



**STEPHENSON
HALLIDAY**

Planning, Landscape & Environment
an **RSK** company

MAES Y DROELL QUARRY EXTRACTION OF INDUSTRIAL SAND

Environmental Statement
Volume II

Chapter 12: Hydrology and Hydrogeology

Silica Sand Mold Limited

Prepared by Envireau Limited

Chapter 12: Hydrology and Hydrogeology

Contents

12	Hydrology and Hydrogeology	12-3
12.1	Introduction	12-3
12.2	Assessment Methodology	12-3
12.3	Baseline Conditions	12-3
12.4	Environmental Setting	12-4
12.5	Conceptual Model	12-5
12.6	Proposed Development	12-5
12.7	Embedded Mitigation	12-6
12.8	Assessment of Effects	12-6
12.9	Summary and Conclusions	12-7

List of Tables

Table 12-1: Impact and Proposed Mitigation	12-7
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12 HYDROLOGY AND HYDROGEOLOGY

12.1 Introduction

- 12.1.1 A Hydrogeological Impact Assessment (HIA) has been carried out by a competent specialist firm, Envireau Limited. The full assessment is located at ES Volume III, **Appendix 12.1 Hydrogeological Impact Assessment** to this Environmental Statement.

12.2 Assessment Methodology

- 12.2.1 The HIA assesses the potential hydrological and hydrogeological effects of the Proposed Development at Maes y Droell Quarry. The assessment comprises a review of baseline geological, hydrogeological and hydrological conditions, identification of potential water-dependent receptors, development of a conceptual hydrogeological model, and assessment of potential impacts and mitigation requirements.
- 12.2.2 The assessment has been informed by site-specific geological investigations, historical hydrogeological studies, groundwater monitoring data, British Geological Survey mapping, site inspections, Natural Resources Wales data and information relating to water abstractions, designated sites and private water supplies.
- 12.2.3 Baseline conditions were established through review of geology, groundwater levels, aquifer characteristics, surface water features and identified receptors within a 1.5 km study area.
- 12.2.4 A conceptual hydrogeological model was developed to characterise groundwater flow mechanisms, recharge pathways, aquifer properties and interactions between groundwater and surface water receptors. The Site was identified as being underlain by the Cefn-y-Fedw Sandstone Formation, with groundwater flow generally directed towards the River Terrig catchment.
- 12.2.5 The HIA was undertaken using a qualitative Source-Pathway-Receptor (SPR) risk assessment approach in accordance with Green Leaves III and Environment Agency guidance on preparing Hydrogeological Impact Assessments. A Tier 1 assessment was considered appropriate due to the established understanding of site hydrogeology and the absence of nearby highly sensitive receptors. Potential hazards, pathways and receptors were identified and assessed by considering receptor sensitivity, magnitude of impact, likelihood of occurrence and resulting risk.
- 12.2.6 The assessment focused on the principal potential hazard of groundwater or surface water contamination arising from accidental spills or leaks of fuels, oils or chemicals associated with quarry operations. The significance of potential effects was evaluated taking account of embedded mitigation measures and a proposed programme of groundwater level and groundwater quality monitoring.

12.3 Baseline Conditions

- 12.3.1 Background information regarding the surface water environment is in the description of the local topography and includes water bodies and the presence of springs in the study area. Precipitation is the only source of water feeding these features. The Site is a mixture of bare rock and rough grassland with variable rates of infiltration and run-off. The surrounding area

close to the Site is also grassland. The local geology consists of shallow marine deposits underlain by the Millstone Grit which includes the target Cefn-y-Fedw sandstone.

- 12.3.2 The Millstone Grit Group is comprised of a variety of coarse sandstones with interbedded siltstones and clay units which creates a multi-layered aquifer with local perched water tables. The sandstones within the group are generally well cemented with low intergranular permeability and so flow mainly occurs along fractures, bedding planes and coarser sandstone layers. Porosity has been measured at around 14%, and mean permeability is 4×10^{-2} m/d in Northern England. However, on-site testing shows a far greater permeability range. Groundwater levels recorded from the on-site boreholes show a gradient running from north to south at more than 10m below proposed extraction levels.
- 12.3.3 There are various faults running through the Site, north-south and east-west. Both geology and the water environment have been surveyed through the sinking of boreholes.
- 12.3.4 The Standard Annual Average Rainfall recorded for the Site is 989mm/year. Based on the local topography, the Flood Consequences Assessment (FCA), provided at **Standalone Document No 2 - Flood Consequences Assessment**, estimates that the surface water catchment for the Site is the Site itself, which consists of parts of three separate catchments that all feed the River Terrig. These are described in the FCA as Eastern, Southern and Western (FCA Fig. 5). The two local watercourses that feed the River Terrig tributary flow outside the application area to the east and west. Where run-off occurs from the northern area it is partially into the southern area and partially onto the public highway.

12.4 Environmental Setting

- 12.4.1 The HIA study considered water-dependent receptors within a 1.5 km study area surrounding Maes y Droell Quarry. The Site lies within the River Terrig catchment on elevated ground north of a tributary of the River Terrig and is underlain by the Cefn-y-Fedw Sandstone Formation, a Secondary A aquifer. Groundwater is inferred to flow generally south-east towards the River Terrig tributary.
- 12.4.2 The Site contains a number of existing quarry ponds and is surrounded by a network of streams, drains and tributaries that ultimately discharge to the River Terrig. The nearest watercourses are located approximately 20 m from the Site boundary, with the River Terrig and its tributaries forming the principal surface water receptors in the area. A total of 17 ponds and lakes were identified within 1.5 km of the Site.
- 12.4.3 The study identified a limited number of potentially sensitive groundwater receptors, including three registered private water supplies located between approximately 785 m and 1 km from the Site, together with a number of wells and springs shown on Ordnance Survey mapping. No licensed groundwater abstractions were identified within the study area.
- 12.4.4 Baseline investigations indicate that groundwater levels occur beneath the proposed quarry floor and that the development would remain above the water table. No groundwater dewatering is therefore proposed. The principal water environment receptors considered in the assessment comprise the Cefn-y-Fedw Sandstone aquifer, the tributary of the River Terrig, nearby private water supplies, wells and springs, together with designated ecological sites where hydrological effects could potentially arise.

12.5 Conceptual Model

- 12.5.1 The Site is underlain by the Cefn-y-Fedw Sandstone Formation, a Secondary A aquifer comprising sandstone layers interbedded with mudstones and siltstones. The mudstone horizons act as low-permeability barriers, creating local perched groundwater conditions and influencing groundwater flow.
- 12.5.2 Groundwater recharge occurs principally through direct infiltration of rainfall into exposed sandstone and previously quarried areas. Groundwater is interpreted to flow generally towards the south and south-east, ultimately discharging towards tributaries of the River Terrig.
- 12.5.3 Groundwater monitoring indicates that groundwater levels lie below the proposed quarry floor, meaning that extraction would remain above the water table and no groundwater dewatering would be required. Any localised perched groundwater encountered during extraction is expected to be limited in volume and would naturally drain to lower areas within the quarry.
- 12.5.4 The conceptual model identified the principal water environment receptors as the sandstone aquifer, the tributary of the River Terrig and nearby wells and private water supplies. The primary potential impact pathway is contamination arising from accidental spills of fuels, oils or chemicals, although the assessment concluded that the geological setting, quarry design and proposed mitigation measures significantly limit this risk.

12.6 Proposed Development

- 12.6.1 In relation to hydrological and hydrogeological impacts, the Proposed Development comprises the reopening and extension of Maes y Droell Quarry for the extraction of silica sand. Extraction would involve reworking existing quarry areas in the south before moving northwards.
- 12.6.2 The southern portion of the quarry would be worked to existing levels, with the lowest excavation remaining at approximately 294 m Above Ordnance Datum (AOD), while the northern extension would be excavated to a maximum depth of approximately 326 m AOD. Existing quarry infrastructure would be removed and a new processing area established within the Site.
- 12.6.3 A fundamental design principle of the Proposed Development is that quarry workings would remain above the groundwater table throughout the operational period. Groundwater monitoring indicates that groundwater levels occur below the base of the proposed excavations and, as a result, no groundwater dewatering would be required. Although localised perched groundwater may be encountered within mudstone horizons, any such water is expected to be limited in volume and would naturally drain within the excavation.
- 12.6.4 Surface water management would rely principally on infiltration to the underlying sandstone. Rainfall and runoff would either infiltrate naturally or be directed to quarry sumps, from where water would gradually infiltrate into the underlying rock. Because excavation remains above the water table, no groundwater abstraction, dewatering discharge or associated settlement infrastructure is required.

12.7 Embedded Mitigation

- 12.7.1 Embedded mitigation measures include the use of industry-standard controls for the storage and handling of fuels, oils and chemicals, including bunded storage areas, pollution prevention measures, spill response procedures and controlled refuelling practices. These measures are intended to minimise the risk of accidental contamination of groundwater or surface waters.

12.8 Assessment of Effects

Assessment Approach

- 12.8.1 The HIA identified potential hazards, pathways and receptors using a qualitative Source-Pathway-Receptor (SPR) risk assessment methodology.
- 12.8.2 As the Proposed Development would remain above the groundwater table and no dewatering is proposed, the assessment focused primarily on the potential for accidental groundwater or surface water contamination arising from fuels, oils and chemicals associated with quarry operations.

Identified Hazards and Receptors

- 12.8.3 The principal hazard identified was deterioration of groundwater or surface water quality resulting from accidental spills or leaks associated with plant, fuel storage or operational activities. Potential receptors included the Cefn-y-Fedw Sandstone aquifer, a tributary of the River Terrig and nearby wells and water supplies located downgradient of the Site.

Embedded Mitigation

- 12.8.4 The assessment assumes implementation of embedded mitigation measures, including bunded fuel and chemical storage, controlled refuelling areas, pollution prevention procedures, spill response measures and compliance with industry best practice for the storage and handling of potentially polluting substances. These measures substantially reduce the likelihood of contaminants reaching groundwater or surface waters and could be secured through appropriately worded planning conditions.

Assessment Findings

- 12.8.5 The HIA concluded that, although contamination could theoretically result in significant impacts if unmitigated, the likelihood of such effects occurring following implementation of the proposed mitigation measures is very low. The substantial unsaturated zone beneath the quarry floor, the absence of dewatering and the Site's hydrogeological characteristics provide additional protection to groundwater receptors.
- 12.8.6 The assessment determined that effects on the Cefn-y-Fedw Sandstone aquifer, the tributary of the River Terrig and nearby wells would all be very low risk and not significant following implementation of the proposed mitigation measures. No significant effects on groundwater quantity, groundwater quality, surface waters or water-dependent receptors are predicted.

- 12.8.7 At present, all surface water within the southern part of the Site is contained within the Site and infiltrates to the groundwater. There is very limited potential for flooding, and this topic is considered in the formal Flood Consequences Assessment provided at **Standalone Document 2 – Flood Consequences Assessment** that accompanies the application for the Proposed Development. No flood risk is identified in the conclusions to the assessment.

Monitoring and Mitigation

- 12.8.8 To verify the HIA assessment findings, it is proposed that a groundwater monitoring programme would be implemented throughout the operational life of the quarry. This would include installation of an additional monitoring borehole, routine groundwater level monitoring, groundwater quality sampling and periodic review by a Chartered Hydrogeologist.
- 12.8.9 Monitoring results would be reported to Natural Resources Wales and reviewed regularly to confirm that quarry operations remain above the groundwater table and that no adverse impacts on groundwater quality occur.

Residual Effects

- 12.8.10 The HIA concluded that, with the proposed mitigation and monitoring measures in place, the Proposed Development would have no significant hydrogeological or hydrological effects. Groundwater levels would remain unaffected because no dewatering is required, and effects on groundwater quality, surface waters and private water supplies would not be significant.

Table 12-1: Impact and Proposed Mitigation

Receptor	Description of Impact	Sensitivity	Magnitude of Impact	Significance of effects	Proposed mitigation measures
Groundwater – Sandstone aquifer	Discharge of contaminated water to ground	Very High	High	Significant	Appropriate storage of fuels and other materials Ground water monitoring
Tributary of the River Terrig	Discharge of contaminated water to river	High	Moderate	Significant	Appropriate storage of fuels and other materials
Two OS map wells	Discharge of contaminated water to ground	Medium	Moderate	Significant	Appropriate storage of fuels and other materials Groundwater monitoring

12.9 Summary and Conclusions

- 12.9.1 The Hydrogeological Impact Assessment concludes that the Proposed Development would not result in significant adverse effects on hydrology, hydrogeology, groundwater resources or surface water receptors. The Site is underlain by the Cefn-y-Fedw Sandstone Formation, a Secondary A aquifer, with groundwater levels occurring more than 10 m below the

proposed quarry floor. As quarry extraction would remain above the water table throughout the operational life of the development, no groundwater dewatering, groundwater abstraction or discharge of pumped groundwater would be required.

- 12.9.2 The principal water environment receptors comprise the Cefn-y-Fedw Sandstone aquifer, the tributary of the River Terrig, nearby wells and springs, and three registered private water supplies located within the wider study area. Potential impacts are limited to the unlikely risk of groundwater or surface water contamination arising from accidental spills or leaks of fuels, oils or chemicals associated with quarry operations.
- 12.9.3 A range of embedded mitigation measures has been incorporated into the Proposed Development, including bunded fuel and chemical storage, controlled refuelling procedures, pollution prevention measures and emergency spill response arrangements. The assessment concludes that, with these measures in place, the likelihood of contamination occurring is very low and potential effects on groundwater quality, surface waters and water supplies would not be significant.
- 12.9.4 The assessment further concludes that there would be no significant impacts on groundwater levels, groundwater flow regimes, surface water resources or flood risk. A programme of groundwater level and groundwater quality monitoring would be implemented throughout operations to verify the assessment findings and demonstrate continued protection of the water environment.
- 12.9.5 Overall, the Proposed Development is considered acceptable in hydrological and hydrogeological terms, with no significant residual effects predicted.