AGENDA ITEM 6

APPENDIX 6

2018/0151/DET

HYDROLOGY AND HYDROGEOLOGY PEAT ASSESSMENT

Chapter 8.0
Hydrology and Hydrogeology
Peat Assessment

Dalwhinnie Quarry, Dalwhinnie

Hydrology, hydrogeology and peat assessments

MNV Consulting Ltd

Dalwhinnie Quarry, Dalwhinnie

Hydrology, hydrogeology and peat assessments

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1 Background

1.1 Proposed quarry works at Dalwhinnie

Dalwhinnie Quarry is located some 1.5km north of the settlement of Dalwhinnie and within the River Truim catchment area (Figure 1). The quarry operated intermittently from 2000 to 2016 producing aggregates for construction works in the area. The current operator of the site, Leiths (Scotland) Ltd, has an interest to re-open the site and is currently developing a planning application for this activity. The Highland Council has confirmed that the proposed development would require an Environmental Impact Assessment (EIA) and within the scope of the EIA a hydrological and hydrogeological assessment and a peat assessment would have to be included.

The current proposal is to extend the existing quarry in a northerly and easterly direction (Figure 2) with the total development area being 15.1ha and the average annual extraction rate will be 70,000 tonnes/year. Extraction will be undertaken on a phased basis with overburden and soils stored around the perimeter of the site and all crushing, processing, stockpiling and loading of HGVs will take place on the quarry floor. Restoration will be undertaken by re-grading the quarry floor and by using the material stored around the periphery of the site creating shallow slopes into the water body and providing a variety of habitats within the site.

In terms of water management, it is understood that the quarry will be developed to include a 3 – 5m deep sump in the floor where water will accumulate. A pump will be operated to manage the water and create dry working areas. The pump will be operated by a float switch, activating the pump when the water gets to a set level. The water will be pumped to a suitable soakaway to the east of the quarry. If the quarry is not going to be operational for extended periods of time (3 months or more) pumping may be temporarily stopped during the period the quarry is not in operation.

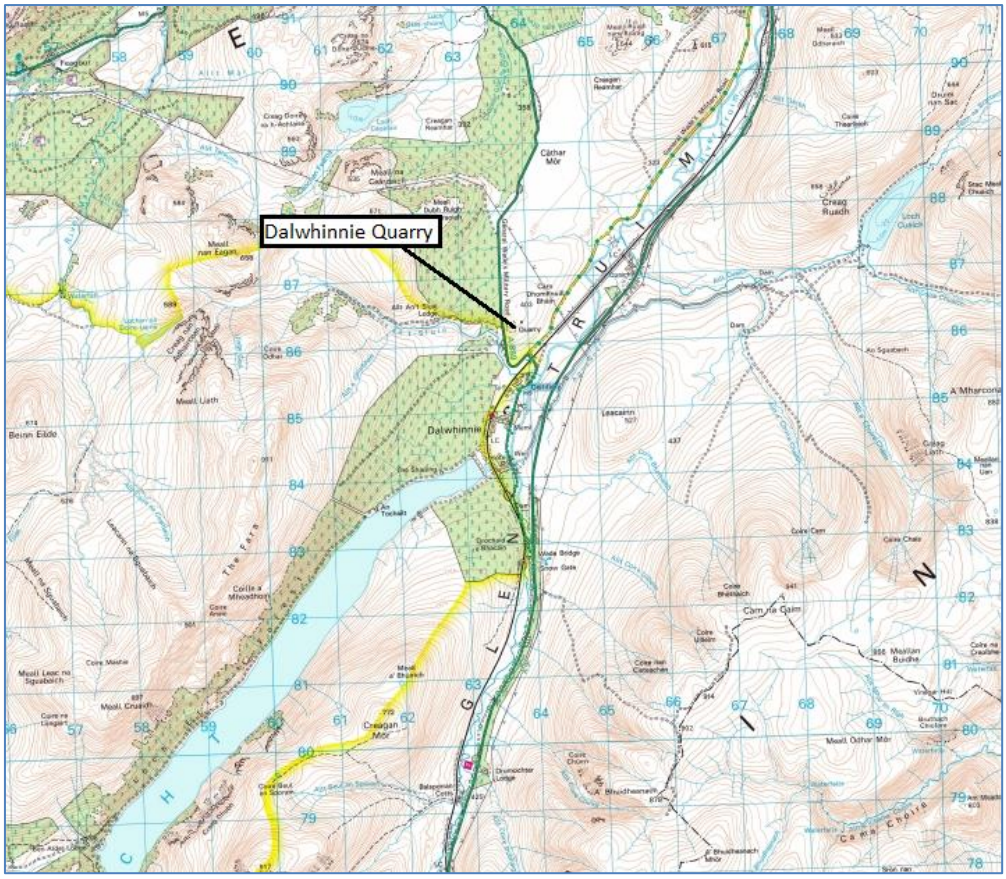

Figure 1 Location of the Dalwhinnie Quarry

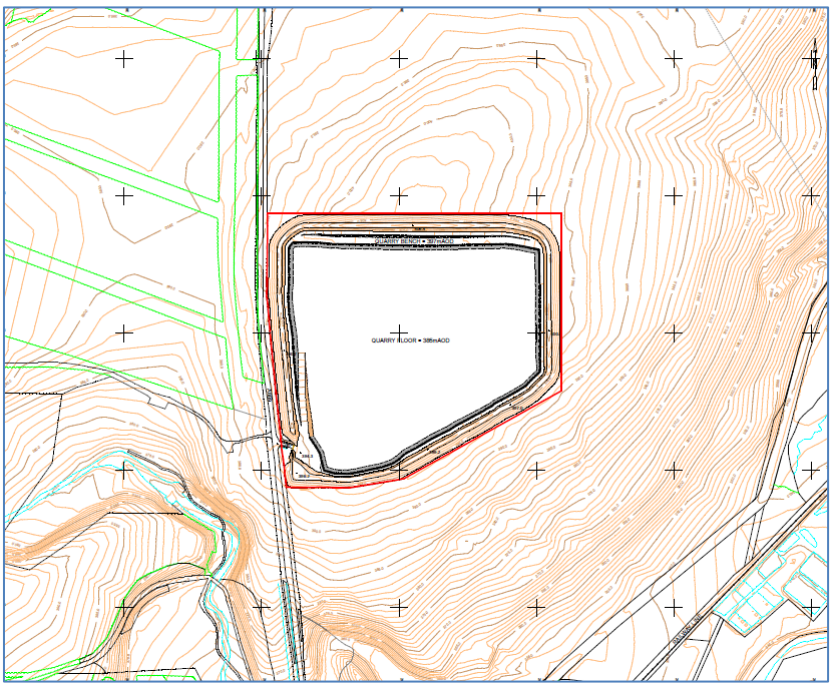

Figure 2 Proposed development site

1.2 Requirements from the scoping report

In relation to the EIA for the proposed development, a scoping response was received from The Highland Council, including responses from a number of organisations. The responses relevant to hydrology, hydro-geology and peats are summarised below:

Highland Council:

- Describe the significant likely effects on the local geology;
- Address the nature of the hydrology and hydro-geology of the site and any potential impacts on watercourses, groundwater, water supplies, water quality and water quantity;
- Assess potential impacts of periods of high rainfall, runoff, high flows in watercourses, flood risk and the design of drainage provision;
- Include measures to prevent erosion, sedimentation or discolouration of water and monitoring and contingency plans.

Scottish Natural Heritage / Cairngorms National Park:

- Peat assessment is required, including a peat survey over the proposed site;
- If peat is to be removed, a method statement will be required.

SEPA

- Details of any groundwater supply sources;
- Map of any engineering activities affecting the water environment;
- Map of the proposed surface water drainage layout;
- Details of pollution prevention measures;
- Map of proposed restoration measures.

1.3 Scope of work

In December 2017, MNV Consulting was contracted by Leiths (Scotland) Ltd to undertake the hydrological and hydro-geological assessment and the peat depth survey and assessment. The following scope of work was agreed with the Client:

Hydrology and hydro-geology:

- Site survey to carry out an audit of the surface water features on the development site, access tracks and land adjacent to the site.
- Include any information about public or private water supplies in the area.
- Obtain maps of the topography, geology and superficial deposits in the area.
- Determine the controls on the surface water features and whether these are rainwater, surface water, flooding or ground water fed systems

Peat deposits:

- Site survey to map the peat depths and level of decomposition on the development site, access tracks and land adjacent to the site.
- Determine the hydrological controls on the peat deposits.
- Determine the potential instability of any peat deposits on steep ground.
- Map the characteristics of the peat deposits within GIS.

1.4 Experience of the consultants

The hydrological, hydro-geological and peat depth surveys and assessments were undertaken by the following members of MNV Consulting Ltd:

Dr Richard Johnson:
44 years' experience
BA Environmental Sciences, University of Lancaster
BA Earth Sciences, Open University
PhD River sediment transport, University of Sheffield.

Marcus Sturrock
10 years' experience
BSc Geology, University of St Andrews

Fraser Cassels
8 years' experience
BEng Architectural Engineering, University of Strathclyde

2 Physical characteristics

2.1 General setting

The development site is located immediately north of Dalwhinnie within the catchment of the River Truim (Figure 3). This location is within a rugged landscape with high plateau mountains dissected by deep glacial valleys. It is an important meeting point for two lines of communications through the Highlands with the road from the west coast joining the A9 corridor which includes a major road and main line railway connecting the north of Scotland to the south.

The site is situated on a low dome shaped feature between two rivers (Figure 4). The River Truim, 680m to the east has developed a glacial valley into a relatively wide feature with a floodplain formed from alluvial deposits with steeper side slopes supporting extensive glacial deposition material. The Allt an t-Sluic, 230m to the west, flows off the hills to the west to join the River Truim just north of Dalwhinnie. This is a typical mountain river with a large volume of coarse sediments transported downstream by the energetic river flows.

Public roads extend around west, south and eastern sides of the site and a railway line is 580m to the east of the site. Apart from the existing quarry, there are no other developments on or around the site. Further away from the site, the settlement of Dalwhinnie has developed at the meeting of the two lines of communication and where the two rivers meet. At the northern end of the settlement there is the Dalwhinnie Distillery which abstracts water from the Allt an t-Sluic and discharges excess water via a series of filter beds, into the River Truim. A second structure exists on the Allt an t-Sluic, forming an intake for the local SSE hydropower scheme.

The quarry is situated on the south facing slope of the dome feature and has an access off the A889 Laggan Road to the west of the site. There are currently no quarrying operations or facilities on the site, the quarry walls have been re-profiled and bunds constructed around the edge of the quarry. Since quarrying activities stopped there appears to have been no water management of the site, with no pumping of water out of the working area so the water in the quarry is at its “natural” level.

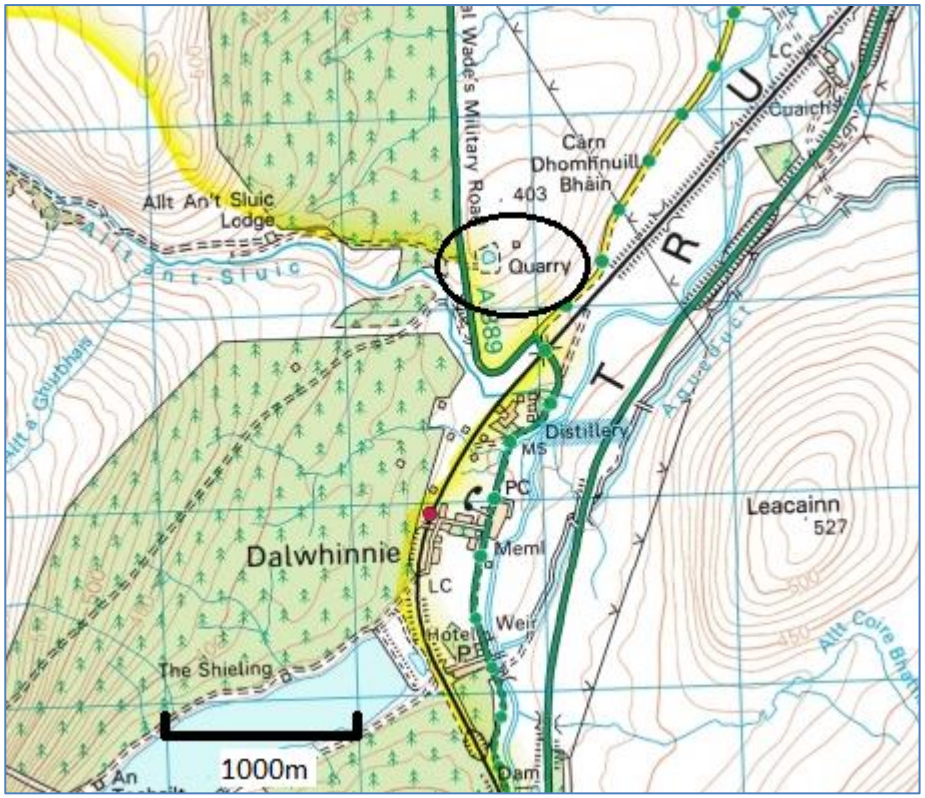

Figure 3 Location of the Dalwhinnie Quarry

Figure 4 General view of the area from the A889, south of the quarry

2.2 Geology

The structural geology of the area is part of the Gaick Psammite formation within a regional structure which includes several major Felsic intrusions and fault lines to the north of the site (Figure 5). Psammite is a medium textured, metamorphosed sedimentary rock with a dominantly sandstone protolith.

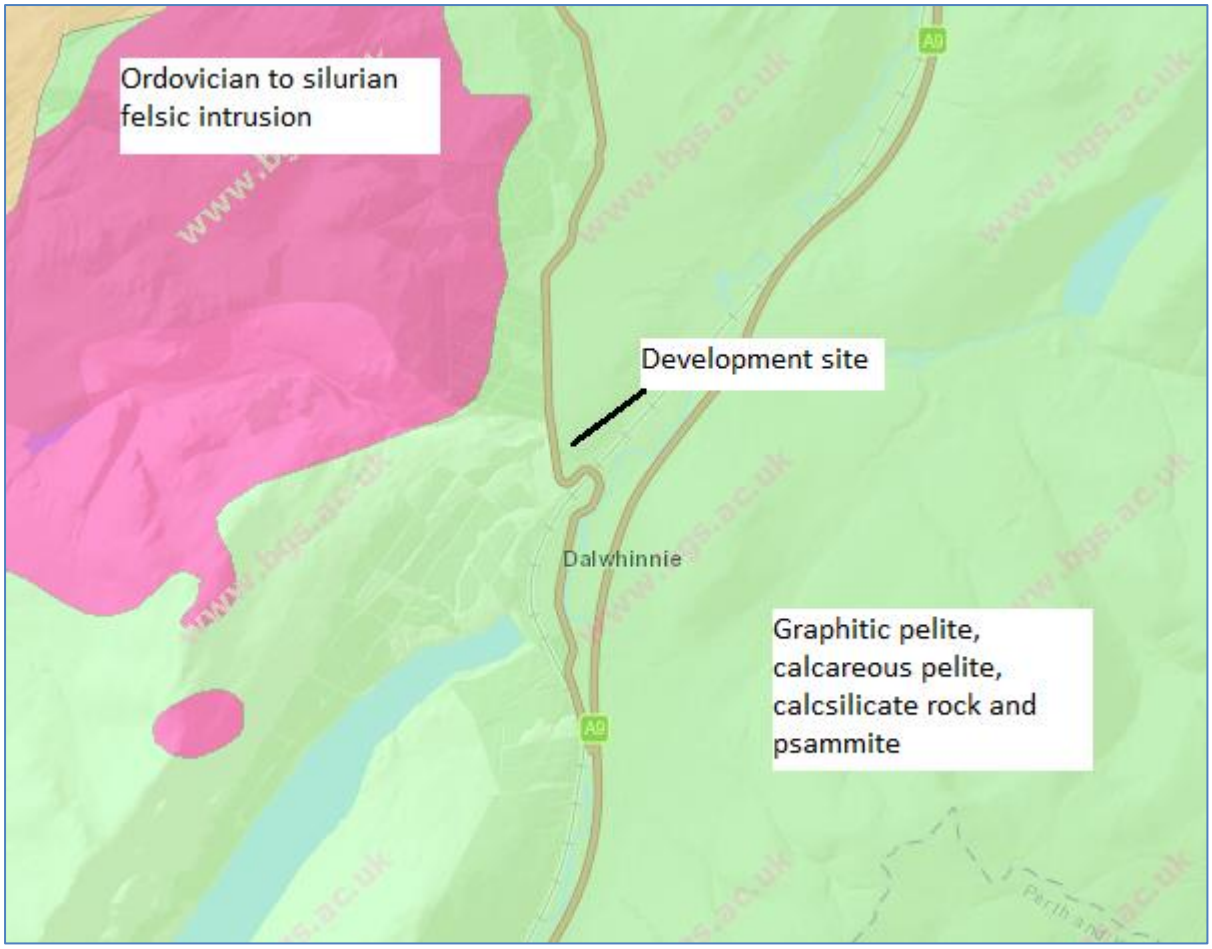

Figure 5 Solid geology of the area

2.3 Superficial deposits

The superficial deposits in the area include extensive glacial and alluvial deposits although over the dome feature there are only Talus rock fragments (Figure 6). The alluvial deposits are mainly in the valley of the River Truim while the glacial deposits are on the lower valley slopes extending up to an altitude of approximately 400mAOD. Peat deposits exist to the west of the site but do not extend to the east of the A889 (Figure 6).

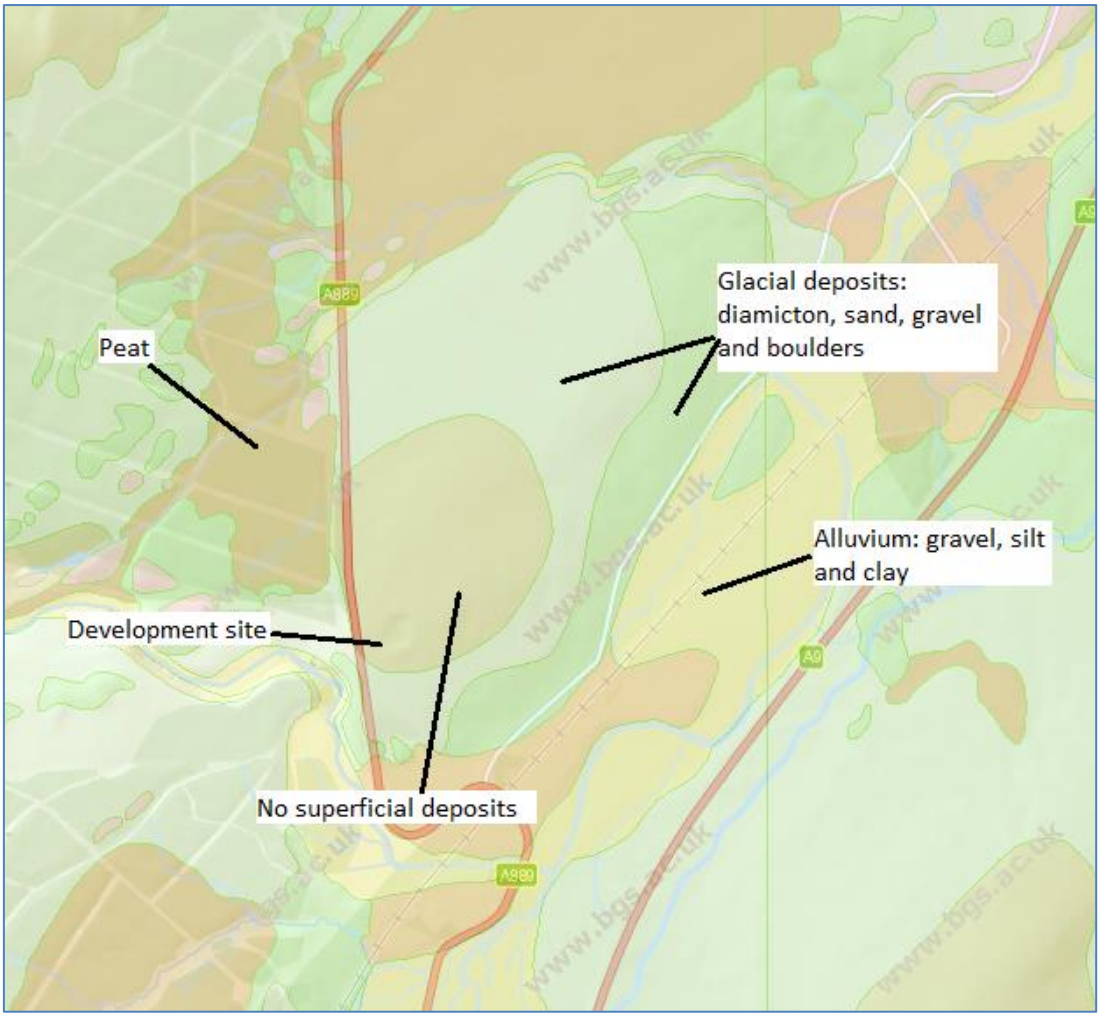

Figure 6 Superficial deposits in the area

2.4 Surface water features

The two largest surface water features in the area are the River Truim (Figure 7), flowing north past Dalwhinnie to join the River Spey at Invertruim, and the Allt an t-Sluic (Figure 8) a smaller river flowing east to join the Truim just north of Dalwhinnie. A smaller watercourse, Allt an t-Slugain, is located to the north of the dome, flowing east into the River Truim.

Over the dome there are no surface water features although around the base of the dome, to the south and east of the site, there are a number of springs with the water flowing through culverts under the public roads and into the surrounding rivers (Figure 9).

The Allt an t-Sluic, to the west of the site has two concrete intake structures built in the channel (Figures 10 and 11), the upstream one is the intake structure for the Dalwhinnie Distillery while the downstream structure is the intake for an SSE hydropower scheme. Between them the intakes abstract all of the river water so downstream of the SSE intake the river channel is virtually dry (Figure 8).

Figure 7 River Truim adjacent to the site

Figure 8 Allt an t-Sluic adjacent to the site

Figure 9 Springs emerging from the base of the dome to the east of the site

Figure 10 Intake structures in the Allt an t-Sluic

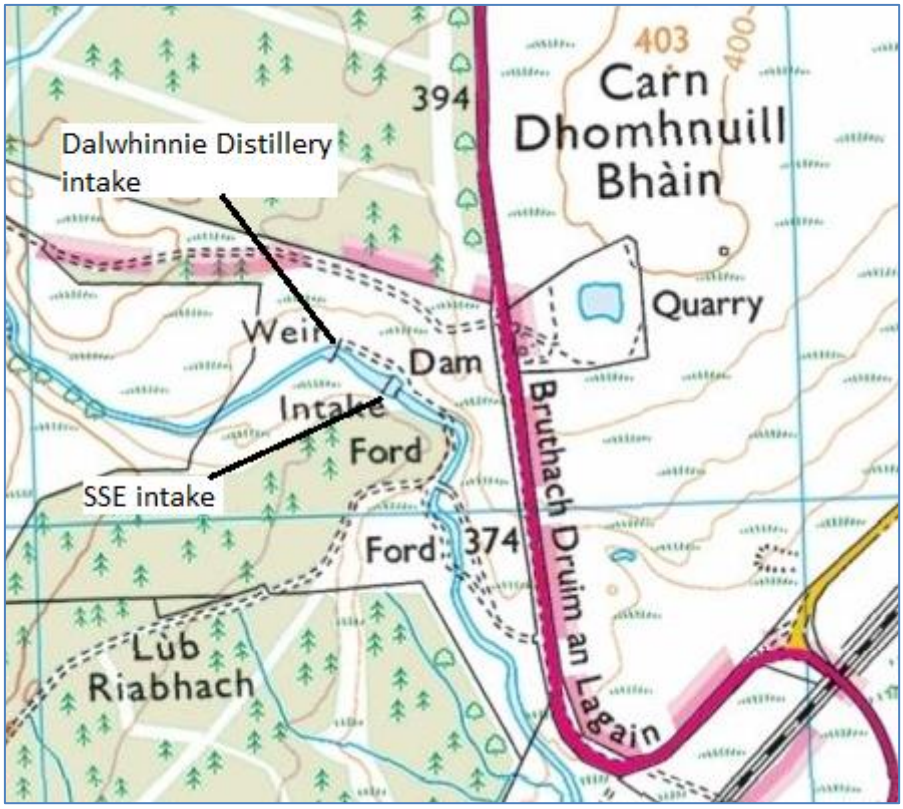

Figure 11 Location of the intakes

3 Site surveys

3.1 Hydrology and hydrogeology

The hydrological and hydrogeological survey was undertaken by Dr Richard Johnson on 30th January 2018. The weather was cold and dry following a period of unsettled weather when there had been significant accumulations of snow.

The survey was organised as a walk-over to locate all surface water features over the development site and also in the adjacent areas which might be affected by the development. All features were assessed in terms of whether they were natural or whether there had been any artificial changes or impacts from recent or past developments. The existing quarry was inspected in detail to see if the past water management, when the quarry was operating, had impacted the surrounding land or adjacent watercourses.

Within the development site the only surface water features present are the accumulation of water in the old quarry (Figure 12) and small areas of standing water and wet soils (Figure 13). The source water in the quarry appears to be primarily precipitation (rain and snow), there is no direct drainage into the quarry but there appears to be slight seepage from the surrounding ground into the quarry. The water level was observed to be at a similar level of the ground beyond the surrounding bund, on the downhill side of the quarry. Data supplied by the operator showed that the water level has been measured at 390.5 to 391.0mAOD with the ground to the south measured at 393.0 to 394.0mAOD confirming that the water level is slightly lower than the adjacent ground.

There is no pump currently on site so it appears that the current outflow from the quarry is from seepage through fractures in the underlying bedrock.

Figure 12 Water in the old quarry

Figure 13 Standing water over the site

The small areas of standing water and wet soils are present over the site and are due to the low infiltration rate of the top soil. The water appears to accumulate in small areas where there are micro hollows. The depths of water are all shallow, less than 20cm.

When the quarry was previously operational, water would have been pumped out of the quarry and through a gap in the surrounding bund to the east of the site. Inspection of the area where the water would have been discharged showed that there was a small trench dug to discharge the water into but there was no evidence of any damage to the surrounding ground from over-saturation and there was no evidence of silt accumulations from the discharged water.

The ground immediately beyond the development site is very similar with no surface watercourses but small areas of standing water. To the north of the site, some 1000m away, there is a small burn (Allt an t-Slugain) which drains the ground to the west of the public road with the water flowing slowly around the north side of the dome feature and discharging into the River Truim. To the south and east of the site there are several springs emerging from the base of the dome immediately above the public road. These springs form small burns which are culverted under the roads. It appears that the spring line is associated with the water which originally fell as precipitation onto the dome, seeping into the soils and fractured rock layer and gradually down the dome to emerge at its base as a series of springs some 430m distance from the site.

To the west and east of the dome there are two significant river systems, the Allt an t-Sluic to the west and River Truim to the east. The Allt an t-Sluic is a typical Highland gravel bed river flowing off the surrounding hills, through the glacial deposits and over the alluvial deposits to join the River Truim near Dalwhinnie. Two structures exist on the river, the upstream one being the intake for the Dalwhinnie Distillery and the lower one the intake for the SSE hydro scheme. The upper intake abstracts a small proportion of the river while the lower intake abstracts all of the residual water.

Downstream of the lower intake the river is dry apart from some pools of water remaining from the last rainfall event. The Dalwhinnie Distillery discharges excess water into the River Truim through a series of filter beds located close to the River Truim to the east of the development site.

Drainage from the western side of the dome will be intercepted by the A889 public road rather than seeping through the soils and broken rock layers into the river. The intercepted water flows into the roadside drain and to the north of the quarry access road, through culverts under the road. To the south of the quarry access road, water flows down the drain to a culvert at the base of the hill where it flows under the road and is discharged into the Allt an t-Sluic, downstream of the existing intakes.

The River Truim is a less active river compared to the Allt an t-Sluic. It is formed from a network of smaller burns flowing into the main valley of the River Truim. The valley floor is relatively wide and gently sloping compared with the tributary burns. The river meanders over the floodplain to discharge into the River Spey near Invertruim. Water drains off the eastern side of the dome and emerges in the series of springs immediately above the public roads. The spring flows form into small burns which flow over the floodplain and into the River Truim.

Therefore the site survey enabled the hydrological processes of the area to be described so that any potential impact of the expanded quarry could be identified. In addition the survey identified two water intake structures and one discharge structure in the rivers close to the development site. No other water abstraction or discharge structures were found.

3.2 Peat depths and characteristics

The peat survey was undertaken by Fraser Cassels and Marcus Sturrock on 1st February 2018. The survey was organised by dividing the development site into a grid with spacing of 50m and extending 50m beyond the development site on the north, east and south sides of the site. At each sampling point the peat depth was measured using a 4m long peat probe and the characteristics described by taking a sample and using the von Post scale to describe the type of material.

Peat depth results (Figure 14) show that over most of the site the peat depths are less than 30cm. Only three of the sample sites showed the peat depth was greater than 50cm however these were in isolated sites where small hollows in the surface have filled with water and vegetation matter to form peat.

The characteristics of the peat, as classified by the von Post scale (Table 1), are shown in Figure 15. Results show that the peat is all scored 4 or less on the scale indicating the material is fibrous and not decayed. While this survey has been called a peat survey, due to the shallow depth and lack of decomposition, the material is more a fibrous soil rather than a peat (Figure 16).

The cores penetrated the upper fibrous layer enabling the material at the top of the bedrock layer to be sampled. The material was characterised as either gritty, sandy or solid. Figure 17 shows the results with most of the material either solid or gritty material.

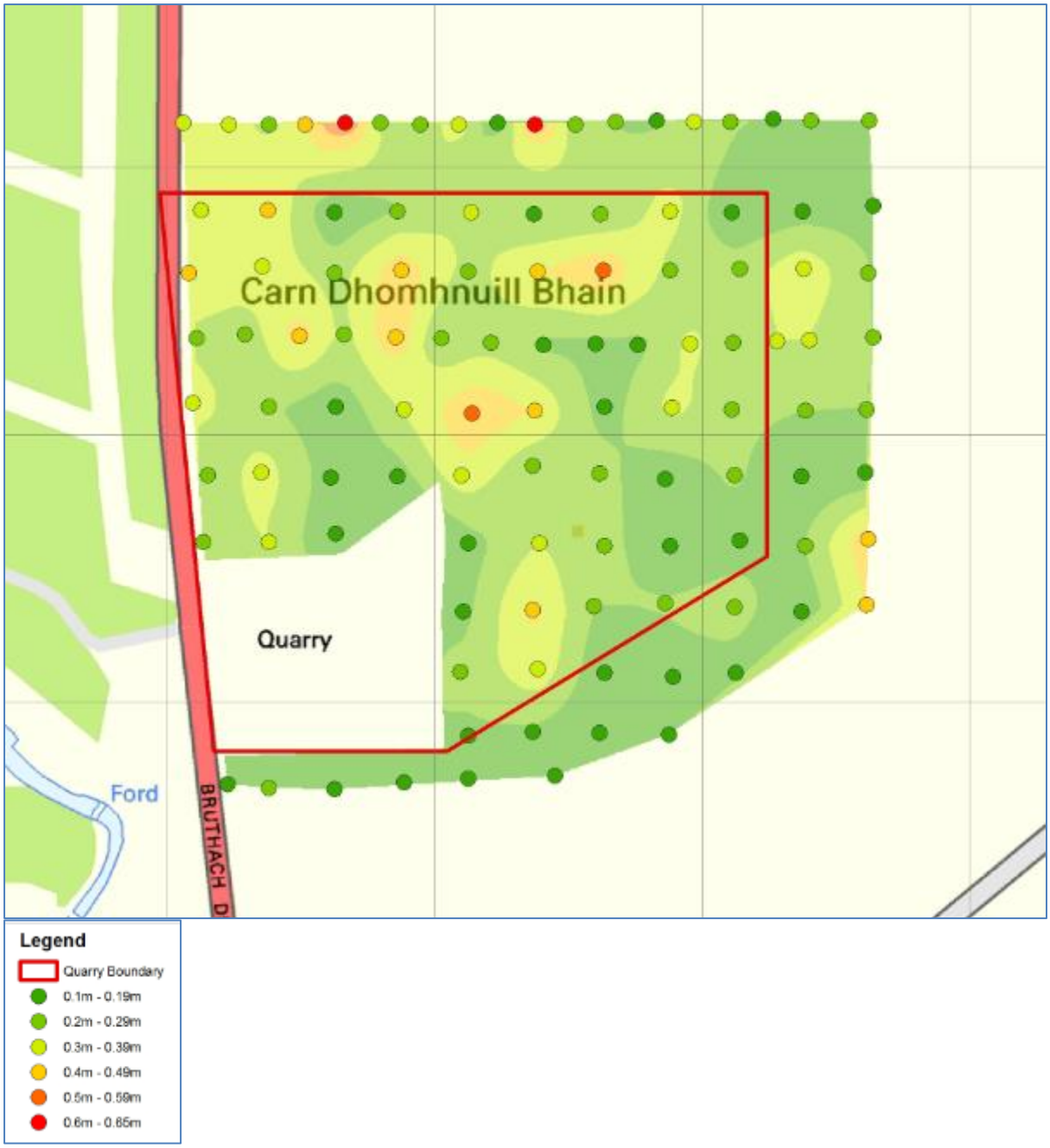

Figure 14 Distribution of peat depths

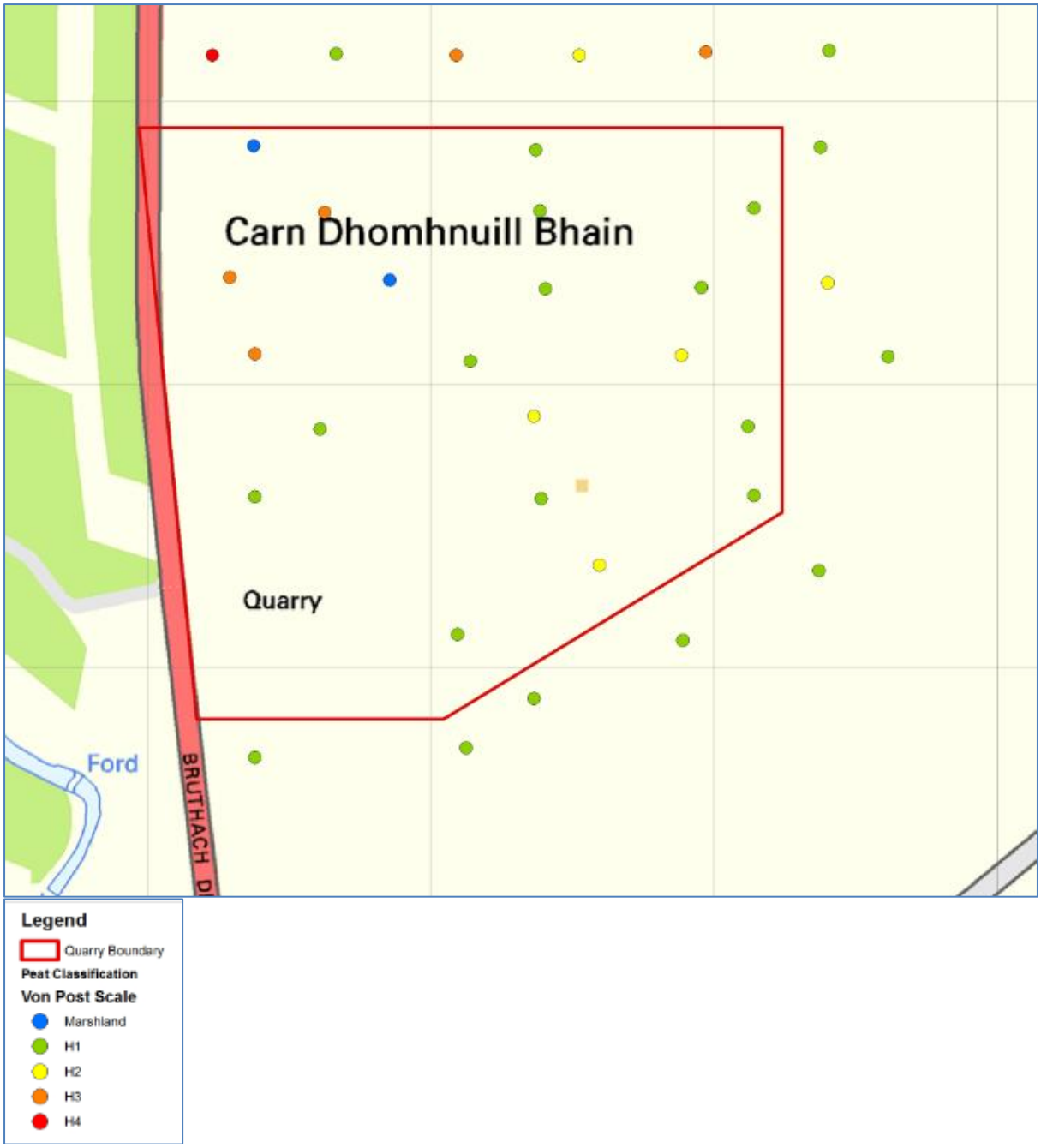

Figure 15 Distribution of peat material

Figure 16 Sample of material

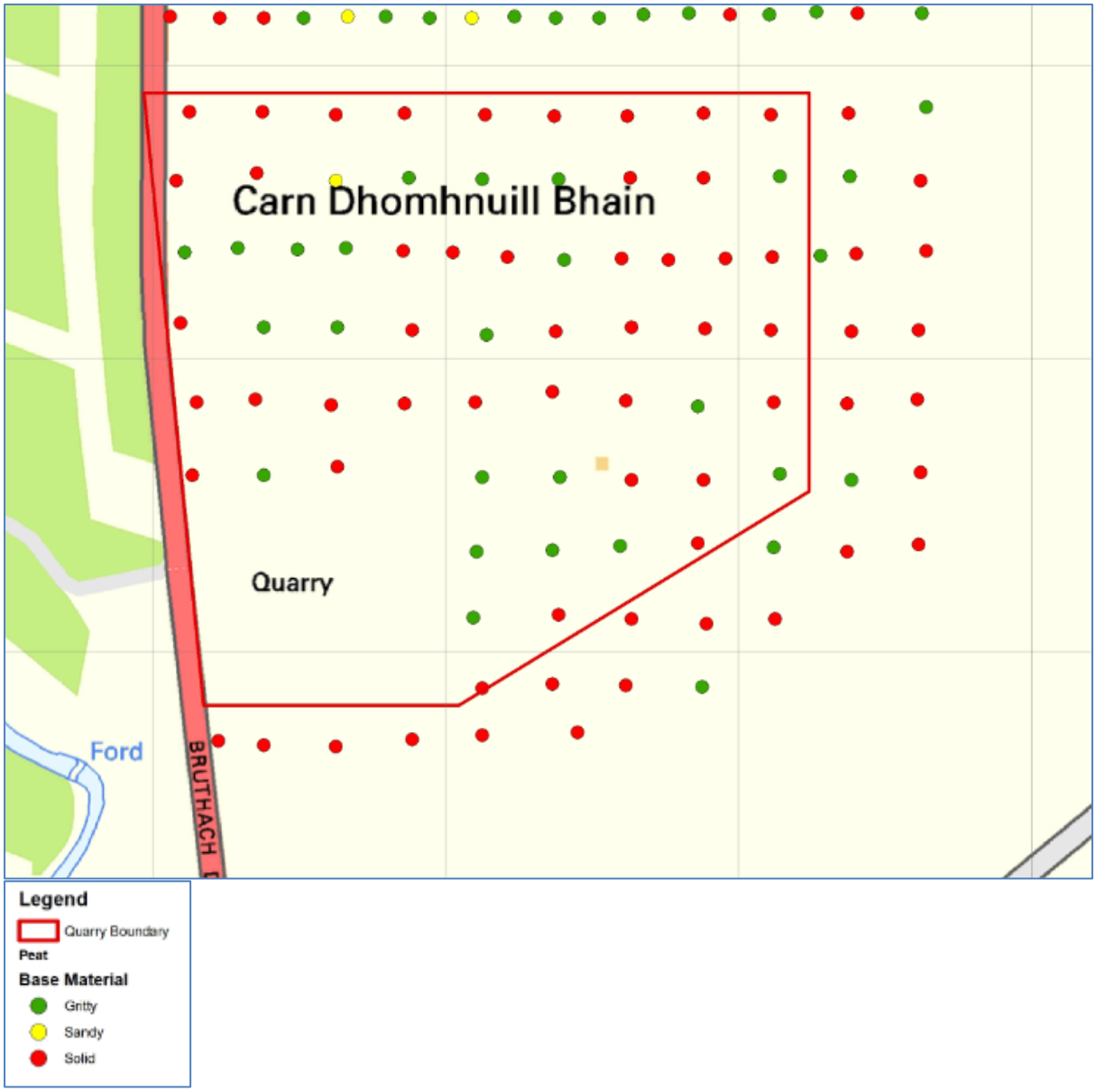

Figure 17 Characteristics of the lower material

Table 1 von Post scale of humification

Scale	Description	Water content
1	Completely undecomposed	Clear
2	Almost undecomposed	Clear or yellowish
3	Slightly decomposed	Muddy brown
4	Slightly decomposed	Very muddy brown
5	Moderately decomposed	Very muddy water
6	Moderately highly decomposed	One third peat escapes
7	Highly decomposed	Half peat escapes
8	Very highly decomposed	Two thirds peat escapes
9	Fully decomposed	Uniform paste
10	Completely decomposed	All peat escapes

4 Potential impacts and mitigation measures

The hydrological survey showed that the dome structure which the quarry will be located on has a natural drainage system where the precipitation drains slowly through the upper soil horizon and into the fractured rock horizon, emerging at the base of the dome to form small watercourses which flow into the surrounding rivers. This natural system appears to be robust with no signs of channelling over the surface and no signs of erosion of the upper soils.

The existing quarry is not operational and without pumping, water accumulates to reach a level slightly below the level of the downhill surface beyond the surrounding bund. This level indicates that the water is draining out of the quarry through the fractured rock horizons. The water in the quarry will rise and fall in response to precipitation but the inflow appears to be balanced by the outflow. When the quarry was operational the water was pumped out to lower the water level. The bund has a low point on the eastern side where the pipes were laid and the water discharged into a trench cut across the slope. There was no sign of overland flow, soil erosion or silt accumulations suggesting that the method for managing water was successful with the vegetation and fractured rock horizon buffering and filtering the discharged water. This therefore appears to be a good method for managing the water in this situation and minimising potential impacts on surrounding environments.

The rivers which exist to the west and east of the development site would be vulnerable if water with high silt content flowed directly into these watercourses. As there are no surface water drainage features over the site, or between the site and the rivers, the water flowing from the development site will be buffered and filtered by the vegetation and soils. The proposed development will therefore have no impact on the water quality or quantity in the rivers surrounding the site.

The potential impacts on surface and sub-surface water features are considered to be negligible when the quarry becomes operational. The proposed method for managing the water in the quarry, i.e. using a float operated pump with water discharged into a soakaway, is considered to be suitable for this situation. This however depends on there being no artificial drainage channels on the dome structure downhill from the quarry so there should be no drainage of the surrounding land. In addition the soakaway should be regularly monitored to ensure the infiltration rate is sufficient to avoid spill and the creation of overland flow. If overland flow is observed then a line of straw bales should be constructed below the soakaway to capture this water.

When the quarry is not operational for periods in excess of 3 months it is planned not to pump water out of the quarry and allow it to fill to its natural level. From observations of the existing quarry, this level will be below the level of the downhill ground adjacent to the site with the water seeping out of the quarry through the fractured rock horizons. It is therefore important to maintain these fractured rock horizons and not create an impermeable barrier on the east and south sides of the quarry.

The risk of flooding caused by the development of the quarry is considered to be negligible as there will be no change to the runoff characteristics of the site. The area of the quarry will increase

however there will be no direct runoff from the quarry into any of the surface watercourse in the area. There will be no artificial drainage of the surrounding area and so the natural runoff from this land and into the surface watercourses in the area, will not be affected.

In extreme rainfall conditions the water in the quarry will rise as the water accumulates in the pond area but the pump will be activated in these conditions which will control the water level. To estimate the potential rise of the water in the quarry without any pumping, the area of the new quarry, including the quarry floor and the side slopes, was estimated to be 300,000m^2 with the area of the quarry floor estimated to be 170,000m^2. Therefore if 150mm of rain fell in a 24 hour period and all of the water from the total quarry area accumulated on the quarry floor, this would represent a rise in water level of only 26mm. Therefore even in prolonged, heavy rainfall the water in the quarry will not spill out of the quarry and there will be no risk of flooding of the surrounding area and no impact on the neighbouring watercourses.

With these systems in place for managing the water it is considered that there will be no impact on the rivers around the site, including during times of intense rainfall. In addition, there will be no impact on water quantity or quality of the water intakes for the Dalwhinnie Distillery or the SSE hydro scheme.

The potential impacts on any peat deposits are considered to be negligible. The majority of the soils in the development site are shallow with a fibrous structure and little or no decomposition. There are some shallow hollows over the site where water has accumulated and some plant decomposition has occurred, the soils in these hollows could therefore be called peat but the total volume of this material which will be affected by the development is negligible. Therefore due to the lack of peat over the development site, the potential impact on peat is considered to be negligible.

5 Summary

A survey of the site was undertaken by MNV Consulting in January/February 2018 to include the hydrological, hydro-geological features and peat deposits in and adjacent to the Dalwhinnie Quarry development site. Table 2 summarises the assessment of potential impacts on key features.

Table 2 Assessment of potential impacts

Potential impact	Risk and mitigation
Impact on the local geology	The impact will be confined to the quarry site with no impact beyond the surrounding bunds
Impacts on watercourses, groundwater, water supplies, water quality and water quantity	Watercourses are sufficiently distant from the development site with no direct discharge into any watercourse. Groundwater will not be impacted as no additional water will be added to the natural groundwater. Two water intake systems in a neighbouring river are sufficiently far upstream of the development site with any discharges from the site buffered and filtered by the soils, fractured rock layers and vegetation. Water quality of any water features in the area will not be impacted as no water will be added or removed from the site and water will be buffered and filtered by the soils, fractured rock layers and vegetation.
Impacts of engineering activities affecting the water environment	The engineering activities are confined within the bunded quarry site and will not affect any features of the water environment in the surrounding area.
Impacts of the proposed surface water drainage layout	No artificial drainage of the site or surrounding area will take place. Water will be pumped out of the quarry and discharged into a soakaway to prevent any impacts on the surrounding area.
Impacts of periods of high rainfall, runoff, high flows in watercourses, flood risk and the design	During high rainfall, water levels in the quarry will rise and if not controlled by the pump the

Potential impact	Risk and mitigation
of drainage provision	water will infiltrate into the surrounding fractured rock layers.
Potential erosion, sedimentation or discolouration of water	Water will be pumped out of the site and discharged into a soakaway where it will be buffered and filtered by the fractured rock layers and vegetation.
Impact on peat deposits	No significant peat deposits exist over the proposed development site.
Impacts after restoration	The site will be restored to enable surface water and groundwater to be controlled by flowing though the fractured rock layers where it will be buffered and filtered.