

# moray offshore renewables ltd

Developing Wind Energy In The Outer Moray Firth

## Environmental Statement

Modified Transmission Infrastructure for  
Telford, Stevenson and MacColl Wind Farms

## Technical Appendix 3.2 A

Hydrology, Geology and  
Hydrogeology



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# ARUP

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# 1 Introduction

This Technical Report accompanies and is in support of the Environmental Impact Assessment (EIA) for the proposed MORL modified transmission cable route from the landfall point at Inverboyndie Bay to the location of the substations near New Deer in Aberdeenshire. The modified export cable route corridor is shown in Figure 3.2.1 of Chapter 3.2 of the ES: Hydrology, Geology and Contaminated Land. This report refers exclusively to the subjects of Hydrology, Hydrogeology, Geology and Contaminated Land.

The EIA is based on two strands:

- Desk study of available information; and
- Site visits.

The available information referred to consisted of:

- Initial description of the proposed works;
- GIS layers of the modified cable route and other environmental information provided by the client;
- Relevant legislation, national and local policies relevant to the subject matter;
- Previous EIA Reports – MORL ES Chapters 3.7, 9.3, 13.3 and Technical Appendix 3.7 A (MORL, 2012);
- Scottish Environment Protection Agency (SEPA) – Flood Hazard Maps;
- SEPA Water Framework Directive (WFD) classification – Data published for 2008 (cartographic format) and 2012 (report format);
- Ordnance Survey (OS) baseline mapping;
- Photographic evidence collected during site visits;
- British Geological Survey (BGS) UK Hydrogeology Viewer;
- SEPA River Basin Management Plan (RBMP) Interactive Map;
- SEPA Aquifer Productivity;
- BGS online viewer and publicly available downloadable data;
- BGS borehole records;
- Department for Environment, Food and Rural Affairs (Defra) Magic website;
- Envirocheck Site Sensitivity Data;
- Historical Mapping – National Library of Scotland;
- Scottish Natural Heritage (SNH) web site;
- Information on private water supplies and CAR licensed abstractions; and
- Responses to consultations.

The site visit was undertaken by Arup staff on 2<sup>nd</sup> – 6<sup>th</sup> June 2014 and included:

- Familiarisation with the area;
- Investigation via direct questioning to residents of the type of water supply for each property within the modified route corridor;
- Photographic evidence of watercourses, cable river crossings, water supply features and general landscape of the area;
- Acquisition of data on water body geomorphological features, vegetation and geometrical characteristics of the water courses; and
- Visual inspection of potentially contaminated sites identified from desk study information.

Two important consultation responses were not received prior to the site visits. These included a list of licensed water abstractions from SEPA (CAR registered and licensed abstractions were received 19<sup>th</sup> June 2004) and a list of contaminated sites from Aberdeen Council (received 6<sup>th</sup> June 2014). Therefore, these locations were not visited during the site visits.

The assessment of the environmental effects of the proposed works (see below) was based on industry standard guidance and the following conceptual model:



## 1.1 Objectives

The objectives of this desk study for the modified OnTI were to:

- Establish the current environmental setting of the study area, namely geology, hydrogeology and hydrology;
- Identify potential geological, hydrological and hydrogeological receptors;
- Identify the potential effects that may be caused by the proposed works along with their anticipated magnitude;
- Relate the effects and receptors via the pathways;
- Identify areas of land with historically potentially contaminative activities;
- Assess areas of potentially contaminated land relative to potential receptors, namely the water environment and human health, in the context of the future use of land within the modified OnTI study area; and
- Combine the above information to obtain an assessment of the environmental impact of the proposed works on the hydrology, hydrogeology and contaminated land issues.

## 1.2 Limitations

This report is based on a desk study of the information available from public sources and information received from MORL reviewed by Arup at the time of writing. The quantity and detail of this information vary and therefore, the impact assessment reflects data availability.

A detailed definition of the modified OnTI, engineering solutions, construction methods, etc. was not available and thus, the report content is commensurate with this degree of detail.

No measurements and/or numerical analysis have been undertaken for this EIA and thus, it will be essentially a qualitative assessment influenced by the judgement on the significance of the effect assessed.

Notwithstanding the efforts made by the professional team by undertaking the assessment and preparing the report, it is possible that other conditions as yet undetected may exist and consequently reliance on the findings of this report must be limited accordingly.

The study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.

The accuracy of maps cannot be guaranteed and it should be recognised that different conditions on site may have existed between and subsequent to the various map surveys. No previous ground investigation reports were reviewed as part of this study.

## 2 Site Information and Environmental Setting

### 2.1 Study Area

The Modified Onshore Transmission Infrastructure (OnTI) corridor runs for approximately 34 km, from its onshore arrival point at Boyndie Bay (approx. NGR NJ670647), immediately west of Banff, to the indicative substation location near New Deer (approx. NGR NJ830450) (see Figure 3.2.1 of the ES chapter). The study area covers a 250 m buffer zone either side of the proposed modified OnTI route. The modified onshore export cable corridor runs through a landscape composed of mainly rolling hills dedicated to farming and some small patches of forestry. There are no sizeable towns or villages within the corridor. However, the area is scattered with multiple farms, cottages and minor settlements. The largest towns near the corridor are Banff, MacDuff and Turriff.

### 2.2 Topography

The topography of the study area consists of gently undulating hills generally ranging from approximately 60 to 170 m AOD, and comprises the Buchan Plateau. The coastal area between Inverboyndie Bay and Banff Bay is formed mainly by low steep cliffs and wave cut platforms, with exposed rocks and the occasional sandy bay.

### 2.3 Hydrology and Water Bodies

There are numerous watercourses in the area, whose size range from the River Deveron, with a catchment area at the proposed crossing of 1,218 km<sup>2</sup>, to very small land drainage ditches. Water bodies potentially affected by the scheme are shown on Figure 3.2.5 of the EIA and listed below:

- Burn of Boyndie;
- Burn of Bachlaw (trib. of R Deveron along Paddocklaw);
- River Deveron;
- Den Burn (trib. of Burn of Montbletton);
- Burn of Montbletton (trib. of R. Deveron along Wester Keilhill);
- Burn of Fortrie;
- Burn of Fishrie;
- Craigston Burn;
- Small stream next to Hill of Brackans (trib. Of Cot Burn);
- Aultan Burn;
- Burn of Monquhitter (Idoch Water);
- Teuchar Stank;
- Burn of Swanford;
- Burn of Asleid; and
- Sea at Boyndie Bay.

The main water bodies crossed by the modified export cable corridor are shown in Table 1 below.

**Table 1 Hydrological characteristics of the main watercourses (FEH-CDROM 3)**

Code	Name	Catchment area (km <sup>2</sup> ) (1)	SAAR (2) (mm)	ALTBAR (mAOD) (3)	SPRHOST (%)
WB005	Burn of Boyndie	27.3	778	84	27.2
WB009	River Deveron	1,218.5	905	216	33.7
WB012	Burn of Fortrie	11.1	798	105	28.7
WB013	Burn of Fishrie	37.3	830	131	25.2
WB014	Craigston Burn	18.7	830	126	23.9
WB017	Burn of Monquhitter (Idoch Water)	37.7	852	135	32.3

(1) At intersection with cable route

(2) Standard Average Annual Rainfall

(3) Mean altitude

(4) Standard Percentage Runoff based on Hydrology of Soil Types.

Based on the site inspection, the majority of the watercourses –especially the smaller ones– have some degree of channelisation. Since the land is mainly dedicated to crop production and grazing the channels are commonly straightened and productive land pushed to the edge of the banks. Raised embankments commonly bound the channels, which are generally incised. There is evidence of bank toe undercutting in numerous locations and many watercourses have very steep banks, which were covered in dense vegetation (high grass and bush) at the time of the visit (June 2014) (Photo 1).



**Photograph 1 – Examples of channelised watercourses. Left: Boyndie Burn next to Mill of Blairshinnoch. Right: Burn of Fortrie at Milltack.**

The river bed material is generally gravel (Photo 2), often covered by fine particles, most common in smaller watercourses and drains (Photo 2 Left). These fines are also found attached to macrophytes (e.g. algae) on the bed, colouring the bed a brown tone (Photo 3).



Photograph 2 – Examples of river bed material. Left: Boyndie Burn at Boyndie Bridge, shortly before Boyndie Bay. Right: Burn of Fortie north-east of King Edward. Note the gravel bed covered with fines.



Photograph 3 – Craigston Burn approximately 1km downstream of Craigston Castle. Note the very fine particles attached to the macrophytes.

The landfall point at Boyndie Bay has a sandy beach, with the Boyndie Burn cutting through it. High vegetated sand dunes are found at the back of the beach (Photo 4).



**Photograph 4 – Boyndie Beach. Boyndie Burn discharges to the right of the image. Note the dunes in the background.**

Figure 3.2.5 of the ES chapter shows the water bodies present within the OnTI corridor.

### **2.3.1 Flood risk**

A number of the watercourses in the study area have been included in SEPA's National Flood Hazard Mapping work. This provides indicative flood extents high likelihood (10 % annual probability; 1 in 10 year), medium likelihood (0.5 % annual probability; 1 in 200 year) and low probability (0.1 % annual probability; 1 in 1,000 year). The flood extents within the corridor were analysed, in particular at the proposed river crossings. The flood extent of the River Deveron is the largest in the study area, with extensive flooding predicted at the river crossing proposed. Flood extents at the remaining watercourses are small.

With regards to coastal flood risk, the SEPA flood hazard maps show flooding is largely contained at the shoreline of Boyndie Bay, with minimal penetration inland.

The works should ensure that the flood risk of the OnTI (both during construction and operation) and surrounding area is not increased. It is recommended that the construction is planned to minimise exposure to high flows and that the final export cable route is adopted with flooding as one of the main design factors, particularly at the crossing of the River Deveron.

The location of ancillary infrastructure should be placed away from areas at risk of flooding and with safe access/egress wherever practicable. It should however be noted that mitigation measures cannot eliminate the risk of flooding completely. Both construction and operation phases may be subject to flooding due to the water body's hydrological regime even if no alteration to the water body occurs.

The proposed Scottish Planning Policy (SPP), which is due to be approved in summer 2014, may require a strategic flood risk assessment (FRA) to inform the location of developments and areas at medium to high risk (0.5% AEP or higher). Such areas are generally not suitable for essential infrastructure unless subject to long term management plans and should be designed and constructed to be operational during floods.

### 2.3.2 Water Framework Directive (WFD) classification and quality of the water bodies

SEPA's WFD classifications for 2008 and 2012 were consulted. The 2008 data can be viewed in cartographic form online, whereas the 2012 classification was consulted via the summary sheets, as no mapping was found. The WFD status/potential of each water body is presented in Table 2.

**Table 2 SEPA WFD classification of the main water bodies in the modified OnTI corridor.**

Name	2012 (1)	2008 (2)	Adopted
Burn of Boyndie	Poor	Poor	Poor
Burn of Bachlaw (trib. of R Deveron along Paddocklaw)	n/a	n/a	n/a
River Deveron	Moderate	Moderate	Moderate
Den Burn (trib. of Burn of Montbletton)	Poor	n/a	Poor
Burn of Montbletton (trib. of R. Deveron along Wester Keilhill)	n/a	n/a	n/a
Burn of Fortrie	Bad	Bad	Bad
Burn of Fishrie	n/a	Moderate	Moderate
Craigston Burn	n/a	Moderate	Moderate
Small stream next to Hill of Brackans (trib. Of Cot Burn)	n/a	n/a	n/a
Aultan Burn	n/a	n/a	n/a
Burn of Monquhitter (ldoch Water)	Bad	Bad	Bad
Teuchar Stank	n/a	n/a	n/a
Burn of Swanford	n/a	n/a	n/a
Burn of Asleid	n/a	n/a	n/a
Sea at Boyndie Bay	Good	Good	Good

(1) [http://www.sepa.org.uk/water/river\\_basin\\_planning/waterbody\\_data\\_sheets.aspx](http://www.sepa.org.uk/water/river_basin_planning/waterbody_data_sheets.aspx),

(2) <http://gis.sepa.org.uk/rbmp/>

The above classification shows that the coastal waters are generally in better conditions than inland waters. However, on-going erosion of coastal features in NE Scotland is highlighted by the National Planning Framework (NPF3) as a concern. In this regard, the response to the Scoping Report provided by Aberdeenshire Council requires that the landfall point be protected against erosion.

The issues affecting water body status include a range of factors including physical modifications and biological/water quality issues associated primarily with agricultural activity. The River Deveron is a game fishery with a sustainable population of salmon, sea trout and brown trout. It has been identified by SEPA as a Diffuse Pollution Priority Catchment.

Arable cultivation, livestock farming and forestry are the main land use activities in areas affected by diffuse pollution on the River Deveron. It is a drinking water protected area (DWPA), providing drinking water for 60,000 people in the Aberdeenshire area. The river has also been designated as a Salmonid Water under the EC Water Framework Directive. Areas of the catchment are included in a Nitrate Vulnerable Zone and the entire catchment has been designated as an Urban Waste Water Treatment Directive Sensitive Area.

The OnTI does not intersect any wetland RAMSAR, SAC or SSSI sites. The response by Aberdeenshire Council to the Scoping Report highlights the importance of the SSSI zones between Cullen and Stake Ness and Whitehills to Melrose, but these will not be impacted by the development which landfalls on the beach.

Whilst there are no peat bog wetlands, there are four areas affected by the pipeline where the soils comprise peat. Two of these are restricted to a narrow corridor along Teuchar Stank. There is approximately a 100 m square area at Boghead Farm, south of Cuminestown (NGR 38000, 848821). The largest area of peat is the Moss of Spottynook (NGR 381689, 846124), which comprises a shallow depression occupying approximately 1 km<sup>2</sup>, as noted in the geology sections of this report. This area has been artificially drained in the past and is currently used as rough grazing land.

### **2.3.3 *Climate Change***

Climate change is predicted to increase the degree of storminess in Scotland. As a result, both rainfall events –and consequently fluvial flows- and coastal flooding may increase in the future. The modified OnTI should take into account the effects of climate change on flood risk from sea and fluvial waters and the risk of erosion of the shoreline and river channel/banks.

## 2.4 Geology

### 2.4.1 *Solid Geology*

The solid geology beneath the modified OnTI was obtained from the 1: 625,000 British Geological Survey (BGS) online. It comprises:

- The Southern Highland Group (SOHL);
- The Middle Old Red Sandstone (MOR);
- Lower Old Red Sandstone (LOR); and
- An Igneous Intrusion.

The Southern Highland Group comprises the Macduff Formation and the Knock Head Grit Member. The Knock Head Grit Member is described as semi-pelite and psammite grit and sub crops beneath the northern most section of the modified export cable route at Inverboyndie.

The Macduff Formation is described as micaceous psammite and semi- pelite/ pelite, (metamorphosed sand stones and mudstones) and is found beneath the southern and northern most ends of the proposed export cable route.

The Middle and Lower Old Red Sandstone are located in the central section of the route alignment and comprise the Gardenstone Conglomerate and the Crovie Sandstone formations described as conglomerates, breccias, mudstones, sandstone and siltstones.

An igneous intrusion of quartz- microgabbro occurs directly beneath the proposed location of the indicative substation. The intrusion lies in almost an east – west alignment and should be considered during foundation designs for the substation.

### 2.4.2 *Superficial Geology*

The superficial geology information was obtained from the 1:50,000 BGS mapping and can be seen in Figure 3.2.3 of the ES Chapter. The superficial geology within the study area is given below.

Alluvium deposits outcrop along the route, following and adjacent to the surface water courses. The alluvium is described by the BGS as clay, silt and sand.

Alluvial Fan deposits are mapped in two small isolated patches on the banks of the River Deveron at Inverichnie (NGR 369314,860645 and 369753, 860120) and are described as gravel, sand, silt and clay.

Blown Sand is confined to a small outcrop near the remains of the church at Boyndie Bay and is described as pale brown, fine-grained, uncemented sand.

Glaciofluvial Ice Contact deposits (GFIC) are described as sand and gravel, with localised lenses of silt, clay and organic material. GFIC is extensively mapped in the northern section of the route, with Glaciofluvial Sheet Deposits (GFSD) mapped along the River Deveron.

Head deposits occur at three locations along the route. The largest outcrop is located to the north of the Hill of Alvah (approximate NGR 366867, 860235). Head is described as comprising gravel, sand and clay depending on upslope source (this being the SOHL) and distance from source. Poorly sorted and poorly stratified deposits formed mostly by solifluction and/or hillwash and soil creep.

Peat occurs in isolated patches from Newton of Teuchar, (NGR 38000, 848821) to the southern end of the route. A large area of peat is situated at Moss of Sprottyneuk (NGR 381689, 846124) and occupies approximately 1 km<sup>2</sup>.

Raised Marine Deposits of Flandrian Age (RMDF) and Raised Marine Deposits of Devensian age (RMDV) are mapped at Inverboyndie and comprise a variable lithology of gravel (shingle), sand, silt and clay and commonly enriched with organic debris.

River Terrace Deposits (undifferentiated) occur in small isolated patches along the major surface water channels and are described as sand and gravel, with local lenses of silt, clay or peat.

Till, Devensian – Diamicton (TILLD) makes up the majority of the superficial deposits along the route and has a variable composition. Till generally comprises sandy, silty clay with pebbles. There is no made ground shown on the geological mapping.

### **2.4.3 Structural Geology**

The structural geology was identified based on the online BGS mapping. A large geological fault crosses the export cable alignment at three locations between Gorrachie Wood (NGR 374641, 856078) and to the south of Fintry (NGR 375597, 854257), and lies generally in a north – south alignment. The location of the fault is shown on Figure 3.2.2 of the ES chapter.

### **2.4.4 Geological Designated Sites**

There is one geological designated site which falls within the study area. The Whitehills to Melrose Coast was designated as a geological Site of special Scientific Interest (SSSI) in 1990 for the structural and metamorphic geology. The SSSI covers an area of 90.30 hectares extending from Whitehills, approximately 1.5 km to the west of Inverboyndie Bay, to Bowie Bate approximately 4.5 km to the east of the bay. Inverboyndie Bay itself does not fall within the SSSI designation which is for the structural and metamorphic geology exposed either side of the bay. The location of the SSSI is mapped on Figure 3.2.2 of the ES chapter.

#### **2.4.4.1 Local Nature Conservation Sites**

There are two local nature conservation sites, identified by Aberdeenshire Council, within the study area. These are named as Cullen to Whitehills Coast and Tarlair to Gardenstown Coast. Cullen to Whitehills is locally important due to the varied stretch of coastline comprising steep cliffs and rocky intertidal shores. The geological interest is in the form of Old Red Sandstone cliffs and glacially transported Jurassic clay. Boyne Quarry has exposures of glacial and interglacial features.

Tarlair to Gardenstown Coasts comprises a mostly rocky stretch of coastline with steep coastal cliffs and a shingle/rocky shoreline. The site is important for its geology and the sediments at Castle Hill, to the west of Gardenstown, are important for understanding glacial processes. The Findon ravine contains a small exposure on the eastern side and is a locality for the Gamrie Fish Bed in which fossil specimens of Middle Devonian are found. There are no publically available BGS borehole records which fall within the 1000 m buffer of the modified OnTI.

## 2.5 Hydrogeology

### 2.5.1 Hydrogeological Classification

The BGS online Hydrogeology Viewer for the UK provides a description and classification of the bedrock in terms of aquifer potential, whereas MacDonald et al. (2004) gives an indication of yields associated with this classification. A summary of these bedrock aquifers is presented below.

*Southern Highland Group (MacDuff Formation and Knockhead Grit Member):* Classified as a Low Productivity aquifer with a yield of 0.1 to 1 litres per second (l/s). This aquifer is capable of providing only small amounts of groundwater in the near surface weathered zone and secondary fractures. It is likely that these aquifers are only used for small domestic supplies.

*Middle Old Red Sandstone (Gardenstown Conglomerate Formation):* Classified as a Moderately Productive Aquifer with a yield of between 1 and 10l/s. The aquifer is described as sandstones, in places flaggy, with siltstones, mudstones and conglomerates and interbedded lavas, locally yields small amounts of groundwater, which obtains its yield from both intergranular and fracture flow.

*Lower Old Red Sandstone (Crovie Sandstone Formation):* Classified as a Moderately Productive Aquifer with a yield of 1 to 10l/s. The aquifer is described as a locally important multi-layered aquifer which obtains its yield from both intergranular and fracture flow.

The BGS UK Hydrogeology Viewer does not include superficial deposits. However, MacDonald et al. (2004) do present a map of superficial aquifer productivity, which also contains a classification table for superficial deposits. Based on this, the classification of the superficial deposits are as presented in Table 3 below.

**Table 3 Superficial deposit classifications**

Productivity Rating	Superficial deposits
High (>10l/s)	Glaciofluvial Sands and Gravels Alluvium River Terrace Deposits
Moderate (1-10l/s)	Raised Marine Deposits
Low (0.1-1l/s)	Sandy and gravelly Glacial Till

SEPA classify key water bodies as part of their RBMPs, which form part of the legislative requirements under the WFD. Along the cable route there are several groundwater bodies defined. These groundwater bodies, together with their water quality status in 2008, are presented in Table 4 below.

**Table 4 Groundwater bodies and water quality status**

<b>ID</b>	<b>Groundwater Body</b>	<b>Location along route</b>	<b>Water Quality Status (2008)</b>	<b>Drinking Water Protection Zone?</b>
<b>150316</b>	Banff coastal sand and gravel	Raised Marine Deposits along coastline adjacent to Banff	Good	Yes
<b>150311</b>	Buchie bedrock and localised sand and gravel aquifer	Knockhead Grit Member at Inverboyndie	Good	Yes
<b>150312</b>	Lower Devron Valley Sand and Gravel	Glaciofluvial Ice Contact Deposits immediately to the south of Banff and Inverboyndie	Good	Yes
<b>150404</b>	MacDuff	corresponds to MacDuff Formation between Banff and Fintry	Good	Yes
<b>150307</b>	Turriff bedrock and localised sand and gravel aquifers	corresponds to the Old Red Sandstone between Fintry and Cuminestown	Poor (diffuse pollution from nitrate use in arable farming)	Yes
<b>150300</b>	Ythan bedrock and localised sand and gravel aquifers	MacDuff formation south of Cuminestown to end of the route	Poor (diffuse pollution from nitrate use in arable farming)	Yes

## 2.5.2 Groundwater Vulnerability

Groundwater vulnerability data has been obtained from Envirocheck and from the BGS/SEPA (2011) classification for Scotland.

The Envirocheck classification correlates to the superficial deposits. The Glacial Sand and Gravel, Alluvium and Raised Marine Deposits are classified as Minor or Moderately Permeable Aquifer, whereas the Glacial Till is classified as Non or Weakly Permeable Aquifer.

The BGS/SEPA (2011) groundwater vulnerability classification indicates that the bedrock, in combination with the overlying superficial deposits, along the export cable route and substation are designated predominately as vulnerability class 4a-5 with some isolated areas classified as vulnerability class 2 or 3. The vulnerability classes are defined in Table 5 below.

**Table 5 Groundwater vulnerability classifications and their interpretation (O'Dochartaigh *et al.*, 2011)**

Vulnerability Class	Description	Frequency of activity	Travel time	
5	Vulnerable to most pollutants, with rapid impact in many scenarios.	Vulnerable to individual events. 	Rapid 	
4	Vulnerable to those pollutants not readily adsorbed or transformed.			4a May have low permeability soil; less likely to have clay present in superficial deposits.
				4b More likely to have clay present in superficial deposits.
3	Vulnerable to some pollutants; many others significantly attenuated.			
2	Vulnerable to some pollutants, but only when they are continuously discharged/leached.			
1	Only vulnerable to conservative pollutants in the long term when continuously and widely discharged/leached.	Vulnerable only to persistent activity.	Very slow	
0	Not sufficient data to classify vulnerability: e.g. below lochs; in urban areas where geological and/or soils data are missing; where superficial deposits are mapped but not classified; or in mined (including opencast) and quarried areas.			

The vulnerability classes have been used in the impact assessment to classify the value/sensitivity of groundwater as a receptor. As the vulnerability mapping is only publically available on a countrywide scale (1 km pixels) the vulnerability classes and geology are not easily correlated. Therefore we have assessed groundwater as one receptor rather than as individual receptors corresponding to the aquifers.

### 2.5.3 Drinking Water Protection Zones

SEPA's RBMP database presents Drinking Water Protection Zones (DWPZs), as designated under the Drinking Water Directive. All the water bodies listed in Table 4 above are classified as DWPZs. Therefore, the entire onshore export cable route and substation location fall within DWPZs.

## 2.6 Water Supplies and Abstractions

### 2.6.1 Private Water Supplies

Under the Controlled Activities (Scotland) Regulations (CAR), surface water and groundwater abstractions of supplies of <math>10\text{m}^3/\text{d}</math> do not require a license to abstract water. Abstractions of between 10 and 50  $\text{m}^3/\text{d}$  must be registered with SEPA but do not required a license. Both these categories are referred to as private water supplies and are classified as Type A (10-50 $\text{m}^3/\text{d}$  or serving >50 people) and Type B (<math>10\text{m}^3</math> or serving <math>50</math> people).

All private water supplies are required to be registered to the local authority in which the source of supply is located. Aberdeenshire Council were therefore contacted to obtain a list of private water supplies within 500 m of the centreline of the export cable route and substation location. It should be noted that these records rely on private water supplies being registered with Aberdeenshire Council, and the records being kept up to date. The records may therefore be incomplete or outdated.

From records provided by Aberdeenshire Council, 58 Type B private water supplies serving a total of 77 properties were identified as being located within 500 m of the export cable route centreline or the substations location. No Type A supplies were identified from the council records.

The location of private water supplies identified by Aberdeenshire Council records are presented in Figure 3.2.5 of the ES Chapter. Properties that were found to be on mains supply during the site survey have been excluded from this figure.

### 2.6.2 CAR Licensed Abstractions

A data request was submitted to SEPA for a list of CAR licensed surface water and groundwater abstractions. The response to this data request was received on 19<sup>th</sup> June 2014 and indicated that one registered abstraction and three licensed abstractions are located with 1 km of the modified OnTI. These abstractions are summarised in Table 6 below.

**Table 6 CAR Licensed surface water and groundwater abstractions**

License No.	Name	Source of Supply	Licence Type	Purpose
CAR/R/1011091	Gellyhill Farm	Groundwater	Registered (10-50 $\text{m}^3/\text{d}$ )	Agriculture, hunting and related service activities
CAR/L/1011461	MacDuff Distillery	Groundwater	Licensed (assume complex >2000 $\text{m}^3/\text{d}$ )	Manufacture of food and beverages
CAR/L/1010255	Slackadale House	Surface Water (Craigstone Burn)	Licensed (assume complex >2000 $\text{m}^3/\text{d}$ )	Agriculture, hunting and related service activities
CAR/L/1009943	Garniestone Farm, Turriff	Surface Water (Craigstone Burn)	Licensed (assume complex >2000 $\text{m}^3/\text{d}$ )	Agriculture, hunting and related service activities

One public water supply, located within 500 m of the export cable centreline and substation location, was provided by Aberdeenshire Council. This abstraction is a spring called Fortrie Intake (easting 373000, northing 858000). The spring could not be located during the site walkover.

## 2.7 Site History

Historical mapping for the modified export cable route was reviewed via publically available online resources from the National Library of Scotland. The historical mapping coverage is limited and a summary of the key findings is given in the table below.

**Table 7: Historical map review summary**

	Map	Area	Historical setting (potential sources of contamination within 1000m buffer zone)
1	Banffshire, Sheet 004.11 Publication date: 1904 Revised: ca. 1902	Inverboyndie	Railway GNSR Banff branch Quarry Banff distillery Corn mill Mill of boyndie Sheep fold
1	Banffshire, Sheet 004.11 Publication date: 1930 Revised: ca. 1928/1929	Inverboyndie	As above plus: Extension to quarry
2	Banffshire, Sheet 004.15 Publication date: 1904 Revised: ca. 1902	Hills of Boyndie	Ladysbridge Station Sand pit at Pig Hills Sand pit Small quarry (as current)
2	Banffshire, Sheet 004.15 Publication date: 1930 Revised: ca. 1928/1928	Hills of Boyndie	Ladysbridge Station Sand pit at Pig Hills Sand pit Small quarry (as current)
3	Banffshire, Sheet 010.03 Publication date: 1904 Revised: ca. 1902	Bachlaw Wood	North of Easter Culbeuchly old gravel pit; Quarry between Wardend and Tipperty
4	Banffshire, Sheet 010.07 Publication date: 1904 Revised: ca. 1902	Hill of Tipperty	Quarry
5	Aberdeenshire, Sheet 004.08 Publication date: 1902 Revised: ca. 1901	Alvah	No significant issues
5	Banffshire, Sheet 010.08 Publication date: 1902 Revised: ca. 1901	Alvah	No significant issues
6	Banffshire, Sheet 011.01 Publication date: 1904 Revised: ca. 1902	Woods of Bauds	Old gravel pit near lower Wanford Small quarry Old Gravel Pit Smithy
7	Aberdeenshire, Sheet 005.05 Publication date: 1902 Revised: ca. 1901	Keilhill	Smithy Railway GNSR Macduff section
7	Banffshire, Sheet 011.05	Keilhill	Smithy

	Map	Area	Historical setting (potential sources of contamination within 1000m buffer zone)
	Publication date: 1902 Revised: ca. 1901		Railway GNSR Macduff section
8	Aberdeenshire, Sheet 005.06 Publication date: 1902 Revised: ca. 1901	Hills of Foulzie	Two quarries
9	Banffshire, Sheet 011.10 Publication date: 1902 Revised: ca. 1901	Woods of Balchers	Two quarries Smithy
10	Aberdeenshire, Sheet 005.14 Publication date: 1902 Revised: ca. 1901	Gorrachie Wood	Lint mill Cowes mill
11	Aberdeenshire, Sheet 005.15 Publication date: 1902 Revised: ca. 1900/1901	Mill of Balmaud	Mill Quarry
12	Aberdeenshire, Sheet 011.03 Publication date: 1902 Revised: ca. 1900	Gairnieston	Quarry
12	Aberdeenshire, Sheet 011.03 Publication date: 1926 Revised: ca. 1925 Levelled: 1900	Gairnieston	2 Sheepfolds Quarry
13	Aberdeenshire, Sheet 011.07 Publication date: 1901 Revised: ca. 1900	Hill of brackens	Smithy
13	Aberdeenshire, Sheet 011.07 Publication date: 1926 Revised: ca. 1925 Levelled: 1900	Hill of brackens	No significant issues
14	Aberdeenshire, Sheet 011.04 Publication date: 1902 Revised: ca. 1900	Lower Cotburn	Corn mill Quarry Mill of Craigston
15	Aberdeenshire, Sheet 011.08 Publication date: 1901 Revised: ca. 1900	Hill of Cotburn	Corn mill Quarry Mill of Craigston
15	Aberdeenshire, Sheet 011.08 Publication date: 1926 Revised: ca. 1925 Levelled: 1900	Hill of Cotburn	No significant issues
16	Aberdeenshire, Sheet 011.12 Publication date: 1901 Revised: ca. 1900	Miekle Cairnhill	No significant issues
16	Aberdeenshire, Sheet 011.12 Publication date: 1926 Revised: ca. 1925 Levelled: 1900	Miekle Cairnhill	No significant issues
17	Aberdeenshire, Sheet 012.05 Publication date: 1901 Revised: ca. 1901	North Everton	2 Old quarries
18	Aberdeenshire, Sheet 012.09 Publication date: 1902 Revised: ca. 1900	Everton	No significant issues
19	Aberdeenshire, Sheet 011.16 Publication date: 1901 Revised: ca. 1900	Castlehill	Mill of Hare Moss
19	Aberdeenshire, Sheet 011.16	Castlehill	Mill of Hare Moss

	Map	Area	Historical setting (potential sources of contamination within 1000m buffer zone)
	Publication date: 1926 Revised: ca. 1925 Levelled: 1900		
20	Aberdeenshire, Sheet 012.13 Publication date: 1901 Revised: ca. 1900	Cuminestown	Saw mill Corn mill
21	Aberdeenshire, Sheet 020.01 Publication date: 1901 Revised: ca. 1900	Monquhitter	Sand pit
22	Aberdeenshire, Sheet 020.05 Publication date: 1901 Revised: ca. 1900	Waggle hill	Quarry
23	Aberdeenshire, Sheet 020.06 Publication date: 1901 Revised: ca. 1900		Mill of Allathan Mill dam Smithy
24	Aberdeenshire, Sheet 020.10 Publication date: 1901 Revised: ca. 1900	Moss of Swanford	Smithy
25	Aberdeenshire, Sheet 020.11 Publication date: 1901 Revised: ca. 1900	Carnbanno	Quarry Smithy (smiddy hill)
26	Aberdeenshire, Sheet 020.14 Publication date: 1901 Revised: ca. 1900	Moss of Blackpool	No significant issues
27	Aberdeenshire, 020.15 Surveyed: 1900 Published: 1901	Grainhill	Newmill Mill of Cairnbanno (Corn)

### 2.7.1 Historical Map Summary

Historically, the area was and remains predominantly agricultural. There are a number of small local quarries shown on the historical mapping along the route, most of which are referred to as old gravel pits.

In Inverboyndie the current distillery was first shown on the earliest ordnance survey mapping dated 1904. The Banff Branch and Macduff branch railways cross the route in 1904 although both are now shown as disused/ dismantled.

There is evidence of local smithies along the modified export cable route corridor with a number of wind pumps and mills.

## 2.8 Environmental Setting

### 2.8.1 *Envirocheck Sensitivity data*

An Envirocheck Report, comprising site sensitivity data, was commissioned for the modified export cable route corridor. A 250 m buffer either side of the route was requested. The site sensitivity data was obtained in GIS format, and is shown on Figure 3.2.4 of the ES Chapter. A summary of the key findings is given below:

- There are four contemporary trade directory entries within the route, of which three are active;
  - An office for Bridgend Sand & Gravel, that provide sand, gravel and other aggregates, at Mill of Balmaud Farm, King Edward, Banff, AB45 3PN
  - A car body repair workshop for Grampian Commercials Ltd in Inverboyndie Industrial Estate, Banff, AB45 2JJ
  - An agricultural engineers workshop for Ian Rennie Ltd in Inverboyndie Industrial Estate, Banff, AB45 2JJ
- There are no Control of Major Accident Hazards (COMAH) registered sites;
- There is one recorded petrol station, Keilhill Filling Station, which is no longer in operation. This is located on the A947, Keilhill, Banff, Banffshire;
- There are eight BGS recorded opencast mineral sites, all of which are stated as no longer operational;
  - Tipperty, in Alvah, Aberchirder, Banffshire
  - Little Swanford, in Burnside, New Deer, Turriff, Aberdeenshire
  - Wood of Milton Pits, in Plaidy, King Edward, Macduff, Banffshire
  - Fintry, in Fintry, Turriff, Aberdeenshire
  - Slacks of Tipperty Gravel Pit, in Alvah, Aberchirder, Banffshire
  - East Swanford, in Burnside, New Deer, Turriff, Aberdeenshire
  - Bridge of Swanford, in Burnside, New Deer, Turriff, Aberdeenshire
  - Funkieston Wood Gravel Pit in Durno House, Longmanhill, Macduff, Banffshire
- There are five records for non-coal mining areas, located in the central section of the route. These are identified as vein minerals and classed as "Rare: Infrequent minor mining may have occurred but restricted in extent";
- There is one registered waste treatment site, Inverboyndie treatment plant, Inverboyndie Industrial Estate, Banff, Aberdeenshire, for the pulverisation of waste with waste transfer. It is categorised as receiving between 10,000 and 25,000 tonnes of waste per year;
- There is one registered landfill site- Foulzie Tip, King Edward, Macduff, Morayshire. This is categorised as receiving between 10,000 and 25,000 tonnes of waste per year. It no longer has a license and there was no known restriction on the waste received. It was operated by Banff & Buchan District Council;
- There is one SSSI, the Whitehills to Melrose Coast; and
- The study area falls within a Nitrate Vulnerable Zone.

### 2.8.2 *Potentially Contaminated Land*

In the scoping response, the Environmental Health Officer (EHO) at Aberdeenshire council identified 676 potentially contaminated sites within the region. The council have provided a list of the sites, and of these only 34 fall within the modified export cable route. The 34 sites comprise:

- Eleven Quarries or gravel pits;
- One Smithy;
- Keilhill filling station ( as listed in Envirocheck);
- Two Sawmills and 14 unspecified mills;

- Fabricators (steel, aluminium and stainless steel welders);
- One store (Parkhill stores);
- One agricultural engineers;
- One commercial business (unspecified); and
- One unspecified activity (given as Inverboyndie).

## 2.9 Site Specific Surveys

The site visit was undertaken by Arup staff between 2<sup>nd</sup> and 6<sup>th</sup> June 2014. Arup staff inspected the full length of the modified OnTI and indicative substation location. As the modified export cable route is 34 km long, the full route was driven, where possible, with walkover surveys at key locations.

Two important consultation responses had not been received prior to the site visits. These were the list of licensed water abstractions from SEPA (CAR registered and licensed abstractions were received 19<sup>th</sup> June 2004) and the list of contaminated sites from Aberdeen Council (received 6<sup>th</sup> June 2014). These locations were therefore not visited.

### 2.9.1 Survey of Surface Water Features

The landfall point and all surface watercourse crossings were surveyed. With the exception of the River Deveron, the majority of the watercourses – especially the smaller ones - have been modified, straightened or deepened to increase their capacity. Since the land is mainly dedicated to crop production and grazing, the channels are commonly straightened and productive agricultural land extends to the bank tops of the majority of watercourses. Low raised embankments commonly bound the channels. The channels are generally incised, with evidence of bank toe undercutting, and have very steep banks, which were covered in dense vegetation (high grass and bushes) at the time of the site visits. The watercourse bed material is generally gravel, often covered by fine soil/sediment particles. These deposits are most common in the smaller watercourses and drains. These fines are also found attached to macrophytes (e.g. algae) on the bed.

### 2.9.2 Water Supplies

Only water supplies falling within 500 m of the cable route centreline or the substation were visited. From the council records, this included 58 private water supplies serving a total of 77 properties. Given the number of properties to visit, detailed surveys of the sources were not undertaken. Therefore only the location and type of supply (well, surface water or spring) was recorded.

From the site surveys of private water supplies, 21 properties were found to have switched to a mains supply and 7 properties were derelict or empty. The findings of the site survey of water supplies are tabulated in Appendix 1.

As the consultation response from SEPA was not received prior to the site surveys (received 19<sup>th</sup> June 2014), no licensed abstractions were identified for a visit. Aberdeenshire Council did identify one other abstraction, Fortrie Intake, within 500 m of the cable route centreline, which was visited. However, no evidence of the abstraction was found on site. In addition, a Scottish Water reservoir, Brackans Reservoir was identified by driving the route. The source of water feeding this reservoir is currently unknown.

The location of the private water supplies, Fortrie Intake and Brackans Reservoir are presented on Figure 3.2.5 of the ES Chapter.

### 2.9.3 *Geology and Contaminated Land*

A site reconnaissance visit was undertaken along the modified export cable route and indicative substation location as part of the assessment of baseline conditions. As the cable route is 34 km long, the route was driven, where possible with stops at key locations along the route.

The locations were determined from the desk based review and targeted as areas of potential land contamination (identified from current and historical land use maps), potential significant geological features and private water supply locations.

During the site visit, a number of potentially contaminated sites were identified and are listed below:

- Possible contaminated land site at Inverboyndie, demolished buildings, made ground/ possible inert rubble;
- Southern end of route is a disused quarry at Swanford Farm, with evidence of rubble and scrap metal;
- Burnside Farm, disused farmyard;
- Hill of Cotburn, motorcross track and caravan site , evidence of fuel containers;
- A large quarry to the west of South of Gorrachie; and
- Paddocklaw Farm, pig farm.



Photograph 5: Demolition rubble at Inverboyndie



Photograph 6: Swanford Farm, with evidence of made ground / rubble and scrap metal



Photograph 7: Quarry near South Gorrachie

### 3 Conceptual Site Model

The UK legislation on contaminated land is principally contained in Part IIA of the Environmental Protection Act, 1990.

The legislation endorses the principle of a “suitable for use” approach to contaminated land, where remedial action is only required if there are unacceptable risks to health or the environment, taking into account the use of the land and its environmental setting.

The contaminated land regime is centred on a risk based framework for dealing with land affected by contamination. The framework recognises that, while contamination can be present, it has to be present at such concentrations and in such circumstances that it has the potential to cause significant harm or pollution to people or the wider environment, based on the current use of the land, for the site to be determined as “contaminated”.

There are three elements to any risk:

- Source: a substance which is in, on or under the land and has the potential to cause harm or cause pollution of the water environment;
- Receptor: in general terms, something that could be adversely affected by a contaminant, e.g. a person, an ecological system or a water body as defined in the statutory guidance; and
- Pathway: a means by which a receptor can be exposed to, or affected by, a contaminant.

All three elements of the linkage must therefore be present for a risk to exist. If one of the elements of the pollutant linkage is absent, there can be no risk.

The conceptual site model describes a risk assessment methodology in terms of ‘significant pollutants’ and ‘significant pollutant linkages’ within a source-pathway-target model of the site.

A qualitative assessment of risks has been completed by identifying the nature of potential contamination hazards, potential receptors on and around the site, and by considering the likely pathways between them.

### 3.1 Modified OnTI Cable route Conceptual Site Model

The desk study review identified potentially contaminated sites within the study area. For the purposes of an Environmental Statement a detailed Conceptual Site Model (CSM) for each individual potentially contaminated site identified is not necessary. As such, a higher level CSM for all sites has been developed as detailed in the following sections.

#### 3.1.1 Sources

Sources are typically described as on site and off site sources. However, as this a linear site the sources have been identified along the proposed cable alignment and 250 m either side of that alignment.

34 potentially contaminated sites were identified by Aberdeenshire Council, within the study area. Based on the information provided by the council the sites have been screened using the Aberdeenshire Council Contaminated Land Strategy Land Use Risk Rating.

**Table 8: Potentially contaminated land (identified by Aberdeenshire Council)**

Potentially Contaminated Sites Identified by Aberdeenshire Council	Risk Rating ( based on Aberdeenshire Council Contaminated Land strategy)
Eleven Quarries or gravel pits	Moderate
One Smithy	Low
Keihill filling station	Moderate
Two Sawmills and 14 unspecified mills	Slight
One Fabricators (steel, aluminium and stainless steel welders);	Moderate
One store (Parkhill stores);	Low
One agricultural engineers;	Low
One commercial business (unspecified); and	Low
One unspecified activity (given as Inverboyndie).	Low

Other potential sources identified during the desk study are summarised in Table 9 below.

**Table 9: Other potential contaminated sites**

Potential Contaminated Sites	Risk Rating ( based on Aberdeenshire Council Contaminated Land strategy)
Farms	Low
Disused Railway	Slight
Registered landfill and treatment sites	High
Peat bogs (source of natural gas)	Moderate
Backfilled quarries	Moderate

Based on this screening process, the CSM for contaminated land will only consider those sites identified as moderate to high risk.

In terms of potential sources which could potentially impact on the wider natural water environment, contaminated sites are not only potential pollution sources of concern.

Construction and decommissioning will involve extensive site work over a 34 km long corridor. In this context, the sources need to be widened in order to consider the impact of construction operations.

These all provide potential sources of contaminated materials that will need to be assessed as part of the EIA process.

The source pathway receptor model can also be applied to flooding-related risks. In the context of this development, the sources would be floodwater.

### **3.1.2 Receptors**

The following receptors have been identified across the study area:

- Human Health : Construction workers, site users, site neighbours;
- Environment: Groundwater aquifers, surface water bodies, coastal water bodies; and
- Built Environment: residential, commercial (primarily farming-related) property and infrastructure.

### **3.1.3 Potential Pathways**

For a risk to exist the source and receptor must be connected by a viable pathway. Potential pathways by which human and environmental receptors may be impacted upon are as identified below:

- Ingestion of contaminated soils, dust and fibres: During demolition and construction of the proposed development, site workers and visitors who are dealing closely with excavated soils may come into contact with contaminants through ingestion of soils and dust. Site end users, potential residents, or workers or users of the development may also be impacted by the ingestion of soils and dust should areas of open soils be present post development;
- Dermal contact with soils and dust: During site development, site workers who are engaged in ground works and handling of excavated soils may come into skin contact with impacted material;
- Inhalation of vapours, dust, fibres and gases: Volatilisation of hydrocarbon products and the emission of soil gases including carbon dioxide, methane, or other toxic and explosive gases may occur in the subsurface and be present in both indoor and outdoor air. Ground gas, potentially generated by the peat bogs within the study area may migrate into confined spaces including open trenches. Generation of dust and potentially fibres through excavation, and stockpiling of excavated material; particularly during any earthworks may impact construction workers;
- Transfer of contaminants via surface run off: From surface run off releasing contaminants from within the ground/contaminated areas and transferring to other areas and into surface water systems;
- Gas Migration: From made ground and peat directly beneath or adjacent to the site, into confined spaces (i.e. any basement structures);
- Lateral and Vertical Migration of Contaminants: Contaminants released to the ground through spillage, presence in contaminated strata or leaks may migrate vertically or laterally through the underlying strata. Service corridors, existing and proposed may provide preferential pathways for such contamination; and
- In the context of flood risk, the pathways would comprise the overland flow routes or in-channel routes taken by floodwaters to receptors such as properties.

### 3.2.1 Plausible Pollutant Linkages (PPL)

From a review of the existing information the qualitative risk assessment for the site has identified the following potential pollution linkages.

**Table 10: Plausible pollution Linkages**

Source	Pathway	Receptor	Plausibility of linkage
<b>Filling Station (Keihill filling station) (hydrocarbons , volatile and semi volatile gases)</b>	Inhalation Dermal contact Ingestion	Human Health	Plausible
	Lateral and vertical migration via man-made pathways such as drains and underground services, historical field boundaries Transfer of contaminants via surface run off	Environment	Plausible
<b>Fabricators (metals)</b>	Inhalation Dermal contact Ingestion	Human Health	Plausible
	Lateral and vertical migration via man-made pathways such as drains and underground services, historical field boundaries Transfer of contaminants via surface run off	Environment	Plausible
<b>Registered Landfill (potential for a wide range of contaminants, possibly including hydrocarbons, metals and asbestos containing materials)</b>	Inhalation Dermal contact Ingestion	Human Health	Plausible
	Lateral and vertical migration via man-made pathways such as drains and underground services, historical field boundaries Transfer of contaminants via surface run off	Environment	Plausible
<b>Backfilled quarries- made ground (un known composition , likely to comprise mostly inert material)</b>	Inhalation Dermal contact Ingestion	Human Health	Plausible
	Lateral and vertical migration via man-made pathways such as drains and underground services, historical field boundaries Transfer of contaminants via surface run off	Environment	Plausible
<b>Peat Bogs (natural gases – methane, carbon dioxide)</b>	Lateral and vertical migration via man-made pathways such as drains and underground services, historical field boundaries Gas accumulation in confined spaces.	Human Health Built environment	Plausible
<b>Construction operations (sediment-laden runoff and spillages)</b>	Multiple routes into water environment	Environment	Plausible
<b>Floodwater</b>	Multiple routes to new receptors, if flood storage and conveyance is affected.	Property	Plausible

## 4 Conclusions

The desk study has provided a baseline view of the environmental setting of the land within the modified OnTI. This includes geology, hydrogeology, hydrology and historic sites.

This baseline contaminated land data has been interpreted using standard contaminated land appraisal principles, namely the conceptual modelling of possible pollutant linkages and their qualitative risk assessment. In so doing, potentially contaminated land within the modified OnTI has been identified considering the proposed development and land's future use. Potentially contaminated land has been categorised to provide an indication of the requirement for further works. Plausible Pollutant Linkages between the following sources and a range of sensitive receptors have been established:

- Filling Station (Keihill filling station) (hydrocarbons , volatile and semi volatile gases);
- Fabricators (metals);
- Registered Landfill (potential for a wide range of contaminants, possibly including hydrocarbons, metals and asbestos containing materials) ;
- Backfilled quarries- made ground (unknown composition , likely to comprise mostly inert material);
- Peat Bogs (natural gases – methane, carbon dioxide);
- Construction operations (sediment-laden runoff and spillages); and
- Floodwater.

The pathways and receptors associated with these sources need to be considered in detail as part of the modified OnTI assessment and design process.

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## Appendix 1 – Summary of results of site survey of water supplies

### Public Water Supplies

Reference	Name	East	North	Source	Notes
n/a	Fortrie intake	373000	858000	springs	No evidence of intake/springs - field filled with crops. Quarry located at bottom of field - 20-30m deep with borehole pump at bottom.

### Private Water Supplies

Reference	Name	East	North	Source	Notes
PWS/N/2505	The Cottage, Mill Of Boyndie	366285	863611	n/a	House derelict
PWS/N/1001	Roadside Cottage	366544	864012	Mains supply	
PWS/N/0075	Mill Of Boyndie Cottage	366321	864127	Mains supply	Derelict cottage
PWS/N/0882	Mill of Boyndie	366311	864112	Mains supply	Derelict farmhouse - mains supply but shut off due to leak in passed. Farmyard supply tanked in from other property
PWS/N/0041	Wardend Cottage	366422	861205	Spring	
	Wardend	366645	861272	Spring	
PWS/N/0038	Inverichnie House West	369293	860743	Spring	Spring to north of properties. Awaiting connection to mains supply - water quality (see proforma)
	Inverichnie House	369309	860726	Spring	
PWS/N/0800	The Coach House	369412	860713	Mains supply	
PWS/N/0834	Upper Inverichnie	370218	860502	Well	Used at farm but also mains supply. Farmer not in to clarify usage - spoke to neighbour.
PWS/N/0063	Foulzie Villa	371559	859875	Well	Shallow groundwater/surface water header tank in field opposite White Cottage. Water pumped up from near Over Foulzie.
	1 Foulzie Cottages	371581	859775	Mains supply	
	2 Foulzie Cottages	371586	859773	Mains supply	
	Foulzie	371816	859841	Well	Same supply as Foulzie Villa and Over Foulzie.
PWS/N/1055	White Cottage Hill Of Foulzie	372448	859628	Mains supply	Used to be private
PWS/N/2470	Gorrachie Smithy	373721	857478	Well	
PWS/N/0763	Gowanlea	373856	857380	Well	
PWS/N/1060	Milltack	373375	857306	unknown	2 cottages. Tenants didn't speak enough English to confirm source other than that the supply was private
PWS/N/1045	Mill Of Balmaud Bungalow	373729	857140	Well	Supplies two cottages and bungalow. Well adjacent to cottages in field.
PWS-5951	1 Mill Of Balmaud Cottages	373747	856926	well	Same supply as Mill of Balmaud Bungalow
PWS/N/1123	Lintmill	373785	856626	Well	Owned by Mill of Balmaud
PWS/N/1121	Mill of Balmaud	374353	856782	Well	In farm yard

Reference	Name	East	North	Source	Notes
PWS/N/1100	Cowsmill	374023	856511	Well	information from neighbour at Mill of Balmaud
PWS/N/1113	Backhill Of Yonderton	374905	856373	No water	Owned by Mill of Balmaud - property vacant
PWS/N/0340	Yonderton	375457	855334	Well	Owned by Mill of Balmaud
	1 Yonderton Cottages	375598	855176	Well	
PWS/N/1065	Mill Of Fintry	375193	854835	Well	Information from neighbour at the Lath who is on mains supply
PWS/N/2222	Cairnhill Cottage	378623	851990	Mains supply	
PWS/N/0510	1 Castle Of Auchry	378613	850481	Mains supply	Had the water source traced by Scottish Water
	Castle Of Auchry Farmhouse	378767	850645	Mains supply	
	2 Castle Of Auchry	378937	850588	Mains supply	
PWS-5772	Torbeck	379089	850362	Well	
PWS/N/1888	Waterside	379434	850462	Well	Well in farmyard. Not operational farm so just house
PWS/N/2676	The Willows	379550	850708	Well	
PWS/N/0422	Reona, Bridgend	379801	850129	Well	Well adjacent to Newton of Teuchar
	Bridgend	379807	850097	Well	
	Teuchar Lodge	379864	849974	Well	
	South Teuchar	379879	849319	Well	
	Kirkton Bungalow	379900	850050	Well	
	Kirkton	379952	849923	Well	
PWS/N/2212	South Teuchar Bungalow	379883	849402	Well	Same well as PWS/N/0422
PWS/N/2644	Castlehill	378713	850221	unknown	No response
	Castlehill	379192	849103	unknown	
PWS/N/2172	Newton of Teuchar	380160	849027	Mains supply	
PWS/N/2165	Caro's Haven	379802	848561	Well	Adjacent to burn supplies house and steadings.
PWS/N/0519	Hillbrae Greeness	379728	848253	Mains supply	
PWS/N/2230	Boghead Of Teuchar	380406	848231	Mains supply	
PWS/N/2163	Rowan Croft	379762	848078	unknown	No response - blinds pulled down so potentially vacant
PWS/N/2182	Quarry Croft	379824	847877	Mains supply	
PWS/N/2144	Hillview	380104	847895	Mains supply	
PWS/N/2233	Berryhill	380709	847706	Well	Shared with neighbour.
PWS/N/1896	Latchfold Croft	381406	847003	Well	Well supply. Second well exists which dried up in past but now has water again - unused.
PWS/N/2129	Meadowside	381351	846259	Well	Well supply in field adjacent to Mill of Muirtack. Only supplies Meadowside
PWS/N/2162	3 Rush Head	381216	846128	Well	House and farm derelict
PWS/N/2110	Swanford Farm	382382	845661	Well	Shallow well on far side of farm
PWS/N/0241	Little Swanford	382382	845661	Mains supply	

Reference	Name	East	North	Source	Notes
PWS/N/2132	Maryhill House	382688	845626	unknown	House very run down and looks uninhabited
PWS/N/2164	Rosebank Cottage	382752	845636	unknown	House uninhabited, run down and padlocked
PWS/N/2240	Upper Burnside	382670	845571	unknown	No response - looks inhabited
PWS/N/2225	Burnside	382682	845490	n/a	House empty
PWS/N/0217	The Neuk	383129	845521	unknown	No response but inhabited - dogs and parrot at property
PWS/N/0672	Bridge Valley	382380	845397	Mains supply	Info from farmer at Swanford Farm
PWS/N/0653	East Swanford	382829	844979	unknown	No response but inhabited - obviously being done up and car there. Possible well found in garden
PWS/N/2487	Mains Of Asleid	383649	844860	Mains supply	Put themselves on mains and old well not good quality.
PWS/N/2135	Mains of Asleid Cottage	383687	844751	Mains supply	
PWS/N/1893	Upper Mains Of Asleid	383650	844387	well	
PWS/N/0347	Mill House	379617	850721	well	Supplies Mill house, the willows and Auchry Lodge and Auchry House.
	Auchry Lodge	379704	850781	well	
	Auchry Villa, Auchry	380244	851062	well	
PWS/N/2176	Newton of Cairnhill	378808	852173	Mains supply	Cairnhill farm also on mains
PWS/N/2475	North Everton Auchry	379209	852461	Well	New farm house on mains all others and farm on well supply
	Meikle Cairnhill Bungalow	379261	852715	well/spring	Farmer says separate supply
	Muirfield	379690	851928	well	
PWS/N/0869	Upper Inchdrewer	365674	861001	n/a	House derelict
PWS/N/0032	Tobartaigh	366348	860837	Spring	feeds house and farm/farmhouse. Collection chamber in field to southeast of Tobartaigh.
	Tipperty	366601	860838	Spring	
PWS/N/0761	Slacks Croft	366433	859768	Spring	In woods circled on map+E15