SECTION 5

RISK ASSESSMENT CASE STUDIES

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SUMMARY 5.1 – 5.2

5.1 Introduction

These cases studies illustrate the **practicalities of carrying out risk assessments** on private water supplies. They focus on the **site survey** and **supply survey** questions, providing many useful photographs as well as the diagram required for each study.

Obtaining the input of the relevant or responsible person/s is crucial, and both makes the assessment easier and ensures the process is an inclusive one.

Not all the survey questions will apply to a given supply, while others will be scored as high risk because they cannot be answered. The case studies have many examples of this and also describe the process for supplies with multiple sources, including examples where the nature and/or location of the supply is uncertain.

5.2 Case study 1 – Surface supply in the Scottish Borders

Dawyck Botanical Garden draws its **supply from an artificial pond** coming from a tributary of the Tweed. There are two holding tanks and a chlorinator feeding the visitor centre and 3 cottages.

This case study highlights the risk of animal remains (dead sheep), wild life, commercial forestry activity (sump oil) and of intermediate tanks having inadequate protection from vermin. Uncertainty about the pipe materials also resulted in the supply network being designated as high risk, but this could be re-assessed at a later date with new information. Changing flow and turbidity were also noted and the overall risk was high with recommended interventions focusing on the above.

5.3 Case study 2 – Estate supply from Perthshire

This is a good example of a **multiple-source supply with uncertainties about source nature and location**. The supply's three sources were previously classed as springs but one source is closer to being a well, another is more like a surface abstraction and the location of the third is not known. All three sources feed one of two holding tanks, while only the well feeds the second tank. Both of the known sources and both tanks were assessed individually, highlighting a large number of high risk areas including the presence of wildlife, livestock, agricultural activity (including agri-chemical run-off), lack of maintenance, forestry activity and inadequate protection of tanks (one of which had been coated with bitumen paint).

Several questions were also scored as "Don't know" (High Risk) because the relevant person was not present, though these could be followed-up later. The study also has an additional note about a high risk join in the lines from the two known sources. Since both the well and the surface source were classified as high risk, as would (automatically) the unknown source, the supply overall was assessed as high risk.

5.4 Case study 3 – Knuttmound Estate Supply, West Perthshire

This is a good example of the complex issues that private water supplies can present. The supply has 4 sources and serves around 180 people in their homes, as well as 2 hotels and a boarding school which controls one of the supplies. It is not clear if that source is connected though.

The other three sources were assessed individually. One was reclassified from spring to well and was assessed on this basis, **including a soil leaching survey**.

The **second source proved inaccessible** because of a deer fence and a steep slope, and so was designated high risk by uncertainty.

The **third source was reclassified** from spring to surface water and there is a good diagram and explanation of this. It was also noted that surface supply assessment did not cover the security of the site in terms of fences etc. so they were listed in additional notes, which shows that **sources may not fall into a single classification.**

Two further additional notes were made about the overall system, relating to evidence of lead pipework and an additional storage tank being found adjacent to the operational one.

The three identified sources had **several risk characteristics** between them, including poor drainage, evidence of livestock and wildlife, lack of fences, ditches and protective well features etc., but this case study also **highlights why supplies cannot be compared via their scores** - because many questions will not be appropriate to a given supply. The scores are there to identify issues, not to rank supplies.

5.5 Case study 4 – Waterbottom Borehole near Peebles

This is an example of a small borehole supply with **headworks below ground**.
The 19 metre-deep borehole feeds 3 nearby properties (around 10 people).

The site survey found herbicide on the headworks and the supply survey found there was no cut-off ditch, the chamber top was not above ground level and no maintenance had been done in the last year. The supply was assessed as high risk with an additional note about the need for a lock for the chamber.

5.6 Case study 5 – Border Estate Supply

This is an **extensive supply with multiple sources and very basic collection equipment** consisting of plastic pipes and buckets.

Again, the **sources were reclassified** from springs to surface waters, because the collection chambers were not within the rock matrix and were under surface influence. This case study shows many photographs of the collection points and intermediate storage points, and **assesses their vulnerability using both the surface and springs risk questions.**

Here the **relevant person could give answers** to questions on the nature of the supply network and the flow and turbidity of the water, assisting considerably.

5.7 Case study 6 – Rooster Cottage/Farm Borehole

This is an example of a small borehole supply with **headworks below ground**. It serves 4 people in the cottage and farm. There were risks arising from **pesticide use** because of the source's location in arable land, and from the absence of a ditch to divert flow from the borehole chamber, although the chamber walls had been raised.

The **responsible person's knowledge** of some issues and uncertainty of others led to a number of high risk characterisations, relating to drainage, sewerage, network materials and maintenance.

5.8 Case study 7 – Surface supplies good and bad designs

This section shows diagrams of a model **surface supply** with protection from flooding, livestock and vermin. It also shows photographs of some bad designs and high-risk problems found in the field.

5.9 Case study 8 – Groundwater well heads

This section has photographs and descriptions illustrating good and bad designs for well heads found in practice, highlighting the risk to any electrical pumping equipment as well as of the risk of contaminating the supply.

5.10 References

There is one reference concerning springs.

Section 5 Annexes

The **completed assessment pro formas** for the case studies (5.1 to 5.7) are annexed here, including **a soil leaching potential map** for the Knuttmound Estate case study.

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5. RISK ASSESSMENT CASE STUDIES

5.1 Introduction

> Common sense is the best distributed commodity in the world,
> for every man is convinced that he is well supplied with it.
> *Descartes, 1637*

There can be no substitute for common sense and, as Descartes says, we all think we have our own personal supply which has seen us through all manner of encounters. While this may very well be true it is almost certain that those with whom you discuss matters of risk and private water supplies will be convinced of their own common sense's superiority over officialdom in general and you in particular.

These case studies have been developed to assist you in preparing for the day when your professional judgement and personal common sense are challenged. The case studies have focused on the risk assessment part of the exercise. The other parts of the risk assessment forms (Sections A, B and C) are straightforward exercises in collating information. The possible exception to this is Section B (6) where a diagram of the supply is requested. Diagrams for each case study are supplied and these have been annotated as instructed in the rubric of the risk assessment form.

Throughout these case studies certain guidelines for completion of the risk assessment forms have been adopted to aid the completion of the forms.

Perhaps the most important and over-riding guideline is

(a) Ensure that you have access to, or the presence of, all those people whom you consider will have knowledge and information pertinent to the supply and the types of questions you will be asking.

The risk assessment process can be carried out without input from relevant persons but the task will be made much simpler if they are present. Their presence will allow you to ask questions and clarify points raised through the risk assessment process but more importantly it will emphasise to the relevant person that the process is an inclusive one – partnership rather than dictatorship. Making contact and ensuring participation will aid in the development not only of the risk assessment but also in the relationship with the relevant person.

The other guidelines applied are:

(b) If the particular question is not appropriate to the circumstances encountered then the question is scored through and not completed.
(c) If the Risk Characterisation assessment results in a low risk score then the corresponding hazard assessment does not require to be completed.
(d) If the Risk Characterisation assessment results in a High Risk occurring due to a positive response in the Don't Know category then the hazard assessment will be undertaken assuming a worst-case

for the corresponding risk. An example of this can be found in Case Study 2 where at Site A1 no information was known about changes in water flow or appearance. The risk characterisation was scored as Don't Know (High) and the hazard assessment assumed that there would be changes in water flow and appearance and assessed the likelihood and overall score on that basis.

Where there are multiple sources that are derived from discrete or widely different catchments then each source should be considered separately in terms of the risk assessment part of the overall exercise. Similarly, where there are extended, complex distribution systems where not all of the sources feed all of the distribution system (see Case Study 2) then the separate sources and their associated intermediate tanks and distribution systems should be considered as separate components of the overall assessment. The rules will remain the same – for the supply the highest level of risk will be the risk category assigned.

In cases where it is uncertain precisely what type of source is being assessed then the most vulnerable source type should be assumed. For example, if there is some debate over whether a supply is being fed from a well or a spring it could be appropriate to score on the basis of the supply being a well. Similarly, if there is some doubt over whether a supply is a spring or a surface derived source it could be appropriate to score on the basis of a surface derived source as this has the highest inherent risk associated with it.

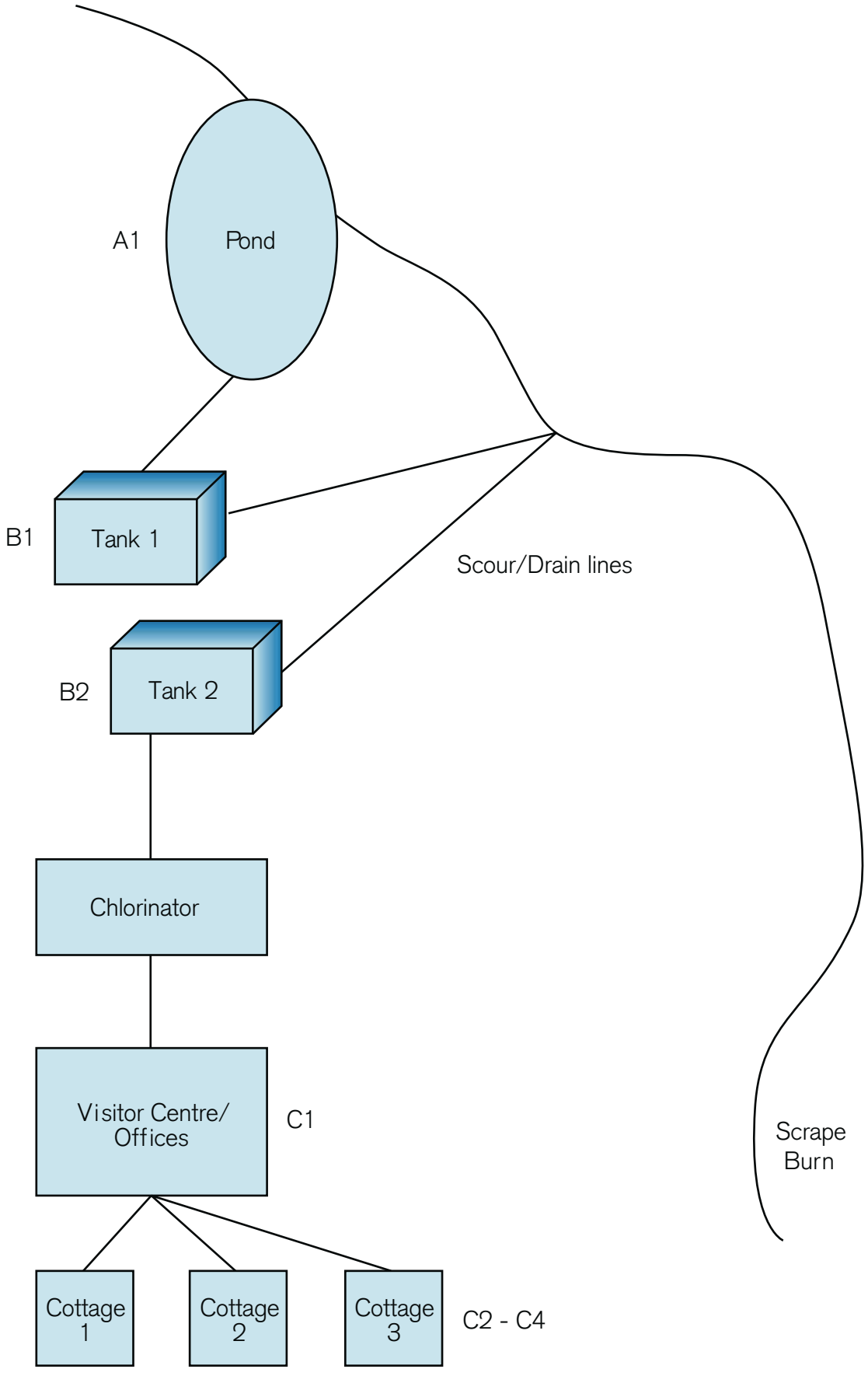
5.2 Case study 1 – Surface-derived water supply from the Scottish Borders

Dawyck Botanical Garden (pronounced "daw ick") in Peebleshire is one of four gardens maintained by the Royal Botanic Garden in Edinburgh. The Garden is located on the south bank of the River Tweed eight miles south-west of Peebles and about 28 miles south of Edinburgh, Scotland's capital city. The gardens at Dawyck have an elevation staring of 165m above sea level rising to 250m and they have an almost Continental climate with temperatures ranging from -19˚C to 28.5˚C and a low rainfall typically ranging between 875mm to 1070mm with the wettest months occurring between October and January. The Dawyck Botanical Garden can trace its origins back over 300 years with some trees still growing that were planted in 1680. The editorial team are very grateful to David Knott, Curator at Dawyck, for giving permission to use the site for this case study.

Water used to supply the visitor centre and three cottages in the Garden is drawn from the Scrape Burn (a tributary of the Tweed). The burn (which is the Scots term for a stream) flows into an artificial pond from where the water is abstracted into two tanks before it flows on to a small chlorination system and then into supply. There are 10 people living in the cottages with a further seven staff working at the visitor centre with a further 24,000 people visiting the visitor centre annually.

Figure 5.1 shows a diagram of the supply while Annex 5.1 gives the risk assessment scores for the supply.

Figure 5.1 Case Study 1: Dawyck Botanic Garden Supply



For the general site survey the assessed risks arose from the following:

Question 23 was scored Yes – risk characterisation high - as there was evidence of sheep grazing around the burn in the reaches above the Garden boundary. Indeed several dead sheep have had to be removed from the catchment in previous years – some quite close to the burn itself. Figure 5.2 illustrates the animal remains found near the Scrape Burn. The hazard assessment likelihood was scored as permanent (16) giving an overall score of 256.

Figure 5.2 Animal remains beside Scrape Burn

Question 24 was scored yes – risk characterisation medium - as there was evidence of wildlife in the catchment including deer – roe and fallow, rabbits and other rodents. The hazard assessment likelihood was scored as permanent (16) giving an overall score of 64.

Figure 5.3 Scrape Burn catchment showing erosion on heather moor at head of catchment

Question 30 was scored as yes – risk characterisation medium – as the catchment area includes large areas of commercial forestry as well as the forestry activity associated with the maintenance of the Garden. The hazard assessment likelihood was scored as permanent (16) as the activity occurs intermittently throughout the year and may not be notified to the Garden when the work is being undertaken in areas outwith the Garden.

Figure 5.4 Sump oil on trackway

Scrape Burn is down slope on right hand side of the picture.

For the supply survey the assessed risks arose from the following:

Question 40 was scored as Don’t Know – risk characterisation High – as the details of the pipe materials were not known at the time of the assessment. Once the information is determined then the assessed risk can be re-evaluated in the light of the evidence presented. The hazard assessment likelihood was scored as permanent (16) giving an overall score of 128.

Question 41 was scored as yes – risk characterisation High – as the drain and scour lines did not have vermin protection at their outlets. The hazard assessment likelihood was scored as permanent (16) giving an overall score of 128.

Figure 5.5 Drain and scour pipe details from collection tanks showing vermin protection absent

Overflow pipe

Scour (drain) pipe from tanks

Question 48 was scored as Yes - risk characterisation High – the garden staff noted that the burn experiences significant changes in the level and flow throughout the year depending on the prevailing weather conditions. The hazard assessment likelihood was considered as once per year (scoring 2).

Question 49 was scored as Yes – risk characterisation High – as in the experience of the staff there were significant changes in the appearance of the water following heavy rainfall. Again the hazard assessment likelihood was considered as once per year (scoring 2).

Overall these scores result in the source risk being assessed as High with recommended interventions focusing on trying to reduce access of animals to the burn, controlling forestry activity in the catchment, protecting drain and scour pipes from entry by vermin, identifying pipe materials and being aware that heavy rainfall can have detrimental effects on the water quality.

Figure 5.6 Scrape Burn showing evidence of historical spate flow conditions

Scrape Burn showing wind fallen logs carried by the burn when in spate

Pond formed from Scrape Burn used as source of drinking water supply at Dawyck Garden

(Note gravel deposits washed into the pond during spate flows)

5.3 Case Study 2 – Estate supply from Perthshire

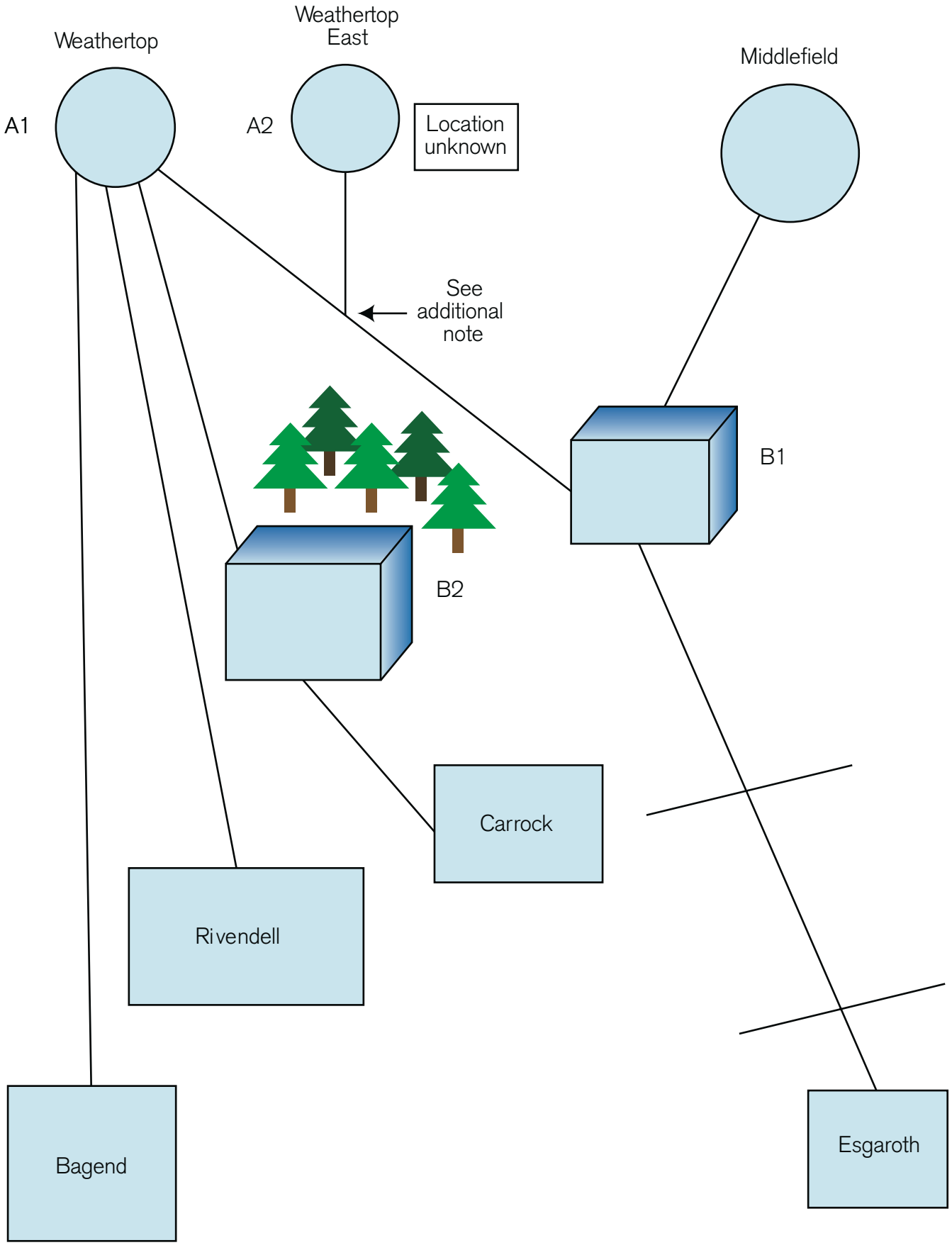
The supply was originally part of an estate supply and currently supplies some 19 properties with a population of 41. The supply has three sources which have previously been classified as springs and has a brick build storage tank serving part of the network. The network extends to around four miles in extent although the actual distance of pipe work is unknown. The catchment area has extensive agriculture with livestock (cattle and sheep) and some mixed forestry. There is no clear responsibility for the maintenance of the sources and for one of the sources, while its existence is known, the precise location of the source has not been found.

The names of the locations used in this case study have been altered to preserve the anonymity of the supply.

An examination of the site of the two known sources suggested that while they had been originally classified as springs the site (A1) was closer to a well in terms of its construction and collection of water while site A3 was closer to a surface abstraction. Risk assessments were undertaken at each of the two sources that could be located.

Figure 5.7 is a diagram of the supply with Annexes 5.2 and 5.3 providing the risk assessments for the two known sources.

Figure 5.7 Case Study 2: Perthshire Estate Supply



If we first consider the source A1 (Weathertop) for the general site survey the assessed risks arose from the following (see also Annex 5.2).

The source collection chamber was located in an area of boggy ground. Due to the waterlogged nature of the ground and the construction of the source it was unlikely that this was a spring supply. Springs may well be feeding the boggy ground but the source had not tapped directly into the source of the spring and so any water collected was under the influence of the surface/soil water. For this reason the source was assessed as a surface water source. The boggy conditions were almost certainly a permanent feature in all but the driest of conditions.

Figure 5.8 General situation encountered at source A1 (Weathertop)

Question 23 was scored as Yes – risk characterisation High – as there was evidence of the surrounding catchment being used for livestock production on a year-round basis. The hazard assessment likelihood score was 16 giving an overall score of 256.

Figure 5.9 Evidence of faecal material deposited on top of collection tank at site A1

Question 24 was scored as Yes – risk characterisation Moderate – as there was evidence of wildlife in the area. As this was almost certainly a permanent feature the hazard assessment likelihood score was 16 giving an overall score of 64.

Question 25 was scored as Yes – risk characterisation High – as the source collection structure was down-slope of an area where agri-chemicals and other materials were being stored. The materials appeared to have been present for a long period of time and so the hazard assessment likelihood score was 16 giving an overall score of 128.

Question 32 was scored as Yes – risk characterisation High – for the reasons given in response to question 25. Again the hazard assessment likelihood score was 16 giving an overall score of 128.

Figure 5.10 Agri-chemical storage upslope of collection system and boggy ground. Waste disposal/waste storage area is behind this area

For the supply survey at location A1 (Weathertop) the assessed risks arose from the following:

Question 40 was scored Yes – risk characterisation High – as the tank (B2 Figure 5.11), which was located in a wood, had inadequate protection around it. The hazard assessment likelihood score was scored as permanent (16) with an overall score of 128.

Question 43 was scored as Yes – risk characterisation High – as there had been no maintenance undertaken on the system in the previous 12 months. The hazard assessment likelihood score was scored as permanent (16) with an overall score of 128.

Figure 5.11 Tank B2 located in wooded area with inadequate protection

Questions 44 - 47 were not relevant to the situation encountered and so were left blank. As a result of the risk characterisation not being relevant the hazard assessment for these questions did not have to be completed.

Question 48 was scored as Don't Know – risk characterisation High. As the relevant person was not present during the investigation of the site the precise details could not be ascertained at the time of the visit. It would be perfectly acceptable to score on the basis described but to follow-up with either a telephone call or further visit to try and secure a definitive answer to the question. The hazard assessment was assessed on the basis of there being some influence on the collection system from surface flows resulting in a change in the flow into the system. The hazard assessment likelihood score was considered to be moderately likely (4) resulting in an overall hazard assessment score of 16.

Question 49 was scored as Don't Know – risk characterisation High. This is a similar situation to that described for Question 48 above and similar processes were applied to arriving at the final hazard score of 32.

Figure 5.12 General catchment area immediately adjacent to source A1 (Weathertop)

We can now turn to the second identified source (A3 Middlefield in Figure 5.13). Annex 5.3 has further details. The source was considered to be a surface abstraction.

Figure 5.13 General Location of Source A3 Middlefield

Question 23 was scored as Yes – risk characterisation High – as the source was immediately adjacent to fields containing cattle and sheep. The fields were utilised for livestock production on a continuous basis and so the hazard assessment likelihood score was permanent (16) with an overall score of 256.

Question 24 was scored as Yes – risk characterisation Moderate – as there was evidence of wildlife activity in the vicinity of the abstraction point. The hazard assessment likelihood score was considered to be permanent (16) with an overall score of 64.

Question 25 was scored as Yes – risk characterisation High – as the abstraction point was down-slope from areas of livestock production. The hazard assessment likelihood score was considered to be permanent (16) with an overall score of 128.

Question 30 was scored as Yes – risk characterisation Moderate – as the abstraction point was adjacent to wooded areas populated with mostly broadleaf trees. The hazard assessment likelihood score was considered to be permanent (16) with an overall score of 64.

Question 41 was scored as Yes – risk characterisation High – as the tank was not secure against vermin and, despite having had substantial remedial works undertaken, was in a poor state of repair. There was also evidence that the inside of the tank had been coated with a bitumen paint which was totally inappropriate for such a use. The hazard assessment likelihood score was considered to be permanent (16) with an overall score of 128.

Figure 5.14 Tank B2 showing inappropriate bitumen paint used in internal tank repairs

Question 43 was scored as Yes – risk characterisation High – as there had been no record of the distribution system (pipes) being disinfected. The hazard assessment likelihood score was considered to be permanent (16) with an overall score of 128.

Questions 44 – 49 were not relevant to the situation and so were left blank.

An additional note (See Figure 5.15) was also made concerning the state of the chamber where the lines from source A1 and A2 join. This was of poor construction with no effective protection against livestock, wildlife or inundation from rainfall/overland flow (flooding). The chamber was down-slope from an agricultural field with evidence of run off coming from the field near to the chamber. This additional evidence would also be considered to be a High Risk component of the system.

Figure 5.15 Chamber where pipework from sources A1 and A2 are considered to join

The overall risk assigned to the whole estate supply was High Risk based on the two source surveys undertaken at sites A1 and A3.

Figure 5.16 Tank B2 showing poor external condition and structural repairs

5.4 Case Study 3 – Knuttmound Estate Supply, West Perthshire

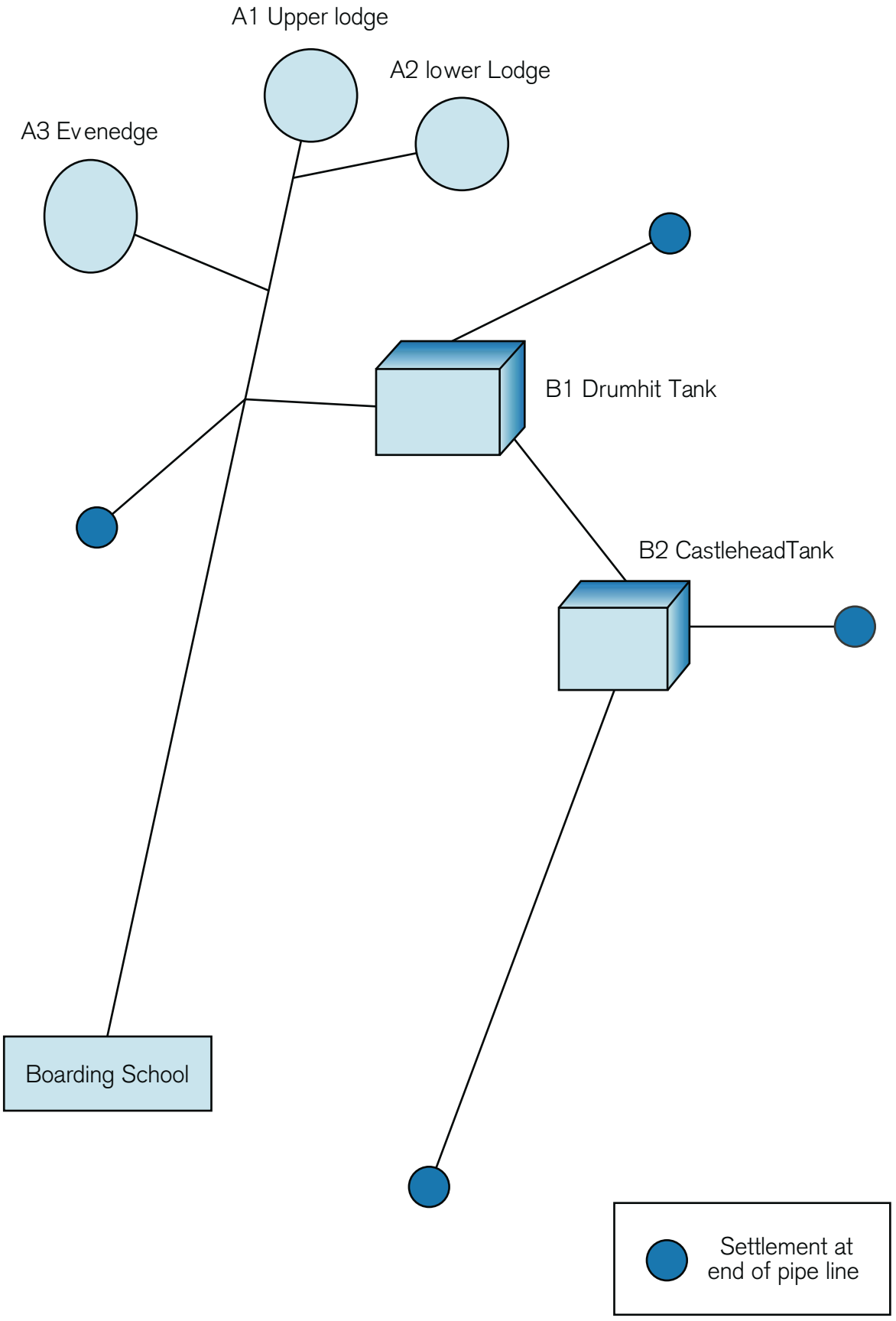
The supply for the Knuttmound Estate serves 68 domestic properties as well as two hotels and a boarding school with an estimated population for the domestic properties of around 180. The total occupancy capacity for the two hotels and the school was uncertain at the time of the risk assessment. The situation is further complicated by the fact that the school has recently changed its main source of water to the mains supply but has retained the connection to the private water supply to enable the school authorities to reduce their metered water bill should the need arise.

The supply is drawn from four sources, one of which is under the control of the school but details as to whether this particular source has been retained within the overall supply system were contradictory and will require further investigation. The remaining three sources were assessed individually with the overall results applicable for the supply as a whole.

The pipework for the distribution network is mainly asbestos cement. There is a chlorination system which treats part of the network and the boarding school and some individual properties have point of entry/point of use treatment systems based around UV.

Figure 5.17 is a diagram showing the supply as it was understood at the time of the risk assessment.

Figure 5.17 Knuttmound Estate Supply, Perthshire



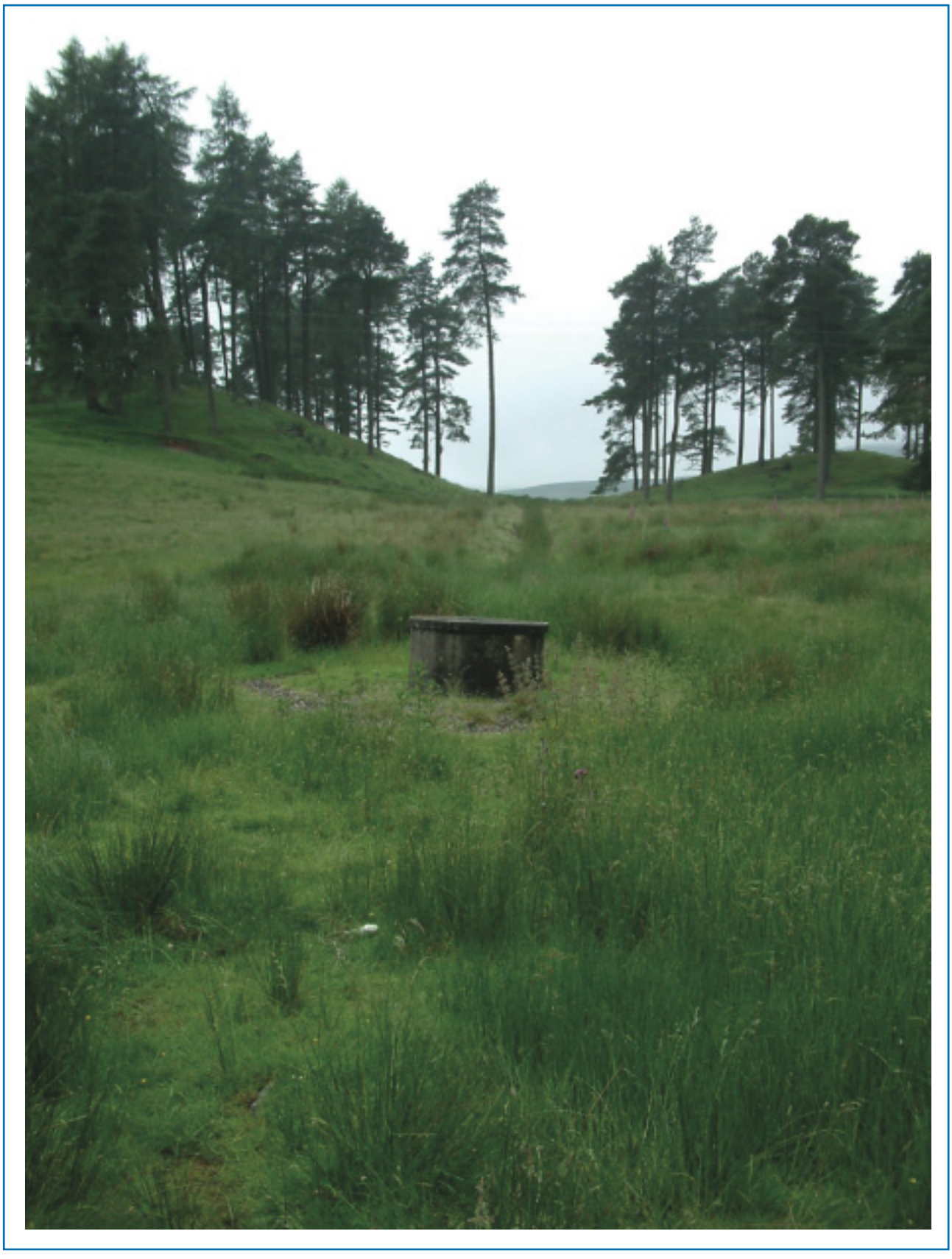
We first consider the risk assessment for the source A1 (Upper Lodge). The risk assessment is provided in Annex 5.4. The source had originally been identified from historic records as a spring but examination at the site revealed that extensive modifications at the source had been undertaken with a well sunk into an area of boggy ground and extensive field drains laid to feed water into the collection point (i.e. the well structure). Having considered this evidence at the site the source was scored using the well risk assessment form.

Figure 5.18 Site A1 Upper Lodge

General Site Survey

Question 23 – the risk characterisation was assessed as High as there was evidence of poor drainage and stagnant surface water. The well had been constructed by excavating a hole and inserting concrete rings to form the well structure. The area around the outside of these concrete rings had been backfilled with gravel which also formed the basis of drainage channels radiating out from the well. The area around the well away from the gravel backfill was extremely boggy as evidenced by standing pools of water and also the vegetation types in the vicinity. The hazard assessment considered these conditions to be permanent and so the likelihood score was 16 with the overall score as 128.

Figure 5.19 Well structure and boggy ground around source A1



Question 24 – the risk characterisation was High and the hazard assessment likelihood score of 16 was based on permanent presence of livestock in the vicinity resulting in an overall score of 256.

Question 25 – the risk characterisation was Medium and the hazard assessment likelihood score of 16 was based on permanent presence of wildlife in the vicinity resulting in an overall score of 64.

Question 32 – the absence of the relevant person resulted in the response being Don’t Know, resulting in a risk characterisation of High. The hazard assessment was scored as moderately likely as the recent work undertaken at the site would suggest that some workers would be aware of the presence of the source. This resulted in an overall hazard assessment of 16.

Figure 5.20

Evidence of sheep (cast wool) at well

Sheep near well (upslope)

Supply Survey

Question 42 – (lack of fence) - risk characterisation was High with the likelihood being assessed as permanent giving an overall hazard assessment score of 128.

Question 43 – (no cut-off ditch) - risk characterisation was High with the likelihood being assessed as permanent giving an overall hazard assessment score of 256.

Question 44 – (no concrete apron) - risk characterisation was High with the likelihood being assessed as permanent giving an overall hazard assessment score of 128.

Question 45 – risk characterisation was Low as the top of the well was 150mm above the surface of the ground. While this was not a concrete apron, the height would be appropriate if a concrete apron were to be retrofitted at the site. So it was considered inappropriate to draw specific attention to this aspect when the other deficiencies concerning the well construction were dealt with in other parts of the risk assessment.

Question 46 – (lack of appropriate cover) - risk characterisation was High with the likelihood being assessed as permanent giving an overall hazard assessment score of 256.

Figure 5.21

Figure 5.22

Evidence of presence of sheep on top of well cover – cast wool

Question 49 and questions 52 – 55 were not appropriate to the situation at source A1 and so were not completed. This highlights why the comparison between supplies is not as simple as comparing the scores – a poor supply where questions can be answered may not score as badly as a good supply where many questions are left unanswered. The purpose of the scores is to identify issues within the supply being examined, not to rank supplies against each other.

Questions 50 and 51 could not be answered in the absence of the relevant person and so were scored as High Risk due to this lack of knowledge. The hazard assessment was scored on the basis of the risk being present resulting in scores of 64 and 128 respectively.

Similarly Questions 56 and 57 could not be answered in the absence of the relevant person and so were scored as High Risk due to this lack of knowledge. The hazard assessment was scored on the basis of the risk being present resulting in scores of 16 and 32 respectively.

The soil leaching risk survey relied upon identifying the source type and location. The soil leaching potential is important as this will determine if soil type has a part to play in source protection. In this case study the source type was a well and the soil leaching has a significant role to play in source protection. From the grid reference for the source it was determined that the soil leaching potential for the source was High1 giving a soil leaching risk potential of High.

The overall risk for the source A1 was HIGH.

If we now consider the risk assessment for source A2 (Lower Lodge) the access to the site was severely restricted due to a deer fence and very steep slope. As access was not available at the time of the risk assessment the source was unclassified and so source A2 was designated as High Risk. A full risk assessment for the source A2 was not undertaken.

Figure 5.23 Source A2 Lower Lodge

Source A3 (Evenedge) is located in an area of boggy ground. The source was historically identified as a spring source. While the boggy area may be being fed by water flowing from the ground the collection tank location and construction made it unlikely that the spring was being tapped at source i.e. within the rock formation. The boggy area may well be a seepage area with any water being collected from this area not being a spring water. When the water emerges from the rock formations into the seepage area the water will then be liable to contamination from the surface. For this reason the collection system as source A3 was scored as a surface water (Annex 5.5). Figure 5.24 gives more details on seepage areas and springs.

Water will flow from an unconfined aquifer wherever the water table intersects the ground surface. Where the flow from an aquifer is diffuse it is termed a seepage; where it is localised, as for example along a fault or fissure, it is called a spring (after Price, 1996).

Figure 5.24 Seepage areas and springs

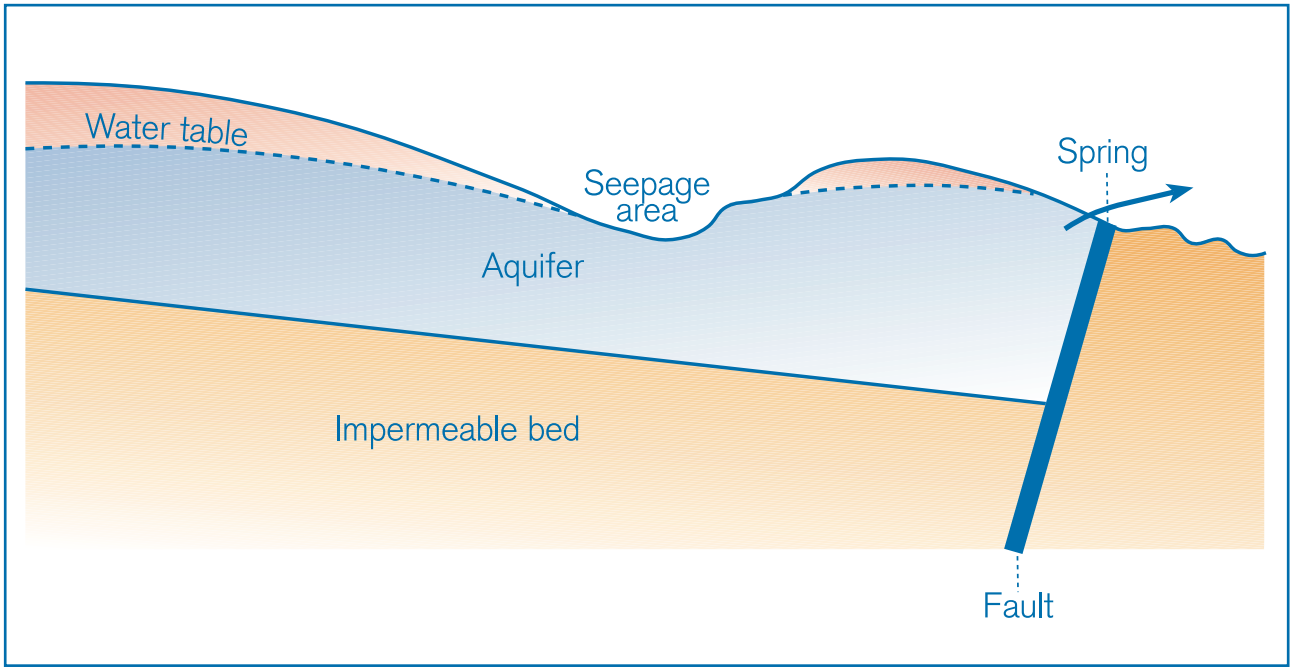


Figure 5.25 Source A3 Evenedge

The general site survey at source A3 risk assessment resulted in the following issues being highlighted:

Question 24 was scored as Yes – risk characterisation Moderate – as the presence of wildlife at the source was highly probable. The hazard assessment likelihood was almost certain (value 16) resulting in an overall score of 64.

Question 31 could not be accurately answered as the relevant person was not present during the risk assessment process. The risk characterisation was therefore High with the hazard assessment being scored on the assumption that agricultural workers did not know there was a supply in the area resulting in a likelihood score of 16 and an overall score of 64.

Question 34 was scored as Don't Know as there was a habitation above the abstraction site which may have had a septic tank. The Don't Know rating would suggest the need for further investigations into this matter. The hazard assessment was undertaken on the assumption that there was unsewered human sanitation in the vicinity on a permanent basis (value 16) giving an overall hazard assessment score of 256.

Question 39 was assessed as Yes – risk characterisation High – as the abstraction site was surrounded by arable crops which could be subjected to pesticide application which may directly (from run off) or indirectly (from wind drift) enter the source area and hence the supply. The likelihood was judged as being Likely and scored at 8. While such applications will not generally occur on a weekly basis, the higher score was used to ensure that the overall hazard assessment score reached above the intervention level provided in guidance. This issue links to Question 31 and with both Question 31 and 39 scoring at 64, the scores will ensure that appropriate attention and awareness is achieved from agricultural workers in relation to the location of the source and appropriate activities to be undertaken near it.

Figure 5.26

Overflow pipe at source A3

The supply survey at source A3 resulted in the following:

Question 40 – based on the historic information concerning the supply this was scored as Yes – risk characterisation High – as records suggested the use of asbestos cement pipes within the distribution network.

Question 41 – the intermediate tank B1 (at Drumhit) also functioned as a chlorination point for part of the system. The tank was not adequately protected from ingress of vermin or from flooding. The tank was located in an area beside a farm yard where cattle and sheep were moved and beside a field in which livestock were grazed. This resulted in the risk characterisation being scored as Yes – High – and the likelihood score as 16 with an overall hazard assessment score of 128.

Question 42 – from the information available an accurate assessment could not be made and so the risk characterisation was scored as Don't Know – High – with the hazard assessment being assessed on the basis of junctions with no back-siphonage protection being present as a permanent feature of the system – likelihood value 16 overall score 128.

Questions 48 and 49 could not be accurately assessed and so were scored as Don't Know (high risk) with the likelihood scores being rated at 4 for both questions resulting in respective hazard assessment scores of 16 and 32.

Figure 5.27 Tank B1 Drumhit

Tank B1

Chlorine reserve at Tank B1

Figure 5.28 Tank at B1 (Drumhit)

Chlorinator at Tank B1

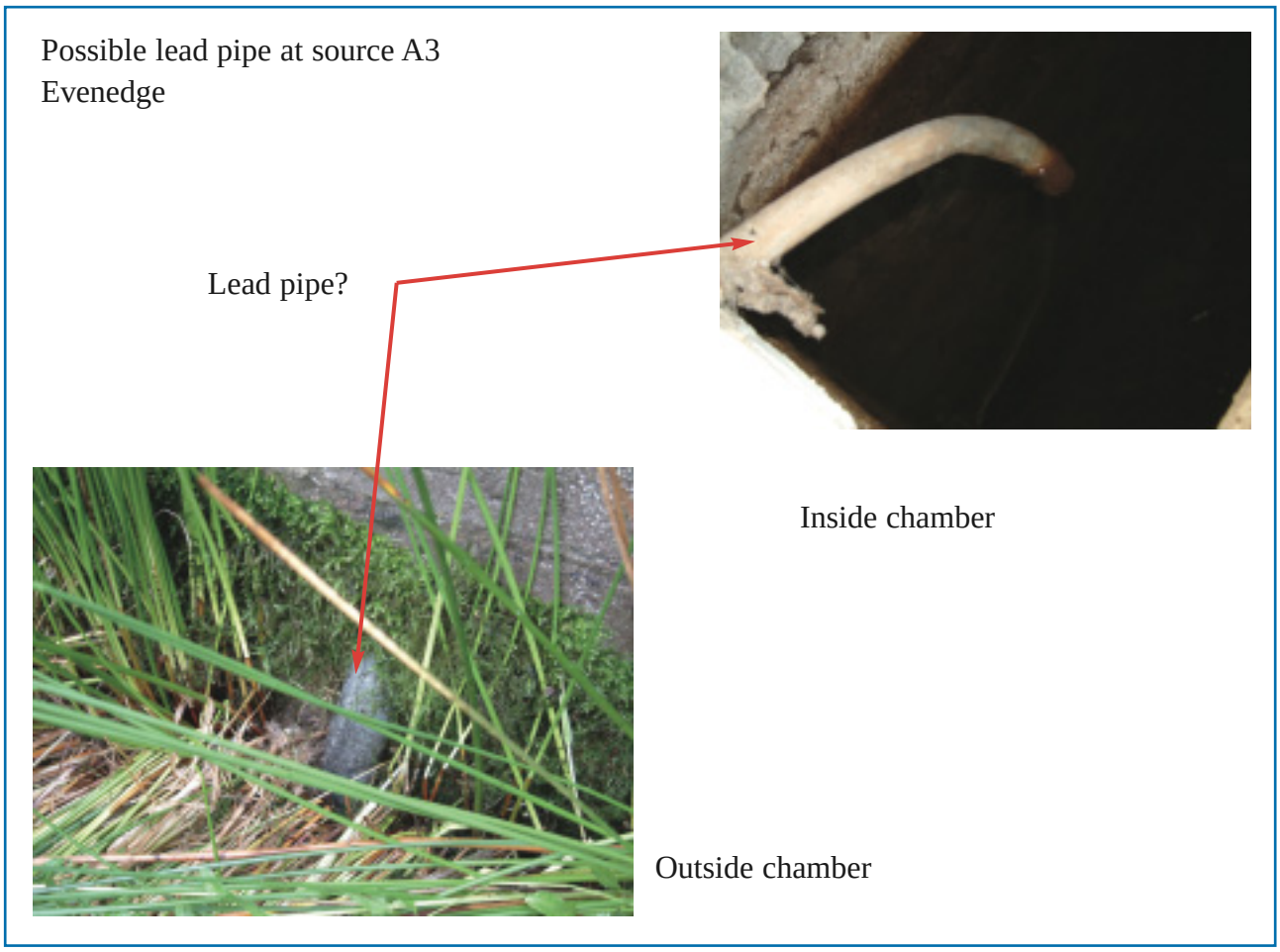
There were three other issues potentially affecting the quality of water being provided by the system which were noted as additional items:

(a) lead pipe – at source A3 (Evenedge) there was evidence that at least part of the system was plumbed using lead pipe. This should be brought to the attention of the relevant person and appropriate sampling undertaken to determine whether the lead levels exceed the Regulatory limits.

(b) at source A3 (Evenedge) the surface supply risk assessment does not cover the security of the site in terms of fences, etc. As the site does not easily fit into the pro formas and the surface supply was the most appropriate in terms of the likely source of the water, the additional items relating to the security of the site and the chamber should also be considered. There was no stock proof fence, no cut-off ditch and the chamber was not vermin-proof. These issues should all be added to the final communication to the relevant person when communicating the results of the investigation and suggested actions for improving the integrity of the supply.

(c) at Tank B1 (Drumhit) a second tank was found adjacent to the operational tank B1. This will require further investigation to determine if it is still used or if it has been properly disconnected from the supply. If it has not been properly disconnected to prevent any material contained in it entering the supply then it will pose a serious risk to the integrity of the system.

Figure 5.29


Possible lead pipe at source A3
Evenedge
Lead pipe?
Inside chamber
Outside chamber

5.5 Case Study 4 – Waterbottom Borehole near Peebles, Scotland

The borehole feeds 3 properties (approximately 10 people) in close proximity to the borehole site itself. Annex 5.6 provides the risk assessment details for this supply.

The borehole was constructed in 1995. It was drilled to a total depth of 19.0 metres and the depth of overburden was 9.0 metres. The depth to groundwater was 6.0 metres which was found to rise overnight to 3.05 metres below ground level. The borehole was lined with 90 x 80mm diameter A.B.S. well casing from ground level to 6.75m and 6.75 to 19.0m with 90 x 80mm diameter well screen through the overburden and the unstable rock formations (see Figure 5.30).

Figure 5.30 Waterbottom Borehole drill log

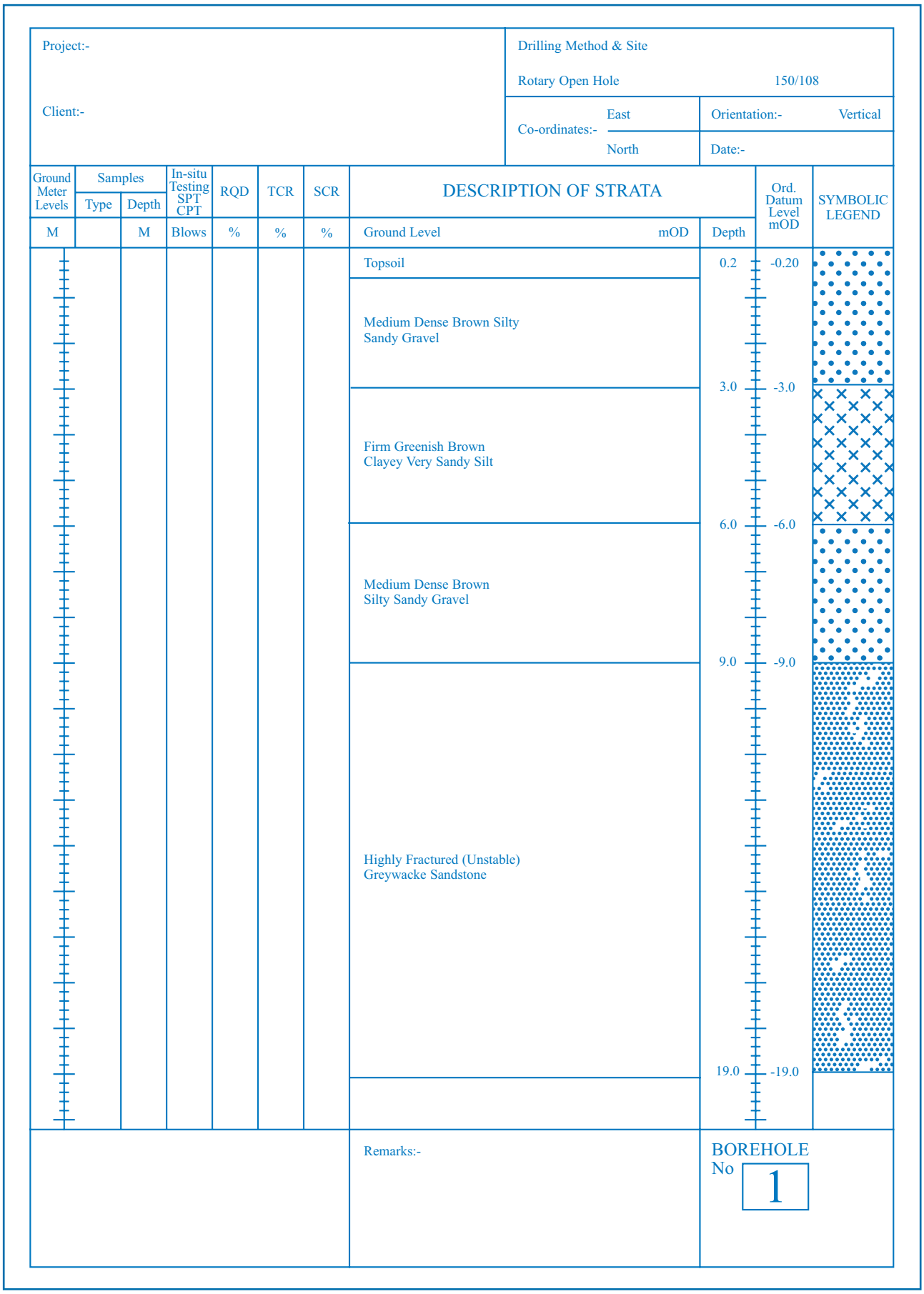
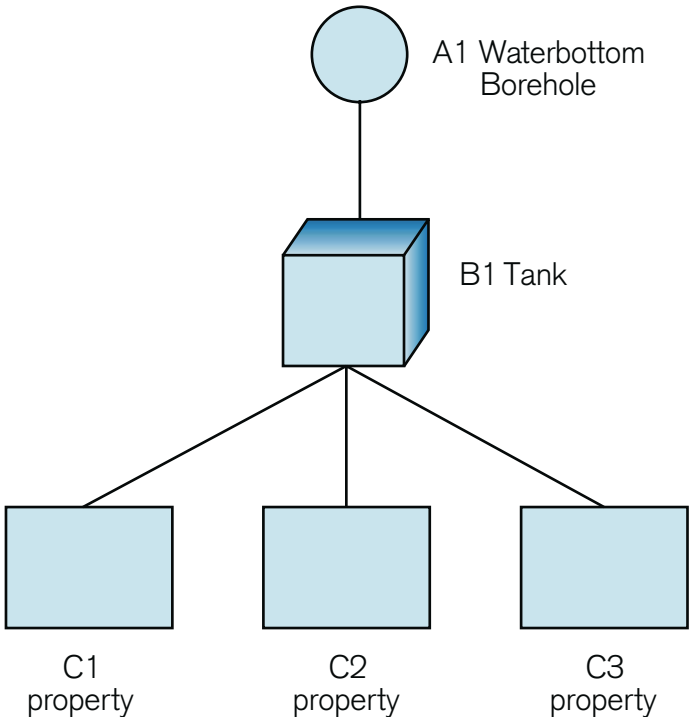


Figure 5.31 Waterbottom Supply diagram



The general site survey identified only one item affecting the integrity of the supply.

Question 40 – there was evidence of recent application of herbicide around and over the top of the borehole head works. This activity resulted in the risk characterisation being scored as Yes – High risk. The likelihood of such applications being repeated was judged to be likely (value 8) giving an overall hazard assessment score of 64.

The supply survey element of the risk assessment identified the following issues:

Question 45 – there was no cut-off ditch or other protection to prevent surface flow (flood) conditions breaching the below-ground borehole headworks. The risk characterisation was therefore scored as Yes – High risk. As the situation would remain permanent until such time as remedial works were undertaken the likelihood score was evaluated as permanent (16) giving an overall hazard assessment score of 256.

Question 46 – the top of the chamber was not raised above the ground level. This resulted in the risk characterisation being scored as Yes – High risk and the likelihood value as permanent (16) giving an overall hazard assessment score of 256.

Question 52 – no maintenance had been undertaken on the system during the previous 12 months. The risk characterisation score was therefore Yes – High Risk with the likelihood of such action having not been taken as permanent (value 16) giving an overall hazard assessment score of 128.

Additional comments recorded were that the cover on the borehole chamber be fitted with a lock. The present arrangement, while difficult to effect removal of the cover, does not secure the cover adequately.

Figure 5.32 Waterbottom Borehole

5.6 Case Study 5 – Border Estate Supply

The supply is part of a former estate supply system and is extensive in nature. The supply serves a residential health care facility (population around 50) as well as a number of houses and a school. The population is over 100 (Type A2). Historical records suggested that the supply was drawn from an extensive area of springs and had been classified as a spring supply. The surface water risk assessment has been utilised as the site investigations revealed that all the "spring" sources were under, or potentially under, the influence of surface flows suggesting that surface water risks were the most appropriate to consider.

Figure 5.33 is a diagram showing the supply as found during the investigations. Annex 5.7 provides details of the risk assessment.

Figure 5.33 Border Estate Supply

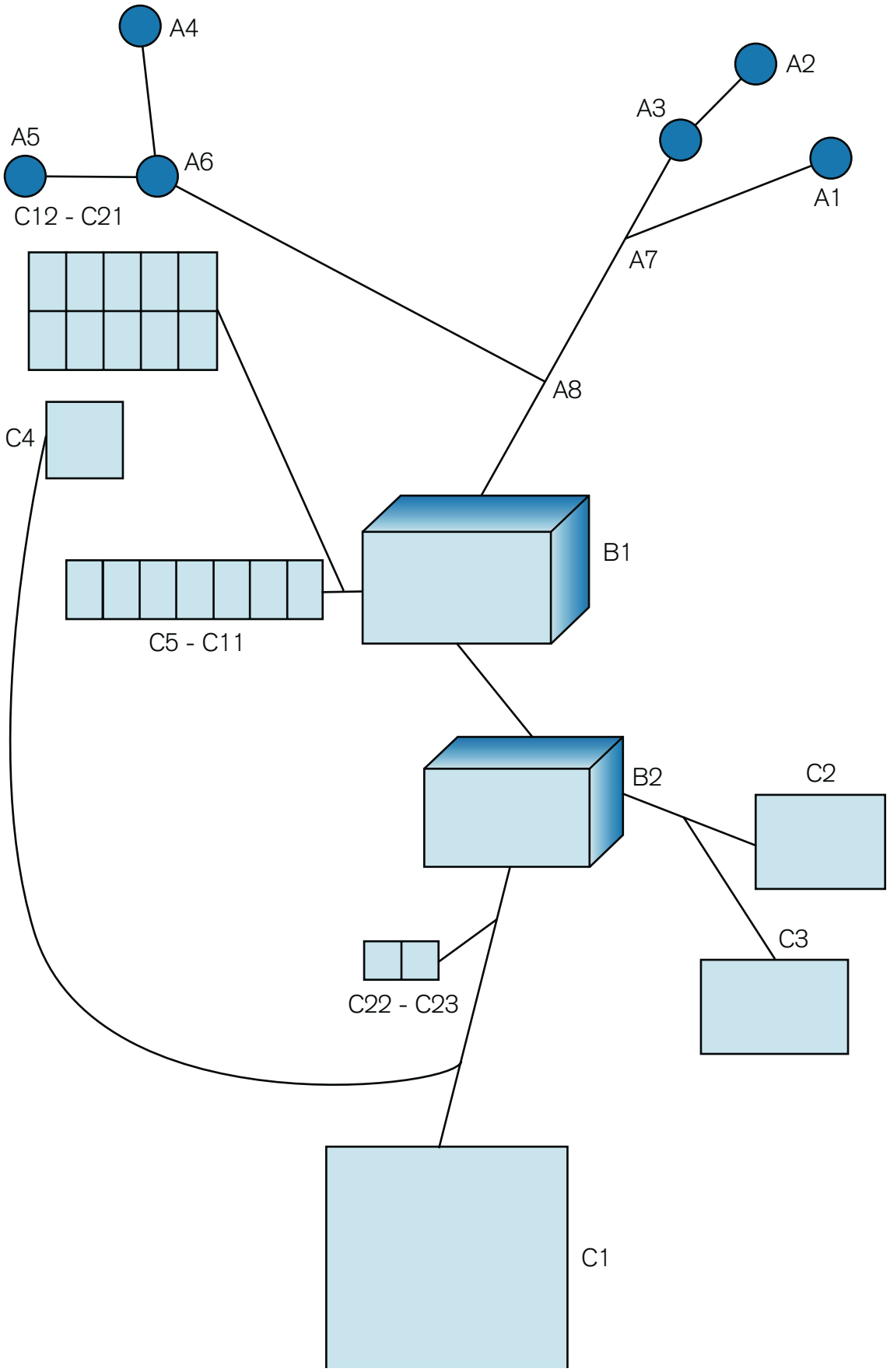
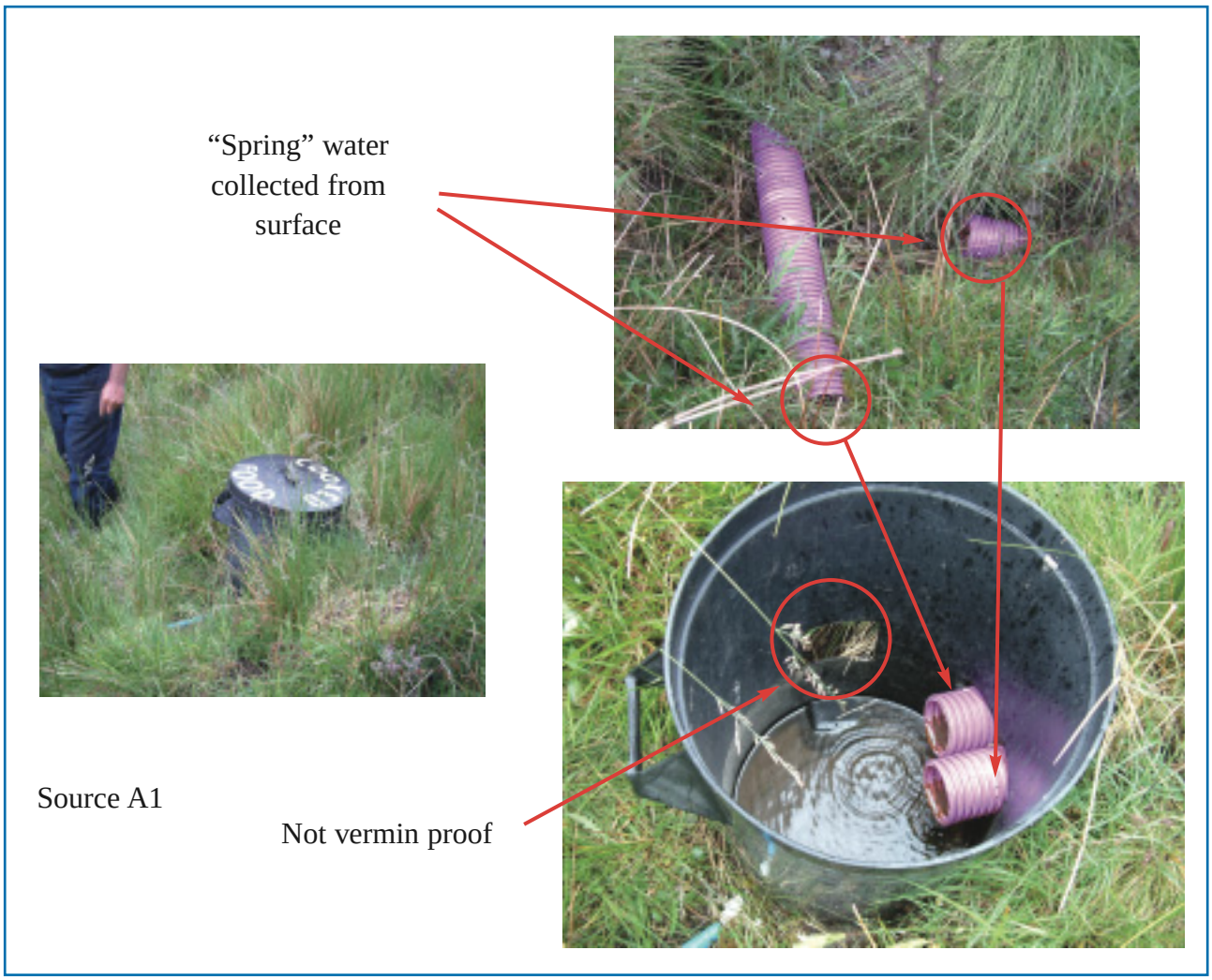


Figure 5.34 Source A1



The sources A1 – A6 were all of a similar nature – springs issuing from the hillside with a collection chamber either down-slope of the point where the spring emerged or within the soil horizon. None of the chambers were constructed so that they were within the rock matrix and therefore capturing the groundwater *in situ*. This meant that all the "springs" were capable of being under surface influence and so were scored as surface water. Further, given the common nature of the systems a single assessment was appropriate to cover the six separate collection areas.

Figures 5.34 – 5.38 provide evidence of the general condition of the sources and the intermediate collection tanks which also act as additional collection points. In general, while the groundwater risk assessment is appropriate, the additional comments section of the form would also be used to note that where there are structures present they are not water or vermin-proof and therefore allow additional points of entry for material best kept out of the drinking water supply.

Figure 5.35

Source A2

Figure 5.36

Source A5

Figure 5.37

Source A6

Figure 5.38

A7 – intermediate collection/storage tank

Figure 5.39

A8 – intermediate storage and collection tank

For the general site survey risk characterisation for Question 23 – history of livestock production - was scored as “Yes” (High Risk). While no livestock were found at the time of the investigation there was ample evidence of their presence in the area. The hazard assessment likelihood score was therefore likely (8) with an overall hazard assessment score of 128.

Question 24 was also scored as high risk and the likelihood score was almost certain (16) giving an overall hazard assessment score of 64. Figure 38 provides evidence of deer in the catchment although evidence of rabbits was also found.

There was evidence of extensive forestry activity in the catchment and so Question 30 was scored accordingly – risk characterisation Moderate; hazard assessment likelihood permanent (16), overall hazard assessment score 64.

The overall risk assessment for the general site survey was High.

Figure 5.40 “Scrape” in catchment

Following discussion with the relevant person the supply survey Question 40 was answered as Yes (High Risk) as there were parts of the supply network that were liable to fracture. The likelihood score was judged to be moderate (4) giving an overall hazard assessment score of 32.

Figure 5.41 Intermediate Tank B1

Intermediate tank B1

The risk characterisation for Question 41 was High – intermediate tank B1 (Figure 39) was in a very poor state of repair and the local landowner actively used the top of the tank as winder grazing for sheep; intermediate tank B2 (Figure 40) was in a similar poor state of repair with sheep evidently using the tank for grazing as their wool had been caught on the ineffective fence surrounding the structure. Neither were vermin-proof nor were they capable of stopping the ingress of water through the structure. For these reasons the hazard assessment was almost certain (16) giving an overall hazard assessment score of 128.

Both Questions 48 and 49 were assessed as High risk as there was evidence from the relevant person that significant changes were seen in both the flow of water and the appearance of the water throughout the year. These facts would lend further weight towards the view that the sources are under surface flow influence – true groundwater springs would not display such changes. The likelihood for each was almost certain (16) and so the overall hazard assessment scores were 64 and 128 respectively.

The risk score for the supply survey was High and so the overall risk score for the supply was also High.

Figure 5.42

Intermediate tank B2

5.7 Case Study 6 – Rooster Cottage/Farm Borehole

The supply to Rooster Cottage and Rooster Farm comes from a borehole supply. The population served is four. Figure 5.43 shoes the layout of the supply. Annex 5.8 provides the details of the risk assessment.

The borehole has the head works located below ground and so section D of the risk assessment form was the appropriate section to be completed. The general site survey was completed and the responsible person for Rooster Cottage was able to inform the investigation team that the borehole location was affected by poor drainage. Question 23 was assessed as having a risk characterisation of High with a hazard assessment likelihood of unlikely (once per year) scored 2 giving an overall hazard assessment score of 16.

Question 26 was also assessed as high risk due to the immediate location of arable cultivation, with a hazard assessment likelihood of unlikely (once per year) scored 2 giving an overall hazard assessment score of 16.

Figure 5.43 Rooster Cottage/Rooster Farm Borehole

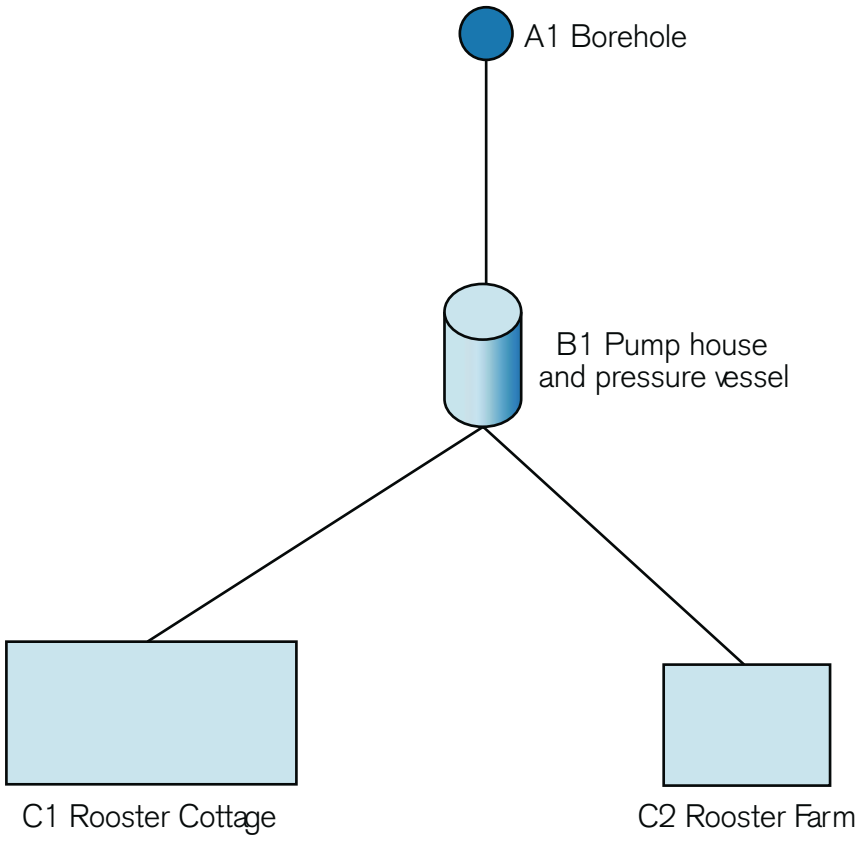


Figure 5.44

The responsible person for Rooster Cottage was unable to comment on the location of septic tanks or where sewerage pipes run and so Questions 35 and 36 had a risk characterisation of Don't Know (High) with a hazard assessment likelihood of almost certain (16) for both questions giving an overall hazard assessment score of 256 and 128 respectively.

Due to the very close location of arable crops and no attempt to ensure an adequate separation from the borehole the risk that pesticides or other materials may sprayed or applied to the field could enter the borehole is high and so the risk characterisation is High with the hazard assessment likelihood being moderately likely (4) with an overall score of 32.

The risk of the borehole head works being inundated with flood water from a nearby burn had resulted in the height of the chamber walls being raised. The work had not, however, included the installation of a ditch to divert flow away from the chamber in the event of more floods. The supply survey identified this deficiency in Question 45 – risk characterisation High; hazard assessment likelihood 16 with an overall hazard assessment score of 256.

The responsible person who was assisting the investigation did not know what materials were used for the pipe work and so question 49 was scored as Don't Know – Risk characterisation High; Hazard assessment likelihood 16 with an overall score of 128.

Discussion with the responsible person suggested that there had been no maintenance on the system in the previous 12 months. Question 52 was scored accordingly with the risk characterisation being scored as High; hazard assessment likelihood unlikely (2) with an overall hazard assessment score of 16.

Figure 5.45

B1 pump house and pressure vessel for Rooster supply

5.8 References

Introducing Groundwater, 2nd Edition 1996. Michael Price. Chapman & Hall, London, Weinheim, New York, Tokyo, Melbourne, Madras. ISBN 0412485001.

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ANNEXES

Annex 5.1 Case Study 1 Risk Assessment (part only) SURFACE SUPPLY

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	16	16	256
24	Evidence of wildlife	M	L	M	16	4	64
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	-	8	-
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
27	Disposal of organic wastes to land	H	L	H	-	8	-
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
29	Remediation of land using sludge or slurry	H	L	H	-	16	-
30	Forestry activity	M	L	M	16	4	64
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
33	Disposal sites for animal remains	H	L	H	-	8	-
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
35	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
36	Sewage effluent lagoons	H	L	H	-	16	-
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H	-	8	-
39	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	16	8	128
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H	16	8	128
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	-	8	-
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
45	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
47	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	2	4	8
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	2	8	16

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.2 Perthshire Estate Supply Source A1 SURFACE SUPPLY

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	16	16	256
24	Evidence of wildlife	M	L	M	16	4	64
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	16	8	128
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
27	Disposal of organic wastes to land	H	L	H	-	8	-
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
29	Remediation of land using sludge or slurry	H	L	H	-	16	-
30	Forestry activity	M	L	M	16	4	64
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	16	8	128
33	Disposal sites for animal remains	H	L	H	-	8	-
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
35	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
36	Sewage effluent lagoons	H	L	H	-	16	-
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H	-	8	-
39	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	-	8	-
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H	16	8	128
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	16	8	128
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
45	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	H	L	H	-	8	-
47	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	4	4	16
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	4	8	32

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.3 Perthshire Estate Supply Source A3 Surface Supply

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	16	16	256
24	Evidence of wildlife	M	L	M	16	4	64
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	16	8	128
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
27	Disposal of organic wastes to land	H	L	H	-	8	-
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
29	Remediation of land using sludge or slurry	H	L	H	-	16	-
30	Forestry activity	M	L	M	16	4	64
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
33	Disposal sites for animal remains	H	L	H	-	8	-
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
35	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
36	Sewage effluent lagoons	H	L	H	-	16	-
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H	-	8	-
39	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	-	8	-
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H	16	8	128
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	16	8	128
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
45	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
47	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	-	4	-
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	-	8	-

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.4 Knuttmound Estate Source A1

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H	16	16	128
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	16	16	256
25	Evidence of wildlife	M	L	M	16	4	64
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	-	8	-
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
28	Disposal of organic wastes to land	H	L	H	-	8	-
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
30	Remediation of land using sludge or slurry	H	L	H	-	16	-
31	Forestry activity	M	L	M	-	4	-
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	4	4	16
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
34	Disposal sites for animal remains	H	L	H	-	8	-
35	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
36	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
37	Sewage effluent lagoons	H	L	H	-	16	-
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
39	Supplies or wells not in current use	H	L	H	-	8	-
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H	-	8	-
41	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur in relation to the supply (source, pipework and properties served)?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	No stock proof fence (to BS1722 or equivalent) at a minimum of 4 metres around the source?	H	L	H	16	8	128
43	No suitable barrier present to prevent ingress of surface flows into the well (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H	16	8	256
44	No concrete apron, a minimum of 1200mm, sloping away from the well and in good repair?	H	L	H	16	8	128
45	The top of the well not 150mm above the apron described in [44]?	H	L	H	-	16	-
46	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H	16	16	256
47	The well construction in an unsatisfactory state-of-repair?	H	L	H	-	8	-
48	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.	H	L	H	16	8	128
49	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. do not have protection described in [42] to [45] above)?	H	L	H	-	8	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	2	4	8
50	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	16	4	64
51	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	16	8	128
52	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
53	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
54	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
55	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
56	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	4	4	16
57	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	4	8	32

D (iii) Soil leaching risk survey (see also Figure A4.1)

Using the NGR identified in [7] to determine and record below the soil leaching potential from the appropriate soil leaching potential map covering the geographic area of interest for location of the source.

National Grid Reference N / O / 0 / 1 / 8 / 0 / 1 / 8

Soil Leaching Risk Classification Assigned HIGH1

Risk Characterisation Score HIGH

Hazard Assessment Score 16

Table Soil leaching risk characterisation and hazard assessment scores

Soil Leaching Risk Classification	Risk Characterisation	Hazard Assessment
Low	Low	4
Intermediate 1	Moderate	8
Intermediate 2	Moderate	8
High 1	High	16
High 2	High	16
High 3	High	16
Built up	High	16

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the three surveys.

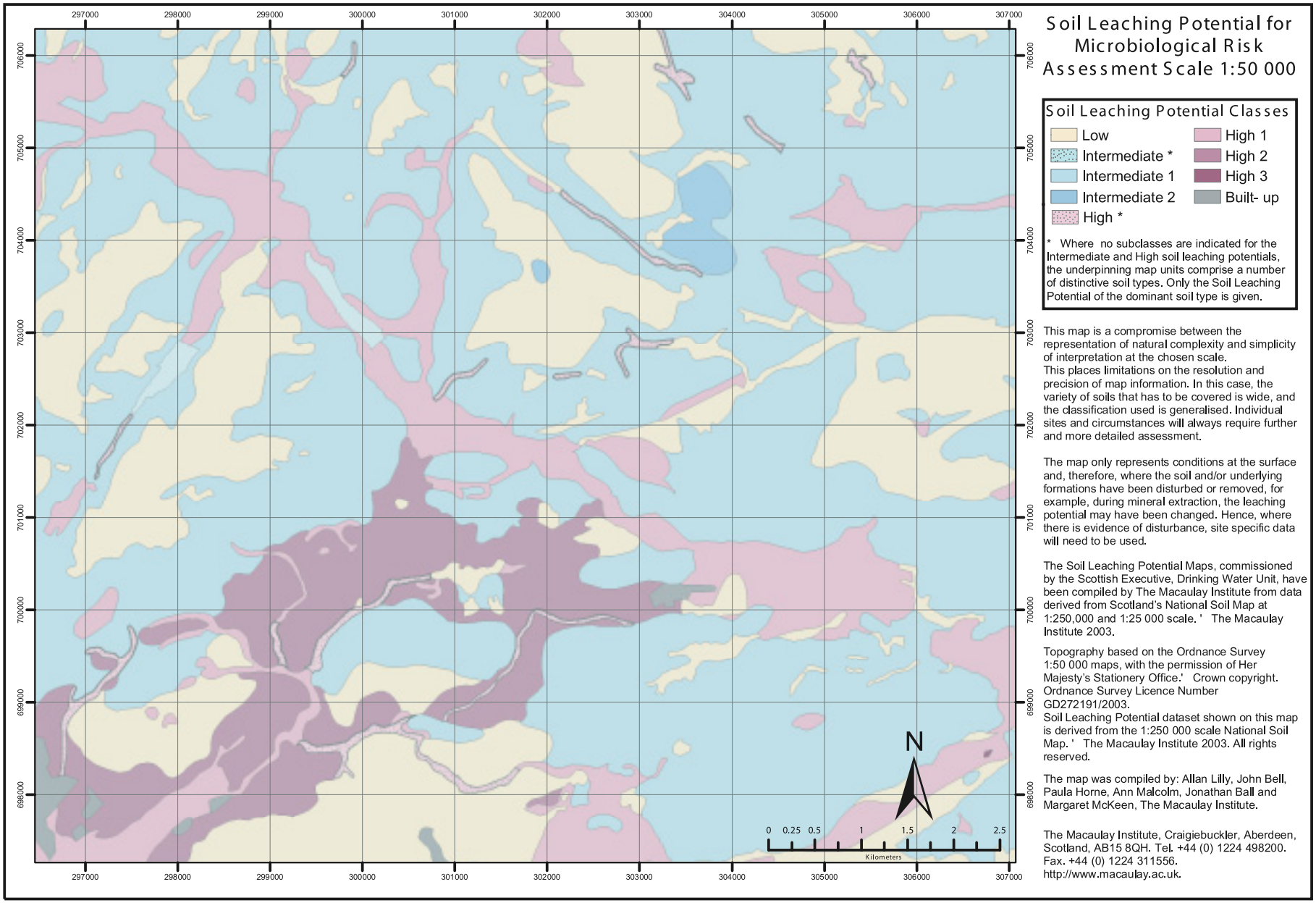
The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Soil Leaching Risk Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Figure A4.1 Soil Leaching Potential Map for area around Knuttmound Estate



Annex 5.5 Source A3 Knuttmound Estate

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	-	16	-
24	Evidence of wildlife	M	L	M	16	4	64
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	-	8	-
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
27	Disposal of organic wastes to land	H	L	H	-	8	-
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
29	Remediation of land using sludge or slurry	H	L	H	-	16	-
30	Forestry activity	M	L	M	-	4	-
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	16	4	64
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
33	Disposal sites for animal remains	H	L	H	-	8	-
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	16	16	256
35	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
36	Sewage effluent lagoons	H	L	H	-	16	-
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H	8	8	64
39	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	16	8	128
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H	16	8	128
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	16	4	64
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	-	8	-
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
45	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
47	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	4	4	16
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	4	8	32

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.6 Case Study 4 – Waterbottom Borehole

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H	-	16	-
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	-	16	-
25	Evidence of wildlife	M	L	M	-	4	-
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	-	8	-
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
28	Disposal of organic wastes to land	H	L	H	-	8	-
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
30	Remediation of land using sludge or slurry	H	L	H	-	16	-
31	Forestry activity	M	L	M	-	4	-
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
34	Disposal sites for animal remains	H	L	H	-	8	-
35	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
36	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
37	Sewage effluent lagoons	H	L	H	-	16	-
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
39	Supplies or wells not in current use	H	L	H	-	8	-
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H	8	8	64
41	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	Below ground chamber not watertight	H	L	H	-	8	-
43	Borehole lining (casing) does not extend at least 150mm above level of floor	H	L	H	-	8	-
44	Watertight lining cap not fitted	H	L	H	-	8	-
45	No suitable barrier present to prevent ingress of surface flows into the chamber (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H	16	16	256
46	The top of the chamber not 150mm above ground level?	H	L	H	16	16	256
47	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H	-	16	-
48	The chamber construction in an unsatisfactory state-of-repair?	H	L	H	-	8	-
49	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	-	8	-
50	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. have protection described in [1] to [5] above)?	H	L	H	-	8	-
51	Junctions present in the supply network, particularly supply animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
52	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	16	8	128
53	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
54	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
55	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
56	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
57	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	-	4	-
58	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	-	8	-

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.7 Case Study 5 – Border Estate Supply

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	8	16	128
24	Evidence of wildlife	M	L	M	16	4	64
25	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	-	8	-
26	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
27	Disposal of organic wastes to land	H	L	H	-	8	-
28	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
29	Remediation of land using sludge or slurry	H	L	H	-	16	-
30	Forestry activity	M	L	M	16	4	64
31	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
32	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
33	Disposal sites for animal remains	H	L	H	-	8	-
34	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	-	16	-
35	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	-	8	-
36	Sewage effluent lagoons	H	L	H	-	16	-
37	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
38	Evidence of use of pesticides (including sheep dip) near source	H	L	H	-	8	-
39	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
40	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	4	8	32
41	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected	H	L	H	16	8	128
42	Junctions present in the supply network, particularly supplying animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
43	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	-	8	-
44	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
45	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
46	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
47	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
48	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	16	4	64
49	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	16	8	128

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

Annex 5.8 Case Study 6 – Rooster Cottage/Farm

D (i) General site survey

Are any of the following known to be present and likely to influence water quality at the source?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
23	Evidence or history of poor drainage causing stagnant / standing water	H	L	H	2	8	16
24	History of livestock production (rearing, housing, grazing) – including poultry	H	L	H	-	16	-
25	Evidence of wildlife	M	L	M	-	4	-
26	Surface run-off from agricultural activity diverted to flow into the source/supply	H	L	H	2	8	16
27	Soil cultivation with wastewater irrigation or sludge / slurry/ manure application	H	L	H	-	16	-
28	Disposal of organic wastes to land	H	L	H	-	8	-
29	Farm wastes and/or silage stored on the ground (not in tanks or containers)	M	L	M	-	8	-
30	Remediation of land using sludge or slurry	H	L	H	-	16	-
31	Forestry activity	M	L	M	-	4	-
32	Awareness of the presence of drinking water supply/source by agricultural workers	L	H	H	-	4	-
33	Waste disposal sites (including scrap yard, car yard, rubbish and hazardous waste disposal, landfill or incinerator including on-farm incineration)	H	L	H	-	8	-
34	Disposal sites for animal remains	H	L	H	-	8	-
35	Unsewered human sanitation including septic tanks, pit latrines, soakaways	H	L	H	16	16	256
36	Sewerage pipes, mains or domestic (e.g. leading to / from septic tank)	H	L	H	16	8	128
37	Sewage effluent lagoons	H	L	H	-	16	-
38	Sewage effluent discharge to adjacent watercourse (where present)	H	L	H	-	16	-
39	Supplies or wells not in current use	H	L	H	-	8	-
40	Evidence of use of pesticides (including sheep dip) near source	H	L	H	4	8	32
41	Evidence of industrial activity likely to present a contamination threat	H	L	H	-	8	-

D (ii) Supply survey

Are any of the following known to occur at the head works site or in relation to the supply?

		Risk Characterisation			Hazard Assessment [1]		
		Yes	No	Don't know	Likelihood	Severity	SCORE
42	Below ground chamber not watertight	H	L	H	-	8	-
43	Borehole lining (casing) does not extend at least 150mm above level of floor	H	L	H	-	8	-
44	Watertight lining cap not fitted	H	L	H	-	8	-
45	No suitable barrier present to prevent ingress of surface flows into the chamber (e.g. cut-off ditch lined with impermeable material, steep incline/decline such as embankments, appropriate walls, etc.)	H	L	H	16	16	256
46	The top of the chamber not 150mm above ground level?	H	L	H	-	16	-
47	No reinforced pre-cast concrete cover slab, or equivalent, in satisfactory condition with a watertight, vermin-proof inspection cover present to BS497 (lockable steel type or equivalent) with or without ventilation?	H	L	H	-	16	-
48	The chamber construction in an unsatisfactory state-of-repair?	H	L	H	-	8	-
49	Supply network constructed from material liable to fracture, e.g. asbestos-concrete, clay, etc.?	H	L	H	-	8	-
50	Intermediate tanks (e.g. collection chambers, holding tanks, break-pressure tanks) are not adequately protected (i.e. have protection described in [1] to [5] above)?	H	L	H	-	8	-
51	Junctions present in the supply network, particularly supply animal watering systems, have no back-siphon protection?	H	L	H	-	4	-
52	No maintenance (including chlorination) has been undertaken in the previous 12 months?	H	L	H	2	8	16
53	If present, header tank within the property (s) does not have a vermin-proof cover?	H	L	H	-	4	-
54	Header tank has not been cleaned in the last 12 months?	H	L	H	-	8	-
55	Any point of entry/point of use treatment equipment has not been serviced in accordance with the manufacturer's instructions in the last 12 months?	M	L	M	-	8	-
56	If present, ultraviolet (UV) lamps are not operating?	H	L	H	-	16	-
57	Is there a noticeable change in the level and flow of water throughout the year?	H	L	H	-	4	-
58	Is there a noticeable change in the appearance of the water (colour, turbidity – cloudiness) after heavy rainfall or snow melt?	H	L	H	-	8	-

D (iv) Overall risk assessment

(a) Risk characterisation

The overall risk assessment for the source is taken as the highest individual risk category identified from each of the two surveys.

The overall risk characterisation category will be recorded as the risk assessment score for the source.

Survey Section	Risk Characterisation Category
General Site Survey	HIGH
Source Survey	HIGH
Overall Risk	**HIGH**

(b) Hazard assessment

Individual components in each of the surveys with a hazard assessment score of 32 or greater should be considered as priority candidates for remedial works capable of reducing the overall risk characterisation category.

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