NON-TECHNICAL SUMMARY

JBA Project Code	2016s4106
Contract	Kerswell Flood Investigation,
Client	East Devon District Council
Day, Date and Time	1 August 2017
Author	Daryl Taylor
Subject	Kerswell Flood Investigation & Options Appraisal

1 Introduction

JBA was commissioned by East Devon District Council to carry out a flood study for the village of Kerswell, Devon. The village has previously experienced flooding, and there is a desire to consider options for flood alleviation works to reduce the risk to the village. The study provides baseline evidence on flood risk to the village, and discusses potential flood alleviation options.

This document is intended to provide a non-technical summary of the work carried out in the study. A full technical report has been produced for East Devon District Council.

2 Study Approach

The study was primarily a hydraulic modelling study. A computer model of the catchment has been developed, which routes rainfall across a ground model and allows flow routes and flood mechanisms to be identified and interrogated. A site walkover was carried out in order to identify hydraulically significant features which are not represented within the ground model, such as ditches and culverts, and these were then build into the model. Topographic Survey of the watercourse channels and structures was collected through the village, in order to accurately include these in the model and more accurately understand the current flow capacity and constraints within the watercourses.

Simulations of multiple rainfall events have been tested in the model, from relatively frequent heavy rainfall events (i.e. 1 in 2-year event) to very infrequent extreme rainfall (1 in 1000-year event). Anecdotal and photographic records were used to validate the model, and the model was shown to replicate flooding mechanisms relatively well. JBA's FRISM software has been used to estimate flood related damages to properties during modelled flood events, which could be used to inform a business case for funding of flood alleviation works in the future.

Using the understanding of the catchment gained, and the results of the FRISM analysis, an initial long list of potential flood risk management options was developed and then refined to a shortlist of feasible options based on indicative costs and significant constraints. Key opportunities and constraints have been identified in the report, and it is expected that the next stage of the study will be for workshops to be held with local residents and landowners to identify ways in which flood management measures could be implemented within the catchment.

www.jbaconsulting.com
www.jbarisk.com
www.jbaenergy.com

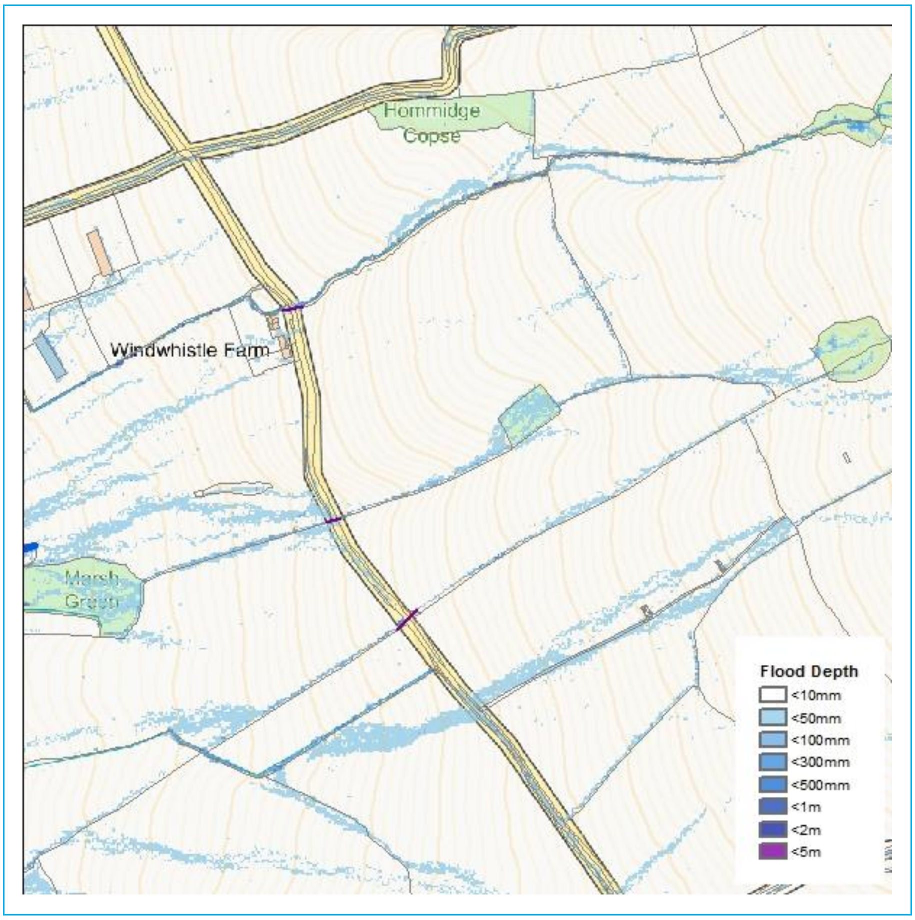
3 Existing Flood Risk

Within the upper catchment, shallow flows follow the natural topography towards the watercourses or follow the courses of historic watercourses where the channel has been diverted. During larger events, flooding of the highway is observed as a result of direct runoff and exceedance of culvert capacity (Figure 3-1).

On the approach to the village, flows are generally constrained to the watercourse channels and their immediate vicinity during smaller events. During larger events, shallow sheet flows can be seen flowing across fields and along highways towards the village, a function of direct runoff from the surface and exceedance of channel capacity in several locations. Around Marsh Green, historic channels and artificial ditches act to intercept these sheet flows, directing them back onto the watercourses.

Significant runoff from fields around the village centre, combined with exceedence flows from upstream channels, is predicted during all rainfall events.

Figure 3-1: Flow routes in the upper catchment

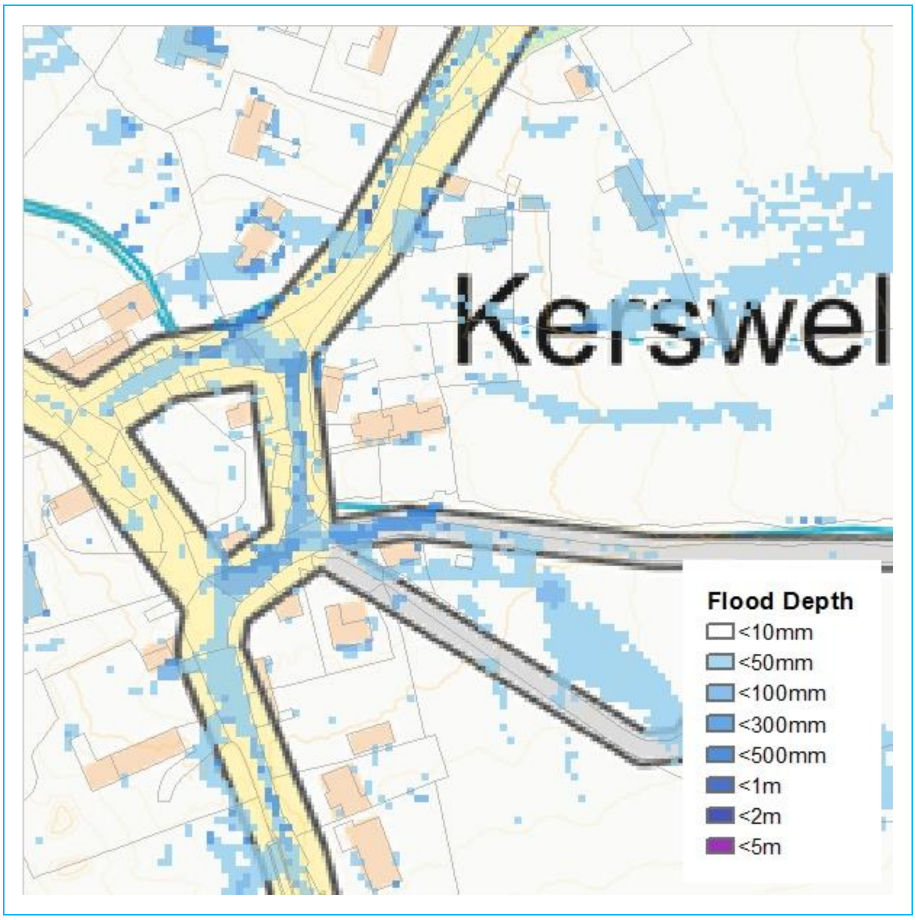


Within the village itself, flooding of the highway is observed during all modelled events, localised to the area between "Haymans" and "Brook Cottage" in the 2-year event but extending to the area near "Rivendell" and "Pales" during the 5-year event and above (Figure 3-2). The source of this flooding is primarily limited capacity in the channel and culvert adjacent to "Brook Cottage", with some contribution from overland flows off local fields to the east of "Tahini".

Hydraulic modelling indicates that out-of-bank flooding first occurs in this location as follows:

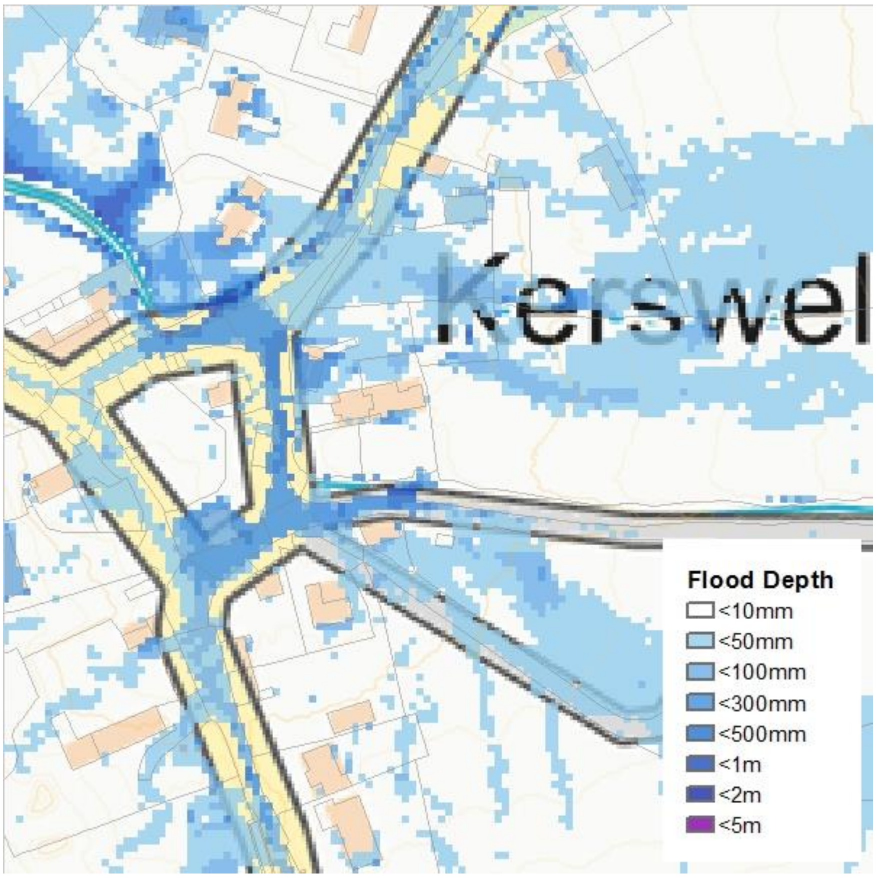
- Ford Upstream of South View Cottage: 0.11m^3/s
- Channel adjacent to South View Cottage: 0.25m^3/s
- Channel adjacent to Brook Cottage: 0.50m^3/s
- Culvert adjacent to Brook Cottage: 0.50m^3/s

Figure 3-2: Village Centre Flood Risk – 1 in 5-year rainfall event.



During more significant events, flooding in the centre of the village remains generally constrained to highways, and flows re-enter the watercourse from the highway and within the yard of “Pales” (Figure 3-3). Internal flooding of properties is predicted to four properties, three of these being directly attributable to the watercourse and the fourth due to surface water flooding from the highway.

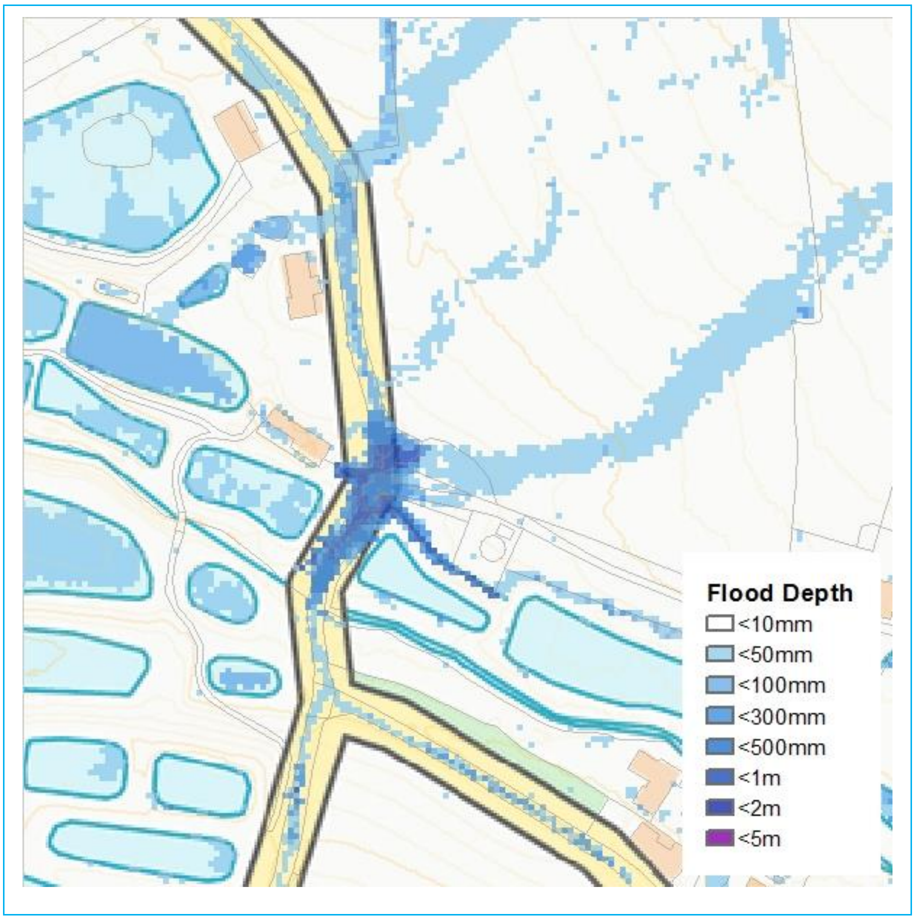
Figure 3-3: Village Centre Flood Risk – 1 in 100-year rainfall event.



Immediately downstream of the village, flows are generally constrained to the watercourse and its immediate vicinity however there are significant overland flows from surface water runoff during more extreme rainfall events. Fish ponds located on the right bank of the watercourse are shown to receive significant overland flows from surrounding fields, however the right bank embankments prevent flooding from the river during all events up to the 1 in 100-year storm.

Significant flooding of the highway is shown in all flood events where it crosses the watercourse, which matches well with observed records (**Error! Reference source not found.**). The cause of this flooding is overland flows from fields collecting in a localised depression and exceedance of channel and culvert capacity during events more extreme than the 1 in 2-year storm.

Figure 3-4: Downstream Culvert Flood Risk – 1 in 5-year rainfall event.



3.1 Damages Associated with Flooding

JBA's FRISM tool has been used to assess the damages associated with surface water flooding, based on the modelling results. FRISM is a GIS-based tool developed to analyse flood impact and damages, implementing the Environment Agency's guidance on assessing damages associated with flooding using the Multi-Coloured Manual (2013). The software produces flooded property counts and financial damages for each modelled scenario, and Present Value Damages which are a measure of the total expected damages over the next 100 years, at current-day values. These estimates have been carried out both of the current day scenario, and on a climate change scenario which assumes a 20% increase in rainfall intensity

NON-TECHNICAL SUMMARY

JBA Project Code	2016s4106
Contract	Flood Investigation, Kerswell
Client	East Devon District Council
Day, Date and Time	1 August 2017
Author	Daryl Taylor
Subject	Flood Investigation, Kerswell

	Current Day Scenario		**Future Climate Change Scenario**	
Return Period	**No of Properties identified at risk of flooding**	**Estimated damages resulting from flooding**	**No of Properties identified at risk of flooding**	**Estimated damages resulting from flooding**
1 in 2 year	0	£0	0	£0
1 in 5 year	0	£0	2	£4,700
1 in 10 year	3	£7,300	4	£19,200
1 in 20 year	4	£20,800	5	£41,900
1 in 30 year	5	£33,900	8	£66,500
1 in 50 year	7	£58,100	11	£93,500
1 in 75 year	9	£79,100	11	£112,600
1 in 100 year	11	£95,000	12	£128,200
1 in 200 year	12	£131,800	13	£178,400
1 in 500 year	14	£205,700	18	£269,500
1 in 1000 year	19	£276,300	22	£360,200
	Present Value Damages over 100-year Appraisal Period	**£133,400**		**£256,600**

www.jbaconsulting.com
www.jbarisk.com
www.jbaenergy.com

4 Options Appraisal

Based on an understanding of the catchment and flooding mechanisms affecting properties and highways, a number of potential options for managing flood risk have been identified. At this stage in the assessment, these options remain at a fairly high level, with consideration given to the general principle and relative cost of options rather than detailed consideration of their cost, operation and form.

The options can be broadly separated into five distinct categories:

A. Changes to upstream land management and land cover to reduce runoff
B. Storage within the upstream catchment
C. “Slow the Flow” upstream to delay / offset peaks
D. Increased channel and structure capacity through the village and downstream
E. Property Flood resistance and resilience

The options considered were:

Option	Description
A1	Land Use Changes within the catchment – Soil improvement
A2	Land Use Changes within the catchment – Tree Planting
B1	Upstream Storage near Broadview
C1	‘Leaky Dams’ in watercourses
C2	Cross-slope structures
D1	Upsize Ford crossing pipes
D2	Increase channel capacity adjacent to Southview Cottage and Brook Cottage
D3	Increase culvert capacity adjacent to Brook Cottage
D4	Increase culvert capacity at highway downstream of village
E1	Individual Property Flood resistance and resilience

The works associated with Options B1 and D1 – D4 (increased channel and structure capacity) are considered to be too costly to achieve a positive benefit:cost ratio, and as such these options are not considered feasible on financial grounds and have therefore been rejected.

The remaining options (A1 – A2, C1 – C2, E1) all have a relatively low associated cost, and should therefore be considered further. A brief discussion of each options is provided below.

A1: Land Use changes – Soil Improvement

Land use within the catchment is largely agricultural, with a mixture of arable and livestock farming, although there are some isolated areas of woodland within the catchment and a more significant wooded area at the upper edges of the catchment. Whilst there was no evidence of significant issues with soil management identified during the catchment walkover, all agricultural fields are considered to have opportunity to reduce runoff and soil erosion by improving soils.

This option would look at opportunities for improved land management within the catchment through changes by land owners and users. This is a low-cost option, as it would rely on education and changes to public attitude rather than a targeted intervention by any particular body, and is also considered to be a "no-regret" option as any positive changes to a site will act to improve the downstream situation and also offers benefits for the landowner. It is not considered possible to reliably model the benefit of the changes on local flood risk, however it is known that any improvements in soil condition will act to reduce flooding and provide additional benefits including improved biodiversity and groundwater recharge. Partial funding may be available to landowners through Catchment Sensitive Farming / Countryside Stewardship programmes.

A2: Land Use changes – Tree Planting

Trees and hedgerows help to reduce the flow and volume of runoff by increasing hydraulic roughness, local raising ground levels around roots, promoting infiltration into the soil around root areas and increasing evapo-transpiration losses. Currently only a small area of the catchment is covered by trees, and this is focussed on the upper reaches of the catchment, and whilst a number of field boundaries are made up of hedgerows there are relatively few cross-slope hedgerows.

Given the widely agricultural uses of the catchment, it is considered unlikely that large areas of block tree planting would be achievable unless fields could be purchased for conversion into woodland. It is however considered that creation of tree shelter belts and hedgerows planted across the slope would be feasible, particularly in livestock fields but also within larger arable fields. Tree shelter belts would be best targeted at larger fields, where significant overland flow routes are predicted in the model and ideally forming an extension to existing hedgerows or treelines, and hedgerows where fields are currently not bounded by a hedge.

This option is considered to be a low-medium cost option, depending on the extent of tree planting carried out, and would be a "no-regret" option where existing field boundaries are planted with hedgerows or new shelter belts are provided in livestock fields as they would provide flood reduction benefits in addition to benefits for the landowner. Partial funding may be available to landowners through Catchment Sensitive Farming / Countryside Stewardship programmes, and if larger areas of woodland could be created the Woodland Trust may provide a financial contribution.

C1: Leaky Dams in Watercourses

Leaky dams and other similar approaches aim to slow the flow of water within watercourse channels, and encourage the use of floodplains in further slowing and infiltrating flood flows. It is known that consideration has already been given to the construction of these structures within the channel with a view to alleviating flood risk.

During a walkover of the catchment, watercourses were briefly assessed for their suitability to site leaky dams or other in-channel structures. Due to the relatively steep and un-forested nature of the channels, none of the channels have a high suitability for leaky dams as there is little in the way of a floodplain present which could attenuate flows, however the structures could still be effective in providing some attenuation of the most rapid floods and in collecting sediment and debris which may lead to downstream blockages.

In-channel structures are likely to be porous and constructed of timber or natural woody matter, and designed in such a way that allows dry-weather flows to be conveyed through the structure but impedes higher flows. These structures tend to be fairly low cost to construct and maintain, however they are likely to need replacement on a fairly frequent basis if no additional debris is brought by the watercourse from upstream to replace rotting materials. Partial funding may be available through Countryside Stewardship / Catchment Sensitive Farming programmes

C2: Cross-Slope Structures

Working in a similar way to both tree shelter belts and leaky dams, the construction of cross-slope structures aims to intercept overland flow routes, typically with porous structures, which will attenuate flows and increase infiltration into the ground but also allow the structures to drain-down so that the time of inundation is limited. In several locations through the catchment, the hydraulic model predicts significant overland flow routes through large open fields. It is considered that these fields provide effective opportunities for structures to be constructed across the slope, without significantly affecting the operation of the field.

Where this approach has been used elsewhere in the UK, the structures have been constructed as earth bunds with a small outlet pipe, engineered log dams or timber and stone walls. Materials are typically selected to best match both what is available locally and what best suits the land use (e.g. earth bunds are not typically suitable in cattle fields due to erosion). The design of these features is typically more formal than in-channel structures, and should aim to maximise the volume of water contained by using the natural topography to best advantage and allow the feature to drain down slowly following a storm.

This option is considered to be a low – medium cost option, depending on the size and form of the structure. Partial funding may be available through Countryside Stewardship / Catchment Sensitive Farming programmes.

E1: Property Level Resistance and Resilience

Property Level Resistance and Resilience measures aim to minimise the ingress of floodwaters, and the impact resulting from floodwater ingress, through the use of measures installed within and around the property perimeter.

Resistance measures are designed to reduce and potentially prevent the ingress of flood water through the fabric of the building. This can be done by retro-fitting flood barriers or flood doors, air brick covers, waterproof masonry seals and non-return valves on plumbing. The selection of measures is typically bespoke for each property, as it is highly dependent on the age, construction type, material and owner of the property. Given the fast response of the watercourse to heavy rainfall and lack of a formal flood warning system, it is likely that passive measures (i.e. automatically operating measures) would be the most appropriate for the village.

Resilience measures involve retrofitting to the interior of the property, such as waterproof skirting, walls and floor coverings, raising of electric sockets and other water vulnerable elements and raising of kitchen appliances above ground level. These measures are typically more complex and expensive to install than resistance measures, and are often only considered cost effective if incorporated to refits or new build properties.

The preferred approach for Kerswell is likely to involve the retro-fitting of flood resistance measures for all properties shown to be at risk in the hydraulic model, a total of 12 properties during the 1 in 100-year event. Property flood resistance is considered to be relatively low cost option, with typical costs of £5,000 - £7,500 per property, and is therefore likely to be a cost-beneficial option. It should however be noted that flood resistance measures have a limited design life of approximately 20 – 30 years, so measures would need to be renewed or replaced once they reach their design life in order to maintain their effectiveness.

5 Next Steps

Due to the low financial damages associated with flooding in the village, funding for any alleviation works will probably not be available through the Environment Agency's Grant in Aid programme. Funding would therefore need to be found from the Local Authority (East Devon DC), Lead Local Flood Authority (Devon CC) and local residents and landowners. Additional funding may be available from other sources, depending on the approach taken.

The nature of the options considered feasible is such that they would be best designed and delivered in close partnership with local residents and landowners. Measures in the catchment will need to be located within or adjacent to agricultural land, so it will be important to ensure that measures have no significant detrimental impact on the operation of the site and ideally offer benefits to landowners.

It is therefore recommended that a workshop be held with local residents and landowners, East Devon DC and other key stakeholders who may be able to offer financial or technical support. This workshop should allow residents to lead on selecting the location and design of flood alleviation measures, with particular input from landowners whose land might be affected by any works, with stakeholders providing technical input and expertise to support decision making.