
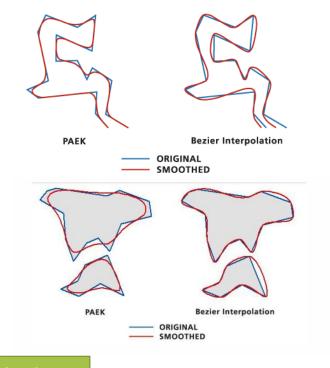— Simplified

— Original
— Simplified

1e. Geometry Generalization: Smooth lines / polygons

- Smooths sharp angles or polygon outlines to improve aesthetic or cartographic quality.

- **PAEK** method : calculates a smooth polygon that does not pass through the vertices of the input polygon. This is the default option.

- **BEZIER_INTERPOLATION** method: adjusts the Bezier curves between the vertices of the polygons without using a tolerance.

  - ➢ Important to note that <u>topological errors can be caused</u> when using this tool.

  - ➢ Remember to <u>check geometry and check errors</u> after running the tool.

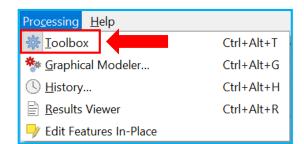 - ➢ Should you see errors try running this tool on polyline then convert to polygons.

PAEK   Bezier Interpolation

— ORIGINAL
— SMOOTHED

PAEK   Bezier Interpolation

— ORIGINAL
— SMOOTHED

* Requires an ArcGIS Desktop **Standard** or **Advanced license**

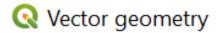# 1e. Geometry Generalizations: Using QGIS

Processing Toolbox
Symbol

QGIS free and open-source cross-platform desktop geographic information system application that supports viewing, editing, and analysis of geospatial data.
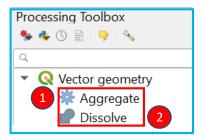

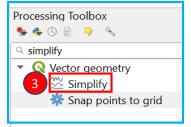**Processing Toolbox** used in QGIS to apply various geometry generalization functions such as:

1. Aggregation
2. Dissolve (Merge)
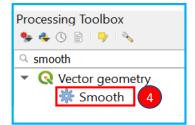3. Simplification
4. Smoothing

Did you know?

Resampling Best Practices

The FGP viewer when reading a web service with a published raster map can display pixels larger than normal when zoomed to the full extent of Canada – **Not an accurate representation of map data**

Due to discretely-classified raster data that have pyramids where re-sampling occurs for different scales of viewing

Cause: Re-sampling methods with particular cell values can cause pixelated outputs for different map extents

Original

Published

Example: Canada Landsat Fire Disturbance 2017

Fix: Run and test different sampling methods to get the best result
- Esri ArcGIS – **Nearest Sampling**, best when cells contain anything other than 'No Data'
- QGIS – **Mode Sampling,** reclassify 'No Data' to other values to achieve accurate results
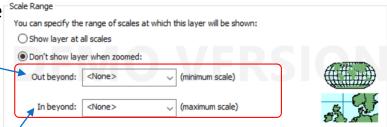
1f. Display Scales: Performance and Optimization

- In general, it is strongly recommended that layers containing a **large number of features** be published using scale ranges.

- Why is this important?
  - Avoids unwanted overlaying of data
  - Significantly improves display time and performance

Defining a scale range in ArcGIS

Out beyond also known as **zoom out beyond** refers to the smallest map scale at which the layer is visible in the display - minimum scale.
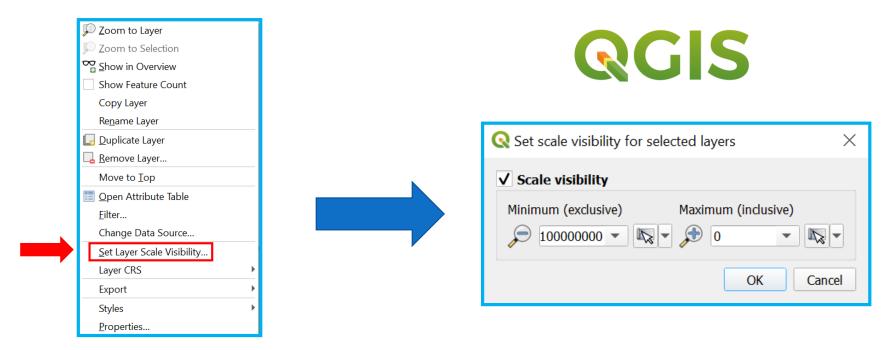
In beyond also known as **zoom in beyond** refers to the largest visible map scale at which the layer is visible in the display - maximum scale.

Scale Range

You can specify the range of scales at which this layer will be shown:

◯ Show layer at all scales

◉ Don't show layer when zoomed:

Out beyond: <None> ⌄ (minimum scale)

In beyond: <None> ⌄ (maximum scale)
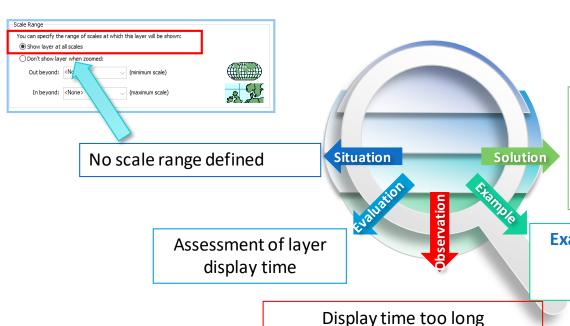
1f. Display Scales: Using QGIS

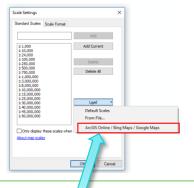QGIS includes options to customize the layer scale visibility for each layer

'Right-click' layer to view options

1f. Display Scales: Example in ArcGIS

No scale range defined

Assessment of layer display time

Display time too long
Average loading: 2 to 5 sec
Critical threshold: **7 sec max**

Solutions:
- Use standard scale ranges from **ArcGIS Online/Google Maps/Bing Maps**
- Define a scale-dependent display for each layer

Example in FGP: Species at Risk Critical Habitats
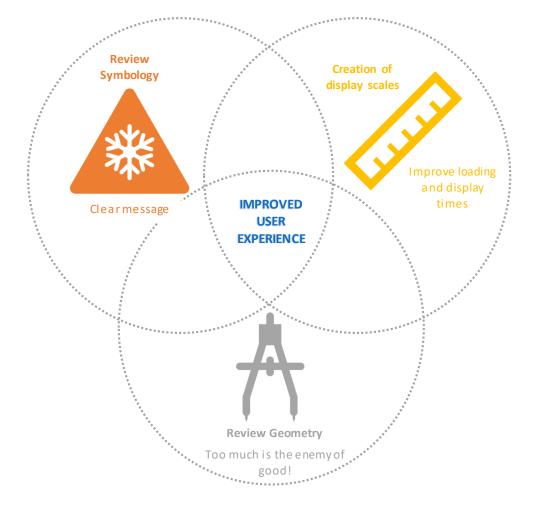**Long display time or fails to load**

In Conclusion

Several methods, techniques and tools are available to help you improve the performance of map data, thus enabling optimized web services.
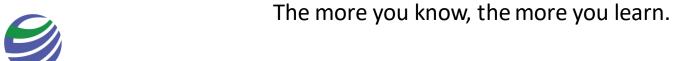
Applying these techniques individually or in combination not only improves the quality of your map data and web service performance, but also increases ease of access for users and usability. **Thus making the user experience much more pleasant**.

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Previous Training Sessions

The more you know, the more you learn.

Previous Training Sessions:

- **GIS Training:**
  - Hands-on training for all federal employees to build custom maps and create geospatial data.
- **FGP Metadata Training:**
  - Metadata best practices, explanation of the Harmonized North American Profile (HNAP) and demonstration. FGP data quality indicators and implementation.
- **Training and demonstration of the FGP Viewer Plugins:**
  - Overview of the new FGP Plugins (range/time slider, thematic slider, swiper, draw, area of interest and charting plugins), demonstration of the FGP Authoring tool and a demonstration of use-case examples.
- **Creating and Implementing Group Layers:**
  - Why and how to create and implement group layers in FGP.
- **Improving Map Data and Web Service Performance in the FGP:**
  - Methods, best practices and tools to help improve the cartographic representation of map data as well as web service performance.

For More Information

☐ **Federal Geospatial Platform (FGP) Website**
   https://gcgeo.gc.ca

☐ **Open Maps Website**
   https://open.Canada.ca/en/open-maps

☐ **The FGP Client Support Services**
   fgpservices-servicespgf@nrcan-rncan.gc.ca

Thanks for Listening!

Do you know of other strategies that improve the representation and performance of your data and services?

Let us know!

Part 2:
Demonstration

- Export feature classes
- Create layer groups
- Symbology
- Merge (Dissolve)
- Aggregate polygons
- Simplify polygons
- Smooth polygons
- Display scales

Thank You