Risk of Flooding from Multiple Sources

Dataset Documentation

June 2017

This document will help you understand and use our Risk of Flooding from Multiple Sources (RoFMS) datasets.

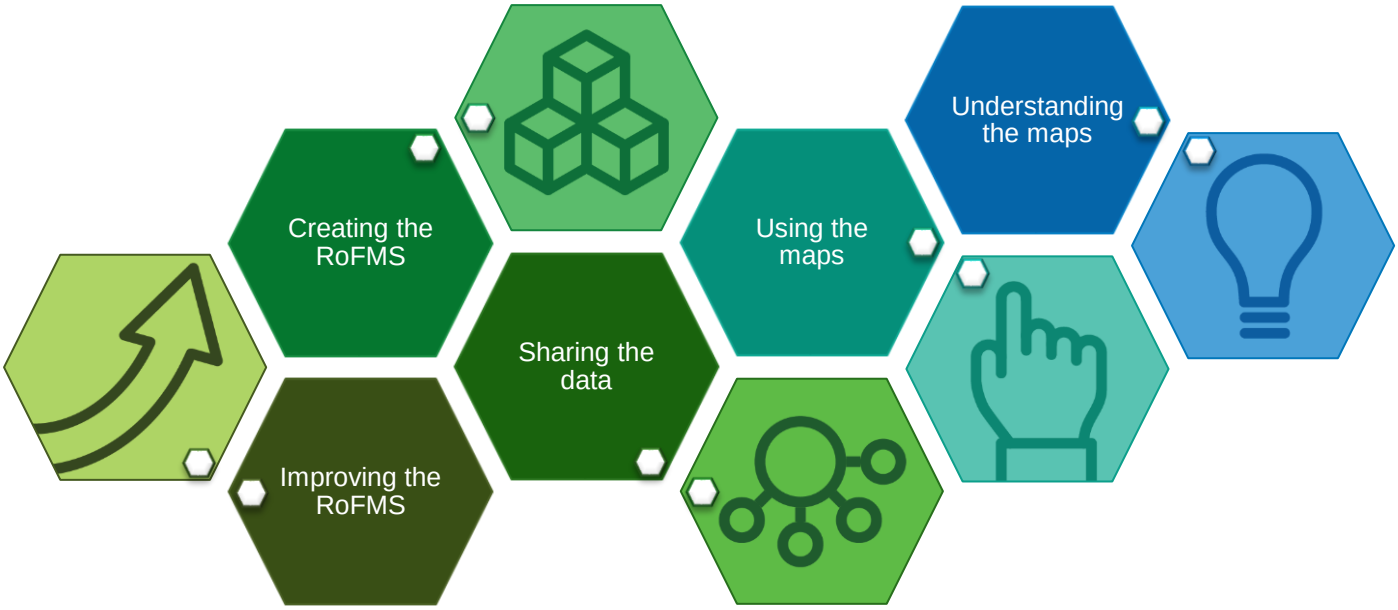
Dataset Overview

Description	The Risk of Flooding from Multiple Sources (RoFMS) is: • a map showing the risk of flooding from multiple* sources for England • produced using our national scale products: Risk of Flooding from Surface Water (RoFSW) and Risk of Flooding from Rivers and the Sea (RoFRS), as inputs • created by adding together risk from individual sources • the first step towards considering combined flood risk *currently, multiple sources includes rivers, the sea and surface water only

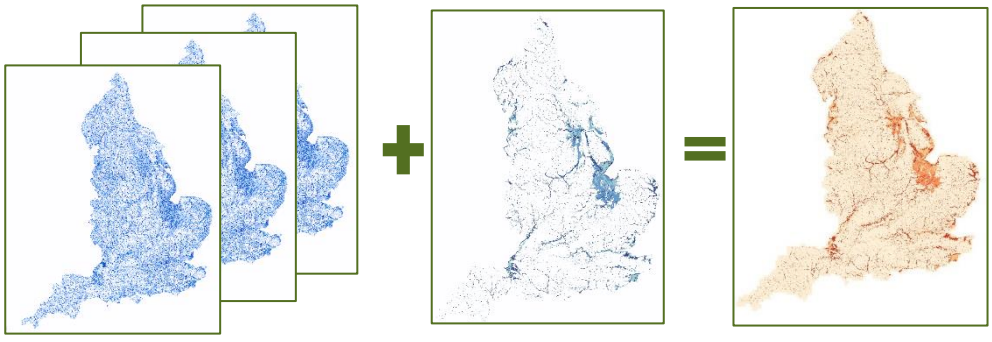
Use	We use it to: • give an indication of the scale and distribution of the risk of flooding from multiple sources in England • raise awareness of locations at risk of flooding from multiple sources Our customers and partners might use it to: • improve understanding of flood risk from multiple sources • target resources for integrated modelling • inform customers of potential flood risk from multiple sources in the area through property reports It is not suitable to be used: • to identify if an individual property will, or will not flood • to count properties at risk (other than at a national scale) • in detailed flood risk assessments • on a map with background mapping more detailed than 1:10,000

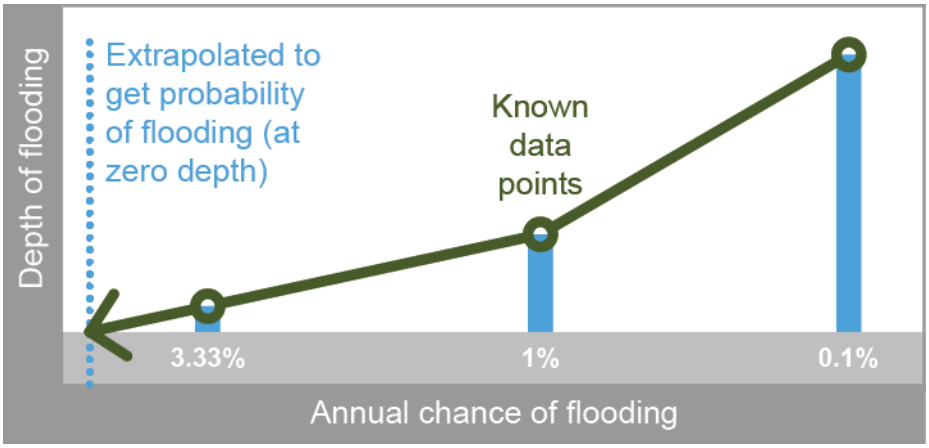
What doesn't it do?	It does not: • replace existing products, including RoFRS and RoFSW • provide further modelling of flood sources, it is simply the result of processing existing model results • show flooding from all potential sources • consider any interaction of multiple sources of flooding with each other

Common questions & known issues



Creating the RoFMS

Why have you created the RoFMS?	We created it to help people understand flooding from combined sources and as part of the implementation of the Flood Re Memorandum of Understanding between Government and the Association of British Insurers (ABI) (2013). It is also the first step towards considering flooding from all sources in our national flood risk assessment for England.
How has the RoFMS been created?	The RoFMS adds together the probability of flooding from Risk of Flooding from River and the Sea (RoFRS) and Risk of Flooding from Surface Water (RoFSW). Probability of flooding from RoFRS is readily available, while probability of flooding from RoFSW is calculated from information from three annual chance depth maps. This approach of simply adding probabilities ignores dependency between sources, although dependency between fluvial and coastal sources is represented already in RoFRS.  RoFSW water depth for 3.3%, 1% and 0.1% annual chances RoFRS flood likelihood category RoFMS risk
Back to the top	As well as the risk band, we have produced information on the proportion of the risk resulting from each source of flooding and an estimate of the reliability of the information.

How is the probability of flooding from RoFSW calculated? Back to the top	We have calculated the probability of flooding from RoFSW at each 2m x 2m cell using depth information from three RoFSW depth maps. The probability of flooding is extrapolated using depth and annual chance (Annual Exceedance Probability - AEP) data points as illustrated below. If the cell is dry for one or more annual chance depth maps, the extrapolated probability will be constrained to the highest annual chance for which the cell appears dry. 
Where can I find out more about how the RoFMS was created? Back to the top	The method we used has been adapted from the Mapping All Sources Tool (MAST) resulting from a research and development project in 2010. You can find more information about MAST in the project summary and associated reports. For more information on how we adapted this tool and used it to create the RoFMS, please see our technical report: Risk of Flooding from Multiple Sources - Technical Report (due for publication in September 2016)

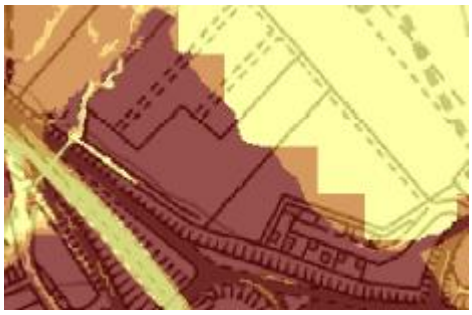
Sharing the maps

Who is the RoFMS for? Back to the top	We created the RoFMS in response to the Flood Re Memorandum of Understanding between Government and the Association of British Insurers (ABI) (2013). However, it is available to anyone who wants to know more about the potential for flooding from multiple sources.
How will insurers use this information? Back to the top	Insurance companies use a range of data sources including flood risk information from the Environment Agency, other commercially developed information purchased from the private sector and their own claims history when issuing insurance quotes. Insurers can access the same information on flood risk as all our customers can on data.gov.uk (https://data.gov.uk/publisher/environment-agency). The Environment Agency has no role in determining insurance cover or setting premiums. Insurers are free to use whichever data they like to determine whether to offer insurance and at what price. The frequency that insurers update their systems with Environment Agency data, if they choose to use it, depends on their policies and capability for updating their systems.
How have you shared the information?	We have shared the RoFMS as 3 GIS layers, available for download from the Environment Agency section on the government's data catalogue (https://data.gov.uk/publisher/environment-agency). This means all our customers have the same access to the information.

Why isn't the map published on your website? Back to the top	We decided not to publish RoFMS as a map online for two reasons: 1. The existing maps on which RoFMS is based (Risk of Flooding from Rivers and the Sea and Risk of Flooding from Surface Water), are a better representation of flood risk from individual sources. 2. We have recently changed the way we share information on flood risk online. We now provide a service where you can easily find out your risk of flooding using a postcode search, rather than having to interpret a series of maps. We believe this is a better way to help customers to understand their risk and do something about it.

Understanding the maps

What sources of flooding does the RoFMS consider? Back to the top	It considers flooding from: • Rivers and the sea • Surface water At this stage, it does not include flooding from groundwater, reservoirs or drainage/sewers
What do the flood risk bands 1-4 mean?	The flood risk bands relate to the overall chance of flooding from any of the potential sources of flooding included in the RoFMS, with 1 describing the highest chance and 4 describing the lowest chance.
What chance of flooding do the flood risk bands 1-4 describe? Back to the top	The flood risk bands relate to the overall chance of flooding from any of the potential sources of flooding included in the RoFMS. The chance of flooding is: • 1 - greater than 3.3% chance of flooding in any year • 2 - between 3.3% and 1% chance of flooding in any year • 3 - between 1% and 0.1% chance of flooding in any year • 4 - below 0.1% chance of flooding in any year 
How do the flood risk bands 1-4 relate to the high, medium and low bands used on the RoFRS and RoFSW maps? Back to the top	The bands we use for RoFMS are the same as the ones we use to show the chance of flooding on RoFRS and RoFSW. At some locations, the chance of flooding will appear the same - for example, a location shown at medium risk of flooding on RoFRS may be in band 2 on RoFMS. But at a location at risk from more than one source, RoFMS may show that the overall chance of flooding (from any source: rivers, sea, or surface water) is higher than the chance of flooding from one specific source, say surface water, as the conditions that lead to flooding from different sources may be different. For example, a location may be at risk of surface water flooding from intense localised short duration rainfall, and may also be at risk of flooding from the river as a result of longer duration, widespread but less intense rainfall. The location would therefore be at risk from both forms of flooding; and although it may be only at medium risk from each separately, there may be a greater than 3.3% chance that it will flooding in any year from one or other of the sources.  If flooding from surface water and the river/sea occur at the same time, then the RoFMS may overestimate the combined likelihood of flooding.

Does the RoFMS replace RoFSW and RoFRS?	No. The Risk of Flooding from Surface Water and the Risk of Flooding from Rivers and the Sea give a better representation of flooding from individual sources.
How does the RoFMS deal with pumped catchments, defence failure or control structures?	RoFMS is the result of processing existing model outputs, so it inherits the information from the input datasets. For example, the way RoFRS deals with pumped catchments, defence failure or control structures, is passed directly into RoFMS, without any changes.
Does depth of flooding affect the combined risk group? Back to the top	No, the RoFMS shows the chance of flooding regardless of depth. Therefore, shallow and deep flood water can occur in the same risk band. This is because the RoFRS outputs show the probability associated with the onset of flooding, not the probability of flooding to a given depth. These outputs are used as the inputs into the RoFMS and are processed without any changes.
How does the RoFMS deal with joint probability?	For RoFMS, we assume the input datasets are independent of each other, therefore no joint probability is assessed between river/sea and surface water. However, where dependency between river and sea flooding has been considered within RoFRS, this is preserved in the RoFMS.
Why is the map so blocky and why do the size of the blocks change? Back to the top	The RoFMS inherits the appearance of the input datasets. The RoFSW data has a finer resolution/smaller cell size than RoFRS. Where there is risk from both RoFSW and RoFRS, or where there is RoFSW only, the finer resolution (2m) is apparent. Elsewhere the larger RoFRS cell size (50m) will be visible. 
Does the 2m resolution mean that it can be used at a property level?	No. The 2m grid for RoFSW is fine enough to allow the RoFSW model to represent some small scale features of the urban landscape such as pathways between buildings that may significantly influence wider inundation patterns. However, although a 2m grid means that the overall patterns of flooding are more representative than they would otherwise be, this does not mean that the mapping is accurate to the nearest 2m. This is due to other uncertainties in the modelling, for example rainfall estimates and the lack of smaller scale local features that may have a big impact on surface water flooding.
Flooding from different sources can occur at the same time or at different times. How does	RoFMS takes the simple approach of adding probabilities from RoFRS and RoFSW and therefore ignores any dependency between sources. This is appropriate if flooding from surface water and river/sea happen separately. If flooding from surface water and the river/sea occur at the same time, then the RoFMS may overestimate the combined likelihood of flooding.

RoFMS deal with this?	The type of rainfall event causing the flooding and the characteristics of the location are two of the things that affect whether flooding from various sources will happen at the same time.
How have you estimated how reliable the results are? **Back to the top**	We have assigned a 'suitability' value to each cell in RoFMS reflecting the confidence we have that the location has been assigned the correct flood likelihood band. This suitability value depends on: 1. the suitability value of the input datasets (RoFRS and RoFSW) at the location 2. whether extrapolation has been used for the RoFSW probability (see "How is the probability of flooding from RoFSW calculated?") 3. a factor to reduce confidence due to the simple addition method used for the combined probabilities (which does not consider dependence) For more details of the approach is provided in the Risk of Flooding from Multiple Sources - Technical Report.

Using the maps

What RoFMS datasets are available? **Back to the top**	There are 3 datasets available for RoFMS. They are: 1. *Risk Band (*raster layer showing risk of flooding from multiple sources, grouped into 4 bands) 2. *Suitability (*raster layer giving an indication of the scale it is appropriate to use the RoFMS, grouped into 5 bands) 3. *Risk Contribution (*raster layer showing the proportion of the combined risk resulting from the primary flood source input data) They are available on *data.gov.uk* to download in two GIS formats: • Layer Packages (*.lpk) containing the data, cartography and other properties of the layer in a single file for ESRI ArcGIS users. • Tagged Image File Format (*.tif) with supporting world files (*.tfw) containing geo-referencing information. Suitable for users of other GIS software, you will need to apply the recommended symbology manually. *See* dataset content and recommended symbology for more information.
What are the strengths of the RoFMS?	The key strength of RoFMS is that it makes flood risk information easier to interpret by combining the probabilities of RoFRS and the depth information of RoFSW into a single probability. This means we can answer some questions about flood risk that we couldn't before. For example: • What is the overall chance that this location will flood*? • How many properties in England have a greater than 3.3% (1 in 30) chance of flooding in any year – irrespective of source*? • How many properties in England have a greater than 1% (1 in 100) chance of flooding in any year – irrespective of source*? • How many properties in [location] have a greater than x% [3.3% or 1%**] chance of flooding in any year – irrespective of source*? (Previously we would have been able to tell how many had a greater than x% chance of flooding from rivers/sea, or from surface water, or from both – but not those where the overall chance of flooding is greater than the separate chances of flooding.)

Back to the top	This approach can be used to help us prioritise actions based on the overall chance of flooding – rather than just the sum of properties with a given risk of flooding from each source in isolation. Note though that counting properties does not constitute a full damage assessment: depth-frequency-damage information is needed to assess this. * From rivers, sea and/or surface water ** We can't answer this question for the 0.1% any better than we could before, with separate maps.
What are the limitations of the RoFMS? Back to the top	As our first step towards understanding flooding from multiple sources, there are some important limitations to be aware of: • The RoFMS inherits the limitations of the input datasets. You can find these limitations described in the documentation accompanying the datasets. • Additional uncertainties are introduced to RoFMS due to the simplified method used to combine the probabilities. In particular, no account is taken of dependencies and an integrated approach modelling combined flood risk has not been used. These additional uncertainties further limit the quality of the product especially where interaction between high river levels and surface water drainage is a significant factor in flooding. • This data should only be used as a first step in assessing flood risk and we strongly recommend that it is used in conjunction with our other flooding information and mapping products. • The RoFMS provides an indication of the likelihood of flooding. Further information is required to determine the expected impact on a specific property. • If you want to display or share this information in map form with others we recommend it should not be used with base mapping more detailed than 1:10,000 as the data is open to misinterpretation if used at a more detailed scale. We will always welcome any feedback on our products. Please send any comments or suggestions to enquiries@environment-agency.gov.uk marked for the attention of Mapping, Modelling and Data.
Is the RoFMS suitable for my purpose? Back to the top	The Suitability Table shows what this means for the suitability and reliability of the data. The suitability rating of the RoFMS ranges between "National to county" and "Street to parcels of land". There are no locations that are suitable for use at a property level. Always check the suitability of the information before using it to make decisions. You can do this by using the RoFMS Suitability dataset.
Can I use this dataset to count properties?	**! Proceed with caution** The nature of surface water information means that flood extents generally don't extend over property footprints, even where model results show that the property may flood internally. This means you should not use a point in property method for counting or you'll underestimate the number of properties at risk. In addition, using a point method with a buffer will often overestimate the properties at risk. Our approach is based on the one we developed for counting properties in RoFSW. The main aspects of the RoFSW method are:

Back to the top	1. Buffer the building footprints by 2m 2. Calculate the proportion of the buffered boundary where the depth is greater than a specified value (for RoFSW, we use 6 different depths) 3. Attribute the property point associated with the building footprint polygon with the proportion of the buffered boundary where the depth is greater than a specified value. 4. Select a depth threshold appropriate for the location and count properties where the wetted perimeter reaches a certain proportion, for example, 50%. We use this method to produce national property counts for RoFSW, however it is not suitable to use unchanged for counts at other scales. To find out more detail about the adapted method used for RoFMS please see the Risk of Flooding from Multiple Sources - Technical Report (due for publication in September). In addition to using the most appropriate method, please be aware that the additive nature of the method to create RoFMS information means combined risk may be overestimated. *(*Please see earlier question*)*

Improving the maps

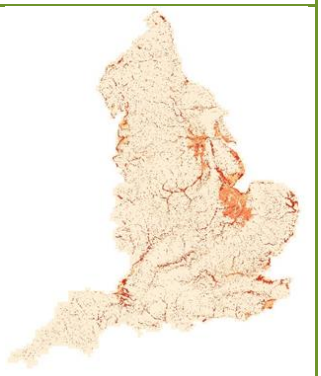
How can I challenge the RoFMS?	If you think that the RoFMS is wrong, it is likely that one of the input datasets has the same issue. First check the input datasets to find out which one it is. • If it is Risk of Flooding from Rivers and the Sea (RoFRS), please contact our National Customer Contact Centre on 03708 506 506 or at enquiries@environment-agency.gov.uk • If it is Risk of Flooding from Surface Water (RoFSW), please contact the relevant Lead Local Flood Authority.
How often is it updated? Back to the top	We do not have a fixed update timetable. Content updates will depend on whether there are updates to the input data and whether we have the resources needed to complete an update. In addition to this, we are reviewing our wider info on flood risk and need to understand how our combined sources work fits within this before we commit to any short term method improvements which may quickly be outdated.
How could you improve the RoFMS? Back to the top	There are a number of ways that RoFMS could be improved: • Using local and/or higher confidence modelling as an input where it exists would make it more accurate. • If all input data had depth information, then the combined probabilities calculation would be possible for different depth threshold other than zero depth. This would mean we could say how likely flooding at different depths was. • Improve the method to calculate the combined probabilities - this will need more data on dependencies and integrated modelling in many locations but would make it more accurate. • Consider more sources of flooding where suitable information is available. This would improve our understanding of flood risk from multiple sources.

Suitability Table

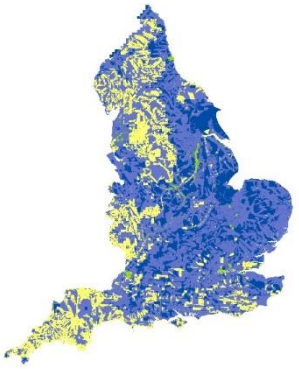
Suitability: 'it's good enough for...'		Reliability: 'how good is it for...'	
Indicative suitable scale	**Indicative suitable use**	**How reliable is this for a local area?**	**How reliable is this for an individual property?**
National to county suitable for identifying which parts of the country or counties are at risk, or which counties have the most risk	Suitable for identifying areas with a natural vulnerability to flood first, deepest or most frequently.	Very unlikely to be reliable for a local area.	Extremely unlikely to be reliable for identifying individual properties at risk.
County to town suitable for identifying which parts of counties or towns are at risk, or which counties or towns have the most risk	Suitable for identifying approximate extents, shallower and deeper areas.	Unlikely to be reliable for a local area.	Very unlikely to be reliable for identifying individual properties at risk.
Town to street suitable for identifying which parts of towns or streets are at risk, or which towns or streets have the most risk	Suitable for identifying flood extents and identifying streets at risk of flooding.	Likely to be reliable for a local area (and so the information is suitable for areas of land, not individual properties).	Unlikely to be reliable for identifying individual properties at risk (and so the information is suitable for areas of land, not individual properties).
Street to parcels of land suitable for identifying which parts of streets or parcels* of land are at risk, or which streets or parcels of land have the most risk	Suitable for identifying flood extents and identifying parcels of land at risk of flooding.	Very likely to be reliable for a local area (and so the information is suitable for areas of land, not individual properties).	Likely to be reliable for identifying individual properties at risk (though not whether they flood internally, so the information is suitable for areas of land, not individual properties).
Property (including internal) suitable for identifying which parts of a property are at risk (including internal / external distinction), or which properties have the most risk	Suitable for identifying flood extents and distinguishing between street and property flooding.	Extremely likely to be reliable for a local area.	Likely to be very reliable at identifying individual properties at risk, including depths of flooding internally (this provides a genuine property level assessment).

Dataset content and recommended symbology

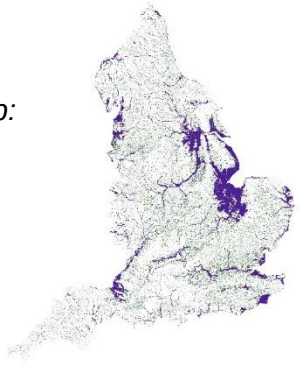
Risk of Flooding from Multiple Sources: Risk Band		
Description	GIS Raster layer showing risk of flooding from multiple sources, grouped into 4 bands.	
Value	1	RGB (215,48,31)
	2	RGB (252,141,89)
	3	RGB (253,204,138)
	4	RGB (254,240,217)



Risk of Flooding from Multiple Sources: Suitability		
Description	Indication of the scale at which is it generally appropriate to use this information to assess flood risk. This scale is common to all our Risk of Flooding information.	
Value/Range	1 - National to County	RGB (0,77,168)
	2 - County to Town	RGB (102,119,205)
	3 - Town to Street	RGB (255,255,115)
	4 - Street to Parcels of land	RGB (152,230,0)
	5 - Property (inc. internal)	RGB (56,168,0)



Risk of Flooding from Multiple Sources: Risk Contribution		
Description	GIS Raster layer showing the proportion of the combined risk resulting from the primary flood source input data.	
Value/Range		*Minimum/Maximum stretch applied to algorithmic colour ramp:*
	+100: RoFRS (positive value)	RGB (117,42,130)
		RGB (174,140,194)
	to	RGB (225,227,222)
		RGB (127,191,122)
	-100: RoFSW (negative value)	RGB (26,120,54)



Note: We do our best to avoid quality problems but this dataset reflects the data we hold. Our datasets may contain errors.