Technical Note:

Trefil Quarry: Abstraction licence applications

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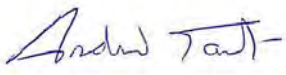
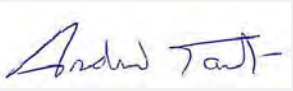
Checked by	Andrew Tait	
Reviewed by	Andrew Tait	

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1 Introduction

1.1 Background

This Technical Note has been prepared by Stantec UK Limited (Stantec) for Gryphonn Quarries Limited (GQL) to support the application for the continued dewatering of Trefil Quarry (the Site). The quarry is located about 4 km to the northwest of Tredegar, and about 300 m north of Trefil village, in Gwent (see Figure 1.1); the nearest postcode is NP22 4HF.

The Site has been used for limestone extraction since the 19th century until quarry operations ceased in the mid-1950s. The quarry was reopened in 1994 by Gryphonn Quarries Ltd.

The base of the quarry is below water table and dewatering of groundwater and incident rainfall is required to facilitate dry working. The Site opened in 1995 and dewatering commenced at some point prior to 2010, and hence would have qualified for a transitional abstraction licence application in relation to the removal of the exemption for quarry dewatering which occurred at the end of 2017; however, a transitional application for the Site was prepared but not submitted by the deadline of 31 December 2019.

This technical note supports GQL's applications for the continued and future dewatering at Trefil Quarry. It is considered this will require one application as follows:

- Application 1: A standard route application for one full licence to cover both used water and transferred (unused) water.[1]

This technical note should be read in conjunction with the application forms WRA and WRD (Appendix A).

1.2 Land ownership and planning permission

As required by Section 4 of application form WRA (Appendix A), Figure 1.1 shows the GQL land ownership boundary at the Site. This is also shown in Appendix B, and Appendix C shows the land ownership boundary together with the site water management plan (WMP).

Appendix F contains the extant planning permissions for the Site that are associated with this abstraction. GQL was granted planning permission for the deepening of Trefil Quarry in February 2009 following a submission in 2006 to revise conditions 1, 2, 17 and 22 of the planning permissions for the site (Planning Application 94/0369). Proposed future quarrying at the Site will be within a northern extension entirely above 467 m AOD which is above the groundwater table and hence dewatering will not be required.

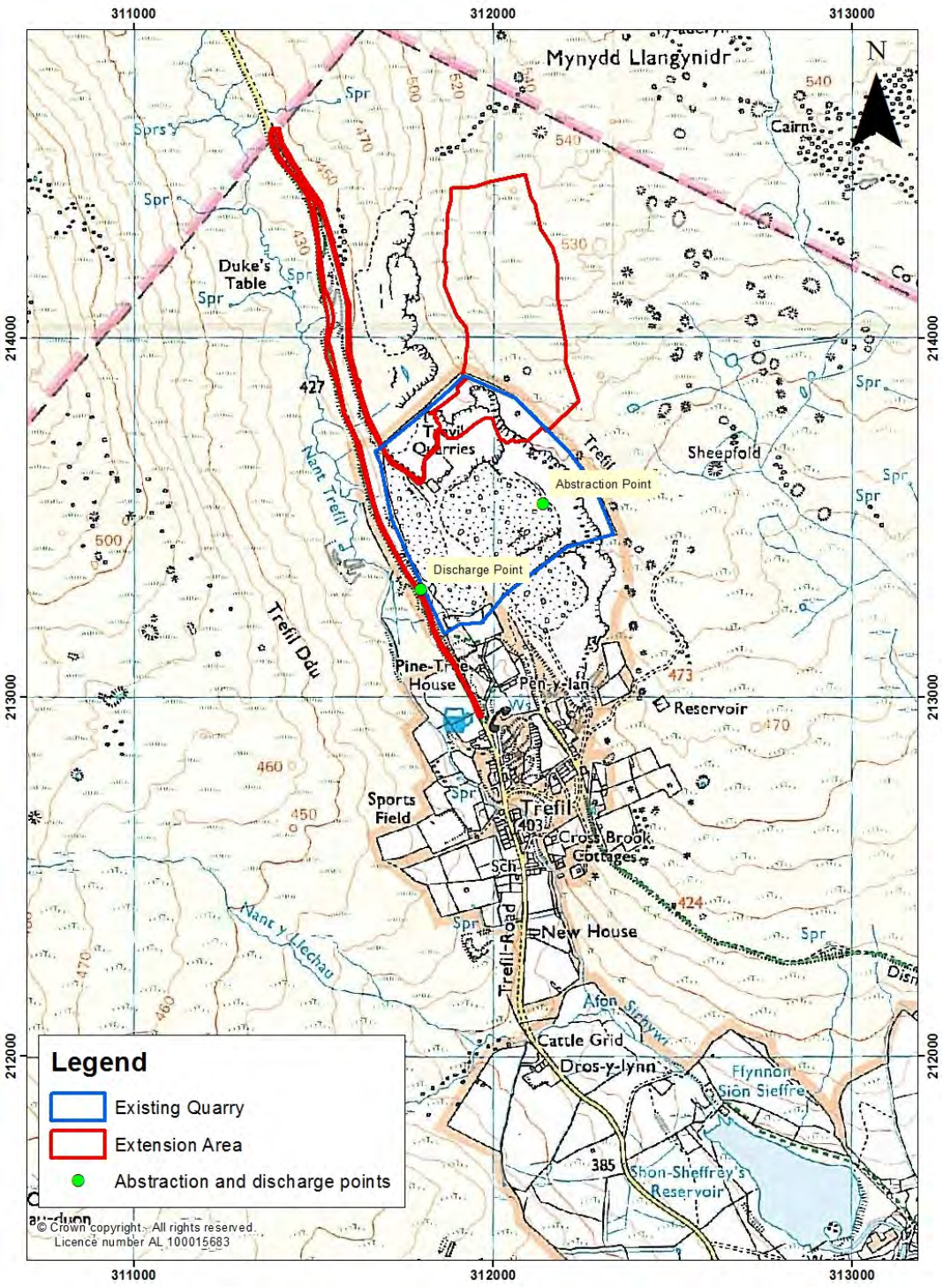
1.3 Report structure

This technical note covers the detailed requirements of the abstraction licence applications and includes the following:

- A summary of the environmental impact assessment for the Site (Section 2);
- Existing water movements and water management at the Site, including abstraction arrangements, water use details, and discharge locations (Section 3);
- A water balance for the quarry sump assessing the historical groundwater dewatering components (Section 4);
- A summary of the abstraction licencing requirements (Section 5).

[1] We are aware that Natural Resources Wales (NRW) consider abstractions that comprise both used and transferred water to require a single full licence rather than separate full and transfer licences for the two components, and we have therefore made the application on that basis.

Figure 1.1 Site location and land ownership boundary (Red line represents pre-application consultation stage)



2 Environmental Impact Assessment

As part of the planning application a Hydrogeological Impact Assessment (HIA) was prepared to assess any potential impacts of the dewatering activities associated with the deepening of the quarry which, at the time of assessment, was considered to be above or very close to the water table and not dewatering groundwater to any significant degree (ESI, 2008). The dewatering-related aspect of this HIA can be effectively considered as the impact assessment for this abstraction licence application. A copy of this report is provided in Appendix G for convenience to the reader and the most recently completed annual report (2020) is presented in Appendix H.

2.1 Receptors

With respect to quarrying impacts, ESI (2008) considered three main receptors which were Shon Sheffrey Spring, Groundwater within the Carboniferous Limestone, and the Nant Trefil. Potential receptors from the proposed dewatering have been reviewed again as part of this application and are set out below:

- Shon Sheffrey Spring (and associated abstraction licences);
- Groundwater within the Carboniferous Limestone;
- Nant Trefil; and
- Mynydd Llangynidr Site of Special Scientific Interest (SSSI).

2.2 Hydrogeological conceptual model

The conceptual hydrogeology at the Site is well understood from the above assessments. A brief summary of the key aspects of the hydrogeological conceptual model is outlined below as taken from ESI (2008). The reader should refer to Appendix G for the full report. Figure 3.4, Figure 3.5 and Figure 3.6 show conceptual hydrogeological cross sections through the Site.

- The local geology in the vicinity of the Site comprises Carboniferous Limestone (Dowlais Limestone and the Oolite Group separated by the clay rich Llanelly Formation), overlain by Millstone Grit. The Lower Limestone Shale (Cwmyniscoy Mudstone) is relatively impermeable and forms the base of aquifer. The strata dip to the south at approximately 5°. The fissured nature of the limestone results in little runoff occurring with almost all of effective rainfall recharging. However, there may also be significant lateral flow of water along karst conduits within the unsaturated zone, particularly along bedding planes.

- The Shon Sheffrey spring, a public water supply, is the main outflow from the local groundwater system and emerges, via the Millstone Grit, at about 365 mAOD to the south of the quarry. The catchment area of the spring is estimated to be around 10 km^2 (although the Source Protection Zone delineated for the spring is 12.2 km^2) with the quarry located within this area.

- The highest groundwater levels in the area are those monitored at Trefil Quarry (433-440 mAOD). This high level is attributed to the occurrence of an upper groundwater system in the Dowlais Limestone that is maintained by the low vertical hydraulic conductivity of the underlying Llanelly Formation.

- In the vicinity of Trefil Quarry, tracer test information suggests that flow within the unsaturated zone is locally westwards to the Nant Trefil, however recharge can also flow towards Shon Sheffrey Spring.

- All water pumped from the Site is discharged to the Nant Trefil via the settlement lagoons, apart from small losses associated with the processing plant (estimated to be around 14 m^3/d and further

considered in Section 4 below). This is controlled under a discharge permit held by GQL which is further discussed in Section 3.1 below).

- There are two recorded licensed abstractors or private abstractions within 2 km of the Site – the Shon Sheffrey Spring public water supply and a private water supply at Dros-y-Lynn both around 1.3 km south of the Site.

2.3 Impact assessment

A brief summary of the key aspects of the impact assessment and proposed mitigation and monitoring is outlined below as taken from ESI (2008):

- The impact assessment concluded proposed dewatering activities will not have any significant effect on flows in the Nant Trefil or Shon Sheffrey spring due to the re-circulation of water discharged to the Nant Trefil.
- The two main hazards identified in ESI (2008) with respect to groundwater and surface water quality are spills from plant operating on site and discharge of sediment-laden water to drains etc.
- Monitoring and mitigation details are included in the Water Management Plan (ESI, 2009) and these include monitoring of groundwater levels, quarry pumping rates, rainfall and suspended solids concentrations.
- On cessation of dewatering, water levels are anticipated to return to pre-development groundwater levels (c. 440 mAOD). This will lead to a recovery of most of the associated groundwater flow systems to a similar condition to before dewatering of the quarry. However, the large volume of water in the quarry void may act as a slight dampener to fluctuations in groundwater level and flow. This would generally be considered to be a net benefit.
- During the period when the quarry void is re-filling with water (1-2 years), there will be lower outflows from the system and so it may be necessary to maintain a small amount of residual pumping during dry periods if any impacts have been detected on surface water flows during the course of quarry development.

An additional receptor assessed in the more recent impact assessment (Stantec, 2021b) is the Mynydd Llangynidr Site of Special Scientific Interest (SSSI). The impact assessment concluded the SSSI was designated due to its karstic geomorphology, particularly the doline field and the karstic features, including the dolines, are due to the dissolution of limestone by percolating groundwater. However, there is currently no evidence to suggest that the dolines are linked to any active cave systems. As such, the designation is not considered groundwater dependant.

3 Water Management

3.1 Existing abstraction licences and discharge consents

There is one discharge consent (reference: AN0258201) associated with the Site for discharge of trade effluent to the Nant Trefil as detailed in Table 3.1. Details of the discharge consent are given in Appendix D. It specifies that the total suspended solids shall not exceed 100 mg/l and the concentration of total oil and grease shall not exceed 10 mg/l; there is no limit on discharge volume or rate.

Table 3.1 Details of discharge of abstracted water

Detail	AN0258201
Location	SO 118 133 (to Nant Trefil).
Reason for discharge	Site drainage derived from quarrying activities.
Volume limits	Dependent on rainfall
Other limits	Suspended solids = 100 mg/l No visible oil & grease = 10mg/l

Environment Agency records also show discharge permit reference AC0121201 to have a site name of Trefil Quarry (this is thought to be associated with the Tarmac cement plant directly to the south of the quarry).

There are no licenced abstractions at the Site.

3.2 Current quarry water management

The water management system at the Site is shown in Figure 3.1 and Figure 3.2 and is summarised below. A schematic which also shows the expected licence type for various water movements is provided in Figure 3.3.

Runoff is permitted to collect in the sump of the active void. Water is pumped from the sump to a water holding tank in the processing plant area. A water meter is fitted upstream of the processing plant area. From the water holding tank (10 m^3 capacity), water is drawn off to a water bowser (8 m^3 capacity) for dust suppression around the Site or pumped to dust suppression spray bars located around the processing area which are used to suppress dust on the quarried mineral. It can also overflow, after which it flows under gravity through some water treatment features (the enhanced lagoon and settling pond) to the discharge point on the Nant Trefil, or it can flow from the enhanced lagoon back to the sump (meaning that meter readings can include an element of recirculated water).

Water is discharged from the Site to the Nant Trefil to the west of the Site under the conditions of a discharge permit (see Appendix D) and runs steeply down the hillside and is culverted under the road at approximately (NGR 3118 2133). The discharge permit has an upper limit on suspended solids of 100 mg/l. The water management system includes oil interceptors and regular observations are recorded on the presence/absence of any elevated turbidity/oil etc.

Turbidity of the quarry discharge is measured by the quarry operator at weekly intervals together with a note of the weather conditions at the time and this is then used to calculate the equivalent suspended solids concentration where no direct measurements of suspended solids data are available. The site drainage system

is inspected on a daily basis to ensure that the oil booms are in place and that there is no visible oil downstream of the booms and the quarry is inspected on a weekly basis for the presence of voids (which might indicate the presence of fast pathways from the quarry to local receptors).

Figure 3.1 Trefil Quarry water management scheme

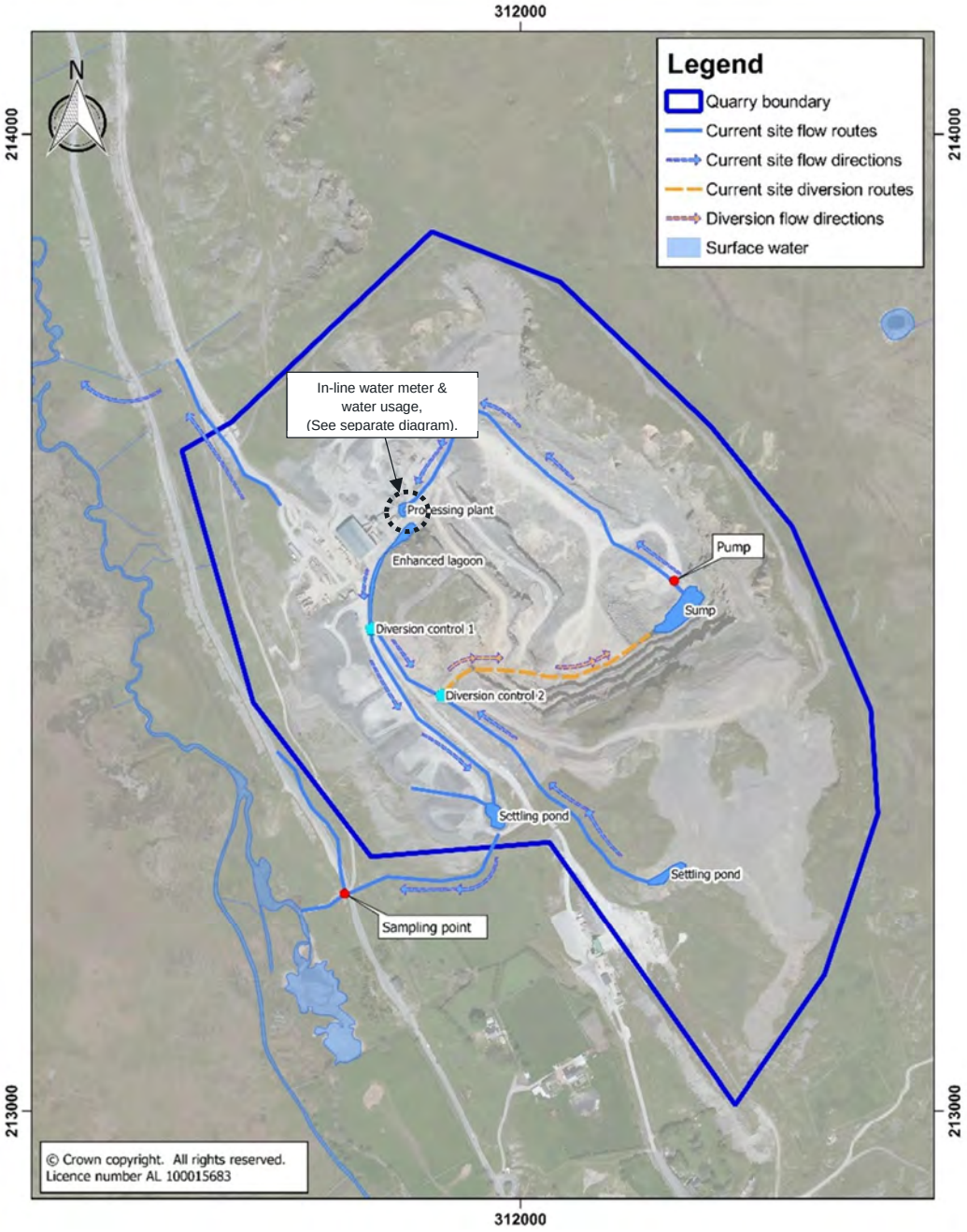


Figure 3.2 Trefil Quarry water management scheme (expanded view of processing plant area)

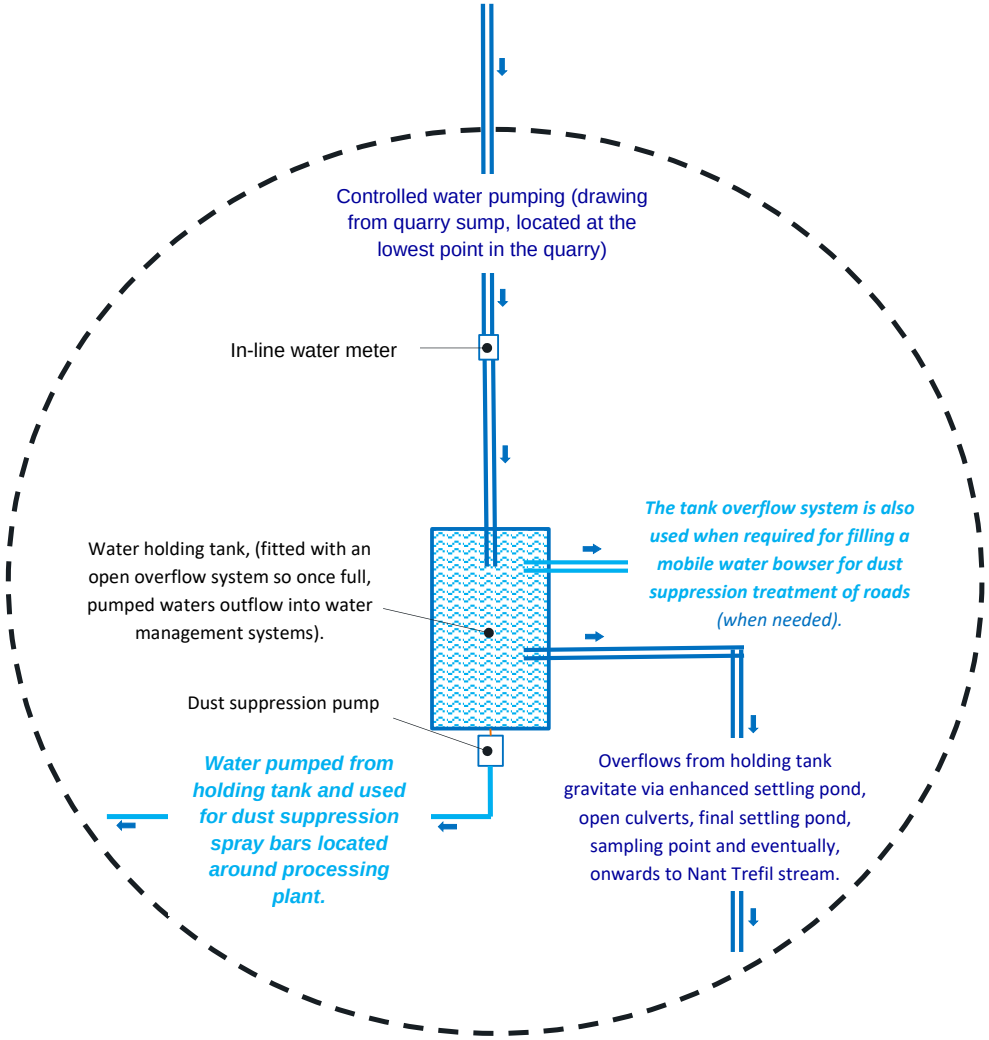
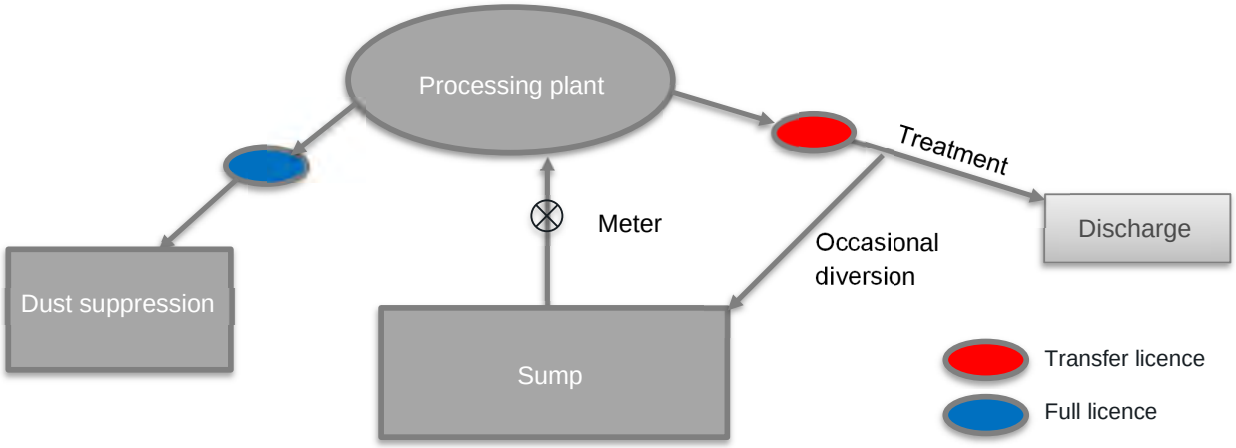


Figure 3.3 Water movements schematic



3.3 Current and future extent of development

GQL is permitted to work to approximately 412 mAOD (the base of the Dowlais Limestone), with the lowest point in the quarry base currently at c.412.9 mAOD. This is almost the maximum depth of dewatering required (27 m). GQL are working towards a northern extension application (currently at pre-application consultation stage) which will see quarrying to a depth of 467 mAOD to the north of the Site. However, this will not extend below the water table and therefore dewatering will not be required.

The cross sections in Figure 3.4, Figure 3.5 and Figure 3.6 shows the approximate extent of current extraction, as well as the current water table levels.

Figure 3.4 Bedrock geology with cross section locations

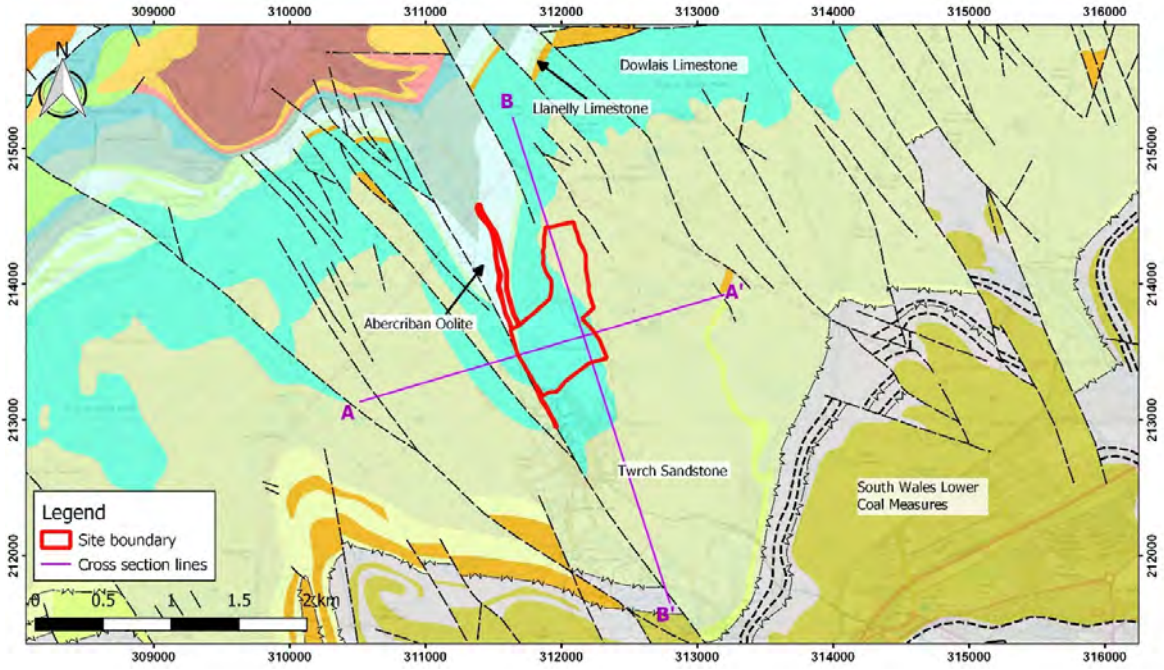


Figure 3.5 Conceptual hydrogeological cross-section through the Site (E – W)

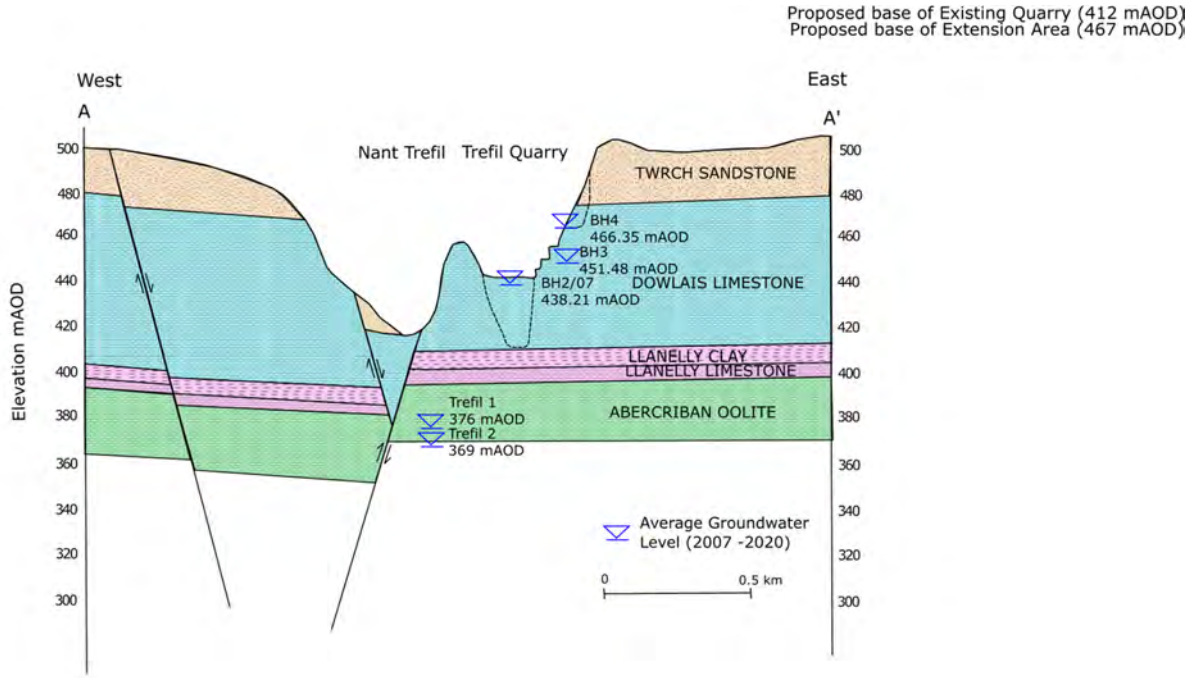
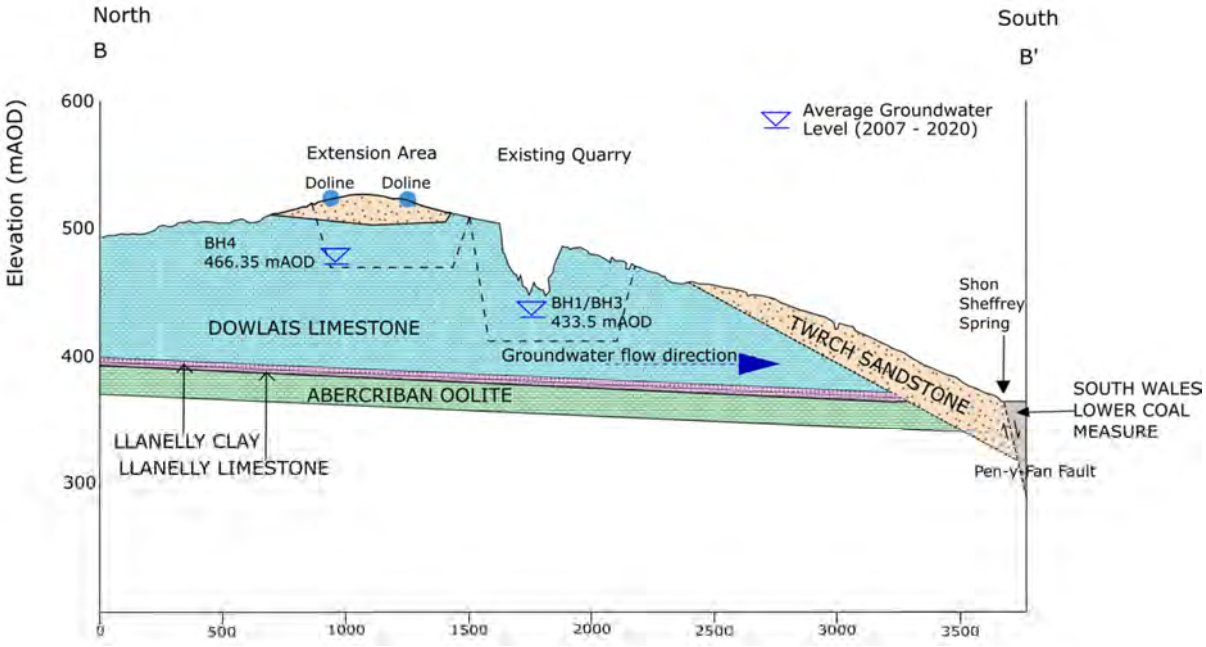


Figure 3.6 Conceptual hydrogeological cross-section through the site (N – S)



4 Water Use Quantification & Summary of Licencing Requirements

4.1 Quarry dewatering volumes

The dewatering components at the Site are summarised as follows:

- Dewatering water that is discharged to surface water can be considered to be transferred only, and not used or consumed.
- A small component of dewatering water will be lost within the processing plant as it is used for dust suppression. This water can be considered to be both used and consumed.

The rate of pumping from the quarry sump is monitored at weekly intervals by means of an in-line flow meter upstream of the water holding tank (see Figure 3.2 and Figure 3.3). The pump is operated manually when water levels in the base of the quarry are required to be lowered to carry out mineral extraction. Pumping records are available between 31 May 2010 and 31 December 2020. The total dewatering requirement for the Site is a summation of rainfall and groundwater ingress. The quarry dewatering data is provided electronically in Appendix E.

4.1.1 Total dewatering

Dewatering data from 2010 to 2020 is summarised in Table 4.1 below.

From 2010 to 2020, the average total abstraction volume for each month ranged between 7,554 m^3 (July) and 29, 054 m^3 (January).

During 2020, monitoring was not carried out between 22nd March and 14th June due to staff being on furlough. Therefore, a total reading of 44,770 m^3 was recorded on 14th June 2020 and a weekly average over the 12-week period has been calculated and used in the table below.

Table 4.1 Monthly pumping totals (m^3)

Date	Pumped volume (m^3)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average during month (m^3)
Jan	-	19,680	19,610	23,860	38,580	27,970	57,810	6,910	27,010	-(1)	40,060	**29,054(3)**
Feb	-	22,590	6,860	25,020	23,360	22,210	32,210	17,830	9,650	-(1)	30,640	**21,152(3)**
Mar	-	4,540	7,220	8,150	38,570	14,240	9,780	24,770	15,160	1,920	25,951(2)	**15,030(3)**
Apr	-	3,140	5,340	13,820	24,160	4,420	13,970	2,890	19,030	10,040	14,924(2)	**11,173(3)**
May	430	4,300	17,820	24,210	10,470	5,670	7,070	4,830	8,690	5,490	18,655(2)	**9785**
Jun	1,460	10,670	23,320	9,690	6,560	3,750	8,140	10,770	6,400	5,640	15,840(2)	**9295**
Jul	5,830	8,760	12,830	6,740	4,700	5,950	6,920	10,830	5,340	1,570	13,620	**7554**

Date	Pumped volume (m^3)											
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average during month (m^3)
Aug	17,180	1,750	13,790	10,970	6,620	12,400	18,160	14,010	18,850	17,110	18,150	**13,545**
Sep	17,000	15,900	9,600	6,900	13,040	12,400	5,940	8,500	12,420	12,440	10,120	**11,296**
Oct	12,220	9,240	20,080	17,520	26,020	9,690	8,040	12,330	16,430	10,680	30,860	**15,737**
Nov	20,330	19,400	20,070	18,370	20,010	26,390	7,880	21,260	26,040	34,360	30,120	**22,203**
Dec	1,750	17,040	21,060	17,300	18,860	44,920	13,720	20,010	-[1]	34,300	40,360	**22,932**
Total m^3	**76,200**	**137,010**	**177,600**	**182,550**	**230,950**	**190,010**	**189,640**	**154,940**	**165,020**	**133,550**	**289,300**	

[1] = water meter failed at the end of November 2018 due to wear and hence no readings from December 2018 to 22 March 2019

[2] = incorporates average rates over period 22nd March and 14th June

[3] = averaged across months in which pumping occurred

4.1.2 Consumptive use

Dust suppression

The only consumptive use of abstracted water at the Site is for dust suppression. This occurs either via a pumped system to spray bars in the processing plant and onto the mineral or through use of a water bowser and onto the wider site (haul roads etc.).

Dust suppression use is not measured at the Site, but the following has been estimated by quarry staff:

For dust suppression in the processing plant, it is estimated that two tanks worth of water (20 m^3) is typically consumed for each day that the Site is working. The maximum number of days that the Site works per year is 276. This means that the total water consumed for this activity is up to 5,520 m^3/yr.

For dust suppression of the wider Site through the use of the water bowser, it is estimated that up to six loads a day (48 m^3) are used but that this would only be required on a relatively small number of days per year. In 2021 this was 21 days per year; however, for hotter drier years this could be greater and it is recommended that there is an allowance of 40 days. This means that the total water consumed for this activity could be up to 1,920 m^3/yr.

Total water use for dust suppression is therefore estimated to be up to 68 m^3/d and 7,440 m^3/yr.

4.1.3 Unused water

Any water that is not used for dust suppression is unused and therefore transferred. This water is either discharged or, occasionally, recirculated to the sump. The volume of water used for dust suppression each day is relatively small and, in the case of the water bowser, is not always required. It is therefore assumed that the metered abstractions could, at times, represent water that is entirely transferred. This has been assumed to be the case in the following discussions.

The maximum instantaneous abstraction rate will be controlled by the pump capacity. This rate has been estimated by site staff as 439 l/s.

During extremely wet periods it is conceivable that the pump could run for a full 24 hours, and therefore maximum daily abstraction could be 38,000 m^3 (for comparison, the highest daily total on record is 24,350 m^3) although daily meter data indicate an average of 3,241 m^3/d.

Annual maximum recorded abstraction is 289,300 m^3 with an average (excluding 2010 which was not a full year of data) is 185,057 m^3.

4.2 Water Efficiency

GQL would follow good practice with regards to water efficiency. This would include regular inspections to identify leaks and storing water in the tanks shown in Section 3. Any identified leaks would be rectified by GQL as soon as is practicable.

5 Summary of Licencing Requirements

Based on the evidence provided above, it is considered that the licencing requirements are as follows:

Use (full) component

- Dust suppression = daily usage of up to 68 m^3 and a total annual usage of up to 7,440 m^3.

Unused (transfer) component

- peak instantaneous pumping rate = 439 l/s (or 1,580 m^3/hr).
- daily dewatering rate = 38,000 m^3/d (max.) / 3,241 m^3/d (avg.).
- annual dewatering rate = 289,300 m^3/year (max.) / 185,057 m^3/year (avg.).

Note that we would not expect that the transfer element to be limited by a numerical limit on flow rates as this will be heavily influenced by incident rainfall and surface water inflows which will vary from period to period.

References

ESI Ltd, 2008. Trefil Quarry: Hydrogeological Impact Assessment. Report reference: 6878R1rev1, June 2008

Stantec UK Ltd, 2021a. Trefil Quarry Annual Monitoring Report - 2020. Report reference 330201714R1D1.

Stantec UK Ltd, 2021b. ES Chapter 13: Hydrology, Hydrogeology, Flood Risk and Drainage. Trefil quarry extension. Report Reference: 6878R8.

Appendices

Appendix A

Application Forms

Appendix B

Key Development Plans

Appendix C

Site Water Management Plan

Report Reference: 330201714TN1

Report Status: Final

Appendix D

Discharge Permit and Abstraction Licences

Appendix E

Quarry Pumping Records (electronic)

Appendix F

Trefil Quarry Planning Permissions

Appendix G

Trefil Quarry Hydrogeological Impact Assessment (2008)

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Appendix H

2020 Annual Report

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