KAYA CONSULTING

Blackford Renewables Ltd

Blackford Energy Park, Rothienorman, Aberdeenshire

Private Water Supply Assessment

May 2025

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1 Introduction

A 500MW battery storage system (BESS) is proposed on land near the existing Rothienorman Substation (**Figure 1**) within the Aberdeenshire Council Area.

Kaya Consulting Limited was commissioned by Blackford Renewables Ltd to undertake a private water supply (PWS) assessment for the area surrounding the proposed development site.

The proposed development site is located adjacent to the Wood of Middleton, ~2km to the west of the village of Rothienorman, and immediately to the east of Rothienorman Substation. The total area of the site, including proposed and existing access routes is 16ha.

The aim of this report is to identify and assess potential effects of the proposed development on groundwater abstractions, including PWS in the vicinity of the site.

In 2024 the Scottish Environment Protection Agency (SEPA) produced *Guidance on Assessing the Impacts of Developments on Groundwater Abstractions*[1] that specifies that appropriate buffer zones should be in place to ensure both temporary and permanent works have no impact on PWS or groundwater abstractions. These buffer zones are specified as 100m for excavations/intrusions less than 1m depth and 250m for excavations/intrusions more than 1m depth. If these buffer distances cannot be achieved, a detailed site-specific assessment of effects on each PWS or groundwater abstraction is required as per SEPA guidance. No development should occur within a buffer radius of 10m of any PWS.

[1] *Guidance on Assessing the Impacts of Developments on Groundwater Abstractions (2024): https://www.sepa.org.uk/media/ijwd3q0y/guidance-on-assessing-the-impacts-of-developments-on-groundwater-abstractions.docx*

Figure 1: General Site Location

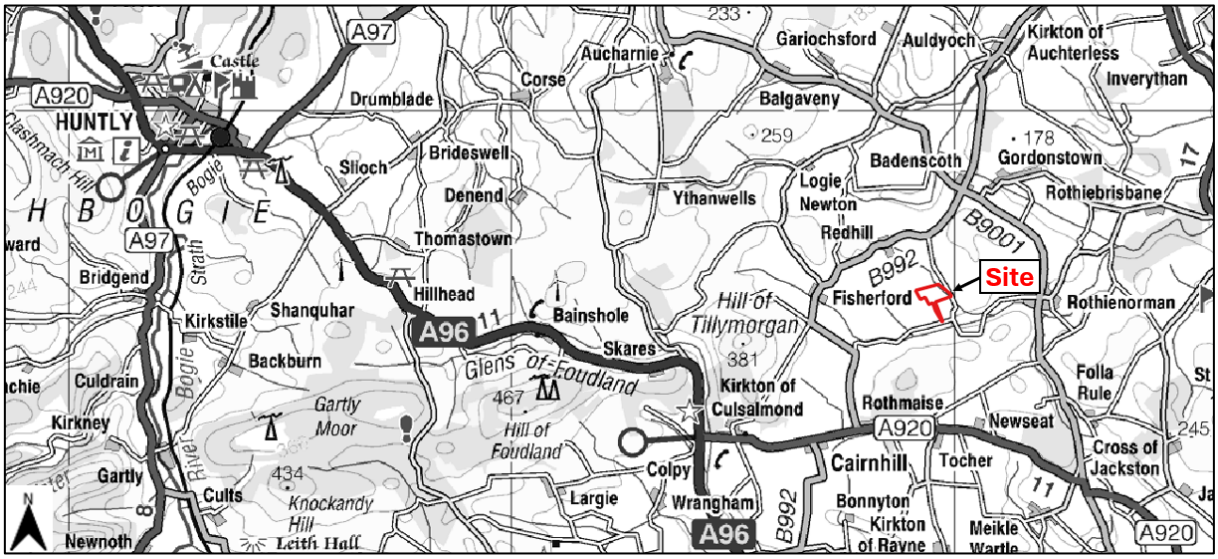
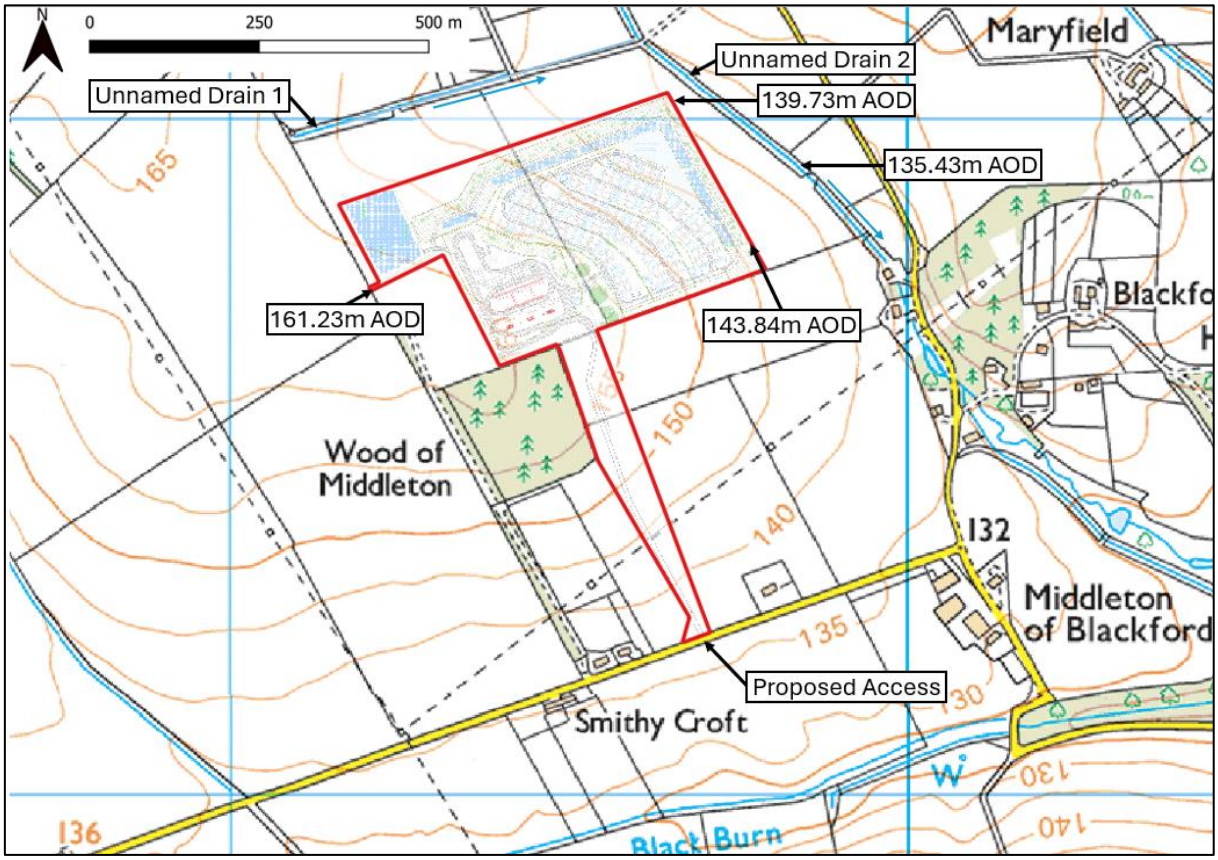


Figure 2: Detailed Site Location



2 Site Information

2.1 Site Description

Figure 2 above shows the site and surrounding area in more detail. The site is bounded by Rothienorman Substation to the west, Wood of Middleton to the south and agricultural land to the north and east. The proposed access is by a new track off the unnamed road to the south.

The proposed development is for battery storage and will comprise a main platformed area where the batteries and district network operator switchgear will be situated, along with a new gravel access track to the east. An existing access track to the south of the site also lies within the redline boundary.

The proposed drainage of the main site compound and southern access track is using infiltration trenches, minimising the impact of the development on local drainage pathways while ensuring runoff from the site is attenuated and treated to a satisfactory standard.

2.2 Site History

Detailed historical mapping of the site from the National Library of Scotland (dating from 1888 to the present day) was viewed and indicates the site comprised agricultural land throughout the past ~140 years. The available mapping indicates the presence of a ‘well’ at Smithy Croft, to the southwest of the site, a ‘well’ to the north of the site at Westfield Croft and the presence of a ‘pump’ at Kinivie Cottage to the south. No further water features of note are shown in the immediate vicinity of the site.

2.3 Site Topography

Based on provided topographic survey the site slopes to the east, with ground levels falling 25.26m from a high point of 161.23m AOD (Above Ordnance Datum) in the south-west, to a low point of 139.73m AOD in the east at a relatively steady slope of 0.05 (around 1 in 20). The site access slopes in a southerly direction.

2.4 Geology & Hydrogeology

The underlying geological conditions of the site were determined through a review of information obtained from the British Geological Survey. The site area is recorded to be underlain by superficial deposits of Devensian Till comprising clays, silts and gravels. Beneath these superficial deposits, the site is recorded to be underlain by Micaceous Psammite, Semipelite and Pelite of the MacDuff Formation, these are metamorphosed sedimentary rocks.

The 1988 Hydrogeological Map of Scotland (1:625,000 Scale) shows that the underlying Precambrian rocks are generally impermeable except at shallow depths. The crystalline basement is considered to offer little potential for groundwater storage and transport other than in cracks and joints which may be associated with tectonic features or near surface weathering. Groundwaters emanating from springs are generally weakly mineralised, although bicarbonate concentrations may attain 120mg/l.

The SEPA interactive Water Environment Hub indicates the Ellon groundwater body (ID 150676) underlies the Site with an overall classification of Poor. The groundwater body has an area 507.4 km^2 and is known to be exploited locally for private potable and agricultural supply.

2.5 Hydrology

Two unnamed drains lie in the vicinity of the site. These are illustrated in **Figure 2**.

Unnamed Drain 1 flows east to the north of the site towards Unnamed Drain 2.

Unnamed Drain 2 flows south-east to the east of the site towards the Black Burn.

The Black Burn lies 220m to the south of the site access. This watercourse is identified as having an overall water classification of Moderate on the SEPA interactive Water Environment Hub.

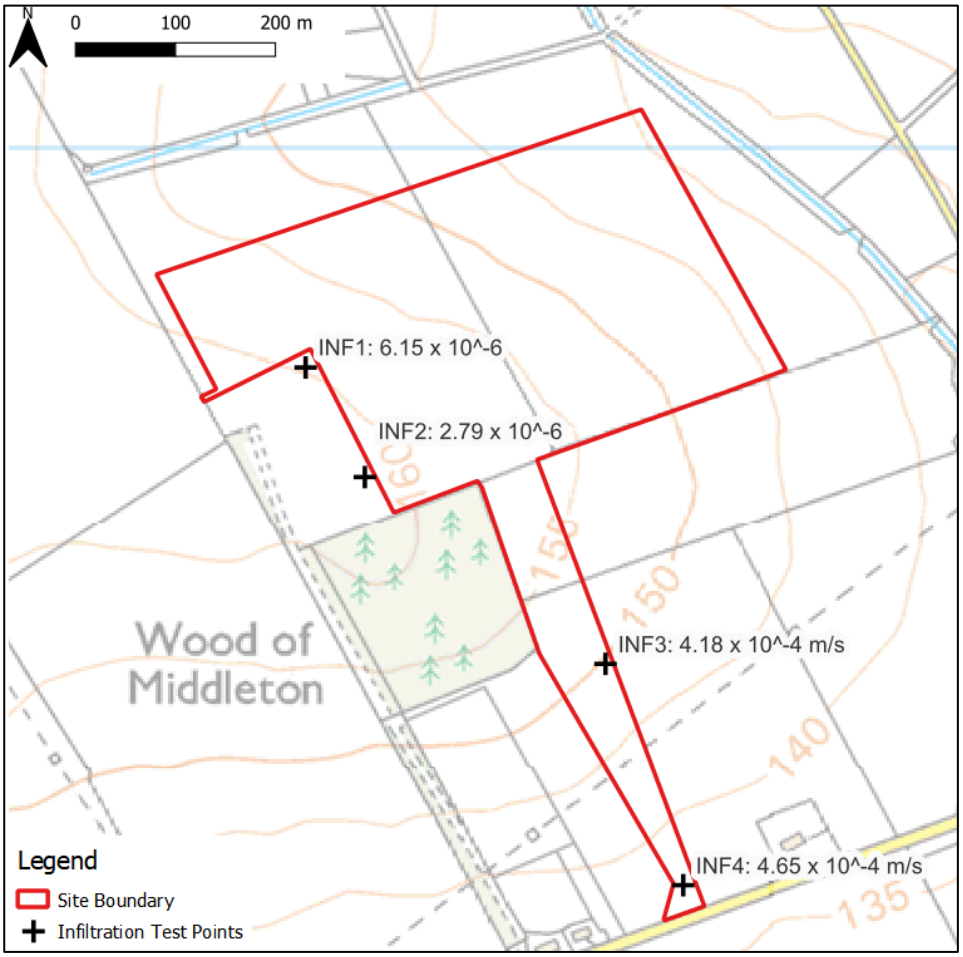
2.6 Available Ground Investigation Information

Infiltration testing was conducted by Raeburn Drilling and Geotechnical Ltd. at two points adjacent to the proposed site compound and two points along the proposed track (**Figure 3**).

The trial pits encountered generally consistent ground conditions across the site. Underlying uppermost topsoil, which was encountered to a depth of 0.25cm at all exploratory locations, deposits largely comprised weathered rock, which became increasingly competent with depth. Trial pits terminated in weathered bedrock (pelite) at depths of between 1.70m (INF1) and 2.50m (INF2/ INF3/ INF4).

Groundwater inflows were not observed during any of the excavations undertaken.

Figure 3: Infiltration Testing Locations



2.7 Private Water Supplies and Groundwater Abstractions

There is no known Scottish Water supply within 500m of the site boundary.

Aberdeenshire Council provided their PWS records for properties in the area.

Questionnaires were sent to all the properties within 500m of the site on the 11th of February to establish the details of their private water supplies. This was followed up with a site visit on Friday the 7th of March where those properties who had not responded were visited to establish the necessary details. Where necessary, properties were visited on two separate occasions throughout the day.

Several residents did not respond to the questionnaire and would not discuss their PWS when visited. In the absence of information on the PWS source location the coordinates of the supply property was used instead.

Table 1 below lists all known PWS within 500m of the site. It should be noted that PWS10 and PWS11 lie slightly outwith the 500m buffer but supply properties which lie within 500m of the site. The PWS locations are also illustrated in **Figure 4** with 100m and 250m buffers shown.

PWS7 is within 100m of the site, while PWS1, PWS2 and PWS3, PWS4, PWS5, PWS6 and PWS13 lie within 250m of the site. Following SEPA (2024) guidance the effect of the proposed development on these abstractions requires further investigation.

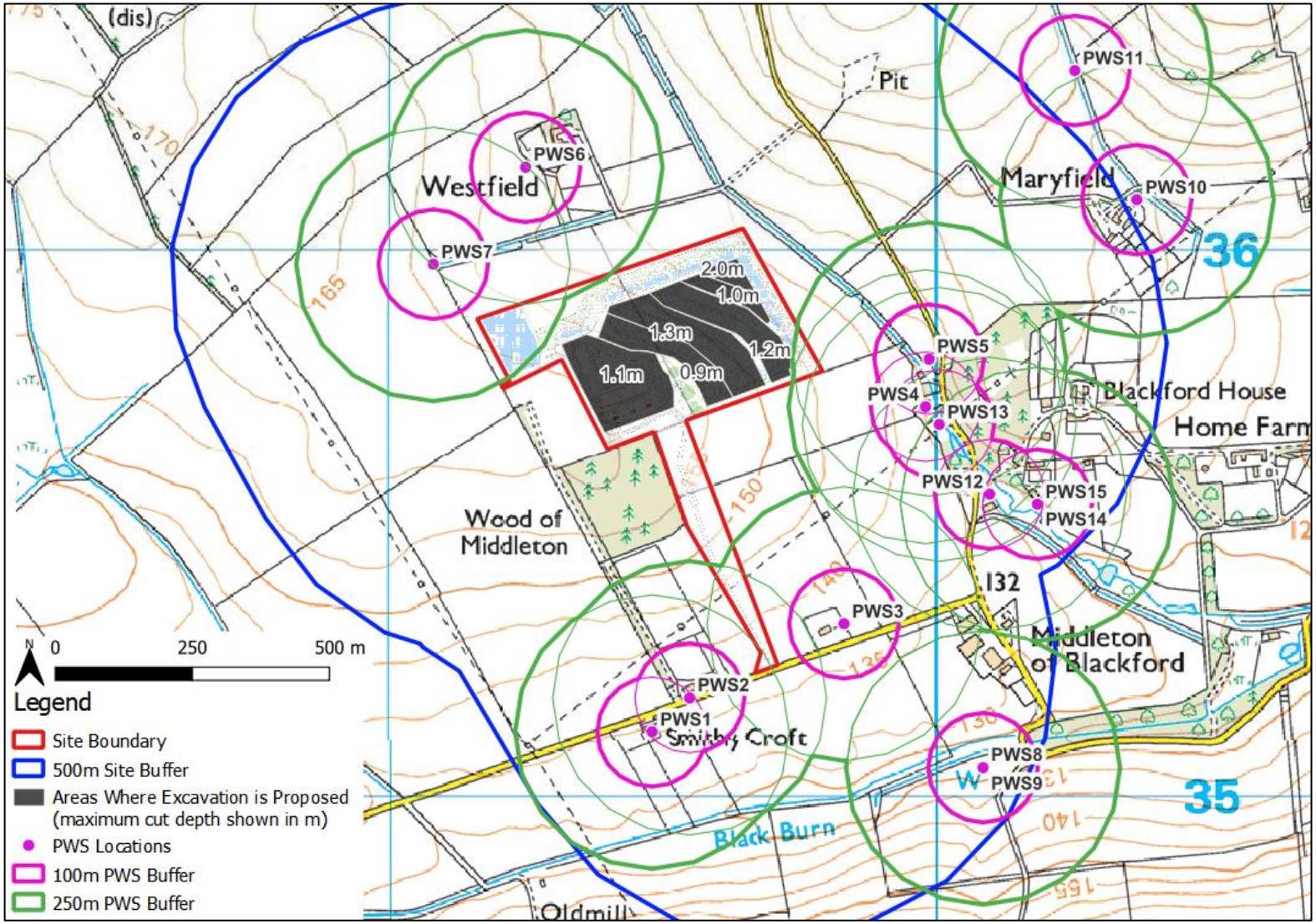
PWS8, PWS9, PWS10, PWS11, PWS12, PWS14 and PWS15 all lie >250m from the site and will not be considered further in the assessment.

Table 1: Private Water Supplies Within 500m of the Site

Name	Grid Reference	Supply Address	PWS Type	End User	Distance from Site Boundary	Notes
PWS1	369480, 835120	Smithy Croft	Borehole	Domestic	215m	Information was available in recent PWS assessment for neighbouring substation.
PWS2	369549, 835182	Kininvie	Well	Domestic & Livestock	129m	Landlord did not respond. Resident showed the location of the well on visit but could provide no further details.
PWS3	369830, 835317	Middleford Grange	Borehole	Domestic	139m	70ft deep borehole with consistent high quality supply.
PWS4	369979, 835713	The Firs	Unknown	Domestic	200m	Resident did not respond. It is possible that this property shares a well with PWS5 adjacent. However, this could not be confirmed. Site observations indicate no well is present in the fields to the west of the property. Coordinates of supply property provided in the Council records have been used in the absence of further information.
PWS5	369986, 835800	Glenhead	Well	Domestic	197m	Well visible to the east of the property. Resident did not respond so details are assumed based on this observation.
PWS6	369250, 836150	Westfield Croft	Borehole	Livestock	233m	Information was available in recent PWS assessment for neighbouring substation.
PWS7	369081, 835971	Westfield Croft	Spring Fed Tank	Domestic & Livestock	128m	Tank and well observed on visiting the site. Further information was available in recent PWS assessment for neighbouring substation.
PWS8	370084, 835054	Middleton of Blackford	Well	Domestic	419m	Shares supply with PWS9.

PWS9	370084, 835054	Middleton House Blackford	Well	Domestic	419m	Shares supply with PWS8.
PWS10	370365, 836091	Maryfield of Blackford	Well	Domestic	653m	Supply property within 500m buffer – supply outwith.
PWS11	370252, 836327	Blackford House	Well	Domestic	670m	Supply property within 500m buffer – supply outwith.
PWS12	370096, 835554	Hillview Blackford	Well	Domestic	380m	Resident notes excellent supply with no quality or quantity issues.
PWS13	370004, 835681	Gowanbank Blackford	Well	Domestic	235m	Resident notes supply can run low during hot weather.
PWS14	370183, 835535	Burnside of Blackford	Well	Domestic & Livestock	460m	Resident notes supply can run out during dry summer weather. Must be used sparingly. They also note the burn adjacent to the site is used to water their livestock.
PWS15	370183, 835535	Blackford Lodge	Well	Domestic & Livestock	460m	Shares supply with PWS14.

Figure 4: PWS Locations – Proposed Maximum Excavation Depths in Site Shown



3 PWS Assessment

As identified in **Section 2.7**, eight PWS are within 250m of the site red line boundary and, therefore, will be assessed in accordance with SEPA (2024) Guidance on Assessing the Impacts of Development on Groundwater Abstractions. These are PWS2 and PWS3, PWS4, PWS5, PWS6, PWS7 and PWS13 as illustrated in **Figure 4**.

3.1 Methodology

A site-specific qualitative risk assessment of each PWS was carried out based on the available data on local geology, hydrology and hydrogeological regime at each location. There is no available data on sub-surface flows and in the absence of data, it is considered that the movement of sub-surface water is primarily driven by topography.

Topographical survey of the site, photogrammetry derived DTM data of the wider area and OS contour data were analysed in QGIS to determine the direction of dominant flow pathways in the surrounding area. In the absence of data on groundwater levels and flow paths, analysis of topography and surface water flows paths were used to infer hydrological and hydrogeological connectivity to the project infrastructure.

The assessment of the impact on a groundwater flow path is made with reference to distance, slope, aspect, typical water table levels and features such as watercourses. This assessment is made with imperfect knowledge of the exact extent that a particular impact may have on specific sub-surface flow paths. As such, it takes a precautionary approach using the available information.

Two specific aspects are considered in the assessment. One is the likelihood of an impact upon a flow path feeding an area of groundwater. The second aspect is the likelihood that an area of groundwater may be drained at an unnaturally fast rate following the introduction of drainage for infrastructure/access tracks.

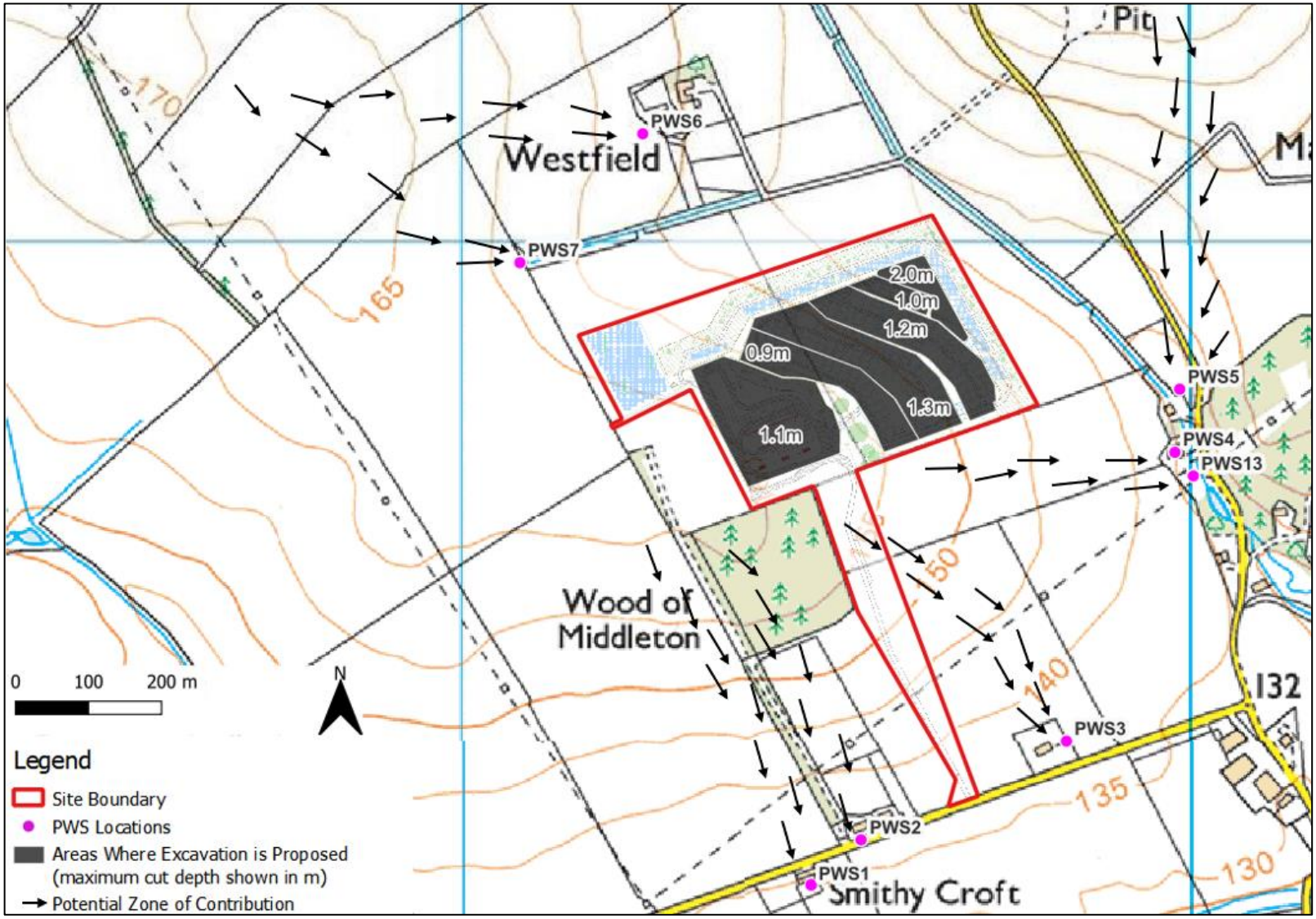
3.2 Proposed Excavations

The SEPA guidance for assessing the effects of development on groundwater abstractions recommends a 250m buffer zone for all excavations deeper than 1m and a 100m buffer for excavations less than 1m deep. A 10m buffer from PWS sources is recommended for all activities.

The proposals include undertaking cut and fill across portions of the main site compound to give level working platforms. Proposed maximum excavation depths are shown in **Figure 4** and range between 0.9m and 2.0m.

The new access track to the south will be of gravel construction requiring minimal excavation depths of up to 1m to allow for the installation of infiltration trenches for drainage.

Figure 5: Potential Zones of Contribution for PWS <250m from Site



3.3 PWS1 – Smithy Croft

The source of the Smithy Croft PWS is a well and the PWS supplies a domestic property. The location is shown in **Figure 5**. PWS1 is located ~525m from the main site compound and ~215m from the new access track. The depth of the well is unknown at the time of writing.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS1 is expected to extend principally in a north-westerly direction to the local high point at the southern corner of the main site compound. To the north of this topographical high, the ground slopes to the north-east and it is expected that groundwater flow paths from the main site area do not supply PWS1. The nearest platformed area of the site (where maximum proposed excavation depth is 1.1m) is ~550m away from the PWS and sits at a ground elevation of ~160m AOD. The PWS borehole is at a ground elevation of ~135m AOD, some 25m below the nearest area of excavation in the main site compound. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS2.

The proposed access track will require minor excavation (≤1m); however, it lies ~215m from PWS2 and outwith the potential zone of contribution to the PWS. Therefore, the construction of the new track is not anticipated to influence PWS2.

3.4 PWS2 – Kininvie

The source of the Kininvie PWS is a well and the PWS supplies a domestic property. The location is shown in **Figure 5**. PWS2 is located ~480m from the main site compound and ~129m from the new access track. The depth of the well is unknown at the time of writing.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS2 is expected to extend principally in a north-westerly direction to the local high point at the southern corner of the main site compound. To the north of this topographical high, the ground slopes to the north-east and it is expected that groundwater flow paths from the main site area do not supply PWS2. The nearest platformed area of the site (where maximum proposed excavation depth is 1.1m) is ~480m away from the PWS and sits at a ground elevation of ~160m AOD. The PWS borehole is at a ground elevation of ~136m AOD, some 24m below the main compound. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS2.

The proposed access track will require minor excavation (≤1m); however, it lies ~129m from PWS2 and outwith the potential zone of contribution to the PWS. Therefore, the construction of the new track is not anticipated to influence PWS2.

3.5 PWS3 – Middleford Grange

The source of the Middleford Grange PWS is a borehole and the PWS is recorded as supplying a domestic property. The location is shown in **Figure 5**. PWS3 is located ~450m from the main site compound and ~139m east of the new access track. The resident notes the well to be 70ft deep (21m).

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS3 is expected to extend principally in a north-westerly direction to the southern corner of the main site compound. To the north of this topographical high, the ground slopes to the north-east away from PWS3 and groundwater flow paths from the main site compound are not expected to supply PWS3. The nearest platformed area of the site (where maximum proposed excavation depths is 1.1m) is ~460m away from the PWS and sits at a ground elevation of ~160m AOD. The PWS borehole is at a ground elevation of ~137m AOD, some 23m below the main compound. The resident notes the depth of the well to be 70ft (21m) deep and the supply aquifer is therefore situated ~40m below the site at this location. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS3.

The proposed access track lies ~139m from the PWS and bisects its zone of contribution. The construction of this track will require minor excavation (≤1m). As it lies >100m from the PWS, construction of the new track is not anticipated to influence PWS3, as the proposed excavation depths are minor and the supply borehole is noted to be ~21m deep.

3.6 PWS4 – The Firs

The location of the source of PWS4 at The Firs is unclear as the residents did not respond to the questionnaire or come to the door when visited. Site observations indicate there are no PWS wells located in the field to the west of the property or within the redline boundary of the site. It is possible that The Firs shares a supply with the neighbouring property (Glenhead - PWS5), however, without further information the assessment assumes supply is located at the property (coordinates provided by Aberdeenshire Council). This location is shown in **Figure 5**. The assumed location of PWS4 is ~200m from the main site compound and ~418m from the new access track. The depth of the well is unknown at the time of writing.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS4 is expected to extend principally in a westerly direction. To the north of this zone of contribution, the ground slopes to the north-east and it is expected that groundwater flow paths from the main site area do not supply PWS4. The nearest platformed area of the site (where maximum proposed excavation depth is 1.2m) is ~260m away from the assumed location of the PWS and sits at a ground elevation of ~147m AOD. The assumed location of the PWS is at a ground elevation of ~139m AOD, some 8m below the nearest proposed area of excavation. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity to PWS4.

The proposed access track will require minor excavation (≤1m); however, it is ~418m from the assumed location of PWS4 and outwith the potential zone of contribution to the PWS. Therefore, the construction of the new track is not anticipated to influence PWS4.

3.7 PWS5 – Glenhead

The source of the Glenhead PWS is a well and the PWS supplies a domestic property. The location is shown in **Figure 5**. PWS5 is located ~197m from the main site compound and ~450m from the new access track. The depth of the well is unknown at the time of writing.

PWS5 lies on the eastern bank of the watercourse which runs along the eastern boundary of the site. As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS5 is expected to extend principally in a northerly direction to a local high point. As PWS5 lies on the opposite bank of the watercourse from the site, the area proposed for development is unlikely to lie within this supply's zone of contribution. The nearest platformed area of the site (where maximum proposed excavation depth is 1.2m) is ~255m away from the PWS and sits at a ground elevation of ~147m AOD. The PWS borehole is at a ground elevation of ~135m AOD, some 12m below nearest area of excavation. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS5.

The proposed access track will require minor excavation (≤1m); however, it is ~450m from PWS5 and outwith the potential zone of contribution to the PWS. Therefore, the construction of the new track is not anticipated to influence PWS5.

3.8 PWS6 – Westfield Croft

PWS6 is one of two PWS at Westfield Croft and supplies both domestic property and livestock. The location of this well is shown in **Figure 5.** PWS6 is located ~233m from the main site compound and ~520m from the new access track. The depth of the well is unknown at the time of writing.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS6 is expected to extend principally in a westerly direction. The nearest platformed area of the site (where maximum proposed excavation depth is 1.3m) is ~295m away from the PWS and sits at a ground elevation of ~152m AOD. The PWS well is at a ground elevation of ~152m AOD, similar to the nearest proposed area of excavation within the development. However, the site lies well outwith the PWS zone of contribution. As illustrated by the 5m contours in **Figure 5**, groundwater flows from the main site compound would flow north-east away from PWS6, which lies north-west relative to the site. It is therefore considered highly improbable that proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS6.

The proposed access track lies ~520m from PWS and is outwith the PWS natural zone of contribution on the other side of the hill on which the site is built. Therefore, construction of the new track is not anticipated to have an effect on PWS6.

3.9 PWS7 – Westfield Croft

PWS7 is one of two PWS at Westfield Croft and supplies both domestic property and livestock. The location of this spring fed tank is shown in **Figure 5.** PWS7 is located ~128m from the main site compound and ~540m from the new access track.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS7 is expected to extend principally in a north-westerly direction. The nearest platformed area of the site (where maximum proposed excavation depth is 1.1m) is ~275m away from the PWS and sits at a ground elevation of ~156m AOD. The PWS is at a ground elevation of ~158m AOD. The proposed excavation within the site lies well outwith the PWS zone of contribution. As illustrated by the 5m contours in **Figure 5**, groundwater flows from the main site compound would flow north-east away from PWS7, which lies north-west relative to the proposed development. It is therefore considered highly improbable that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS7.

The proposed access track lies ~540m from PWS and is outwith the PWS natural zone of contribution on the other side of the hill on which the site is built. Therefore, construction of the new track is not anticipated to have an effect on PWS7.

3.10 PWS13 – Gowanbank

The source of the Gowanbank PWS is a well and the PWS supplies a domestic property. The location is shown in **Figure 5**. PWS13 is located ~235m from the main site compound and ~420m from the new access track. The depth of the well is unknown at the time of writing.

As illustrated in **Figure 5**, based on analysis of surface water flow paths, the potential zone of contribution feeding groundwater to PWS13 is expected to extend principally in a westerly direction. The nearest platformed area of the site (where maximum proposed excavation depth is 1.2m) is ~280m away from the PWS and sits at a ground elevation of ~147m AOD. The PWS well is at a ground elevation of ~132m AOD, some 15m below nearest area of excavation. The platformed areas lie outwith the PWS13 potential zone of contribution. It is therefore considered highly unlikely that the proposed excavations of up to 2m at the main compound would have an effect on groundwater quality or quantity from the well at PWS13.

The proposed access track lies around 420m from the PWS and lies within the upper portion of its zone of contribution. This portion of the proposed track lies ~25m higher than the ground levels at PWS13. The construction of this track will require minor excavation (≤1m). As it lies >250m from PWS, construction of the new track is not anticipated to influence PWS13.

3.11 Summary

Table 2 below provides a summary of the assessed effects of the proposed development on the supplies within 250m of the site boundary and outlines any mitigation measures proposed.

Table 2: Private Water Supplies Within 250m of the Site – Assessed Impact and Mitigation

Name	Supply Address	Summary of Assessment	Mitigation	Effect
PWS1	Smithy Croft	The proposed access track will require minor excavation (≤1m); however, it lies ~215m from PWS1 and outwith the potential zone of contribution to the PWS.	No mitigation required.	No effect.
PWS2	Kininvie	The proposed access track will require minor excavation (≤1m); however, it lies ~129m from PWS2 and outwith the potential zone of contribution to the PWS.	No mitigation required.	No effect.
PWS3	Middleford Grange	The proposed access track lies around 139m from the PWS and bisects its zone of contribution. The construction of this track will require minor excavation (≤1m). As it lies >100m from the PWS, construction of the new track is not anticipated to influence PWS3, as the proposed excavation depths are minor and the supply borehole is noted to be ~21m deep.	No mitigation required.	No effect.
PWS4	The Firs	The nearest proposed area of excavation lies >250m from this PWS and the development lies outwith this supply's potential zone of contribution.	No mitigation required.	No effect.
PWS5	Glenhead	The nearest proposed area of excavation lies >250m from this PWS and the development lies outwith this supply's potential zone of contribution.	No mitigation required.	No effect.
PWS6	Westfield Croft	The nearest proposed area of excavation lies >250m from this PWS and the development lies outwith this supply's potential zone of contribution.	No mitigation required.	No effect.
PWS7	Westfield Croft	The nearest proposed area of excavation lies >250m from this PWS and the development lies	No mitigation required.	No effect.

		outwith this supply's potential zone of contribution.		
PWS13	Gowanbank Blackford	Proposed access track is within the zone of contribution of this PWS. Excavation depths on the proposed access track will be limited to ≤1m. As it lies >250m from PWS, construction of the new track is not anticipated to influence PWS13.	No mitigation required.	No effect.

4 Conclusions

Kaya Consulting Limited was commissioned by Blackford Renewables Ltd to undertake a private water supply (PWS) assessment for the area surrounding the proposed development site.

SEPA (2024)[2] specifies that appropriate buffer zones should be in place around infrastructure to ensure the development has no impact on PWS or groundwater abstractions. These zones are specified as 100m for excavations/intrusions less than 1m depth and 250m for excavations/intrusions more than 1m depth. If these buffer distances cannot be achieved, a detailed site-specific assessment of effects on each PWS or groundwater abstraction is required as per SEPA guidance.

The assessment identified eight private water supplies within 250m of the development's boundary. No supplies were found within 100m of new excavation.

Ground investigations at the site encountered solid bedrock at depths between 1.7m and 2.5m. Groundwater inflows were not observed during any of the excavations undertaken.

The proposed maximum excavation within the main site compound is 2m. No PWS lie within 250m of proposed excavation >1m within the main site area. The available topographical data indicate that flow pathways from the main site compound run in a north-easterly direction away from all eight PWS within 250m of the site boundary.

The proposed access track lies around 139m from PWS3 and bisects its zone of contribution. The construction of this track will require minor excavation (≤1m). As it lies >100m from the PWS, construction of the new track is not anticipated to influence PWS3. The proposed track also lies within upper portion of PWS13 potential zone of contribution. This portion of the proposed track lies approximately 25m higher than the ground levels at PWS13. The construction of this track will require minor excavation (≤1m). As it lies >250m from PWS, construction of the new track is not anticipated to influence PWS13.

Based on the available information, the Proposed Development will not have an adverse effect on PWS in the vicinity.

[2] *Guidance on Assessing the Impacts of Developments on Groundwater Abstractions (2024): https://www.sepa.org.uk/media/ijwd3q0y/guidance-on-assessing-the-impacts-of-developments-on-groundwater-abstractions.docx*