



# TOPOCHECK

Topological anomalies

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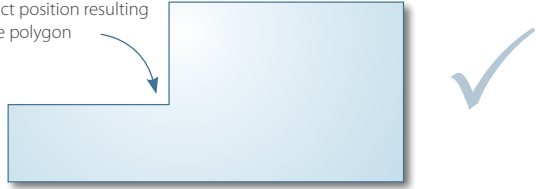
EXAMPLE

1.

A segment incorrectly touches or crosses another segment of the same polygon

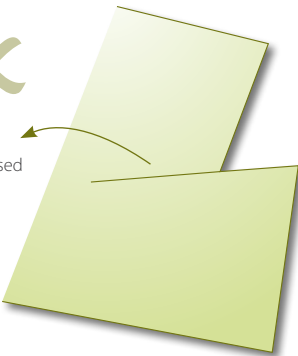


To rectify, the vertex is moved to its correct position resulting in only one polygon

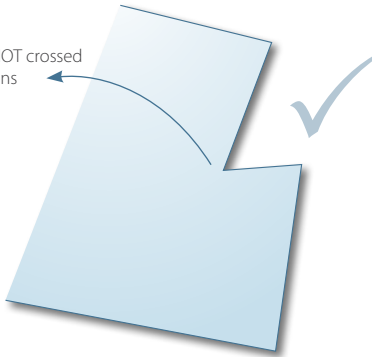


X

The vertex is crossed in two directions



The vertex is NOT crossed in two directions



2.

### Anomaly #101

## Loopbacks – Self-intersections:

### Geometries affected

1. Lines
2. Polygons

### Description

A loop back or self-intersecting polygon is when:

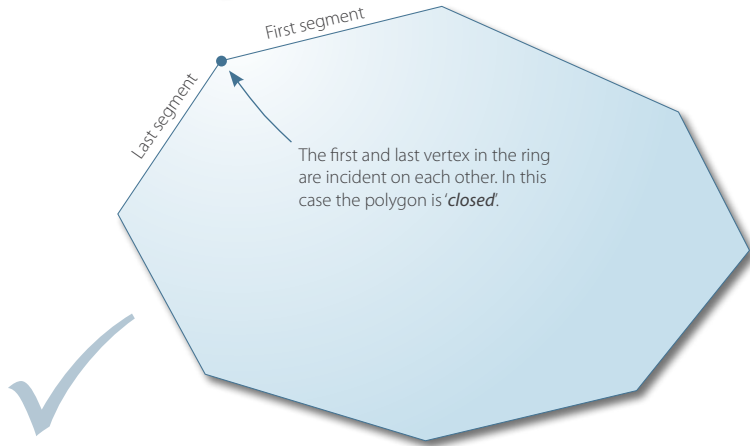
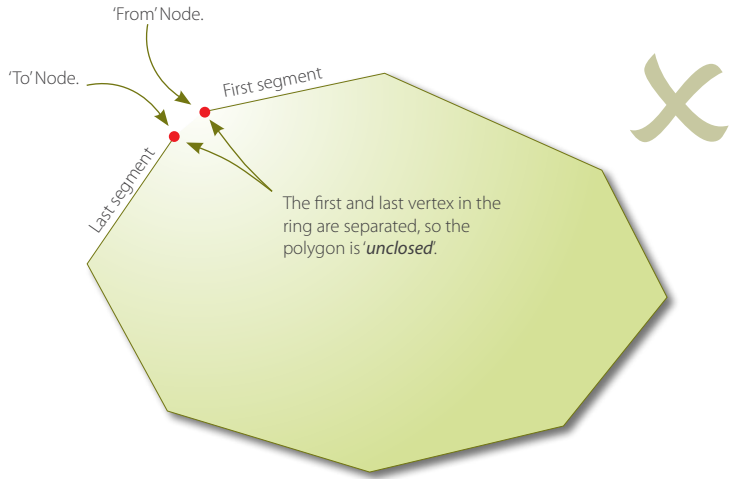
1. The boundary of the polygon crosses itself. This error is sometimes described as a 'Butterfly' or 'Figure of Eight' polygon, or
2. The line recrosses a vertex in a different direction.

These two events are illustrated in the diagrams to the left. As no tolerance is used in the loopback or self-intersecting polygon test, these errors are not created by points that are close to each other, but are not necessarily self-intersecting, snapping together. If a 'clean' with a set fuzzy tolerance is run before or after this test, it could be expected that more self-intersecting polygons would be identified.

### Resolution

This error is resolved by modifications to the geometry within a GIS editing session. It is not possible to automate this process.

EXAMPLE



### Anomaly #102

## Unclosed Polygons/Rings:

### Geometries affected

1. Polygons

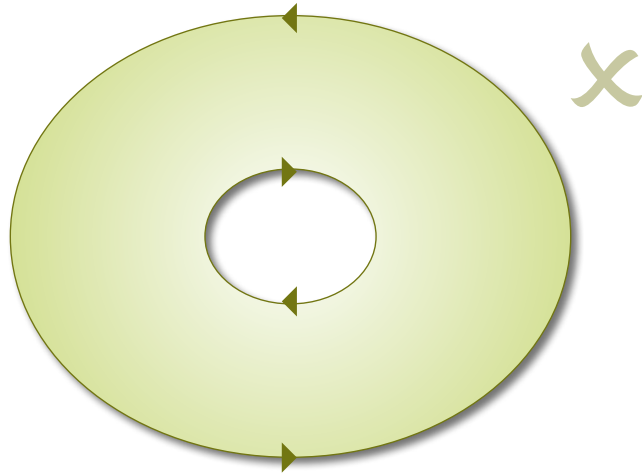
### Description

A polygon geometry should have the same start and end point. This means that the end or 'to' node on the last segment must be incident on the start or 'from' node on the first segment. In case the start and end points are not the same, the polygon will be unclosed.

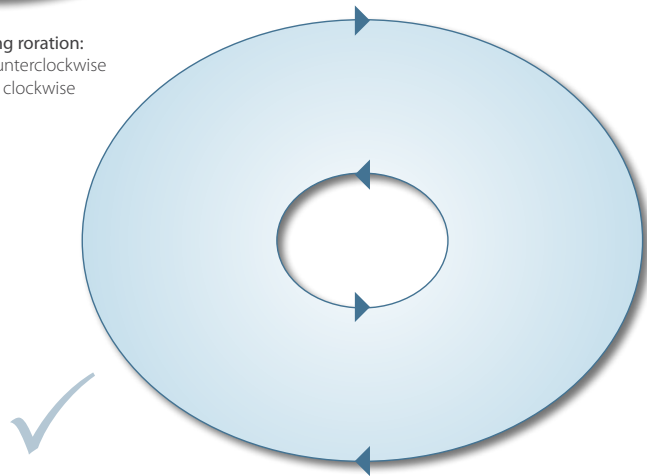
### Resolution

This error can be resolved by ensuring that the start and end nodes are exactly the same on the first and the last segment within the polygon. This error correction process can be automated.

EXAMPLE



**Incorrect ring rotation:**  
Outer ring - counterclockwise  
Inner ring - clockwise



**Correct ring rotation:**  
Outer ring - clockwise  
Inner ring - counter clockwise

### Anomaly #103

## Internal Polygons with Incorrect Rotation:

### Geometries affected

1. Polygons

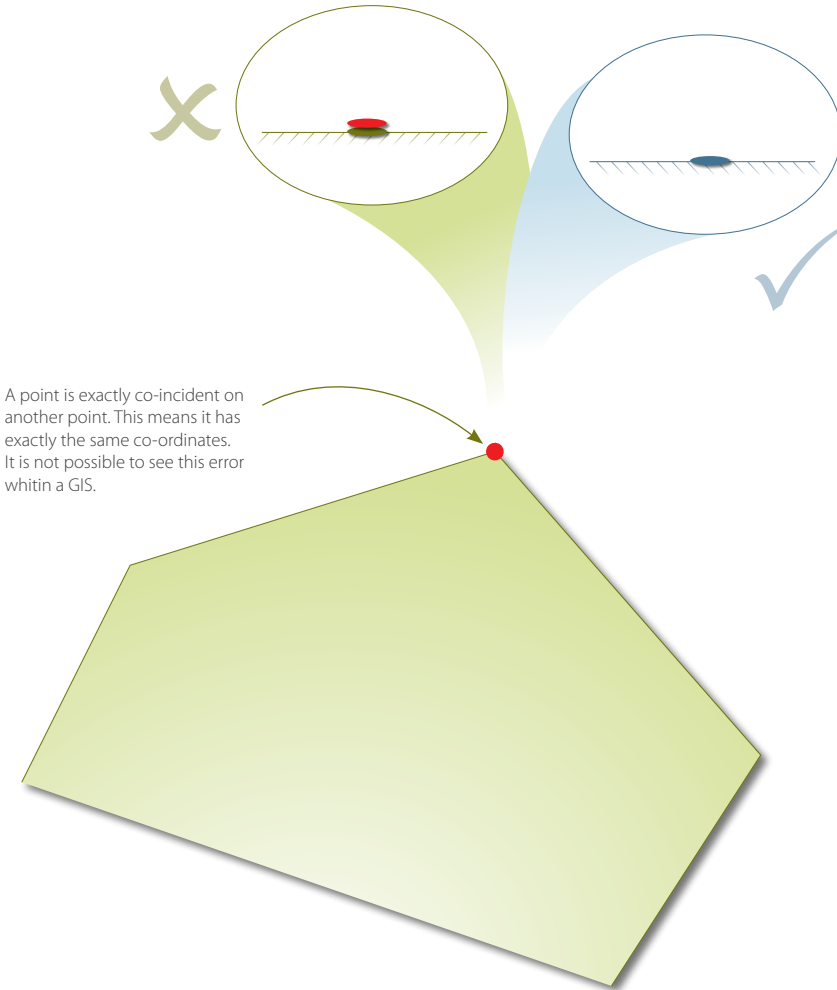
### Description

When the polygon is topologically simple, but its rings are not oriented correctly, the problem results in incorrect ring rotation. The external ring of a polygon should be oriented clockwise whereas internal rings should be counterclockwise.

### Resolution

This error is resolved by reversing or flipping the orientation of the offending ring. This can be an automated process.

EXAMPLE



A point is exactly co-incident on another point. This means it has exactly the same co-ordinates. It is not possible to see this error within a GIS.

Anomaly #104

### Duplicated Points:

Geometries affected

1. Points
2. Lines
3. Polygons

Description

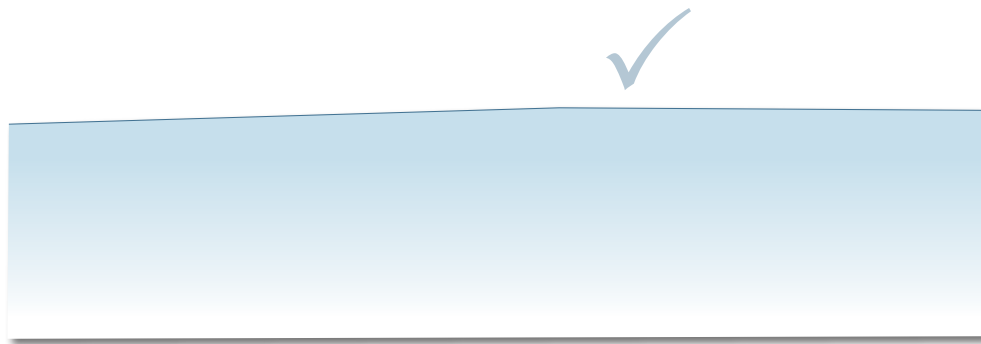
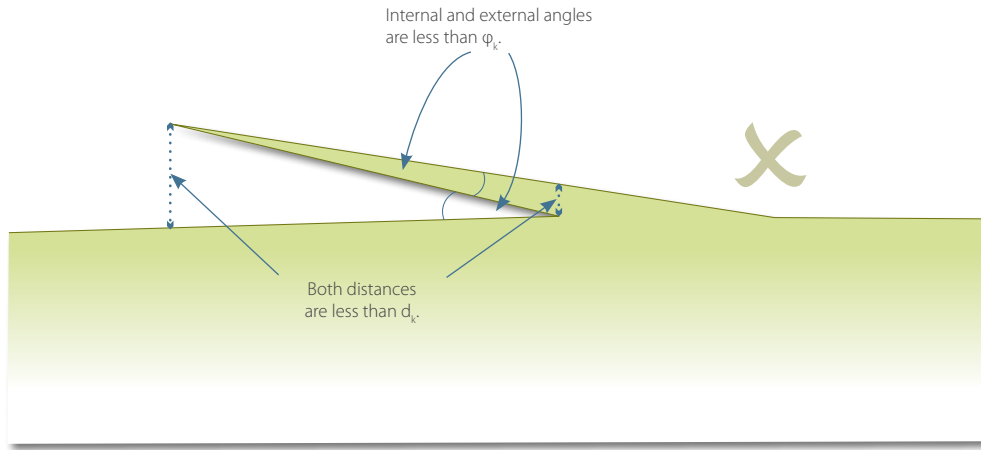
As no tolerance is used in this test, a duplicate point is seen to have exactly the same co-ordinates as another point. For lines and polygons this means that one point in the line or polygon feature is incident upon another point. If a point of one feature is exactly incident on a point of another feature, the two features are seen overlapping.

The use of a tolerance to return points which are within a distance of each other will return a different result to the approach with no tolerance used. The short segment test replicates this approach with a tolerance specified prior to the test being run.

### Resolution

The error is resolved by automated techniques. If no tolerance is used, the geometry of the object will not be altered by such techniques.

EXAMPLE



## Anomaly #105

### Kickbacks:

#### Geometries affected

1. Lines
2. Polygons

#### Description

An event is defined as a kickback when:

1. The internal and external angles between two segments are less than  $\phi_k$  (e. g. 55 degrees);
2. Both the distance between the external spike and the external polygon boundary and the distance between the internal spike and the internal polygon boundary are less than  $d_k$  (e. g. 1 metre).

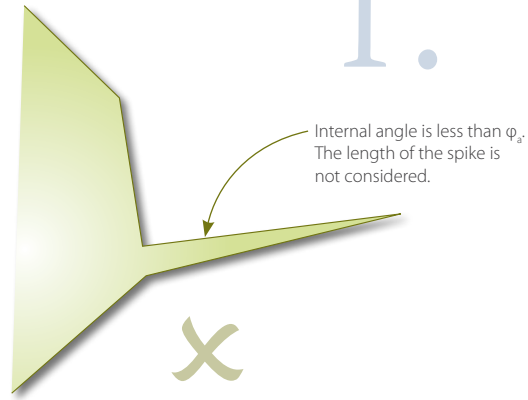
There is commonality between the kickback test algorithm and the spike test algorithm, which means that errors can be labeled both as a kickback and a spike. The parameters set for these two tests are seen to be the best compromise between picking up genuine issues and not reporting too many false positives.

### Resolution

The error can be resolved by editing the offending kickback within a GIS environment.

EXAMPLE

1.



Anomaly #106

Spikes:

Geometries affected

1. Lines
2. Polygons

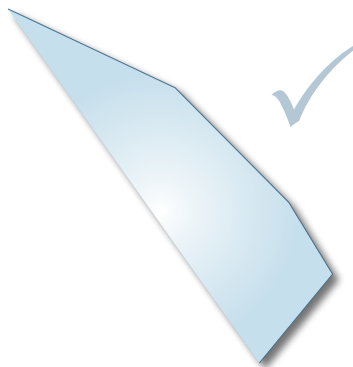
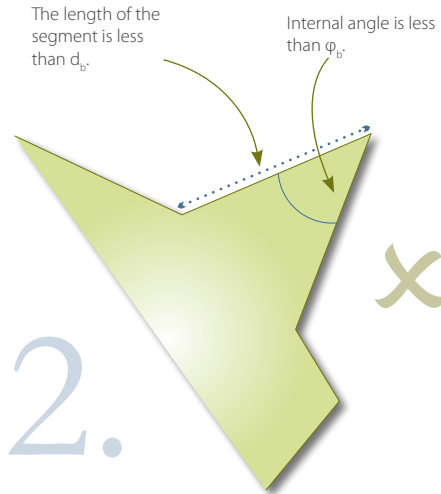
Description

A Spike is formed when:

1. The internal angle of the two segments that make up the spike is less than  $\phi_a$  (e. g. 5 degrees); or
2. The internal angle between the two segments is less than  $\phi_b$  (e. g. 55 degrees) and the segment length is less than  $d_b$  (e. g. 2 metres).

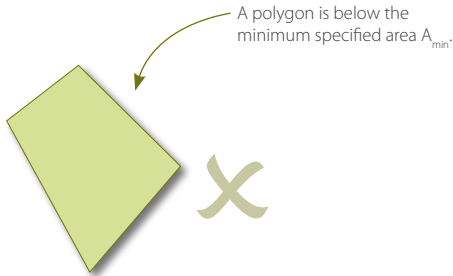
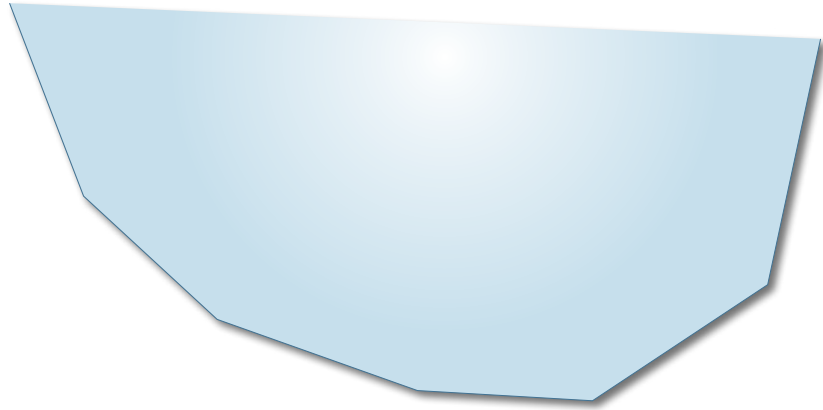
Resolution

The error can be resolved by editing the offending kickback within a GIS environment.





EXAMPLE



A polygon is below the minimum specified area  $A_{min}$ .

### Anomaly #107

## Small Areas (polygon less than a specified size in square metres):

### Geometries affected

1. Polygons

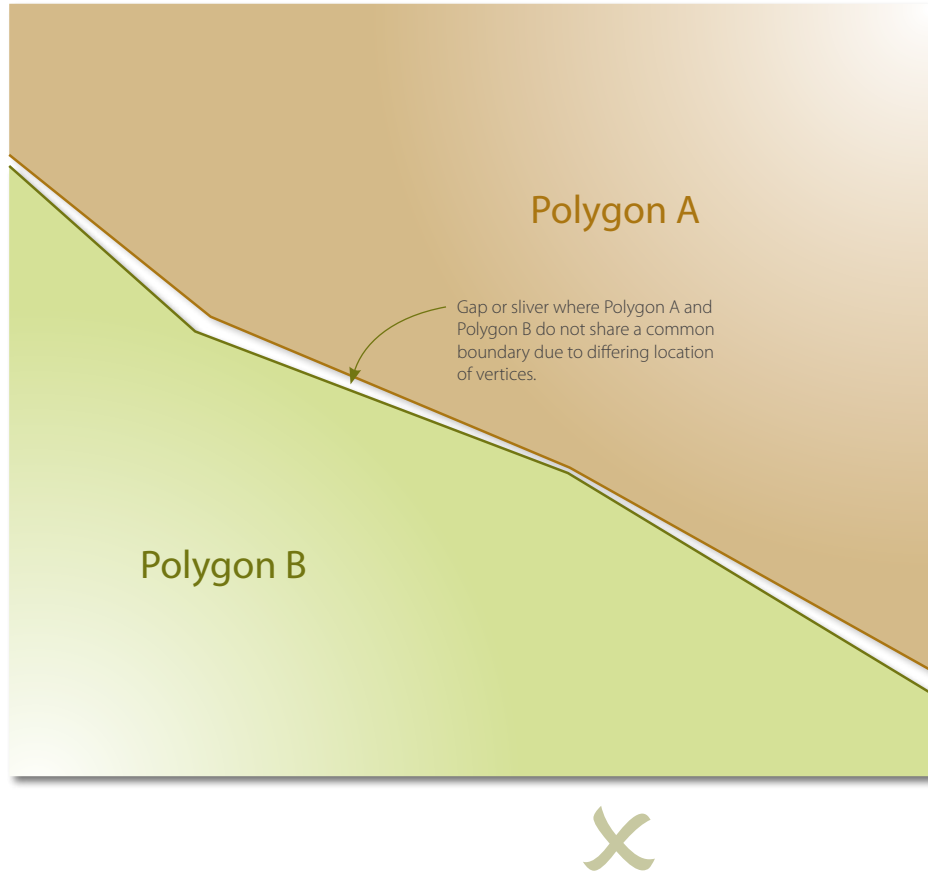
### Description

A 'small area' anomaly is reported when the area of the polygon is below a specified threshold,  $A_{min}$  (e. g. 10 m<sup>2</sup>).

### Resolution

This error is resolved by deleting the polygon feature with an area below the threshold. The deletion process can either take place in a GIS environment or a database environment as a batch process based on selection criteria applied against the dataset.

EXAMPLE



### Anomaly #108

## Slivers or Gaps:

### Geometries affected

1. Polygons

### Description

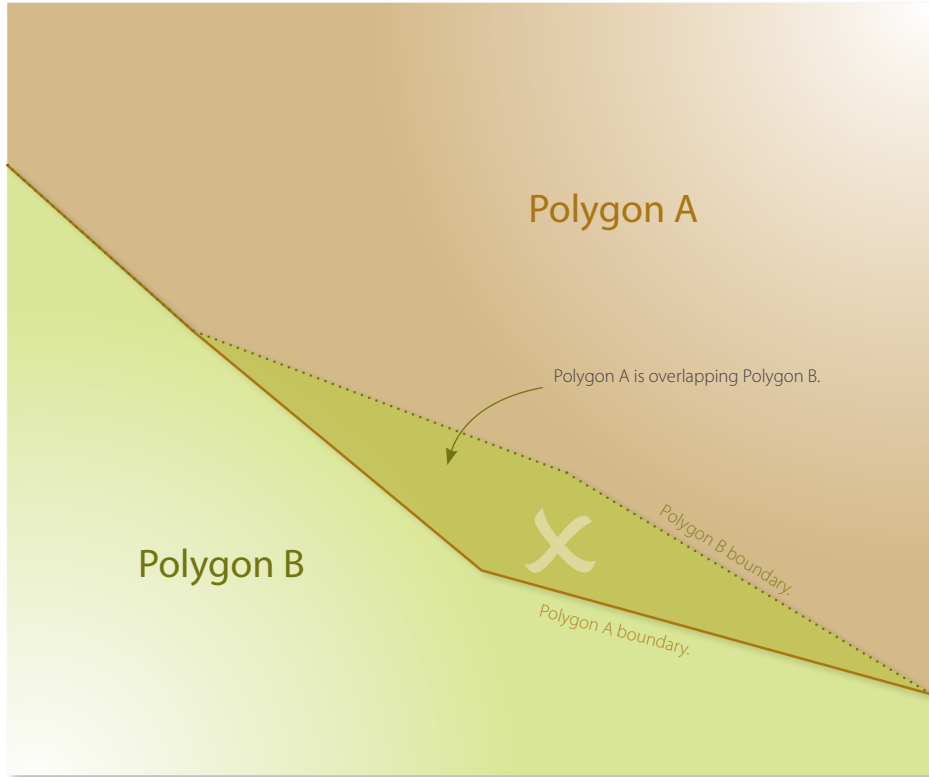
A sliver or gap is formed when:

1. The area of inner rings remaining after neighbours are merged is less than  $A_s$  (e. g. 2 m<sup>2</sup>) or
2. The area of the gap is less than the perimeter (in metres).

### Resolution

This error is resolved by manually editing the polygon vertices or running a 'clean' process against the dataset which would result in the polygon boundaries snapping together.

EXAMPLE



Anomaly #109

## Overlapping Polygons:

### Geometries affected

1. Polygons

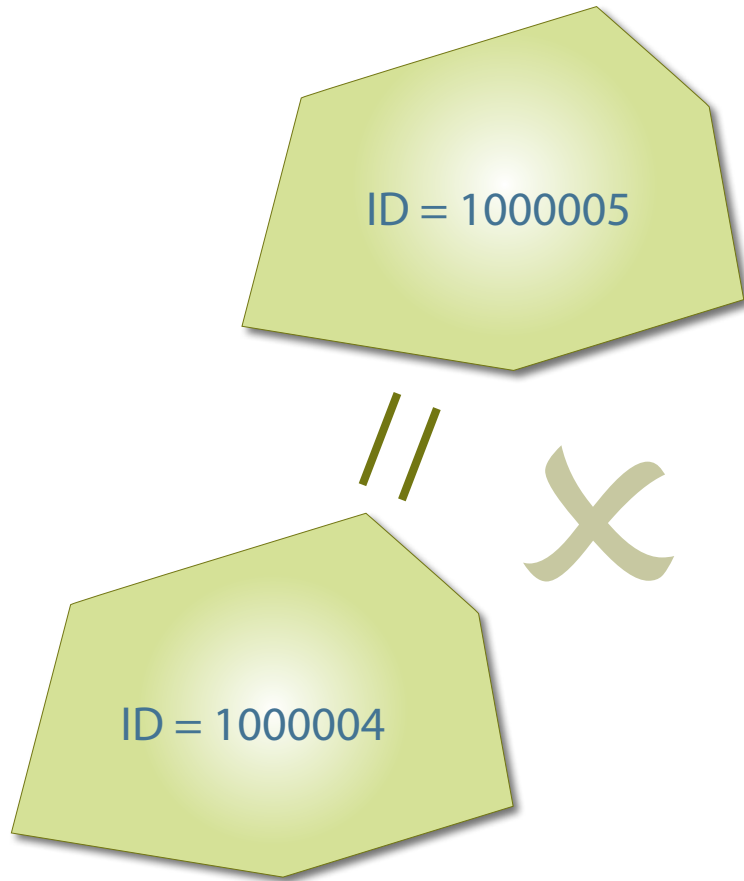
### Description

An overlapping polygon is computed by looking at the geometric intersection of any contiguous polygons. If the result is not empty, there is an overlap – regardless of size.

### Resolution

This error is resolved by editing the polygon vertices manually, or running a 'clean' process against the dataset, which will result in the polygon boundaries snapping together if they are within the specified tolerance.

EXAMPLE



### Anomaly #110

## Duplicate Polygons (polygons with identical attributes):

Geometries affected

1. Polygons

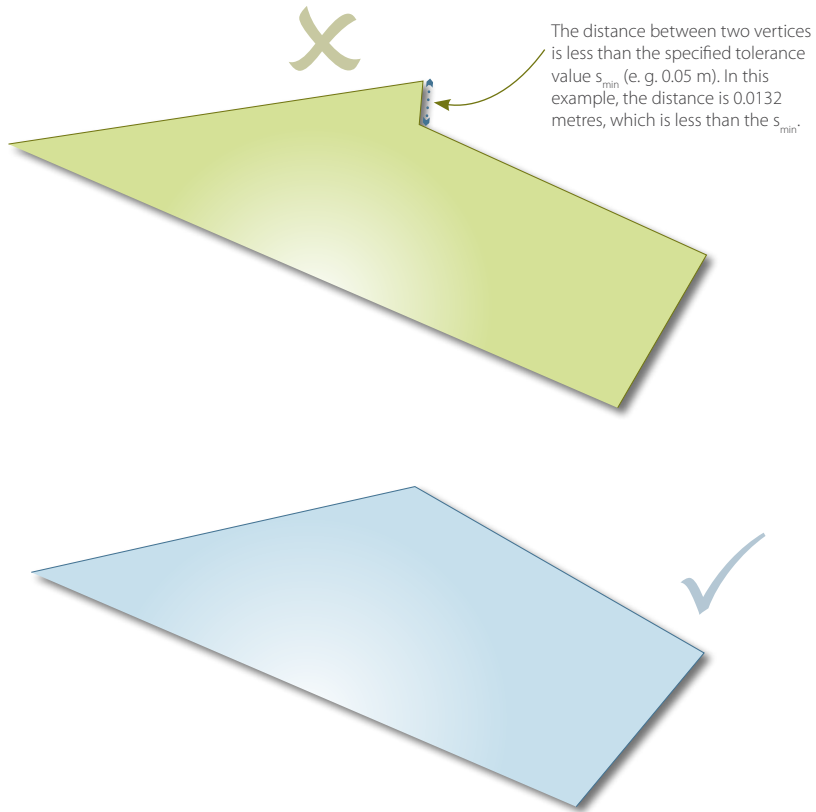
### Description

A duplicate polygon is seen as an exact copy of another polygon both in attribution and geometry. The only thing telling the two features apart is that each one would have a different feature identifier within the dataset.

### Resolution

This error is resolved by deleting a row from the dataset to remove the duplicate polygon.

EXAMPLE



### Anomaly #111

## Short Segments

### Geometries affected

1. Lines
2. Polygons

### Description

A short segment is reported when two subsequent vertices fall within a specified tolerance to each other. The default value is  $s_{min}$  (e. g. 0.05 metres).

### Resolution

This error is resolved by deleting one of the vertices within a GIS editing environment.

## EXAMPLE

ID	GEOMETRY	AREA	VALUE
1000001	POLYGON	1023,56	512
1000002	NULL ✘	0	43
1000003	POLYGON	523,23	231

Anomaly #112**Null Geometry - Table records with Null Shape:**

## Geometries affected

1. Points
2. Lines
3. Polygons

## Description

The line, point, or polygon feature has no values in the geometry column of the dataset. As the geometry column is null, no feature is associated with the row.

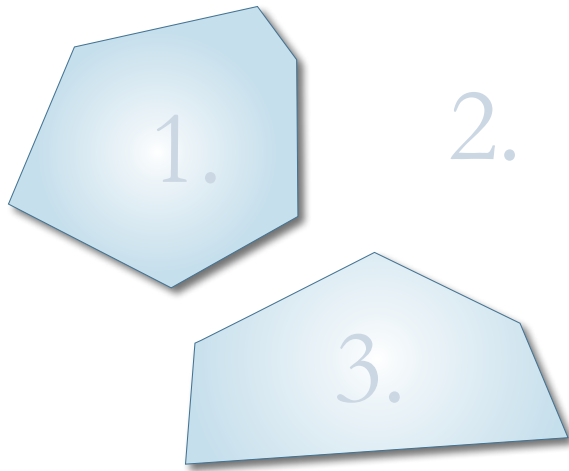
**Resolution**

This error is resolved by deleting the row within the dataset.

## EXAMPLE

Second polygon part is empty.

MULTIPOLYGON ((123..., 432...), **()**, (345..., 654...))

Anomaly #114**Empty Parts (geometry has multiple parts and one is empty):**

## Geometries affected

1. Points
2. Lines
3. Polygons

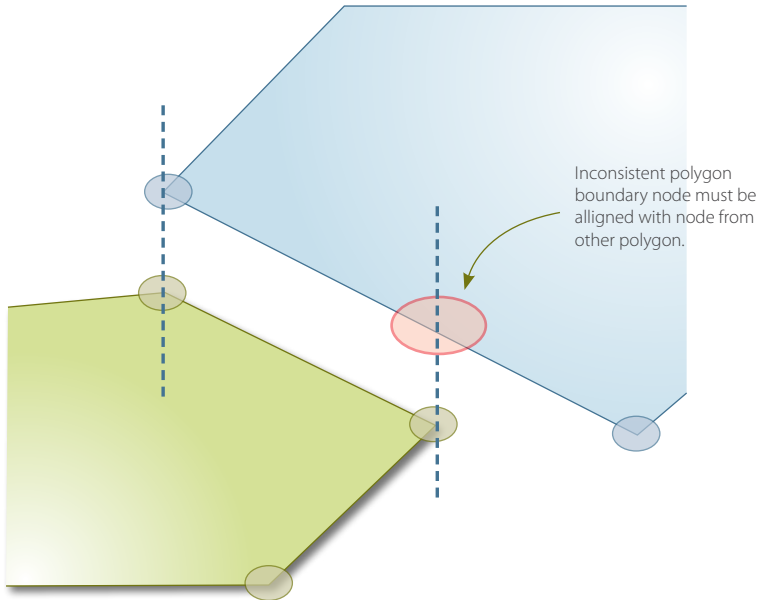
## Description

Empty parts occur within a multipart feature, such as a multipart line or polygon. An Empty Part occurs when a geometry within the multipart feature is null.

**Resolution**

This error is resolved by editing the multipart feature.

## EXAMPLE

Anomaly #115**Inconsistent polygon boundary node:**

## Geometries affected

1. Polygons

## Description

A polygon boundary node touches another boundary edge. Polygon boundaries are consistent when all shared boundaries touch each other in their nodes.

**Resolution**

This error is resolved by aligning the polygon boundaries in a way, that all shared boundaries touch each other in their nodes.





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