science summary

Environment Agency

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Assessing the impact of dewatering on water resources

Science Summary SC040020/SS

Introduction: The Water Act 2003 has introduced significant changes to the abstraction licensing system in England and Wales. Among other provisions, the dewatering of mines, quarries and engineering works, water transfers into canals and internal drainage districts, use of water for trickle irrigation, and abstractions in some areas that were previously exempt, will now need a licence, to make sure that they are managed appropriately and that any impact on the environment can be dealt with. There are now three types of abstraction licence:

- ***Temporary licences:*** for water abstraction for any purpose over a period of less than 28 days.
- ***Transfer licences:*** for water abstraction to transfer water from one source to another without intervening use, or to transfer water within the same source for dewatering activities in connection with mining, quarrying, engineering works etc, again without intervening use.
- ***Full licences:*** for water abstraction for any other licensable use.

Water Management Consultants Ltd was commissioned to develop a methodology that provides practical guidance on how to assess the hydrogeological impact of groundwater abstractions in connection with dewatering operations at quarries, mines and engineering works. It is relevant to those who are preparing applications to the Environment Agency for transfer and full licences.

The HIA methodology: The hydrogeological impact appraisal (HIA) methodology is designed to fit into the Environment Agency's abstraction licensing process, including the changes brought about by the Water Act 2003. It also fits within the Environment Agency's approach to environmental risk assessment, so that the effort involved in using the methodology in a given situation can be matched to the risk of environmental impact associated with the dewatering.

The methodology has 14 steps:

Step 1: Establish the regional water resource status.

Step 2: Develop a conceptual model for the dewatering operation and the surrounding area.

Step 3: Identify all potential water features that are susceptible to flow impacts.

Step 4: Apportion the likely flow impacts to the water features, based on the conceptual model.

Step 5: Allow for the mitigating effects of discharges, to arrive at net flow impacts.

Step 6: Assess the significance of the net flow impacts.

Step 7: Define the search area for drawdown impacts.

Step 8: Identify all the features within the search area that could potentially be impacted by drawdown.

Step 9: Predict the likely drawdown impacts.

Step 10: Allow for the effects of any measures being taken to mitigate the drawdown impacts.

Step 11: Assess the significance of the net drawdown impacts.

Step 12: Assess the water quality impacts.

Step 13: If necessary, redesign the mitigation measures to minimise the flow and drawdown impacts.

Step 14: Develop a monitoring strategy, focussing on the flow or drawdown impacts.

The steps are not intended to be prescriptive; some steps will be a formality in many situations, but it is important that the same thought-process occurs every time, to ensure consistency. The methodology depends heavily on the development of a good conceptual model of the dewatering operation and the surrounding aquifer. The steps of the methodology are followed iteratively, within a structure with three tiers, and the procedure continues until the required level of confidence has been achieved.

The Science Report on the HIA methodology for dewatering abstractions also provides the following information:

- A discussion of common misconceptions about groundwater abstractions and the way in which they behave.
- A scoring exercise to give abstractors a rough idea of the level of effort likely to be required for undertaking HIA at a particular quarry or mine.
- A summary of tools and techniques that can be used when undertaking HIA, such as basic analytical equations, two-dimensional steady-state analytical models, and three-dimensional numerical groundwater models. As part of the project, over twenty commonly-used analytical equations (such as Theis, Thiem and Dupuit-Forcheimer) were assembled from textbooks and other publications, and put into an MS Excel spreadsheet for convenience.
- A revised version of the methodology for use in karstic aquifers, when the assumptions built into many models and equations break down, and there is far greater uncertainty associated with prediction of hydrogeological impacts.
- Discussions and guidance on the application of the HIA methodology to fractured crystalline rocks (such as slate, granite, basalt and dolerite), and also to excavations (opencast and underground) in the Coal Measures.
- Guidance on the application of water balances to dewatering operations, including allowing for surface run-off and direct rainfall into excavations.
- Examples of the application of the HIA methodology to real-life dewatering operations, in the form of six case studies, which include quarries, mines and construction dewatering.

HIA methodology for 'ordinary' groundwater abstractions: As part of the project, a version of the HIA methodology was produced for 'ordinary' groundwater abstractions from boreholes and wells, for purposes such as public water supply, irrigation and industrial use. This methodology is described in a separate Science Report (see below), but there is no significant difference in the approach, and there are the same 14 steps to be followed. Guidance is given on designing, undertaking and interpreting pumping tests

Both versions of the HIA methodology place strong emphasis on monitoring and mitigation of the impacts of groundwater abstraction, and provide practical guidance on the subject.

Catalogue information: This summary relates to information from Science Project Sc040020, reported in detail in the following outputs:

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