Indicators and trends

Monitoring climate change adaptation

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Indicator name				Version
BT17 Risk of traffic disruption as a result of flooding				**14/03/16**

Indicator type:	**Risk/opportunity**	**Impact**	**Action**
	X		

SCCAP Theme	SCCAP Objective	CCRA risk/opportunity
Buildings and infrastructure networks	B1; B2; B3	FL8a Roads at significant risk of flooding TR1 Disruption of road traffic due to flooding

At a glance
• Climate change projections suggest that flooding of road infrastructure in Scotland will become more extensive and more frequent resulting in disruption to traffic, particularly on roads carrying large traffic flows. • Only a very small proportion of the trunk road network is at risk of high levels of traffic disruption as a result of flooding (under 2%). These areas are mostly in the central belt.

Latest Figure	Trend
Current headline figures for the trunk road network are listed below[1]: • 0.21% of the trunk road network is at risk of high levels of traffic disruption as a result of fluvial flooding • 0.9% of the trunk road network is at risk of high levels of traffic disruption as a result of pluvial flooding • 0.06% of the trunk road network is at risk of high levels of traffic disruption as a result of coastal flooding This risk-based indicator is designed to enable the potential for traffic disruption as a result of flooding to be tracked over time.	

Why is this indicator important?

[1] The assessment of this indicator has been undertaken for 0.5% probability (1:200 year) flood events only (see Limitations section for further information)

Flooding can disrupt the operation of the road network with knock-on consequences for many social and economic functions – e.g. delaying deliveries, preventing or delaying people from accessing employment, disrupting vital healthcare services etc.

Climate change will increase flood risk and without adaptation, traffic disruption will also increase. This indicator uses modelled data to assess the risk of traffic disruption as a result of flooding. It provides a range of metrics highlighting the different degrees of flood risk across the trunk road network as a function of traffic volume.

Related Indicators:
BT2 Road network at risk of flooding
BT4 Flood events affecting the trunk road network
BT6 Trunk road network benefitting from fluvial flood protection

What is happening now?

This indicator provides a proxy assessment of the risk of traffic disruption as a result of flooding on the trunk road network. The assessment uses average daily traffic volume thresholds to define the criticality of the road section so that road sections serving higher traffic volumes are considered to be more critical and therefore at risk of higher levels of traffic disruption , given the same probability of flood event occurrence (i.e. where risk is a function of event likelihood and consequence). This assessment defines three levels of traffic volume criticality (high, medium and low) and then determines the proportion of the trunk road network at risk of flooding which falls within each criticality level.

Table 1 below shows the proportion of the trunk road network at risk of flooding (fluvial, pluvial and coastal) within each criticality level threshold[2].

Overall, Table 1 indicates that for the three sources of flooding assessed, the proportion of the trunk road network falling within the high criticality level is lower than the medium and low levels. More specifically, for fluvial source flooding only 0.21% of the trunk road network serves high traffic volumes compared to 0.45% and 1.47% for medium and low traffic volumes respectively. In essence, whilst 2.13% of the trunk road network is exposed to a fluvial flood hazard overall, only 0.21% of the network can be considered at risk of high levels of traffic disruption.

The proportion of the trunk road network that can be considered high risk in terms of the traffic disruption related consequences of pluvial and coastal flooding is 0.9% and 0.06% respectively

Table 1. Proportion of trunk road network at risk of flooding for different levels of traffic disruption (1 in 200 year event)

[2] This assessment mirrors the assessment in BT2 *Risk of road closures from flooding* – in that the combined flood risk by source across all criticality thresholds in this is equal to relevant trunk road outputs from BT2.

Flood source	Trunk road traffic disruption			Disruption (all levels)
	High	Medium	Low	
Fluvial	**0.21%**	**0.45%**	**1.47%**	**2.13%**
Pluvial	**0.9%**	**1.19%**	**3.15%**	**5.24%**
Coastal	**0.06%**	**0.14%**	**0.53%**	**0.73%**
Disruption (all sources)	**1.17%**	**1.78%**	**5.15%**	**8.1%**

Note: Metrics are presented in terms of 'trunk road traffic disruption' based on the level of traffic carried by sections of the trunk road network, where severe disruption corresponds to a high level of traffic, moderate disruption to a medium level of traffic and minor disruption to a low level of traffic. The figures represent the proportion of the trunk road network that would experience a given level of disruption (high, medium and low) should flooding take place, for a 1:200 year flood event. Further, the level of disruption provides a proxy for flood event consequence, therefore, taking flood likelihood as constant (1:200 year), the portion of the trunk road network where traffic disruption is severe can be considered high risk overall, where flood risk is a function of the likelihood of an event occurring combined with its consequences (see Table 4 for further information).

Geographically, sections of the trunk road network that are at 'high risk' of traffic disruption due to flooding (all sources) are focussed around the central belt of Scotland (M8, M73, M74, M77, M80, M9 and M90), reflecting the densely populated nature of the region and the associated high demand for transport. See Figure 1 below. Areas of pluvial and fluvial flood risk are across the region reflecting the spatial distribution of watercourses and their catchments (fluvial flood risk) and roads and other less permeable features (pluvial flood risk). There are two key areas at risk of high levels of traffic disruption due to coastal flooding where trunk road routes coincide with the Firth of Clyde and the Firth of Forth and areas of high traffic demand (M8 east of Langbank and the M9 south of Bridge of Allan).

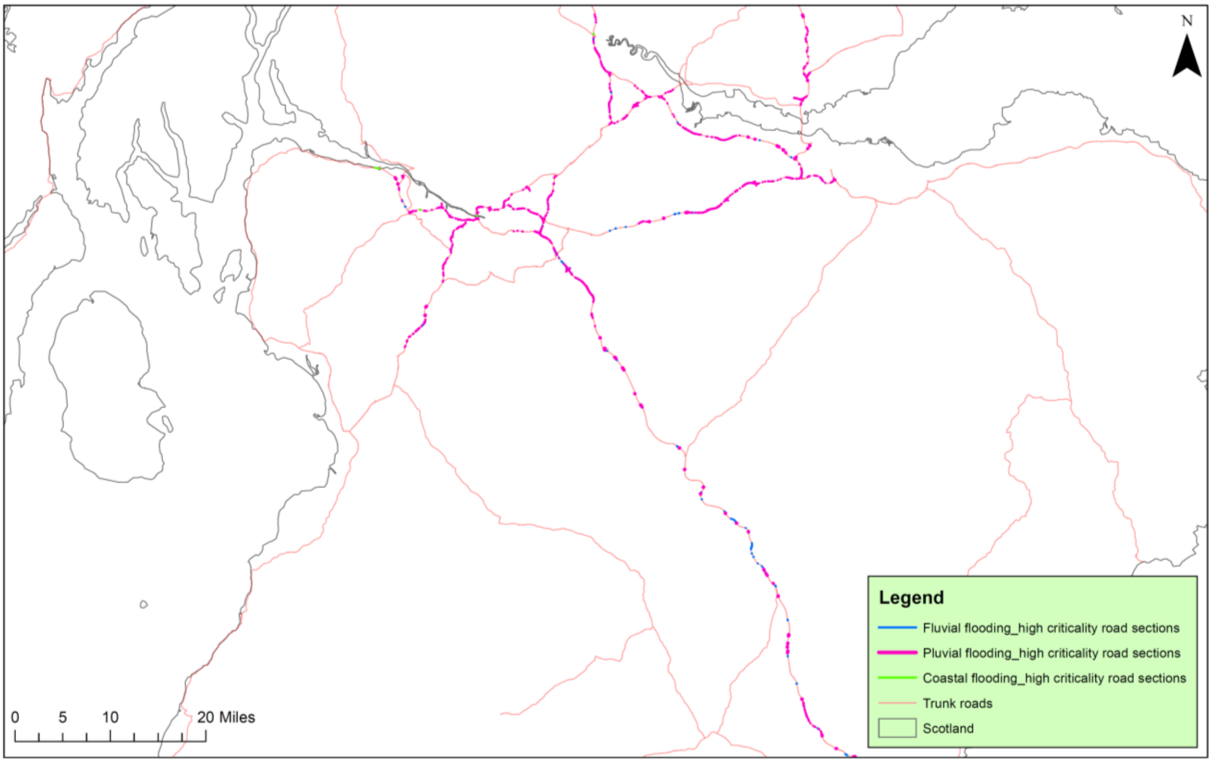

Figure 1 Sections of the trunk road network that are at 'high risk' of traffic disruption due to flooding

Note: Sections of the trunk road network at risk of fluvial and pluvial source flooding are coincidental in some instances. Where this is the case the fluvial source flood risk (blue lines) may not show up on the map above.

What has happened in the past?

Historic flood hazard and traffic volume data is not available to assess BT17 metrics in earlier years. However, past climate data shows how key aspects of climate (such as rainfall) have changed. Overall there is a clear upward trend in winter precipitation as well as increasing heavy rainfall in winter (Sniffer, 2014). It is likely that these climatic changes will have led to increased frequency and extent of pluvial and fluvial source flooding. In the context of BT17 however it is not possible to understand how the risk of traffic disruption as a result of flooding has changed without access to historic traffic volume (i.e. road criticality) data. Trends in traffic volume are influenced by a range of transport supply and demand factors such as extent and condition of the trunk road network, demographics, population distribution and economic factors.

What is projected to happen in the future?

The UK Climate Change Risk Assessment (HR Wallingford et al, 2012a; Thornes et al, 2012) assessed changes in flood risk to road infrastructure as a result of anticipated climate changes. Whilst this assessment was only undertaken for England and Wales (due to data availability) it provides a broad indication of what might happen in Scotland in the future given anticipated climate changes. Given this, transport specific aspects from the UK CCRA (ibid) can be used in conjunction with general aspects from the Scotland CCRA (HR Wallingford et al, 2012b) to understand how flood risk to road infrastructure might change in the future. BT2 provides a detailed description of the assessment undertaken. In summary however the following projected changes are anticipated to take place in the future:

- The proportion of the road network located in areas at risk of flooding is projected to increase
- Road infrastructure that is already located in the floodplain is expected to be affected by flooding more frequently
- Increased incidence of intense rainfall events may result in more frequent pluvial flooding

In relation to this indicator, the first projected change is of particular relevance. If the proportion of the road network located in areas exposed to flood hazards increases, additional road sections with potentially different traffic volume patterns would be exposed also. This would increase the overall exposure of the trunk road network. It may also be the case that the proportion of high, medium and low risk changes also.

Furthermore, changes in transport system supply and demand could also influence future disruption. Structural changes in population (e.g. a higher proportion of elderly people), population size and distribution, and wider economic factors will all affect transport demand. Changes in the transport system (e.g. new roads, road enhancements) will affect supply. All of these factors have the potential to influence traffic volumes and the spatial distribution of high, medium and low traffic volumes (criticality) and thus risk. It has not been possible to assess the potential influence of transport system supply and demand on future risks though the transport infrastructure overview document provides a summary of trends for key contextual indicators.

Patterns of change

No patterns of change have been identified

Interpretation of indicator trends

No trends identified due to lack of historical data.

Limitations

Given the nature of the data used to compute these metrics it is not possible to compare either the likelihood or the potential consequences of flood events to other types of disruptive event (such as road traffic collisions or other extreme weather events). Indicator *BT4 Flood events affecting the road network* supports the comparison of the frequency of flood events on the trunk road network to other types of incident.

There are several key limitations to the assessment of this indicator as summarised below:

1. Roads in the floodplain are often raised above the ground surface on embankments. The difference in elevation afforded by these embankments is not always identified in flood modelling and mapping (Thornes et al, 2012). As such it may be the case that flood risk to road infrastructure is over estimated – i.e. where the embankment would raise the road out of the inundated area and this is not reflected in the modelling due to the granularity of SEPA's flood hazard modelling process.
2. The projections of what might happen in the future in terms of risk of road closures due to flooding are based on English and Welsh data only from the UK CCRA (see BT2 assessment also). Whilst this provides a useful broad indication of possible future risks, quantitative assessment is very limited, and the 'future risk assessment' / trends assessment is based on climate projections data only, as per the Scotland CCRA. Furthermore, it has not been possible within the scope of this project to consider how future changes in transport system supply and demand may influence future risk of traffic disruption due to flooding – i.e. given that the spatial distribution of traffic volumes (road infrastructure criticality) may change as a result of changing patterns of supply and demand which, in turn, would influence the spatial distribution of risk.
3. The social and economic effects of flooding are not fully reflected in this assessment which would require a more in-depth understanding of the duration of the event, the number vehicles affected by a flood event, the journey purpose of those affected and the availability and length of any diversion route amongst other factors.
4. The SEPA Flood Risk Management Strategy Characterisation Data (SEPA, 2015) that underpins the assessment of this indicator includes some inaccuracies when classifying roads. As part of this assessment process a search term[3] is used to extract Baseline Appraisal outputs that relate to trunk roads only (see Table 4). The Baseline Appraisal's classification of trunk roads is not entirely in agreement with Transport Scotland's official list of trunk roads (Transport Scotland, 2015) meaning that the assessment for trunk roads only is a slight over estimate.
5. These metrics have been derived at the national level only. It has not been possible to identify any regional differences in road network exposure to flood risk beyond the simple visual assessment of areas at risk of 'high level disruption' from flooding. As such, future iterations of the indicators could be expanded to include regional assessments (e.g. Local Plan Districts, Potentially Vulnerable Areas, catchments) to explore the degree to which climatic differences across Scotland are reflected in SEPA's flood hazard modelling.

Due to resource constraints, assessment was only undertaken for 0.5% probability (1:200 year) modelled flood events. These are low probability events and are located at the more severe end of the flood event spectrum. Higher probability events (e.g. 1:10, 1:50) can be expected to affect a smaller extent of the network than 1:200 year events but on a more frequent basis. It should also be

[3] Trunk roads are identified in the Baseline Appraisal CLASSIFA field as 'Primary Road' or 'Motorway' (Lauren Addis – SEPA Hydrologist, personal communication, February 17, 2015)

noted that the flood hazard modelling is based on historic data. As a result of climate change, the magnitude of a 1:200 year event may be greater than represented in this analysis.

References

HR Wallingford, AMEC Environment and Infrastructure, The Met Office, Collingwood Environmental Planning, Alexander Ballard Ltd, Paul Watkiss Associates, and Metroeconomica (2012a). *UK Climate Change Risk Assessment* [online]. Available at: https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report [accessed 22/05/15]

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Transport Scotland (2015). *List of roads maintained under Section 2 of the Roads (Scotland) Act 1984* [online]. Available at: http://www.transportscotland.gov.uk/system/files/documents/tsc-basic-pages/Official%20List%20of%20Roads%201%20April%202015.pdf [accessed 21/05/15]

Further information

ClimateXChange (2016) Adaptation to Climate Change: Context and Overview for Transport Infrastructure Indicators. Available online at: http://www.climatexchange.org.uk/adapting-to-climate-change/indicators-and-trends/

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SEPA provided the bulk of the data that underpinned the assessment of this indicator.

Appendix One: Indicator metadata and methodology

Table 1: Indicator metadata

	Metadata
Title of the indicator	Risk of traffic disruption as a result of flooding
Indicator contact: Organisation or individual/s responsible for the indicator	ClimateXChange
Indicator data source	Ordnance Survey – Master Map Integrated Transport Network (ITN) Layer
Data link: URL for retrieving the indicator primary indicator data.	SEPA – Early version of the Flood Risk Management Strategy Characterisation Data (SEPA, 2015)

Table 2: Indicator data

	Indicator data
Temporal coverage: Start and end dates, identifying any significant data gaps.	2015 baseline
Frequency of updates: Planned or potential updates	OS ITN Layer data is updated six weekly.
Spatial coverage: Maximum area for which data is available	Flood Risk Management Strategy data to be updated every 6 years
Uncertainties: Uncertainty issues arising from e.g. data collection, aggregation of data, data gaps	Scotland wide
Spatial resolution: Scale/unit for which data is collected	See 'Limitations' section
Categorical resolution: Potential for disaggregation of data into categories	Flooding data to 5m resolution
Data accessibility: Restrictions on usage, relevant terms & conditions	Analysis by sub-regions (e.g. Local Plan District) would be possible, but not currently undertaken.

Table 3 Contributing data sources

Contributing data sources Data sets used to create the indicator data, the organisation responsible for them and any URLs which provide access to the data.
Ordnance Survey Master Map Integrated Transport Network (ITN) Layer: http://www.ordnancesurvey.co.uk/business-and-government/products/itn-layer.html SSEPA's Flood Risk Management Strategy Characterisation Data (SEPA, 2015) [not available online]

Table 4 Indicator methodology

Indicator methodology The methodology used to create the indicator data
This indicator comprises 9 separate metrics. Individual methodologies have been provided for each separate metric. A separate methodology has been provided for common elements. This section begins with an introduction to the general approach adopted. *Introduction to the approach* This indicator provides a proxy assessment of risk of traffic disruption as a result of flooding for the trunk road network only. The proxy assessment is based on traffic volume thresholds which are used to define the criticality of the road section – i.e. the greater the volume of traffic the more critical the road section (in terms of transport dependent services and activities) and the more susceptible it is to disruption by flooding. This type of criticality approach has also been adopted in the English climate change adaptation indicators (HR Wallingford, 2014) to improve the understanding of risk – i.e. where risk is a function of the likelihood of an event occurring combined with the consequences. In this respect, sections of road at risk of flooding serving high traffic volumes will be at greater risk than road sections serving lower traffic volumes, where the probability of flooding is the same. The assessment of this indicator is based primarily on an early version of SEPA's Flood Risk Management Strategy Characterisation Data 'flooded sections' outputs for fluvial, pluvial and coastal source flooding (SEPA, 2015). These outputs include a 'VOLUME' field defining traffic volumes in terms of annual average daily traffic for each road section identified as at risk of flooding through SEPA's modelling and assessment. This field is used to define traffic volume criticality thresholds that in turn are used to identify the proportion of the road network at risk of flooding (all sources) carrying high, medium and low traffic volumes. The 'flooded sections' outputs identify only those sections of the road where flood depth is greater than 0.15m – this is the depth at which safe driving is impeded. SEPA's modelled assessment of flood risk to road infrastructure, as per the Baseline Appraisal Method for Flood Risk Management Strategies (ibid) is used. This is a risk indicator based on modelled predictions of flood hazards and risks i.e. it is not based on data from actual flood events / impacts observed on the ground – this is picked up through indicator BT4 *flood events affecting the road network*. It should also be noted that given resource constraints, the assessment of this indicator has been undertaken for 0.5% probability (1:200 year) flood events only.

Metrics assessed under indicator BT17

Box 1. The nine metrics assessed under indicator BT17

1. Proportion of trunk road network at risk of **fluvia**l flooding carrying **high** traffic volumes
2. Proportion of trunk road network at risk of **fluvial** flooding carrying **medium** traffic volumes
3. Proportion of trunk road network at risk of **fluvial** flooding carrying **low** traffic volumes
4. Proportion of trunk road network at risk of **pluvial** flooding carrying **high** traffic volumes
5. Proportion of trunk road network at risk of **pluvial** flooding carrying **medium** traffic volumes
6. Proportion of trunk road network at risk of **pluvial** flooding carrying **low** traffic volumes
7. Proportion of trunk road network at risk of **coastal** flooding carrying **high** traffic volumes
8. Proportion of trunk road network at risk of **coastal** flooding carrying **medium** traffic volumes
9. Proportion of trunk road network at risk of **coastal** flooding carrying **low** traffic volumes

Note: All metrics assess risk of traffic disruption on the basis of 'flooded section' outputs from SEPA's Baseline Appraisal. These outputs identify only sections of the road where flood depth is greater than 0.15m i.e. just the parts of the road where that criteria is exceeded. This is the output of a GIS clip process. This output will always be smaller than the associated impacted sections output[4].

Approach for defining criticality thresholds

Criticality thresholds are used to define sections of the trunk road network exposed to flood hazards that are high, medium and low risk. In essence, road sections exposed to flooding serving high traffic volumes are considered to be high criticality and therefore high risk etc. The following approach to defining criticality thresholds has been adopted (noting that this is based on ArcGIS functionality):

1. Redefine the symbology for the SEPA fluvial flooding 'flooded sections' layer to the 'VOLUME' field (traffic volume) using the 'quantities' option.
2. Use the 'Natural Breaks' (Jenks) classification option defined to 3 classes.
3. Make a note of the 'VOLUME' (traffic volume) thresholds within each band.

Stakeholders should note that the methodology outlined above has been undertaken for fluvial flooding 'flooded sections' data. The volume thresholds identified at (3) have then been applied to pluvial and coastal source flooding also. The volume thresholds applied in the remainder of the methodology (detailed below) are based on traffic volume data incorporated in SEPA's Flood Risk Management Strategy Characterisation Data as supplied in April 2015.

Methodologies adopted in the assessment of BT17 metrics

This section provides details of the methodology adopted to assess each BT17 metric. The methodologies include steps that are undertaken in a GIS indicated in pale green and steps that are undertaken in Microsoft Excel indicated in dark green. A separate metric calculation template has been created in Microsoft Excel.

Assessment methodology for Metrics 1, 2 and 3 – risk of traffic disruption from FLUVIAL flooding	
Step	**Method**
1	Sum the SHAPE_Length field from OS MasterMap Integrated Transport Network (ITN) Trunk Roads only Layer
2	Select trunk roads only from the RoadsFldLen ("flooded sections") SEPA Baseline Appraisal **fluvial** output using the following query: "CLASSIFICA" = 'Primary Road' OR "CLASSIFICA" = 'Motorway'
3	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **high** traffic volumes (i.e. high criticality sections) using the following query: VOLUME > 838
4	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **medium** traffic volumes (i.e. medium criticality sections) using the following query: VOLUME > 579 AND VOLUME ≤ 838

[4] Ruth Ellis (SEPA Hydrologist), personal communication, October 14, 2014.

5	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **low** traffic volumes (i.e. low criticality sections) using the following query: VOLUME ≤ 579
6	Sum the FLLength field from the output of Assessment Step **No.3** to identify the total length of flooded (fluvial) trunk road sections that are **high** criticality
7	Sum the FLLength field from the output of Assessment Step **No.4** to identify the total length of flooded (fluvial) trunk road sections that are **medium** criticality
8	Sum the FLLength field from the output of Assessment Step **No.5** to identify the total length of flooded (fluvial) trunk road sections that are **low** criticality
9	Divide the output of Assessment Step **No.6** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.1: *Proportion of trunk road network at risk of **fluvial** flooding carrying **high** traffic volumes*
10	Divide the output of Assessment Step **No.7** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.2: *Proportion of trunk road network at risk of **fluvial** flooding carrying **medium** traffic volumes*
11	Divide the output of Assessment Step **No.8** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.3: *Proportion of trunk road network at risk of **fluvial** flooding carrying **low** traffic volumes*

Assessment methodology for Metrics 4, 5 and 6 – risk of traffic disruption from PLUVIAL flooding	
Step	**Method**
1	Sum the SHAPE_Length field from OS MasterMap Integrated Transport Network (ITN) Trunk Roads only Layer
2	Select trunk roads only from the RoadsFldLen ("flooded sections") SEPA Baseline Appraisal **national pluvial** output using the following query: "CLASSIFICA" = 'Primary Road' OR "CLASSIFICA" = 'Motorway'
3	Select trunk roads only from the RoadsFldLen ("flooded sections") SEPA Baseline Appraisal **regional pluvial** output using the following query: "CLASSIFICA" = 'Primary Road' OR "CLASSIFICA" = 'Motorway'
4	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **high** traffic volumes (i.e. high criticality sections) using the following query: VOLUME > 838
5	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **medium** traffic volumes (i.e. medium criticality sections) using the following query: VOLUME > 579 AND VOLUME ≤ 838
6	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **low** traffic volumes (i.e. low criticality sections) using the following query: VOLUME ≤ 579
7	Select flooded trunk road sections from the output of Assessment Step **No.3** that carry **high** traffic volumes (i.e. high criticality sections) using the following query: VOLUME > 838
8	Select flooded trunk road sections from the output of Assessment Step **No.3** that carry **medium** traffic volumes (i.e. medium criticality sections) using the following query: VOLUME > 579 AND VOLUME ≤ 838
9	Select flooded trunk road sections from the output of Assessment Step **No.3** that carry **low** traffic volumes (i.e. low criticality sections) using the following query: VOLUME ≤ 579
10	Sum the FLLength field from the output of Assessment Step **No.4** to identify the total length of flooded (**national** pluvial) trunk road sections that are **high** criticality
11	Sum the FLLength field from the output of Assessment Step **No.5** to identify the total length of flooded (**national** pluvial) trunk road sections that are **medium** criticality
12	Sum the FLLength field from the output of Assessment Step **No.6** to identify the total length of flooded (**national** pluvial) trunk road sections that are **low** criticality
13	Sum the FLLength field from the output of Assessment Step **No.7** to identify the total length of flooded (**regional** pluvial) trunk road sections that are **high** criticality
14	Sum the FLLength field from the output of Assessment Step **No.8** to identify the total length of flooded (**regional** pluvial) trunk road sections that are **medium** criticality
15	Sum the FLLength field from the output of Assessment Step **No.9** to identify the total length of flooded (**regional** pluvial) trunk road sections that are **low** criticality

16	Sum the output of Assessment Steps **No.10** and **No.13** to identify the total length of flooded (pluvial) trunk road sections that are **high** criticality
17	Sum the output of Assessment Steps **No.11** and **No.14** to identify the total length of flooded (pluvial) trunk road sections that are **medium** criticality
18	Sum the output of Assessment Steps **No.12** and **No.15** to identify the total length of flooded (pluvial) trunk road sections that are **low** criticality
19	Divide the output of Assessment Step **No.16** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.4: *Proportion of trunk road network at risk of* ***pluvial*** *flooding carrying* ***high*** *traffic volumes*
20	Divide the output of Assessment Step **No.17** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.5: *Proportion of trunk road network at risk of* ***pluvial*** *flooding carrying* ***medium*** *traffic volumes*
21	Divide the output of Assessment Step **No.18** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.6: *Proportion of trunk road network at risk of* ***pluvial*** *flooding carrying* ***low*** *traffic volumes*

Assessment methodology for Metrics 7, 8 and 9 – risk of traffic disruption from COASTAL flooding	
Step	**Method**
1	Sum the SHAPE_Length field from OS MasterMap Integrated Transport Network (ITN) Trunk Roads only Layer
2	Select trunk roads only from the RoadsFldLen ("flooded sections") SEPA Baseline Appraisal **coastal** output using the following query: "CLASSIFICA" = 'Primary Road' OR "CLASSIFICA" = 'Motorway'
3	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **high** traffic volumes (i.e. high criticality sections) using the following query: VOLUME > 838
4	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **medium** traffic volumes (i.e. medium criticality sections) using the following query: VOLUME > 579 AND VOLUME ≤ 838
5	Select flooded trunk road sections from the output of Assessment Step **No.2** that carry **low** traffic volumes (i.e. low criticality sections) using the following query: VOLUME ≤ 579
6	Sum the Length_KM[5] field from the output of Assessment Step **No.3** to identify the total length (km) of flooded (coastal) trunk road sections that are **high** criticality
7	Sum the Length_KM[6] field from the output of Assessment Step **No.4** to identify the total length (km) of flooded (coastal) trunk road sections that are **medium** criticality
8	Sum the Length_KM[7] field from the output of Assessment Step **No.5** to identify the total length (km) of flooded (coastal) trunk road sections that are **low** criticality
9	Multiply the output of Assessment Step **No.6** by 1,000 (translates the output into metres instead of kilometres for use in Assessment Step **No.12**)
10	Multiply the output of Assessment Step **No.7** by 1,000 (translates the output into metres instead of kilometres for use in Assessment Step **No.13**)
11	Multiply the output of Assessment Step **No.8** by 1,000 (translates the output into metres instead of kilometres for use in Assessment Step **No.14**)
12	Divide the output of Assessment Step **No.9** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.7: *Proportion of trunk road network at risk of* ***coastal*** *flooding carrying* ***high*** *traffic volumes*

[5] SEPA advised that the Length_KM field should be used as a measure of 'flooded length' in the assessment of coastal flooding metrics. This necessitates a separate step in the assessment of all coastal metrics to translate a kilometres output into a metres output for comparison with other BT2 metrics, which are all assessed in metres: Lauren Addis (SEPA Hydrologist), personal communication, January 27, 2015

[6] Ibid

[7] Ibid

13	Divide the output of Assessment Step **No.10** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.8: *Proportion of trunk road network at risk of **coastal** flooding carrying **medium** traffic volumes*
14	Divide the output of Assessment Step **No.11** by the output of Assessment Step **No.1** and multiply by 100. This produces a figure for BT17 Metric No.9: *Proportion of trunk road network at risk of **coastal** flooding carrying **low** traffic volumes*