The design of a catchment drain

The design of flood risk management measures requires consideration of multiple technical, environmental and land-use factors. For example, the ground conditions throughout the area need to be fully understood so that the design team can assess the suitability of the combination of measures required to reduce flood risk as part of a flood risk management scheme. The process involves a significant amount of desk-based study before a site-specific survey can be undertaken.

There are a number of engineering and technical standards that need to be met through the design process set by the Environment Agency, the British Standards Institution (BSI), European Committee for Standardisation CEN), the Construction Industry Research and Information Association (CIRIA), International Organisation for Standardization (ISO) standards for Hydrology, and OfWAT.

During the design of a catchment drain, a number of potential diversion alignments are reviewed, together with the ground conditions, to assess the best possible route from a hydraulic perspective. This can result in various options, ranging from an open lined to a piped channel or box culvert.

The Rivers Mint and Kent are classified within the River Kent Special Area of Conservation (SAC). The Stock Beck River system falls within the River Kent and tributaries Site of Special Scientific Interest (SSSI). Located on the River Mint, the catchment drain outfall will be designed to be in keeping with the local environment.

Site surveys and investigations

Site surveys and ground investigations are important; they allow engineers to understand the existing natural processes which are occurring in a study area, for example groundwater flow, surface water flow and fluvial activity. They provide detail on the composition of the ground and what impact that might have on the proposals.

Ground investigations together with ongoing monitoring (for example of ground water levels) also allows engineers to conduct an array of testing, both on site at the time of the survey, and on samples taken in a laboratory. This enables a deeper understanding of how the ground will behave, and what the potential impact might be on the proposed flood risk measures.

The role of a catchment drain within a flood risk management scheme

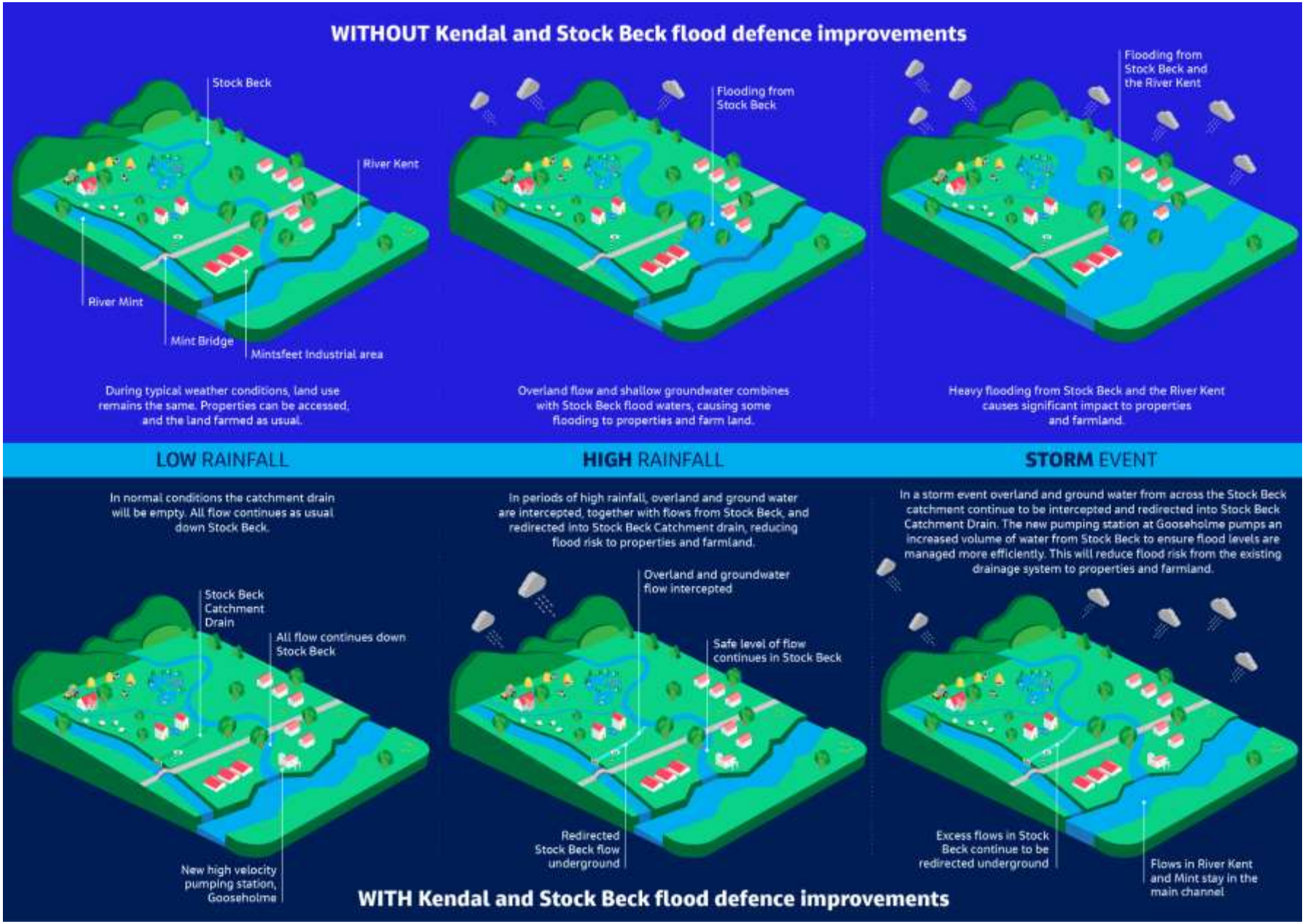
A catchment is an area of land that collects surface water from areas higher up the valley(s), that flows down the slopes and drains into the network of tributaries (where a stream or smaller river joins a larger stream or river) across the area. This water is then picked up by the storage areas and main rivers as it reaches the bottom of a catchment.

The role of a catchment drain is to limit the amount of water that flows into a main river during high rainfall, reducing flood risk to homes and businesses. It achieves this by diverting flows into a different, larger, main river before the levels in both rivers reach their peak.

In the Kendal and Upper Kent Catchment Flood Risk Management Scheme, the catchment drain will carry surface and ground water from the upper reaches of Stock Beck East and Stock Beck North and divert flows into the River Mint. This will reduce the risk of flooding in the residential area of Sandylands, Kendal.

A controlled flow of water will always pass forward on Stock Beck East and North, at an amount which balances flood risk, biodiversity, and operational requirements. Flow will only begin to be diverted into the catchment drain if this pass forward flow is exceeded.

Located on the River Mint, the catchment drain outfall and control structures on Stock Beck East and Stock Beck North will be designed to be in keeping with the local environment and keep the channel as natural looking as possible.


WITHOUT Kendal and Stock Beck flood defence improvements
Stock Beck
River Kent
River Mint
Mint Bridge
Mintsfeet Industrial area
Flooding from Stock Beck
Flooding from Stock Beck and the River Kent
During typical weather conditions, land use remains the same. Properties can be accessed, and the land farmed as usual.
Overland flow and shallow groundwater combines with Stock Beck flood waters, causing some flooding to properties and farm land.
Heavy flooding from Stock Beck and the River Kent causes significant impact to properties and farmland.
LOW RAINFALL
HIGH RAINFALL
STORM EVENT
In normal conditions the catchment drain will be empty. All flow continues as usual down Stock Beck.
In periods of high rainfall, overland and ground water are intercepted, together with flows from Stock Beck, and redirected into Stock Beck Catchment drain, reducing flood risk to properties and farmland.
In a storm event overland and ground water from across the Stock Beck catchment continue to be intercepted and redirected into Stock Beck Catchment Drain. The new pumping station at Gooseholme pumps an increased volume of water from Stock Beck to ensure flood levels are managed more efficiently. This will reduce flood risk from the existing drainage system to properties and farmland.
Stock Beck Catchment Drain
All flow continues down Stock Beck
New high velocity pumping station, Gooseholme
Overland and groundwater flow intercepted
Safe level of flow continues in Stock Beck
Redirected Stock Beck flow underground
Excess flows in Stock Beck continue to be redirected underground
Flows in River Kent and Mint stay in the main channel
WITH Kendal and Stock Beck flood defence improvements

Designing a viable scheme – the Environment Agency's key tests

The suitability of each potential flood risk measure is assessed in more detail against the Environment Agencies key tests: to ensure they are, technically feasible, environmentally sustainable, economically viable, socially acceptable, and safe to deliver. Throughout this process, multi-criteria analysis is used to evaluate potential risks, opportunities and their likely impact. On completion of the analysis, each option is either discounted or progresses to the next stage in the design process.

- **Technical feasibility** – each option is assessed to ensure it is technically achievable, constructable, robust and reliable. This takes into consideration buildability, ongoing maintenance, and health and safety.
- **Environmental sustainability** – potential environmental impacts of each option on the natural environment is assessed, together with the appropriateness of any specific land use designations and whether they align with the Environment Agency's strategic environmental goals.
- **Economic viability** – takes into consideration ongoing maintenance, whether the benefits would outweigh the cost, and if the cost is within the scheme's budget. Each option is also analysed to determine any other non-financial benefits they offer to the local community and environment, and/or the potential for this.
- **Social acceptability** – consideration is given to a number of criteria which include landowner constraints, location within designated sites, proximity to recreational areas or public rights of way (PROW), and overall social acceptability. As the scheme progresses, we take this out for consultation in order to consider and incorporate feedback from the wider community.
- **Health and safety** – each option is reviewed to check that it can be designed, constructed and maintained safely. Identification of risks and opportunities to the wider community are also assessed and used to inform the design.

This process will ensure we design a scheme that provides a better standard of protection, delivered in the right places, at the time.