Report prepared for:

Moray Flood Alleviation
The Moray Council
The Wards
Elgin
IV30 6AA

Hydrogeological Report on Chapletonmoss Spring

This report, prepared by BGS geologists, is based on analysis of records and maps held in the National Geoscience Data Centre (NGDC), and includes descriptions of rock types and the hydrogeology of the site. It also contains geological map extracts taken from the BGS Digital Geological Map of Great Britain at the 1:50,000 scale (DiGMapGB-50) and a listing of the key geoscience data sets held in the NGDC for the area around the site.

Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

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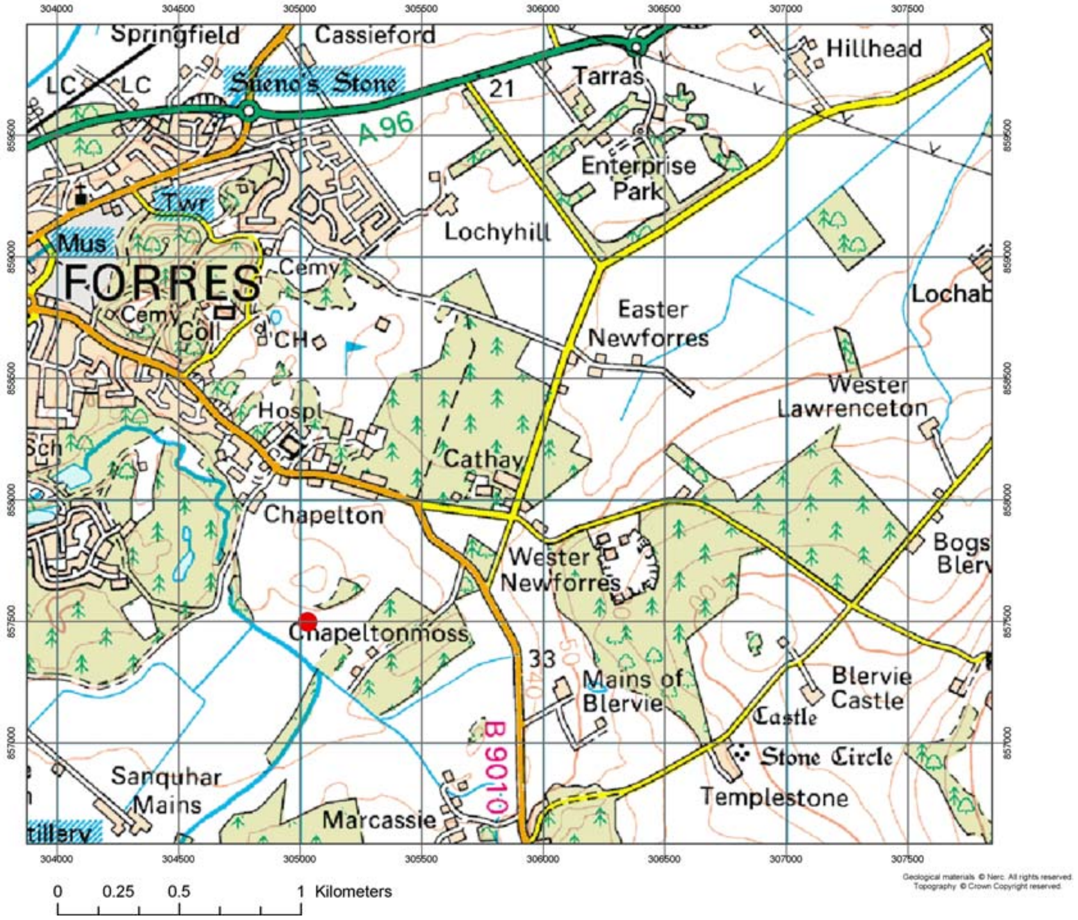


Location of Chapeltonmoss Spring outlet

Figure 1 Location of Chapeltonmoss Spring to southwest of Forres

BACKGROUND

The Chapeltonmoss Spring supplies water to Benromach Distillery at Forres. The spring outlet takes the form of a pipe discharging to the ground surface into a drainage ditch flowing to the Burn of Mosset (Figure 1). A separate pipe collects water from the spring outlet pipe and carries it to Benromach Distillery via a system of collection tanks and sand filters.

The Chapeltonmoss Spring does not form a spring in the true sense (i.e., a discharge of groundwater directly from an aquifer to the ground surface). The water discharging at the spring outlet pipe travels from various sources through a mixed system of buried pipes and surface water flows.

The Chapeltonmoss area is part of a proposed flood alleviation scheme that would see a large part of the area covered by stored flood water during high flow times, including the current spring outlet pipe and at least part of the spring catchment area. The size of the proposed flooded area and the duration of flooding events will vary depending on the nature of the flow event.

This report considers the following:

- the hydrogeology of the area;
- the chemistry of the spring water;
- an estimate of the catchment area of the Chapeltonmoss Spring (i.e., the sources of the water discharging at the spring outlet);
- an estimate of the rate of recharge to the aquifer within the spring catchment area;
- an estimate of the impact that stored flood water will have on the spring system, including the impact on water quality and quantity.

SETTING

Most of the area of Chapeltonmoss comprises gently undulating land, lying largely between 25 and 40 m above Ordnance Datum (OD). Wright's Hill forms a distinct area of higher ground immediately to the north of Chapeltonmoss Spring. A low, indistinct ridge of higher ground lies to the northeast. To the east, the land rises relatively steeply to over 100 m OD.

A number of drains are mapped in the area, particularly to the east of Wright's Hill. Field evidence shows that both open ditches and buried pipes are in existence today. Evidence from old maps shows that many drains were in place at least 130 years ago. The age of the current drainage system is not clear, but it is likely that much of it dates from Victorian times.

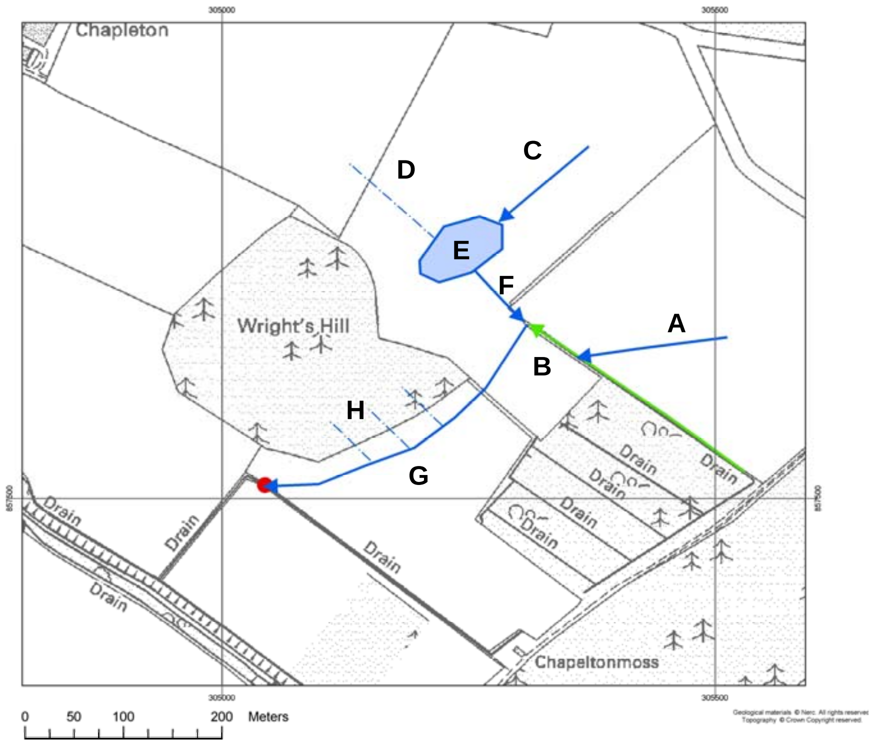
Landuse in the area is largely arable agriculture, with some undrained areas left as rough ground. Forest covers the higher ground.

DESCRIPTION OF SPRING OUTLET AND ASSOCIATED PIPE SYSTEM

The Chapeltonmoss Spring outlet takes the form of a pipe approximately 200 mm in diameter that discharges to the ground surface into a small drainage ditch that flows to the Burn of Mosset. The outlet pipe is at approximate National Grid Reference 305045 857515 (NJ 0505 5752). A separate pipe, 150 mm in diameter, collects water from the spring outlet pipe and carries it to Benromach Distillery. Not all the water discharging at the spring outlet is piped to the distillery: a proportion flows in the drainage ditch to the Burn of Mosset.

It has not been possible to measure the flow of water at the spring outlet. The estimated water flow through the 150 mm diameter pipe carrying water from the spring outlet to the distillery is between 1.2 million and 2.0 million litres/day (or approximately 14 to 23 litres/second). Benromach Distillery reports that the flow at the spring outlet is relatively constant both seasonally and inter-annually, including during dry years, such as 2003 (Gordon & MacPhail, pers.com.).

The water discharging at the spring outlet pipe travels to the outlet through a mixed system of buried pipes and surface water flows. Parts of this system have been identified by ground observation, geophysical surveying (Ground Penetrating Radar or GPR) and divining. The main known features of the system are illustrated in Figure 2. Pipes have been identified to the northeast of Wright's Hill, running from northeast to southwest. One of these pipes (A in Figure 2) is thought to discharge to a drainage ditch (B). Another (C) may have once joined a pipe that runs from northwest to southeast (D). At some point, both pipes C and D appear to have been broken, and water now discharges from them to the ground surface where it lies as slow moving, almost standing water, forming wet ground (E). Another pipe (F), possibly originally the continuation of pipe D, drains water from this wet ground to the end of drainage ditch B, where the water discharges to the surface once again. From here, all the water from drainage ditch B is carried through another pipe (G) that skirts Wright's Hill on its southern side and runs towards the southwest to discharge at the Chapeltonmoss Spring outlet. The flow at the spring outlet is much greater than the flow entering the pipe from drainage ditch B, indicating that pipe G is fed by additional water sources. Divining has indicated the presence of parallel drains running from northwest to southeast down off Wright's Hill (H), which may drain shallow groundwater from Wright's Hill into pipe G.



Flow in buried pipe where pipe ends are visible and/or pipe location has been identified by GPR or divining

Flow in buried pipe where pipe ends are not visible and/or pipe location has been only tentatively identified

Flow in open drainage ditch

Water storage at ground surface: most of this water discharges from buried pipes and subsequently flows to a downstream buried pipe and then to spring outlet

Spring outlet

Figure 2 **Main features of known Chapeltonmoss Spring pipe system**

GEOLOGY

Superficial geology:

Most of the Chapeltonmoss area is underlain by glaciofluvial ice contact deposits. Along the main stream channels, outcrops of alluvium overlie the glaciofluvial deposits. The alluvium and glaciofluvial deposits are likely to be similar, as the alluvium comprises largely re-worked material from the older glaciofluvial deposits. Borehole records and site observations show that the alluvium and glaciofluvial deposits in this area are dominated by sand and gravel, often with rounded cobbles, and occasionally with varying proportions of silt and clay. Silt and clay occasionally form distinct beds. Where boreholes have reached bedrock, the superficial deposits have been proved to be typically between 15 and 25 m thick, although at least one borehole shows superficial deposits up to 30 m thick.

In the southwest of the area, peat is mapped at the ground surface. There may also be thin bands of peat within the alluvial sequence.

Beneath the high ground to the east there is glacial till, typically a mixed deposit of clay, silt, sand and gravel. The till is likely to be less than 3 to 5 m thick.

Towards the coast to the north, there are outcrops of raised marine deposits and lacustrine alluvium.

The superficial geology is illustrated in Figure 3.

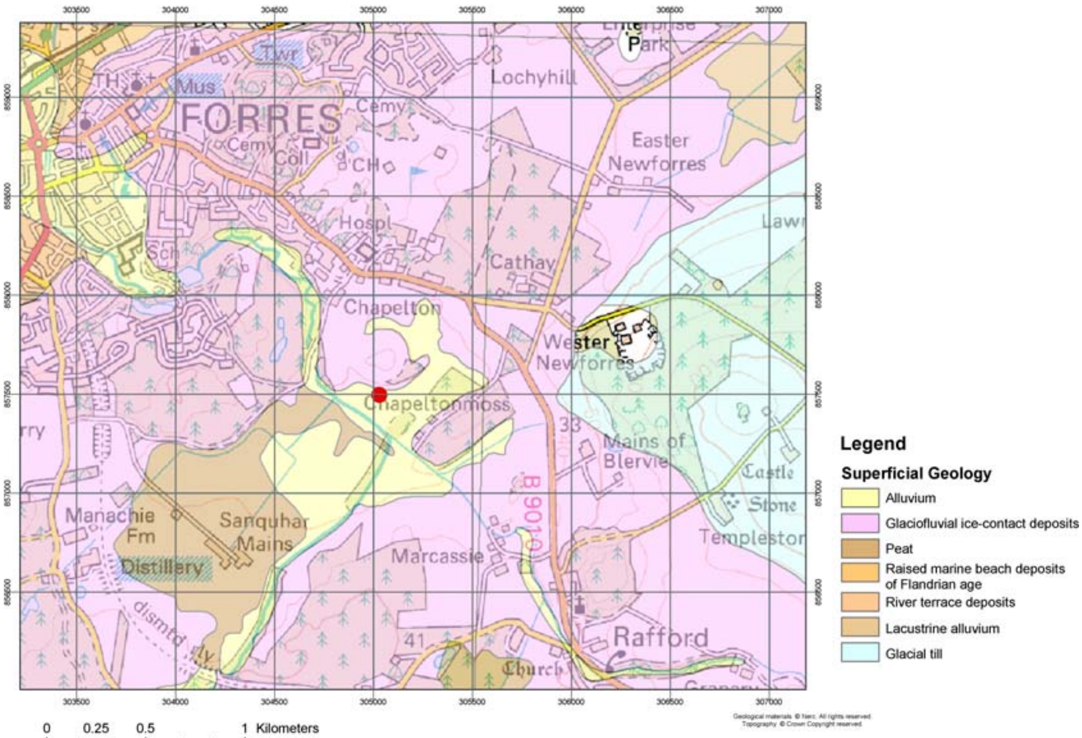


Figure 3 Superficial deposits in the Chapeltonmoss area

Bedrock geology:

Bedrock beneath the area of Chapletonmoss and Wright's Hill comprises red and grey sandstones with rare siltstones and pebbly beds of the Forres Sandstone Group, of Middle to Upper Devonian age. To the east of Chapletonmoss, the geology is mapped as pebbly sandstones of the Alves Beds. The Alves Beds are part of the Forres Sandstone Group, and probably represent a gradual geological change to a coarser grained sandstone. The Forres Sandstone Group is likely to be at least 100 m deep beneath the site.

To the east of the Alves Beds, at Wester Newforres and Mains of Blervie, the Devonian sandstones overlie metamorphic rocks of the Nethybridge Psammite Formation, of Precambrian age. These are grey, flaggy psammites (metamorphic schists) with subordinate semipelitic schists and quartizes (also metamorphic rocks), and also contain occasional calc-silicate beds. Metamorphic rocks of the Grampian Group and Dava Succession also crop out to the northeast of the site at Lochyhill. These are likely to be very similar to the Nethybridge Psammite Formation.

Bedrock in this area comprises red sandstones of the Forres Sandstone Group and pebbly sandstones of the Alves Beds, both part of the Old Red Sandstone Supergroup of Devonian age.

The bedrock geology is illustrated in Figure 4.

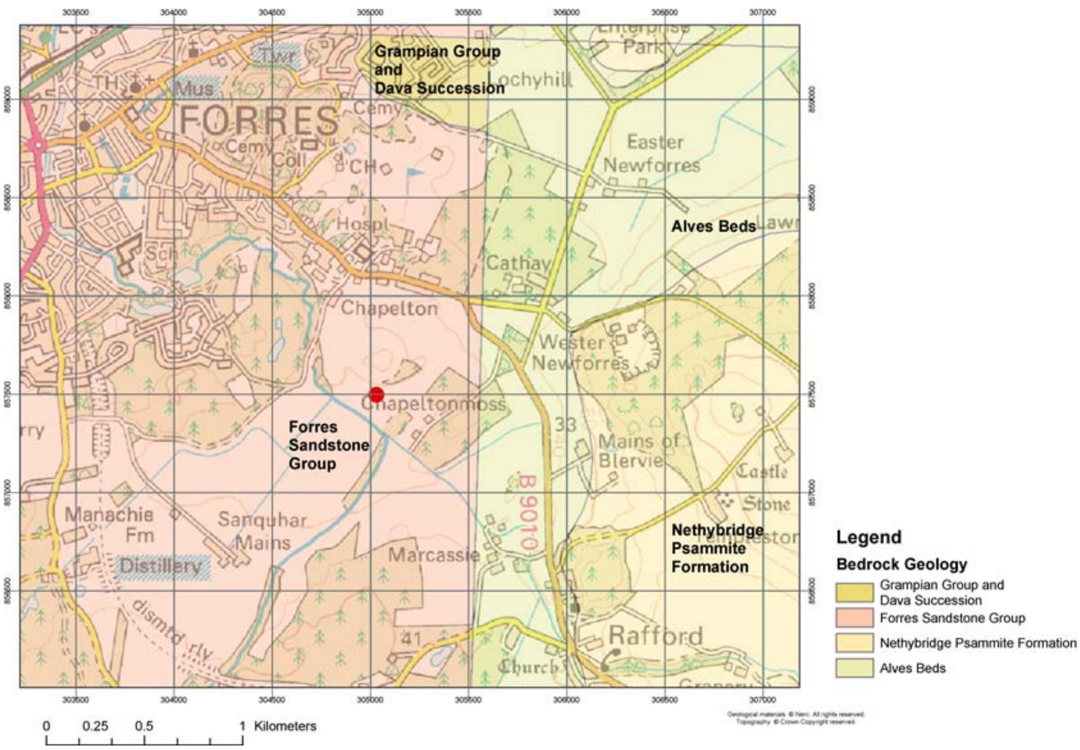


Figure 4 Bedrock geology in the Chapeltonmoss area

GENERAL HYDROGEOLOGY

There is likely to be a dual hydrogeological system in the Chapeltonmoss area: an upper superficial deposits aquifer, comprising alluvium and glaciofluvial deposits, and a lower bedrock aquifer, comprising Devonian sandstones.

The superficial alluvium and glaciofluvial deposits are likely to form a highly permeable aquifer, with rapid groundwater flow. The large thickness of the superficial deposits aquifer, as proved by trial drilling in the Chapeltonmoss area, means that large volumes of groundwater may be stored in the aquifer. The water level in a shallow well (at approximately 2 m deep, this well abstracts from the superficial deposits aquifer) at the house at Chapeltonmoss (NGR 305290 857340) was 0.70 m below ground level when measured on 10 March 2005, and it is reported that this water level does not vary significantly throughout the year (Gordon & MacPhail, pers.com.) This is likely to be similar across most of the area, although beneath higher ground (e.g. Wright's Hill) the water level is likely to be deeper.

Beneath the superficial deposits aquifer, the Devonian sandstone is likely to form a moderately to highly permeable aquifer. A number of water abstraction boreholes have been drilled into the bedrock in Forres and the surrounding areas. The recorded rest water level in these boreholes is typically very shallow, often less than 1 m below ground level. Borehole yields are between 5 and 10 litres/second. There is likely to be a significant degree of hydraulic contact between groundwater in the superficial deposits and the bedrock aquifer, but this is not possible to characterise or quantify accurately. The movement of groundwater between the bedrock and superficial deposits aquifers will be dependent on the relative piezometric head of the two aquifers, which may vary throughout the year.

The high permeability and storage of the superficial deposits aquifer, combined with the very shallow water table, indicate that this aquifer forms a significant source of shallow groundwater. The topography of the Chapeltonmoss area includes low lying areas that are often covered with standing water, which have typical marsh vegetation such as reeds. The extensive drainage system across the area suggests that such wet areas were once more extensive across the area, and were drained to allow agricultural development. The evidence indicates that under natural, pre-development conditions there would be a number of diffuse springs or seepages across the Chapeltonmoss area, coming from the shallow superficial deposits aquifer where the water table was shallow enough to intersect the ground surface.

Some of the groundwater discharging at springs and seepages may have moved upwards from the bedrock aquifer, but most is likely to be derived solely from the superficial deposits aquifer.

HYDROCHEMISTRY

Chemical analyses of sixteen water samples taken from the Chapeltonmoss Spring outlet are held by Benromach Distillery. The water samples were collected between September 1992 and February 2005. Six water samples were taken between 1992 and 2003; and ten between July 2004 and February 2005. Major and minor ion analysis is available for most of the samples. The water chemistry has been relatively stable, particularly since July 2004 when more regular water sampling began.

A Piper diagram showing the major ion distribution in the spring water is presented in Figure 5. The water is of calcium-chloride to chloride type, with moderately high sodium, moderate bicarbonate and sulphate, and low magnesium concentrations. Nitrate and iron concentrations are moderately high. Measured water colour according to the platinum-cobalt scale is typically high. The water becomes increasingly discoloured after heavy rainfall (Gordon & MacPhail, pers.com.).

The bromide-chloride ratio of the water indicates that the dominant source of chloride in the spring water is seawater. The source of seawater may be channels in the superficial deposits that allow preferential flow from the coast or from tidal reaches of local rivers and streams; or it may be residual seawater in the superficial deposits aquifer left from an earlier time of higher sea level when the aquifer was flooded with seawater.

A sample of the spring water was analysed for two chlorofluorocarbon fractions, and showed a CFC-12 concentration of 2.44 pmol/L and a CFC-11 concentration of 5.66 pmol/L. Assuming an average recharge temperature of 5 to 6 degrees Celsius (because most recharge occurs during winter months), this equates to a sample containing between 60 and 80 % modern water (modern water refers to water recharged from rainfall since the mid 1990s). This supports the premise that the bulk of the water discharging to springs and seepages in Chapeltonmoss is derived from recent direct rainfall recharge to the superficial deposits aquifer, with only a small proportion of older groundwater, some of which may have moved upwards from the underlying bedrock aquifer.

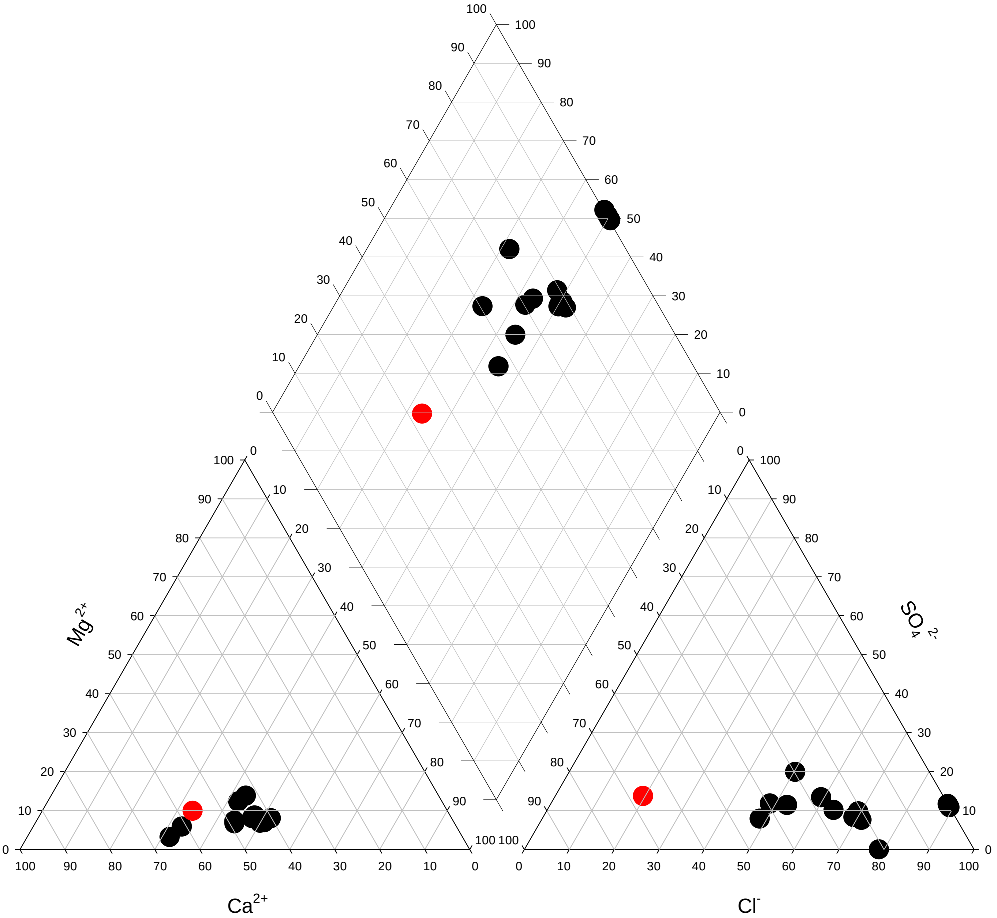


Figure 5 Piper plot showing the major ion distribution of waters from Chapeltonmoss Spring (black points) and Chapeltonmoss Well (red point)

Comparison of the spring water chemistry with chemical analyses of groundwaters and surface waters from other parts of the Chapeltonmoss area and from the wider Forres-Elgin area helps to put the chemistry of Chapeltonmoss Spring in context.

Field chemistry measurements of groundwater from the Chapeltonmoss Spring, the Chapeltonmoss Well and a number of surface waters in the Chapeltonmoss area were carried out on 10 March 2005. The results of the measurements are presented in Table 1. There is a clear distinction between groundwater from the Chapeltonmoss Well and surface water in the Marcassie Burn and a drainage ditch adjacent to the Marcassie Burn (all in the south and southeast of Chapeltonmoss); and the spring water itself and the surface waters tested on the north and east of Wright's Hill. The surface waters in the north and east issue from pipes close to where they were measured, and are likely to represent recent groundwater discharge. The surface waters in the southeast of the area are also likely to contain a significant proportion of recent groundwater discharge.

The spring water and waters to the north and east all have high conductivity: in excess of 770 μS/cm in all cases except for standing water at one point, which may have been diluted by recent rainfall. The water in Chapeltonmoss Well, the Marcassie Burn and adjacent ditch all have relatively low conductivity: less than 280 μS/cm.

The conductivity of water is an indicator of the concentration of minerals in the water. Although conductivity can be affected by many different minerals, the dominance of chloride in water from the Chapeltonmoss Spring indicates that the conductivity of local waters is controlled largely by chloride. The low conductivity and low chloride concentration of water from the Chapeltonmoss Well supports this view. The measured conductivity values can therefore be taken as an indicator of chloride content.

NGR	Location	SEC μS/cm	Temperature °C	pH	Eh	Alkalinity mg/l HCO_3
305280 857780	Flow from broken pipe in NE corner of boggy ground	771	6.1			
305220 857750	Standing water in wet ground	478				
305310 857680	In ditch (flow from SE) – probably mostly from field to E	866	6.9			
305310 857680	In ditch – inflow from NW from boggy ground	850	6.6			
305048 857507	Chapeltonmoss Spring at pipe outlet	799	6.8	8.1	+ 140	66
305195 857200	Marcassie Burn	277	6.3			
305290 857340	In ditch by Marcassie Burn (flow from SW)	241	6.6			
305290 857340	Chapletonmoss Well	186	6.3			

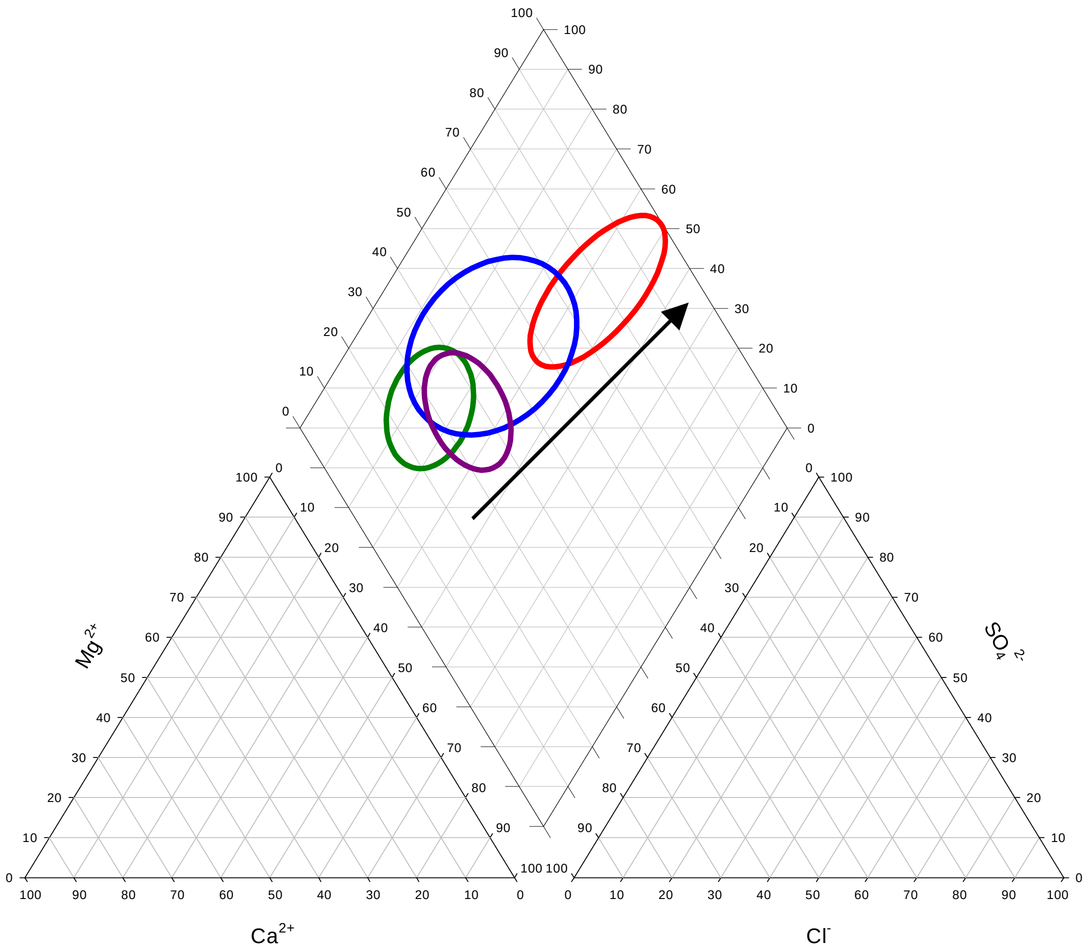
Table 1 Field chemistry measurements of waters in the Chapeltonmoss area

A chemical analysis of groundwater from the shallow well at the house at Chapeltonmoss, sampled on 23 February 2005, has been provided by Gordon & MacPhail. As indicated by the field measurements, the water is significantly different from the Chapeltonmoss Spring water: it is of calcium-bicarbonate type (Figure 5), with noticeably lower concentrations of the major ions chloride, sodium, calcium, magnesium, sulphate and nitrate.

Groundwaters from both Devonian and Precambrian bedrock aquifers are typically of calcium-bicarbonate type (Figure 6). Groundwater from the Devonian sandstone aquifer is typically moderately hard and mineralised, with alkalinity values of between 150 and 250 mg/l as bicarbonate, and moderate concentrations of the major ions calcium, magnesium, sulphate and chloride. Groundwater from some boreholes has shown naturally high concentrations of iron and manganese. Measured concentrations of nitrate in groundwater in the sandstone aquifer are variable, from less than 5 to 25 mg/l (Robins et al, 1989).

Groundwaters from boreholes that penetrate both superficial deposits and Devonian bedrock (and are therefore likely to represent a mix of superficial and Devonian groundwater) are generally of calcium-bicarbonate or calcium type, or of no dominant type (Figure 6) (Robins et al, 1989).

Water from Chapeltonmoss Spring has noticeably different major ion chemistry from most of these groundwaters, although it overlaps with the higher chloride/lower bicarbonate end of the range of groundwaters from mixed superficial/Devonian aquifers (Figure 6). The change in water chemistry from the Devonian bedrock groundwater to the Chapeltonmoss Spring water is similar to what would be expected if fresh groundwater (from both bedrock and superficial deposits aquifers) was mixing with seawater under oxidising conditions.



Chapeltonmoss Spring water – calcium-chloride type

Local groundwater from mixed superficial/Devonian bedrock aquifers and local superficial deposits aquifer at Chapeltonmoss well – calcium or calcium-bicarbonate type

Local groundwater from Devonian bedrock aquifers – largely calcium-bicarbonate type

Local groundwater from basement aquifers – largely calcium-bicarbonate type

Arrow indicates the chemical changes that would be expected if fresh groundwater was mixing with saline water (e.g. seawater, either recent or residual) under oxidising conditions

Figure 6 Piper plot illustrating the major ion distribution of groundwaters from various sources in the Forres-Elgin area

SOURCE OF CHAPELTONMOSS SPRING WATER

Based on the known hydrogeological conditions at Chapeltonmoss, including the aquifer geometry and water chemistry, water discharging at the Chapeltonmoss Spring outlet is likely to be largely derived from shallow groundwater from the superficial deposits aquifer. This groundwater discharges naturally via diffuse springs and seepages that have been diverted by a system of drainage pipes and ditches that conduct water to the Chapeltonmoss Spring outlet. The drainage system that has been identified indicates that the spring water flows largely from the northeast of Wright's Hill, with a component of unknown size flowing off Wright's Hill itself. As described above, shallow groundwater is likely to form diffuse springs or seepages across the area that have been intercepted by the drainage system.

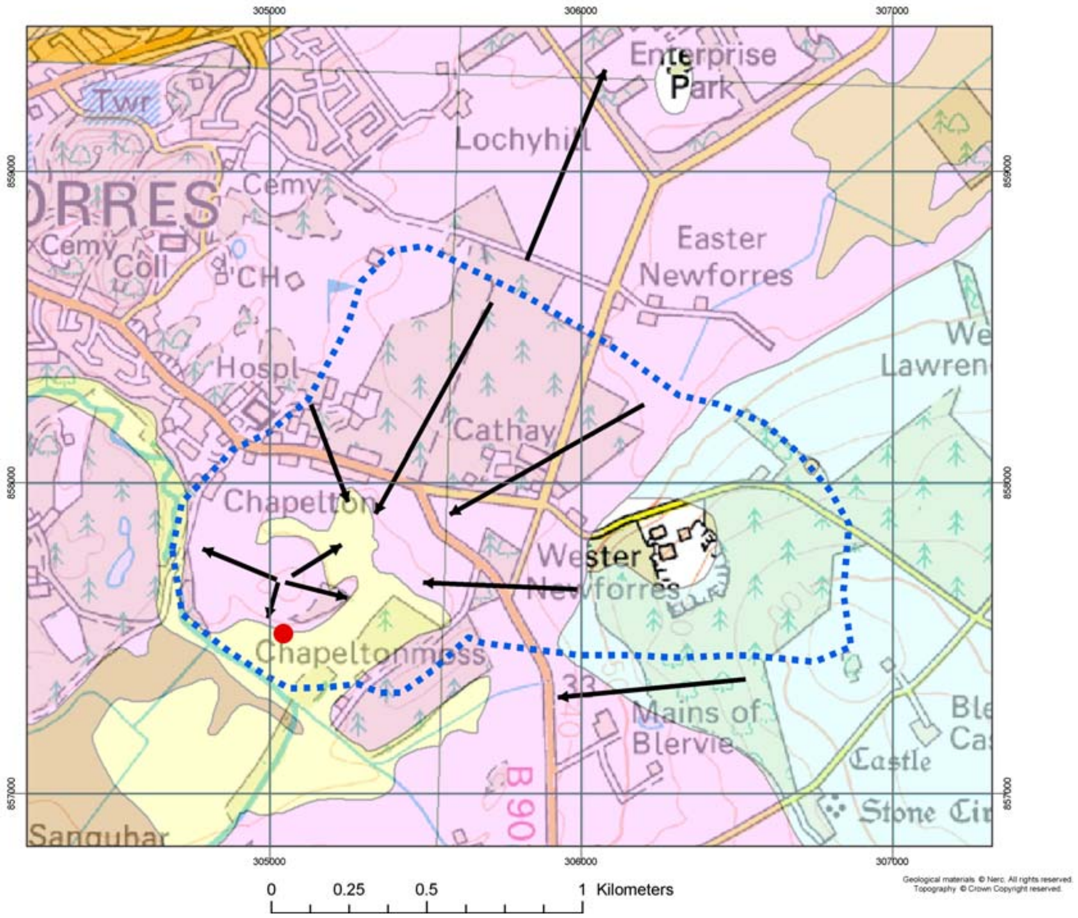
The Chapeltonmoss Spring water is also likely to include a small input from rainwater and surface water runoff: this is indicated by the increased discolouration observed in the spring water after heavy rainfall (Gordon & MacPhail, pers.com.); by observations of leaves in the pipe flowing to the spring outlet (Gordon & MacPhail, pers.com.); and by the fact that the transported water is not always below ground, but discharges to the ground surface in at least two areas (the open wet ground – point E in Figure 2 – and the drainage ditch – point B in Figure 2).

The source of the shallow groundwater feeding the diffuse springs and seepages cannot be identified precisely, but is estimated based on the known hydrogeology and hydrochemistry. There are significant differences between the conductivity (and therefore probably in the chloride content) of water from the northeast of Wright's Hill, which flows to the Chapeltonmoss Spring, and water from the south and southeast of Chapeltonmoss. These differences indicate that shallow groundwater in the south and southeast of Chapeltonmoss is flowing from a different source than shallow groundwater in the north and northeast, which feeds the Chapeltonmoss Spring. The main source of the shallow groundwater that feeds the Chapeltonmoss Spring is likely to be from the northeast of the Chapeltonmoss area, with a component of flow occurring radially outwards from Wright's Hill. The main area in which this groundwater is intercepted by the drainage system is likely to be to the northeast and east of Wright's Hill.

Shallow groundwater in the south and southeast of the area, including the area around the Chapeltonmoss Well, is likely to flow in from the east and southeast.

An estimated catchment area for the groundwater flowing into the Chapeltonmoss area, from which the Chapeltonmoss Spring water is derived, is illustrated in Figure 7. Figure 7 also illustrates the estimated direction of groundwater flow in the superficial deposits aquifer across the area.

This catchment area includes an area of the higher ground to the east of Chapeltonmoss that is underlain by glacial till, not by the glaciofluvial/alluvial aquifer. A small amount of groundwater may recharge to the glacial till if it is dominated by high permeability sand and gravel rather than by finer grained material, and then flow westwards into the main superficial deposits aquifer. However, any such input is likely to be small.



Estimated catchment area of groundwater flowing to Chapeltonmoss Spring

Estimated direction of groundwater flow

Chapeltonmoss Spring outlet

Figure 7 **Estimated catchment area for groundwater flowing into the Chapeltonmoss area, and estimated groundwater flow directions**

ESTIMATE OF NATURAL RECHARGE TO SPRING CATCHMENT

An accurate calculation of recharge to the spring catchment is not possible, partly because the catchment area itself cannot be accurately delineated, and partly because there are unknowns in the hydrological data, including rainfall, evapotranspiration and vegetation impacts. A simple estimate of recharge has been made as described below.

The effective catchment area for the Chapeltonmoss Spring is likely to be approximately 2.0 km^2. The average rainfall in this area is likely to be between 600 and 800 mm/a. The potential available recharge to the shallow aquifer, after losses to evapotranspiration and surface flows, is estimated to be between 200 and 500 mm/a. Over the catchment area, this equates to between 400,000 and 1,000,000 m^3/a, or between 1.1 and 2.7 million litres/day on average. This is on the same order of magnitude as the estimated flow at the Chapeltonmoss Spring outlet of between 1.2 and 2.0 million litres/day (see above).

ESTIMATE OF THE IMPACT OF STORED FLOOD WATER ON THE SPRING SYSTEM

The proposed flood alleviation scheme will store flood flows from the Burn of Mosset in a reservoir at Chapeltonmoss. During flood events with a return period exceeding about 1 in 5 years, the reservoir will flood the majority of the low lying parts of the area (Royal Haskoning, 2004). This is likely to include much of the catchment area for the water discharging at Chapeltonmoss Spring. The Chapeltonmoss Spring outlet pipe itself is at risk of flooding during events with a return period in excess of about 1 in 25 years (Royal Haskoning, 2004). The reservoir will increase the frequency of all flooding events to more than once in 5 years (Royal Haskoning, 2004). The maximum inundation depth of the spring outlet pipe will be approximately 5.0 m (Royal Haskoning, 2004), but the maximum inundation depth of parts of the rest of the catchment area may be greater. This maximum depth will occur for only a few hours at times of peak flood flow (Royal Haskoning, 2004). The maximum length of time that the spring outlet pipe will be flooded will be approximately 5 days (Royal Haskoning, 2004); this may be longer for lower lying parts of the spring catchment area.

The storage of flood water in a reservoir in the Chapeltonmoss area is likely to impact on both the quantity and quality of water discharging at the Chapeltonmoss Spring outlet. The largest impact is likely to be on water quality.

The impacts will be both directly at the spring outlet pipe and across the spring catchment area.

At the spring outlet pipe, which is not hydraulically sealed but where water discharges to the ground surface, flooding is likely to cause flood water to enter the downstream pipe and therefore to flow to the distillery. This is an engineering rather than a hydrogeological factor, and is not discussed further here.

Flooding across the spring catchment will add an additional resource and head of water over the superficial deposits aquifer, which will increase recharge to the aquifer during the period of flooding. The amount of increase in recharge will depend on the storage capacity of the aquifer (how much additional recharge it can accept) and factors such as the field capacity of the soil. The shallow water table across the catchment indicates that there is limited capacity for additional recharge before the aquifer becomes fully saturated, and therefore unable to accept further recharge. Once flood waters have subsided, the temporarily raised water table is likely to cause increased flows to springs and seepages, which would temporarily increase flow through the drainage system to the Chapeltonmoss Spring. It is not possible to estimate accurately the extra flow volume and the duration of increased flow. However, it is likely that the increased flow will not be significant.

The impacts of flooding on groundwater chemistry are likely to be more significant, but are more difficult to characterise. The chemistry of the water flowing from the Chapeltonmoss Spring is distinct from the known chemistry both of other groundwaters from shallow superficial aquifers in this area, and of groundwaters from bedrock aquifers in the Forres-Elgin region. Increased recharge from flood water, which may also have a very different chemistry, is likely to cause at least some dilution of the shallow groundwater, possibly changing the water chemistry. The chemistry of the proposed flood water is not known, but is likely to have lower concentrations of major ions such as chloride, sodium and calcium. It may also have higher concentrations of ions such as nitrate, from agricultural sources. The surface flood water may also contain biological (e.g. bacteriological) contaminants, which could then enter the shallow groundwater.

References

Robins N S, Cook J M and Miles D L. 1989. Groundwater near the Moray Firth: the coastal aquifer between Forres and Elgin, Grampian Region. Quarterly Journal of Engineering Geology **22**, 145-150.

Royal Haskoning. 2004. Burn of Mosset Flood Alleviation Scheme: Hydrogeology Study. Final Report (Rev A) 9P7081, September 2004.

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4. Limitation of liability

4.1 The Council makes no representation or warranty that advice or information given by any of its employees or any personnel engaged in performing the Work, or the content or use of any materials or information provided in connection with the Work, will not constitute or result in infringement of third-party rights.
4.2 The Council accepts no responsibility for any use which may be made of any Results, nor for any reliance which may be placed on Results, nor for advice or information given in connection with Results.
4.3 The Customer agrees to indemnify the Council, and every employee of the Council, and all personnel engaged to perform the Work ("the Indemnified Parties"), and keep them fully and effectively indemnified, against any claim made against any of the Indemnified Parties as a result of the Customer's use of Results or any materials, works or information received from them pursuant to the terms of this Agreement.
4.4 The liability of the Council for any breach of this Agreement, or arising in any other way out of the subject-matter of this Agreement, will not extend to any incidental or consequential damages or losses or any loss of profits, loss of data, loss of contracts or opportunity, even if the Customer has advised the Council of the possibility of those losses or if they were within the Council's contemplation.
4.5 In any event, the maximum liability of the Council to the Customer under or otherwise in connection with this Agreement or its subject-matter is equal to the total of the sums payable by the Customer under this Agreement.
4.6 Nothing in this Agreement is intended to exclude or restrict any liability of the Council in respect of death or personal injury caused by its negligence.

5 Force majeure

If the Council's performance of the Work is delayed or prevented by circumstances beyond its reasonable control, then the Council will use all reasonable endeavours to resume performance as soon as possible, but will not be in breach of this Agreement because of any delay in performance. However, if the delay in performance exceeds six months, the Customer may terminate this Agreement with immediate effect by giving notice to the Council.

6. Termination

6.1 Either party may terminate this Agreement with immediate effect by giving notice to the other party if:
6.1.1 the other party is in breach of any provision of this Agreement and (if it is capable of remedy) the breach has not been remedied within 30 days after the first party's notice specifying the breach and requiring its remedy; or
6.1.2 if the other party becomes insolvent, or if an order is made or a resolution is passed for the winding up of the other party (other than voluntarily for the purpose of solvent amalgamation or reconstruction), or if an administrator, administrative receiver or receiver is appointed over the whole or any part of the other party's assets, or if the other party makes any arrangement with its creditors.
6.2 If the Customer terminates this Agreement pursuant to clause 5, or the Council terminates this Agreement pursuant to clause 6.1.1, the Customer will immediately pay any unpaid sums in respect of Work completed before the date of termination, and any costs of the Council incurred as a result of the termination including (but not limited to) the cost of any materials or goods reasonably ordered by the Council for use in the performance of the Work which the Council has paid for or is liable to pay for.
6.3 Clauses 2, 3, 4, 6.2, 6.3 and 7 will survive the completion of the Work or termination of this Agreement for any reason.

7. General

7.1 *Notices.* Any notice to be given under this Agreement must be in writing and addressed to the party's representative as set out on the front page of this Agreement. It may be served as follows:

Method of service	**Deemed day of receipt**
By hand	The day of delivery
By pre-paid national business post	The second day after posting
By international courier	The seventh day after posting
By fax	The next day after sending

7.2 *Headings*. The headings in this Agreement are for ease of reference only and do not affect the interpretation of this Agreement.
7.3 *Assignment etc*. No party may assign or otherwise transfer this Agreement or any of its rights or obligations under it, whether in whole or in part.
7.4 *Illegal/unenforceable provisions.* If the whole or any part of any provision of this Agreement is void or unenforceable in any jurisdiction, the other provisions of this Agreement, and the rest of the void or unenforceable provision, will continue in force in that jurisdiction, and the validity and enforceability of that provision in any other jurisdiction will not be affected.
7.5 *No agency etc* Nothing in this Agreement is intended to create, imply or evidence any partnership or joint venture between the parties or the relationship between any of them of principal and agent. No party has any authority to make any representation or commitment or incur any liability on behalf of any of the others.
7.6 *Entire agreement.* This Agreement and any Schedule or Schedules (which are incorporated into and made a part of this Agreement) constitute the entire agreement between the parties relating to its subject-matter. Each party acknowledges that it has not entered into this Agreement on the basis of any warranty, representation, statement, agreement or undertaking except those expressly set out in this Agreement. Each party waives any claim for breach of, or any right to rescind this Agreement in respect of, any representation which is not an express provision of this Agreement. However, this clause does not exclude any liability which any party may have to any other (or any right which any party may have to rescind this Agreement) in respect of any fraudulent misrepresentation or fraudulent concealment prior to the execution of this Agreement.
7.7 *Variations.* No variation of this Agreement will be effective unless it is made in writing and signed by each party or its authorised representative.
7.8 Any other terms and conditions of contract which may be printed on any correspondence, including purchase orders shall not be applicable or supersede those included in this quote
7.9 *Governing law, etc.* This Agreement will be governed by and construed in accordance with English law. The English Courts will have exclusive jurisdiction to deal with any dispute which has arisen or may arise out of or in connection with this Agreement, except that any party may bring proceedings for an injunction in any jurisdiction.

Important notes about this report

- The data, information and related records supplied in this report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.

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