APPENDIX 12.3: CONCEPTUAL SITE MODEL

12.1 Introduction

Objectives

12.1.1 This appendix provides further information to support the conclusions presented in Chapter 12: Surface Water. The objective of this Conceptual Site Model (CSM) is to summarise and illustrate the source-pathway-receptor relationships that may exist between Borrow Pit C (BPC) and the private water supply PWS2 and therefore determine whether BPC may have an impact on the private water supply. BPC is located less than 250 m from PWS2 and, as a consequence, represents a potential risk to the private water supply based on guidance within SEPA's Land Use Planning System Guidance Note 31 (LUPS-GU31). The approach is based on a CSM under the guidance referred to LUPS-GU31. This appendix should be read in conjunction with Chapter 12: Surface Water.

12.1.2 Figures 12.2.1 and 12.2.2 illustrate the main components relevant to hydrogeological risk assessment for the area of interest.

12.2 Methodology

12.2.1 The following information has been used as the base to formulate the CSM:

- Geological map of the area from the British Geological Survey (BGS), Campbeltown, Sheet 12, 1:50,000 (BGS, 1996);
- Hydrogeological map of Scotland from the British Geological Survey, 1:625,000 (BGS, 1988);
- GeoIndex map from the British Geological Survey website;
- Historical OS map of Scotland from the National Library of Scotland website;
- Topography from the DTM (Digital Terrain Model);
- The drainage system;
- The catchment areas;
- A 3D view of the area with the software Google Earth Pro; and
- The observations and information gathered during the field survey carried out in March 2018.

12.2.2 The CSM presented below has been developed using professional judgment. It should be noted that the information available did not permit a purely quantitative approach to be adopted. Crucial data such as the potential existence and position of the collector system, the thickness of the geological layers and the detailed local groundwater flow direction are unknown at this stage. However, a semi-quantitative approach has been adopted to determine potential hydrogeological catchments areas that may contribute to PWS2.

12.3 Baseline Environmental Conditions

Geology and Hydrogeology

12.3.1 According to the geological map (BGS, 1996), the bedrock geology between and around BPC and PWS2 comprises a contiguous sequence of Stonefield Schists. For the most part the bedrock in mainly covered by till deposits, except toward the top of the hill, where it is covered by peat. The geological map of the area of interest is presented in Figure 12.2.1. Stonefield Schists are metamorphic rocks from the Precambrian period. The mapping suggests that the drift geology mostly comprises till from the late Devensian period with a minor area of BPC located on an area of peat cover. The peat depth contour map in Figure 11.6, based on peat probing data, suggests that the peat deposits are more extensive than indicated by the geological map (BGS, 1996) and that the area around BPC is mainly covered by a thin layer of peat (>0.5m). The BGS Hydrogeological

Map (BGS, 1988) shows the region as underlain by impermeable rocks, generally without groundwater except at shallow depth. In the Water Framework Directive (WFD) classifications, the Argyll Group, which includes the Stonefield Schists formation, is classed as a low productivity aquifer, which is characterised by a small amount of groundwater in near surface weathered zone and fractures. It is likely that the source acts as a groundwater discharge due to locally favourable characteristics in the geology, that are not evident, such as enhanced fractures in the bedrock and/or increased presence of gravel in the till. It is anticipated that the recharge to the groundwater system comes from immediate precipitation, part of which infiltrates through the ground, in this case peat or till, until reaching the groundwater table. The regional groundwater flow is expected to go toward the sea, however it can follow a different direction locally, depending on the geological variations and characteristics.

Characteristics of PWS2

12.3.2 According to the information gathered during the field survey through interview with the resident who uses PWS2, the mapped location is understood to comprise a collection tank for groundwater outflow from a system of collector pipes buried below ground. The groundwater flow mechanism and the layout of the collector system (if present) are believed to be shallow. This collection tank supplies two properties: Lagalgarve Farm and Tangytavil.

12.3.3 It is not known whether the source is fed by a discrete spring or the collector pipe system as purported. Assuming the source is fed by the latter arrangement the extent, depth and composition of the collector pipe network is unknown. The date of the implementation of the collector system (if existent) is unknown and is assumed to have been supplying water to the Lagalgarve property, which was built in 1900, for a long time. The precise chronology of installation of the collector system and the afforestation is unknown. The establishment of PWS2 as a source pre-dates the current occupants and potentially the forest around it.

12.3.4 The discharge outlet forming PWS2 is approximately 244 m from the proposed BPC. Assuming the pipe collector system exists (although its layout is unknown) it is possible that the pipes could be located, at least partly, within 250 m from BPC.

Drainage system and catchment area

12.3.5 In identifying the proposed Borrow Pit locations, search areas were initially studied and then subsequently refined to working areas which have been assessed and included within the scope of the application for consent (as set out in Chapter 5: Description of the Development). The area between BPC and PWS2 comprises three separate catchments of potential relevance. The three catchments are further considered in Table 12.2.2 and illustrated in Figure 12.2.1.

12.3.6 PWS2 is located in 'Catchment 1', very close to the division line with another catchment ('Catchment 2') as illustrated in Figure 12.2.1. The working area for BPC is located near the top of a hill, at the boundary of the surface water catchment areas annotated as Catchments 2 and 3 in Figure 12.2.1 and 12.2.2. Figure 12.2.2 gives an oblique aerial view of the site, showing relief, to illustrate the subdued topography between BPC and PWS2; i.e. the topography is relatively flat and a hydrogeological pathway may transect a subdued topographic divide.

Case scenarios

12.3.7 A number of potential source- pathway- receptor linkages could exist between BPC and PWS2. These potential linkages are described in Table 12.2.1 and presented as a range of plausible scenarios. These consider the possibility that the groundwater divide between catchments 1 and 2 may extend into catchment 2 and/or that PWS2 may incorporate a collector system.

12.3.8 Correspondingly, the possible areas of contribution for each scenario are presented in Table 12.3.2 and complemented by Figure 12.2.3. The collector system has been assumed to be approximately 75m long. The hydrogeological catchment areas that contribute to PWS2 or to the collector system

have been determined based on the geomorphology of the area and on our professional judgement.

12.3.9 Figures 12.2.1, 12.2.2 and 12.2.3 show the dog-leg projection of the hydrogeological cross section AA'. The cross-section AA' transects through PWS2 in catchment 1 and BPC in catchments 2 and 3. Profile AA' goes through the closest side of BPC relative to catchment 1, as it is the area that is most likely to generate an effect on PWS2.

12.3.10 Figure 12.2.4 presents a schematic representation of the potential hydrogeological linkage between BPC and PWS2 for each case scenario presented in Table 12.2.1. The source, receptors and pathways, in addition to the likely groundwater flow direction, are presented for each scenario. It should be noted that the thickness of the geological layers, in addition to the presence, extension and depth of the collector system are unknown. Pathways through saturated zones have the potential for impacts on quantity and quality of supply, however impacts on quality can also originate from the unsaturated zone.

Table 12.2.1: Case Scenarios

N°	Case Scenario	Potential Pollution Source	Potential Pathway	Potential Receptor	Potential effect / Mitigation
1	No collector system and no hydrogeological connection between BPC and PWS2. For example, a discrete spring source at the current source location.	Borrow Pit C	None	PWS2	No impact predicted No bespoke mitigation required
2	No collector system (for example a discrete spring source at the current source location) but source is hydro-geologically connected to BPC due to groundwater pathway/s crossing the divide between catchment 2 & 1 and extending far enough to intercept a flow path from BPC.		Unsaturated and saturated zones		Potential for adverse effects on quality and quantity of supply should the groundwater flow paths be disrupted. See below for mitigation.
3	Collector system and no hydrogeological connection between BPC and the source collector system. Although the collector system could extend into catchment 2 it does not extend far enough to intercept a flow path from BPC.		None		No impact predicted No bespoke mitigation required
4	Collector system sources are hydrogeologically connected to BPC due to the collector system extending into catchment 2 and/or groundwater pathway/s crossing the divide between catchment 2 & 1 and extending far enough to intercept a flow path from BPC.		Unsaturated and saturated zones		Potential for adverse effects on quality and quantity of supply should the groundwater flow paths be disrupted. See below for mitigation.

Table 12.2.2: Catchment Areas supplying PWS2 by scenario

Case scenario	Areas (m2)	Catchment 1	Catchment 2	Catchment 3
1	Area of catchment contributing to PWS2 (m^2)	41,332	0	0
	Total area contributing to PWS2 (m2)	41,332		
	Area of BPC working area within catchments (m^2)	0	16,315	3,685
	Area from BPC working area contributing to PWS2 (m^2)	0	N/A	N/A
	Contribution from BPC working area in relation to total area of contribution to PWS2 (%)	0%		

Table 12.2.2: Catchment Areas supplying PWS2 by scenario				
2	Area of catchment contributing to PWS2 (m^2)	41,332	16,548	0
	Total area contributing to PWS2 (m2)	57,880		
	BPC working area within catchments (m^2)	0	16,315	3,685
	Area from BPC working area contributing to PWS2 (m^2)	0	2,193	N/A
	Contribution from BPC working area in relation to total area of contribution to PWS2 (%)	4%		
3	Area of catchment contributing to the collector system	41,332	8,119	0
	Total area contributing to the collector system (m2)	49,451		
	BPC working area within catchments	0	16,315	3,685
	Area from BPC working area contributing to the collector system (m^2)	0	0	N/A
	Contribution from BPC working area in relation to total area of contribution to PWS2 (%)	0%		
4	Area of catchment contributing to the collector system	41,428	20,241	0
	Total area contributing to the collector system (m2)	61,669		
	BPC working area within catchments	0	16,315	3,685
	% of zone of contribution from BPC working area to collector system	0	4,767m^2	N/A
	Contribution from BPC working area in relation to total area of contribution to PWS2 (%)	8%		

12.4 Mitigation Measures and Monitoring

12.4.1 The applicant intends to identify a long-term sustainable solution for the PWS2 water supply. Therefore, post-consent the applicant will seek to establish the PWS users' current needs regarding water use and quantities. The applicant will seek the PWS users' input and support for any protection and/or mitigation measures relating to the PWS' infrastructure and will strive to maintain, if not improve, the current PWS water quality and quantity. The applicant accepts that the protection of the PWS to the satisfaction of SEPA and the PWS users will be required as part of the consent/pre-commencement Planning Condition. Any agreed protection and mitigation measures would be included in an updated post-consent / pre-construction CEMP, for example, an alternative temporary water supply may be made available for use from the outset and throughout the construction period, in case PWS2 be temporarily adversely affected.

12.4.2 The CEMP also specifies good practice monitoring measures in line with SEPA guidance LUPS-GU31[1]. As part of the water quality monitoring programme, monitoring of the PWS2 groundwater supply will be undertaken to assess whether the quality of groundwater and/or hydrological connectivity is being maintained, taking cognizance of Appendix 5 of the SEPA guidance LUPS-

[1] LUPS-GU31, Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, SEPA 2017.

GU31[2]: Monitoring will take place before, during and after construction; with timescales to be agreed with SEPA as part of a post-consent CEMP.

12.5 Conclusion

12.5.1 Depending on the hydrogeological connection between PWS2 and BPC, there is the potential for either 'no effect' or 'adverse effects' on quality and quantity of supply to this receptor. It should be recognised that there are data limitations, in particular, the unknown actual existence or extent of the collector pipe system (if present) sourcing groundwater for PWS2. Given the uncertainties regarding the potential hydrogeological connection between BPC and PWS2, it has been assumed that a hydrological linkage may exist and therefore mitigation is required. Liaison and discussion with PWS users post-consent, and further assessment of the PWS infrastructure will inform the most appropriate mitigation, in combination with a PWS monitoring programme to be agreed with the PWS users and SEPA. For example, provision of a temporary alternative water supply may be provided from the outset of any on-site works. It is anticipated that the requirement for relevant mitigation measures and monitoring, to be agreed with the PWS users and SEPA, would be secured via a suitably worded planning condition.

12.6 References

British Geological Survey (BGS) (1996), Campbeltown, Sheet 12, 1:50,000, Solid and Drift, Geological Survey of Scotland, 1:50,000 geological map series.

BGS (1988), 1:625,000, Hydrogeological Map of Scotland

SEPA (2017) LUPS-GU31, Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems

[2] The Monitoring of Infrastructure with Excavations Less than 1m Deep within 100m of Sensitive Receptors (Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystem), Appendix 5 to SEPA Planning Guidance LUPS-GU31, 2017

Figure 12.2.1: Geological map of the area of interest

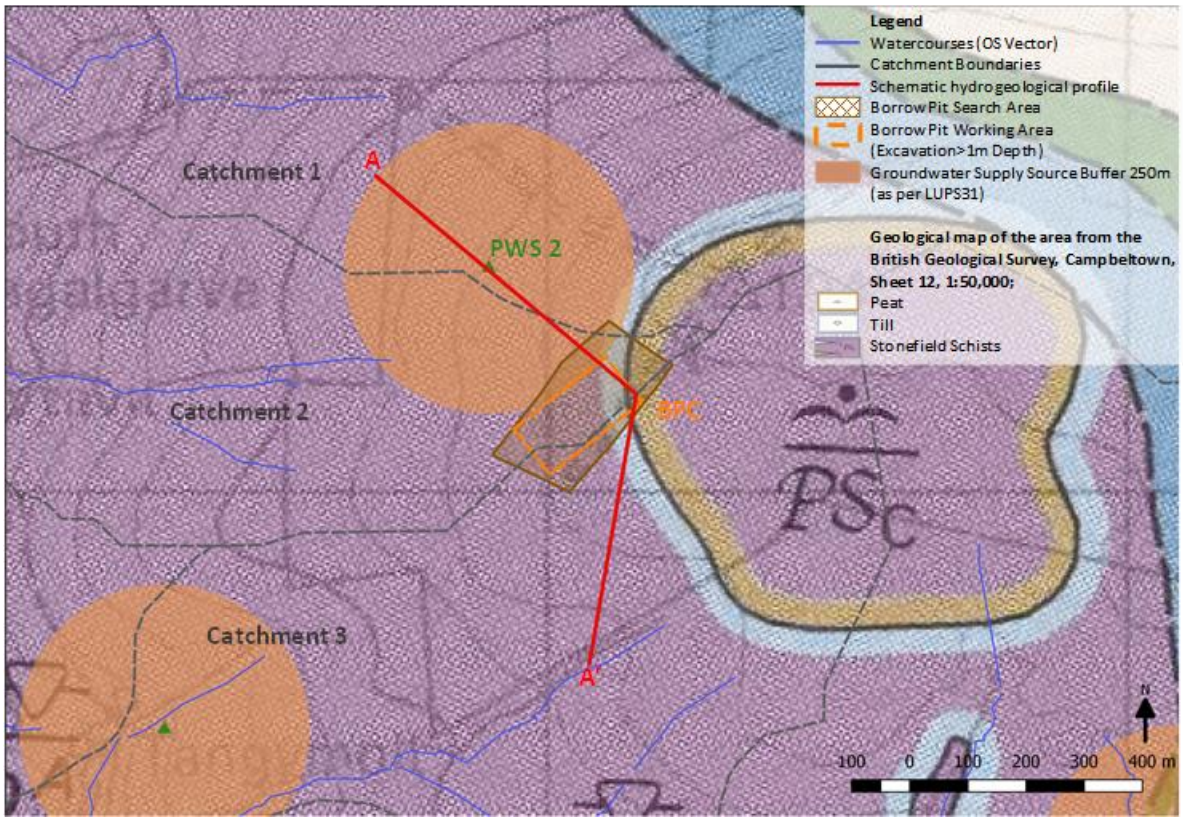


Figure 12.2.2: 3D view from Google Earth of the area of interest (elevation exaggeration:3)

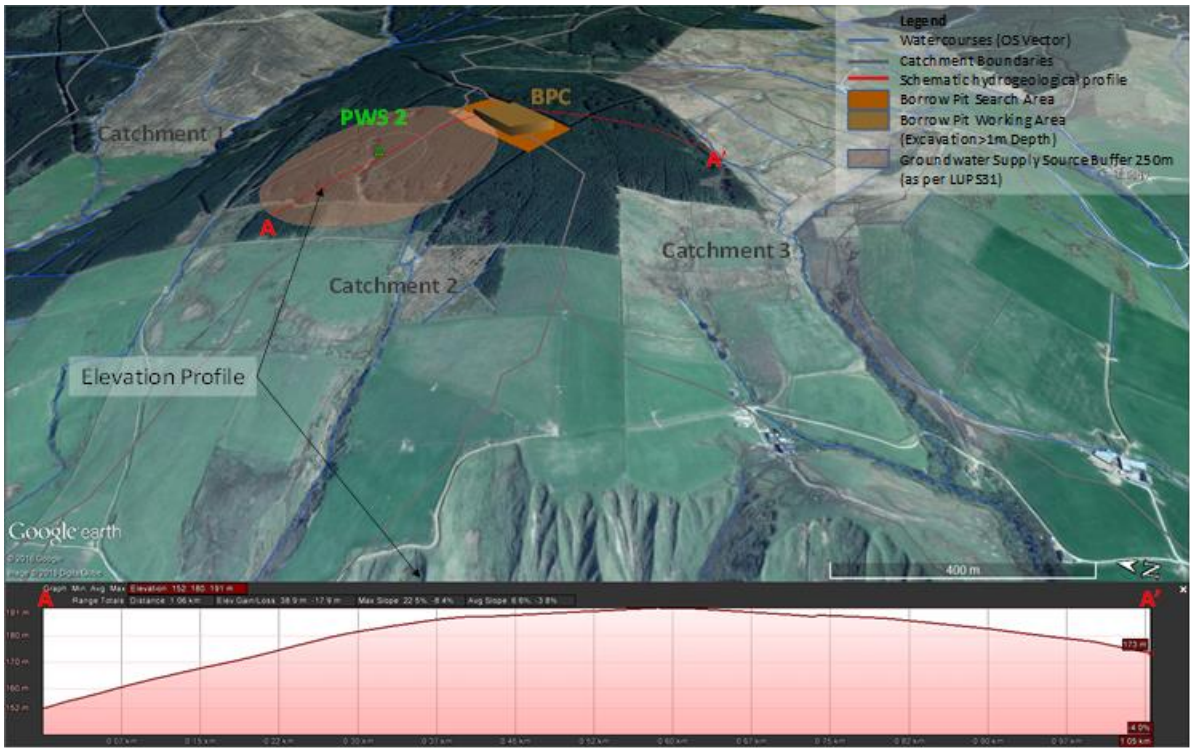


Figure 12.2.3: Hydrogeological catchment area contributing to PWS2 and/or to the collector system

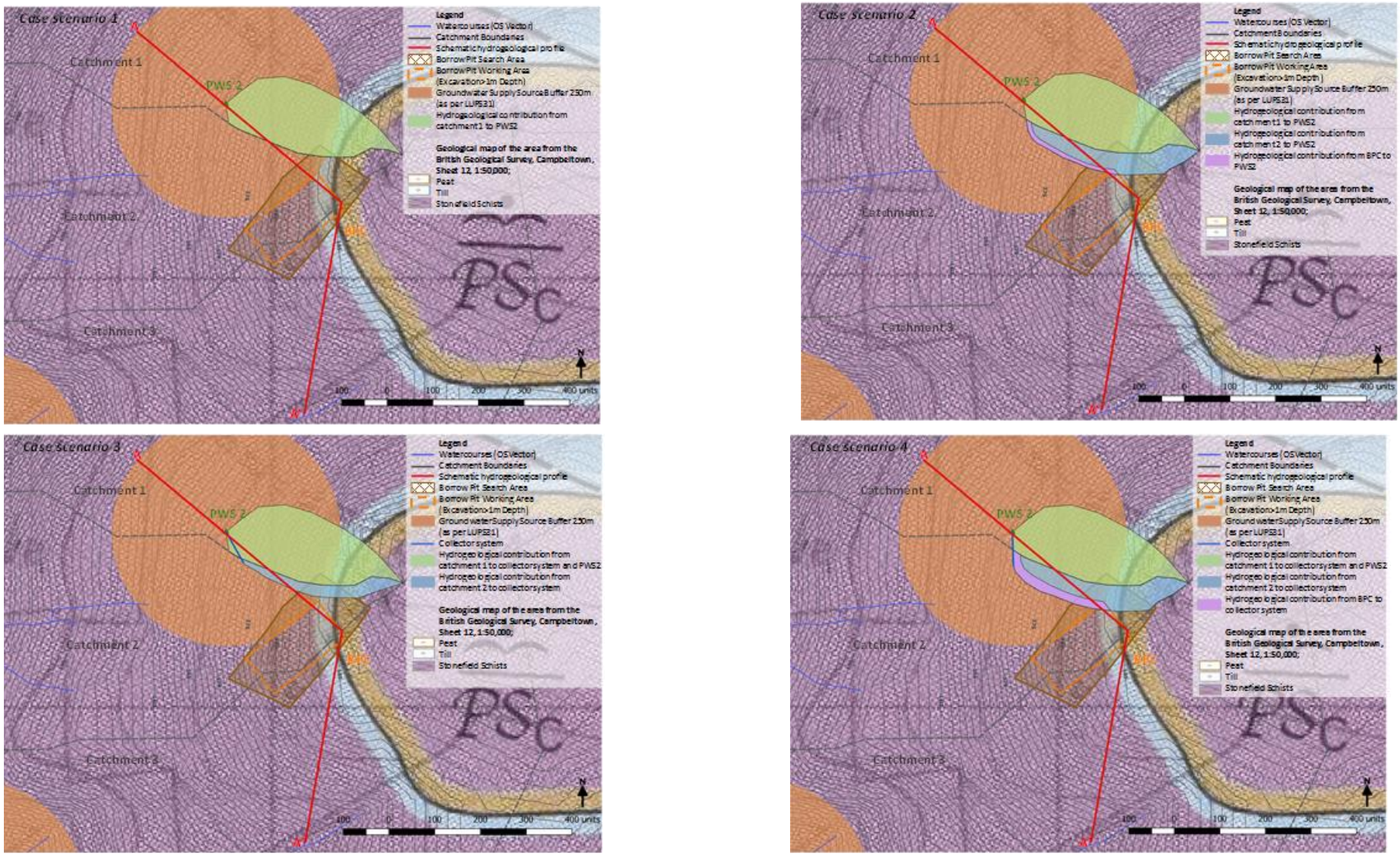
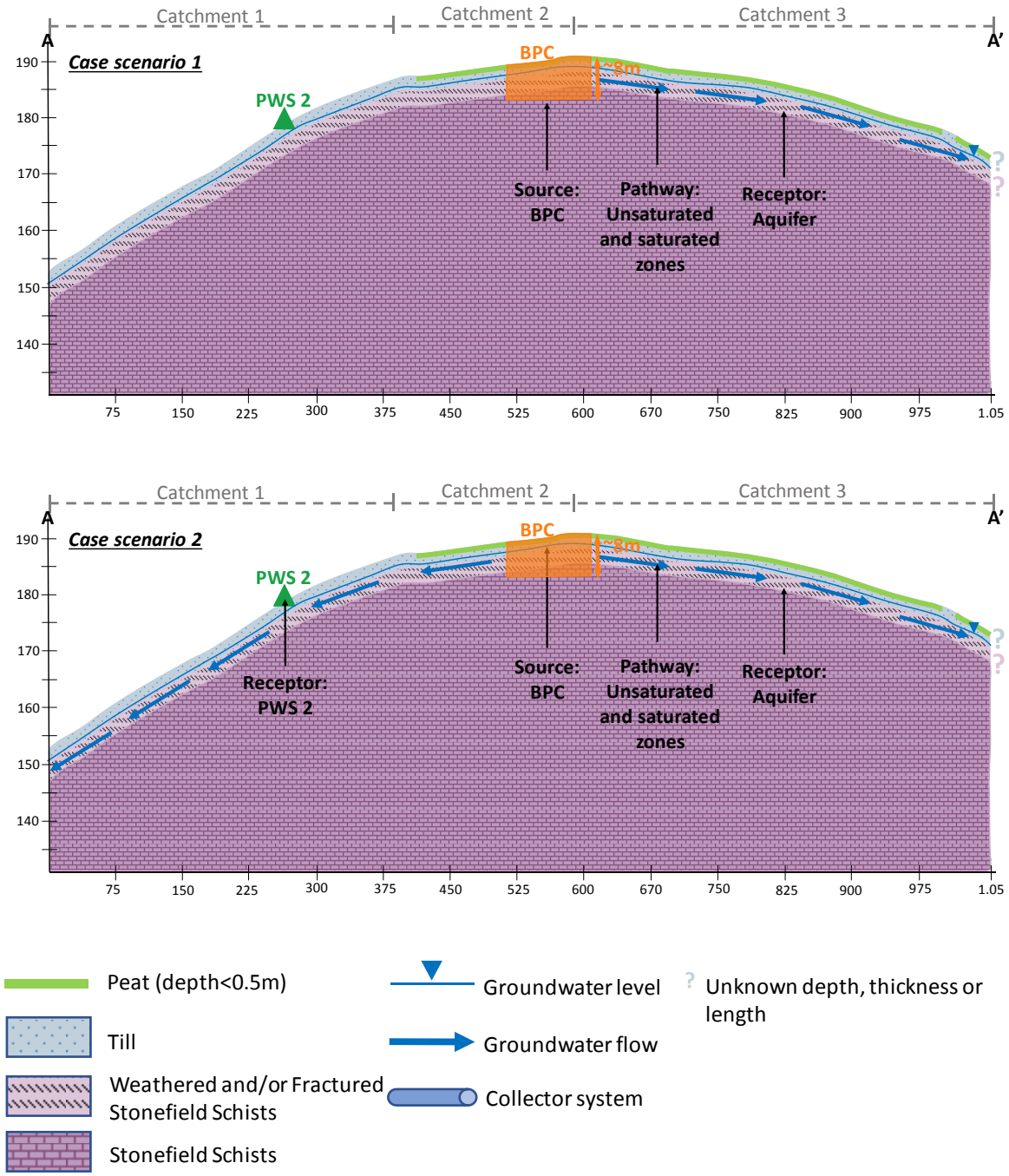
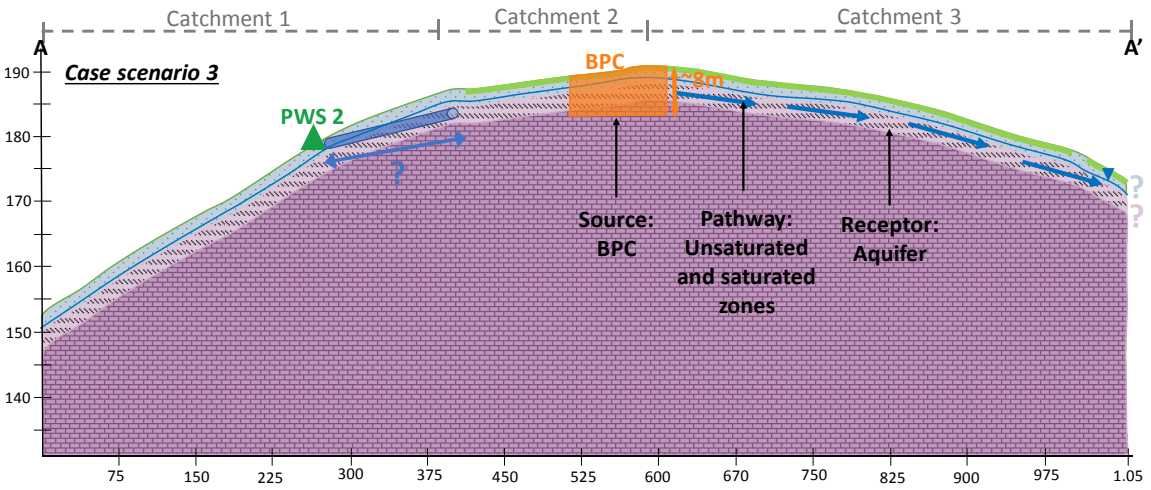
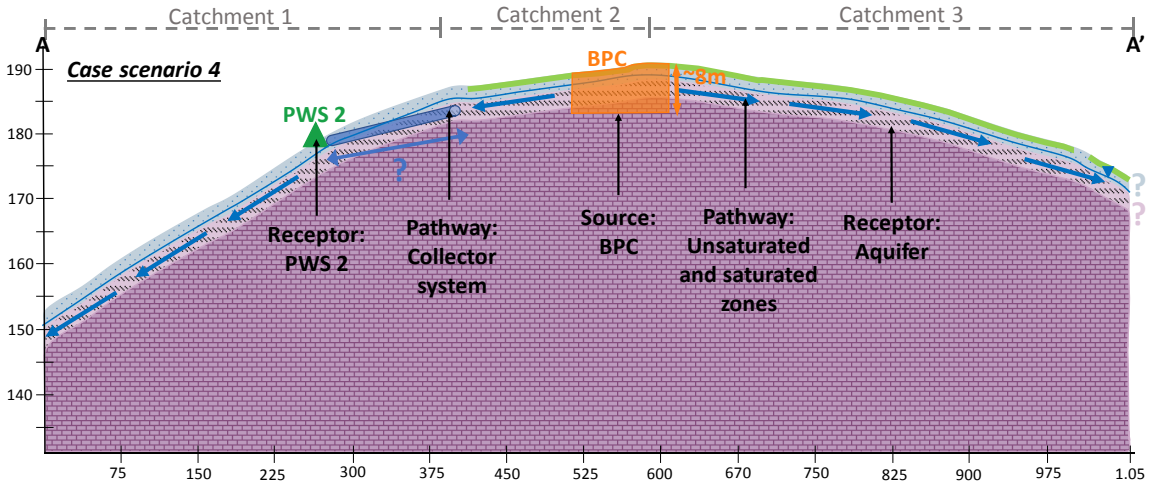
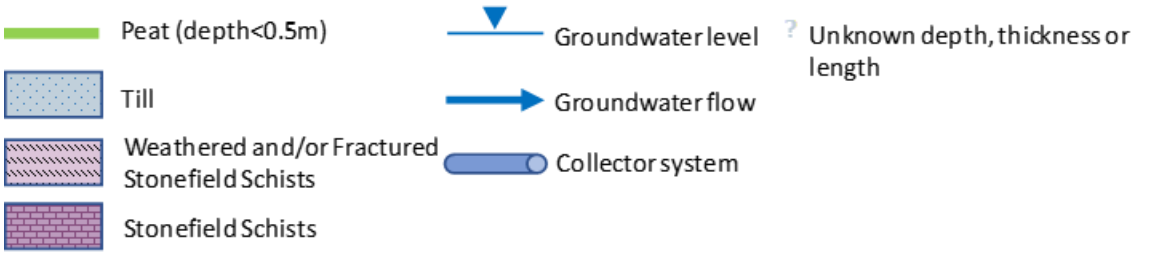


Figure 12.2.4: Cross section




Catchment 1
Catchment 2
Catchment 3
A
A'
Case scenario 3
BPC
~8m
PWS 2
Source: BPC
Pathway: Unsaturated and saturated zones
Receptor: Aquifer
190
180
170
160
150
140
75
150
225
300
375
450
525
600
670
750
825
900
975
1.05


Catchment 1
Catchment 2
Catchment 3
A
A'
Case scenario 4
BPC
~8m
PWS 2
Receptor: PWS 2
Pathway: Collector system
Source: BPC
Pathway: Unsaturated and saturated zones
Receptor: Aquifer
190
180
170
160
150
140
75
150
225
300
375
450
525
600
670
750
825
900
975
1.05


Peat (depth<0.5m)
Till
Weathered and/or Fractured Stonefield Schists
Stonefield Schists
Groundwater level
Groundwater flow
Collector system
Unknown depth, thickness or length