What is modelling and why do we do it?

This is a supplementary document put together by the project team to help explain what modelling is, and why we use models to help inform our decisions on how to manage flood risk effectively.

A model is a representation of a real world system. Environmental systems such as rivers are generally represented using either physical or computer models. The Environment Agency uses computer models to understand the risk of flooding at a national and local level and to explore options to reduce flood risk.

A model = a representation of the real world

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Why do we do modelling?

A flood model is an important part of developing projects to manage flood risk.

A model helps us understand how a river system behaves during flood conditions. It helps us identify areas that may be affected by flooding. It also enables us to assess the impact of both natural and man-made features upon flood risk.

A model supports decisions on investment to reduce flood risk. It is used to test the impact of flood alleviation options upon local communities affected by flooding and also explore the impacts upon the wider catchment. By testing different options we are able to identify the most effective solutions.

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What information does a flood model need?

Flood models use a range of information to help make them as reliable as possible. This information includes:

- the **topography** (shape and height) of the land. This is obtained using LIDAR (Light Detection and Ranging), an airborne survey method that involves using a laser scanner to measure the height of the land
- detailed **surveys** of the river channels and existing flood defences and structures, such as bridges and culverts
- historical records of **water levels and river flows** from a network of river gauging stations across the country
- historical records of **rainfall**
- historical records of **previous floods**
- information about the different types of **land use** which could influence how the catchment responds to rainfall
- **climate change** predictions
- other general information about the **catchment** such as its size

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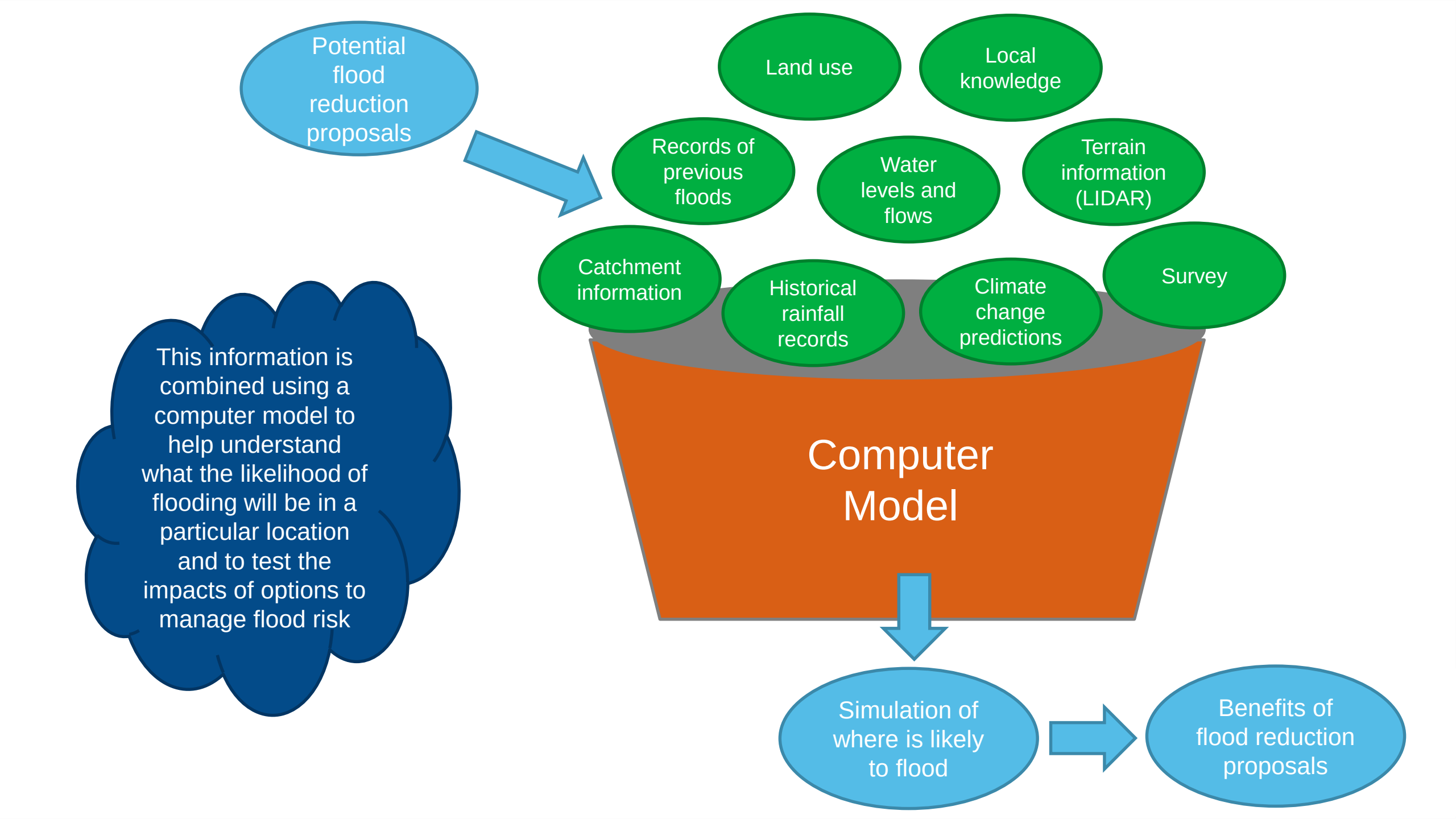
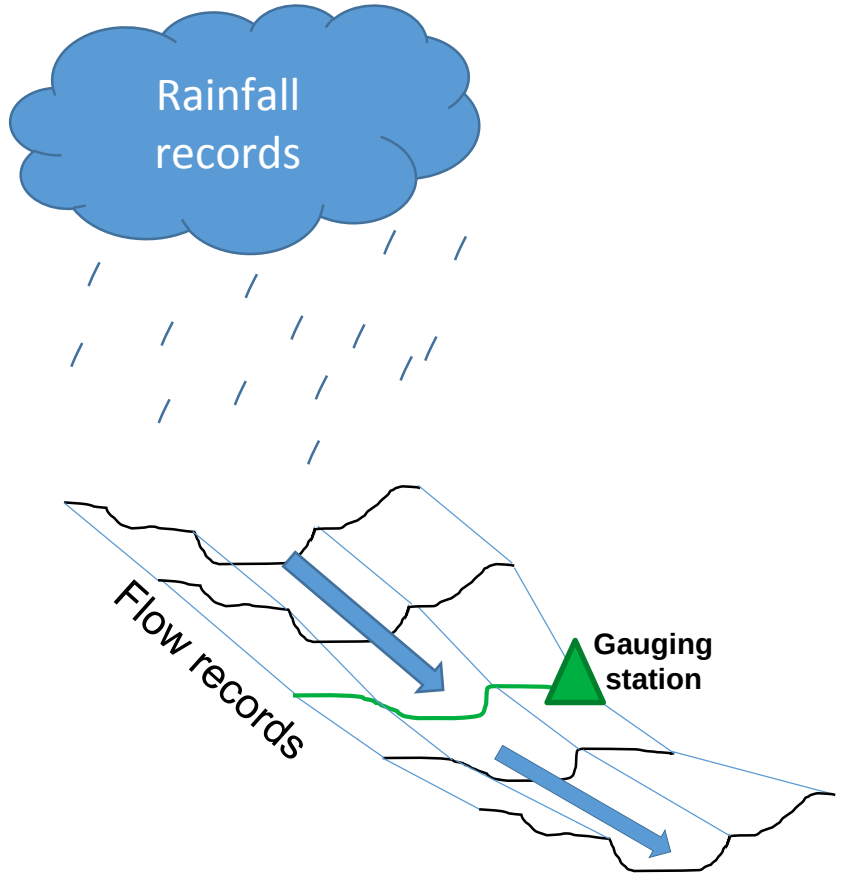

Potential flood reduction proposals
Land use
Local knowledge
Records of previous floods
Water levels and flows
Terrain information (LIDAR)
Catchment information
Historical rainfall records
Climate change predictions
Survey
Computer Model
This information is combined using a computer model to help understand what the likelihood of flooding will be in a particular location and to test the impacts of options to manage flood risk
Simulation of where is likely to flood
Benefits of flood reduction proposals

How much water?



If there is no rainfall or flow information available, we can use the records for watercourses which have similar characteristics, such as size, soil type and slope.

We use records of rainfall and river flows to estimate flood flows for a range of storm events

We look at how much rainfall and flow there has been in the past and use this to work out the size of the flows we see regularly along the river

This allows us to estimate the probability (or likelihood) of a certain flood flow occurring

This allows us to estimate how likely it will be that a larger flow will occur

On top of this we make an allowance for climate change

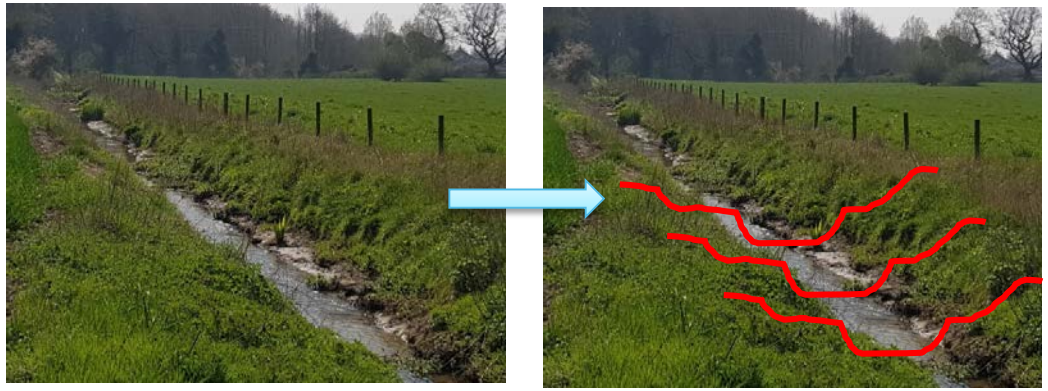
Where does the water go?

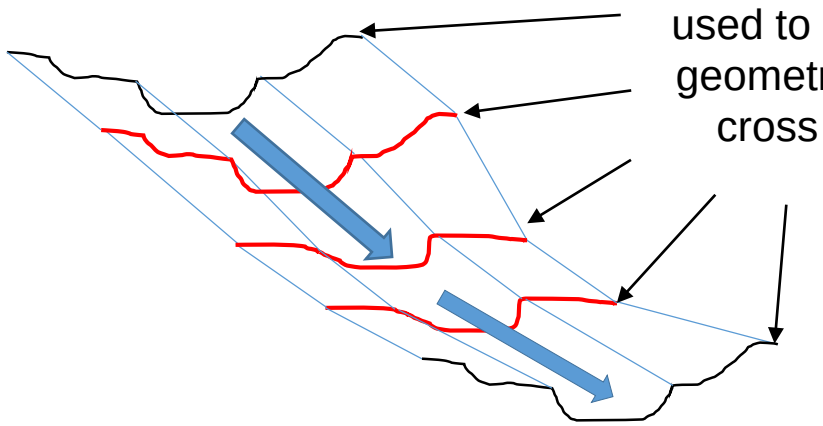
we carry out survey of the river channel to understand the size and shape (geometry) of the channel

using this information, the model can calculate the water level for different flow conditions

by adding information about the shape and height of the land adjacent to the channel, the model can work out where water will flow when the channel capacity is exceeded

this allows us to estimate the extent of the floodplain for high and low frequency flood events





Topographic survey used to obtain the geometry of each cross section

How confident can we be in the results?

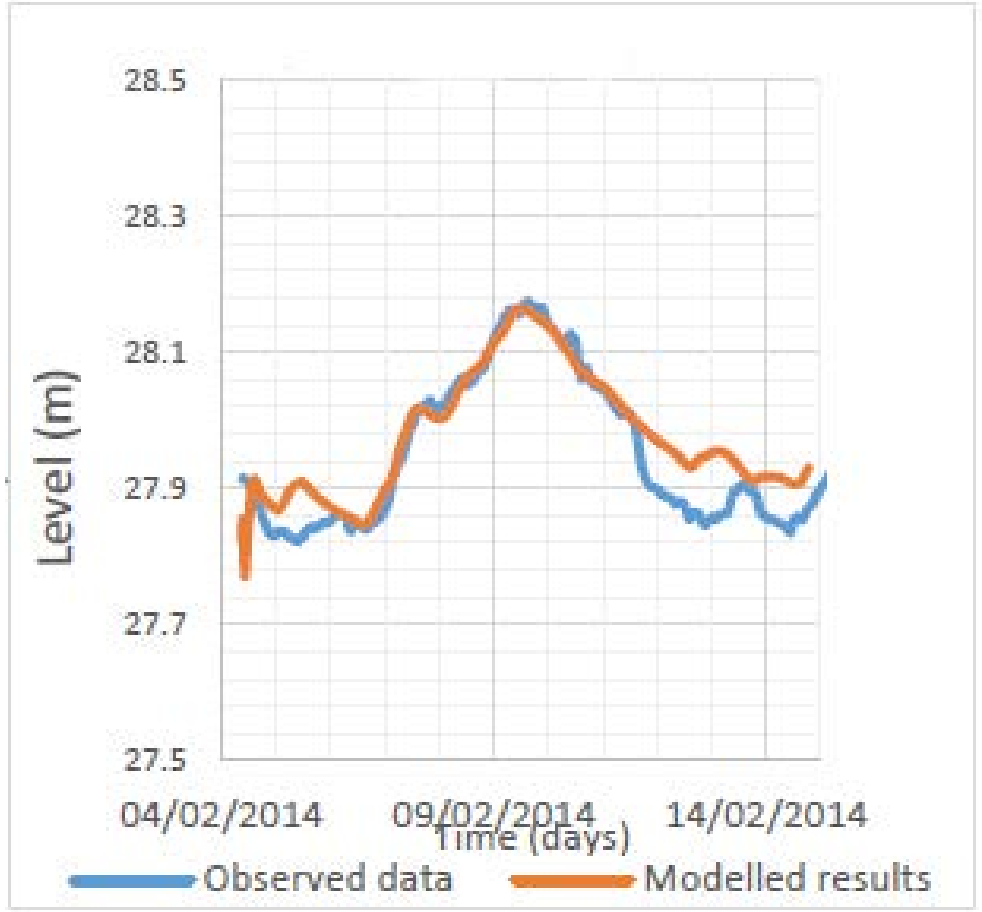
Flood models provide an ‘estimate’ of what will happen. There will always be some uncertainty.

However, we can use data from actual flood events to 'calibrate‘ models.

This is the process of adjusting model parameters so that model predictions match real-world observations.

We use data from river gauging stations, photographs and personal accounts to calibrate models.

Where the performance of the model is shown to closely match real-world observations, we can be confident in the results.



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How do we allow for uncertainty ?

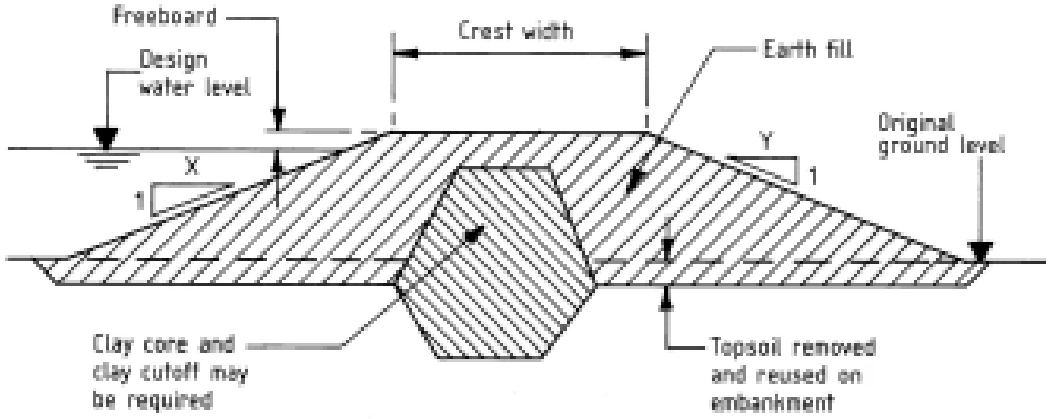
Models represent complex, real-world systems. It is often necessary to make assumptions about the parameters that control how the model operates. This can lead to uncertainty in the results.

Models provide estimates of flood levels that should be used to design flood defences.

The top (crest) of a defence =

Modelled (design) flood level + ‘freeboard’ (or margin of safety)

The ‘freeboard’ allows for uncertainty in modelling and other factors such as the deterioration of the defence over time.



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What software do we use to model flood risk?

The modelling for the Ruislip project is being developed in a piece of software called Flood Modeller. More information can be found here: https://www.floodmodeller.com/getting-started

This is industry-standard software used for the majority of Environment Agency projects where modelling is required

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