Chapter 9
Geology, Hydrology, Hydrogeology, Water Resources and Peat

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Introduction

9.1 This chapter presents the findings of the assessment of the likely significant construction and operational effects of the proposed Kendoon to Tongland 132 kilovolt (kV) Reinforcement Project ('the KTR Project') on geology, hydrology, hydrogeology, water resources and peat, details of which are provided in **Chapter 4: Development Description** and **Chapter 5: Felling, Construction, Operational Maintenance and Decommissioning**. It details the baseline environment, based on desk-based studies supplemented by comprehensive field surveys of the Study Area. A description of potential effects and their significance, together with mitigation measures is also provided, including an assessment of cumulative effects.

9.2 This chapter should be read alongside **Chapter 10: Ecology** due to interactions between both chapters in terms of the potential effects of water quality on fish and other species/habitats and potential effects on Ground Water Dependant Ecosystems (GWDTEs) which are considered within this chapter. Planning policies of relevance to this assessment are provided in **Chapter 6: Planning Policy Context**.

9.3 The hydrology and water resources assessment was undertaken by Kaya Consulting. The geology, hydrogeology and peat assessment was undertaken by Fluid Environmental Consulting Ltd (Fluid). East Point Geo Prepared the Peat Landslide Hazard Risk Assessment.

9.4 The chapter is supported by the following appendices:

- **Appendix 9.1: Watercourse Crossings;**
- **Appendix 9.2: Catchment Areas Draining to Access Tracks and Initial SUDS Sizing;**
- **Appendix 9.3: Private Water Supply Assessment;**
- **Appendix 9.4: Peat Survey Report;**
- **Appendix 9.5: Outline Peat Management Plan;**
- **Appendix 9.6: Peat Landslide Hazard Risk Assessment; and**
- **Appendix 9.7: Ground Water Dependent Terrestrial Ecosystem Assessme**nt.

Scope of the Assessment

9.5 Effects assessed in detail are listed in **Table 9.1** below. On the basis of the desk based and field survey work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, and feedback received from consultees, a number of topic areas have been 'scoped out' of detailed assessment, as proposed in the Scoping Report. **Table 9.1** details the potential effects assessed in detail (scoped in) and those scoped out of assessment.

Table 9.1: Effects Scoped in and Scoped Out

Connection	Potential Effects Scoped in to Detailed Assessment	Potential Effects Scoped out of Detailed Assessment
P-G via K	Effects during construction on surface and ground water quality and private drinking water supplies. Effects on channel morphology (bank erosion and channel form) during construction. Effects during construction on run-off rates and flood risk. Effects during construction on GWDTEs[1]. Direct loss and/or indirect disturbance of peat during construction. Direct losses of peat occur where peat is excavated and cannot be appropriately re-used. Indirect peat loss occurs where temporary infrastructure covers the vegetative peat surface or activities near the peat, such as excavation and drainage can dry the peat out. Effects on hydrology/flood risk during operation.	Effects on bedrock geology during both construction and operation. Changes to public/private water supply yield because of changes to run-off rates and volumes during both construction and operation. Operational effects on surface water quality and PWS. Cumulative effects on water quality and hydrology during construction and operation taking into account other development proposals (**Figure 3.1**) and the other five KTR connections. There are a number of wind farm developments within the Water of Ken/River Dee catchment area, which all drain (indirectly) into the Water of Ken/River Dee. Assuming these wind farm schemes have all been designed and will be constructed in line with Scottish Planning Policy (SPP) and national guidelines with respect to SUDS and pollution control, there will be no cumulative effect on downstream catchments. Cumulative effects on peat, assuming the other developments i.e. wind farms have followed best practice guidance, avoided deep peat where possible and can appropriately re-use/reinstate any excavated peat. Effects on peat during the operational phase.
C-K	As for P-G via K	As for P-G via K
E-G	As for P-G via K	As for P-G via K
BG Deviation	As for P-G via K (except peat due to the absence of peat)	As for P-G via K and also: • Direct and indirect disturbance of peat due to the absence of peat.
G-T	As for P-G via K. Peat Slide Risk[2].	As for P-G via K
N and R Removal[3]	P-G via K connection (N and part of R route north of Glenlee): • effects during decommissioning on surface water quality private drinking water supplies. G-T connection (part of R route south of Glenlee): • Effects during decommissioning on surface water quality and private drinking water supplies. • Effects on channel morphology (bank erosion and channel form) during decommissioning (associated with the number of watercourse crossings).	As for P-G via K and also: • Effects during decommissioning on run-off rates and flood risk. • Direct and indirect disturbance of peat during decommissioning as the access tracks are temporary and will be floated where required with no excavation/earthworks required.
KTR Project as a Whole	As for P-G via K	As for P-G via K

[1] Small areas of moderately dependent GWDTE are present in the P-G via K and G-T connections only, so effects on GWDTE are only assessed for these connections.

[2] As detailed in Appendix 9.6, the requirement for a peat slide risk assessment was screened out of all connections with the exception of G-T.

[3] The assessment of effects for the removal of 'N' and 'R' routes is presented within the assessment of the effects of the P-G via K connection and the G-T connection.

Assessment Methodology

Legislation and Guidance

Legislation

9.6 This assessment is carried out in accordance with the principles contained within the following legislation:

- The Flood Risk Management (Scotland) Act 2009;
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR);
- Water Framework Directive (2000/60/EC) (WFD), and Water Environment and Water (Scotland) Act (WEWS Act) 2003;
- Pollution Prevention and Control (Scotland) Regulations 2012;
- The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 ('the 2017 EIA Regulations') as amended;
- Control of Pollution Act 1974 (as amended) Part II: Pollution of Water;
- Surface Waters (Fish life) (Classification) (Scotland) Directions 2007;
- The Water Supply (Water Quality) (Scotland) Regulations 2001;
- European Drinking Water Directive (Council Directive 98/83/EC);
- Private Water Supplies (Scotland) Regulations 2006;
- Water Environment (Drinking Water Protected Areas) (Scotland) Order 2007;
- Groundwater Daughter Directive (2006/118/EC) (GWDD);
- The Scotland River Basin District (Classification of Water Bodies) Directions 2009;
- The Scotland River Basin District (Surface Water Typology, Environmental Standards, Condition Limits and Groundwater Threshold Values) Directions 2009; and
- The Waste Management Licensing (Scotland) Regulations 2011.

Guidance

9.7 This assessment is carried out in accordance with the principles contained within the following documents:

- The Scottish Environment Protection Agency (SEPA)'s Guidance for Pollution Prevention (e.g. PPG1, GPP2, GPP4, GPP5, PPG6, GPP8, GPP21, GPP22 and GPP26);
- Scottish Government Planning Advice Notes (PANs) and Guidance (including PAN 51 Planning, Environmental Protection and Regulation; PAN 1/2013 Environmental Impact Assessment; PAN 69 Planning and Buildings Standards Advice on Flooding; and PAN 79 Water and Drainage);
- Scottish Executive: River crossings & migratory fish: Design guidance, 2012;
- SEPA: Technical Flood Risk Guidance for Stakeholders, version 12 (SEPA, May 2019);
- SEPA: Water Environment (Controlled Activities) (Scotland) Regulations 2011 - A Practical Guide, Version 8.4 October 2019;
- SEPA: Position Statement to support the implementation of the Water Environment (Controlled Activities) (Scotland) Regulations 2005, WAT-PS-06-02: Culverting of Watercourses - Position Statement and Supporting Guidance, Version 2, June 2015;
- SEPA: Engineering in the Water Environment Good Practice Guide – River Crossings, WAT-SG-25, 2010;
- SEPA: Engineering in the Water Environment Good Practice Guide – Temporary Construction Methods, WAT-SG-29, 2009;
- SEPA: Sector Specific Guidance: Construction Sites, WAT-SG-75, 2018;
- SEPA: Policy No. 19, Groundwater protection policy for Scotland, 2009;
- SEPA: Special requirements for civil engineering contracts for the prevention of pollution, WAT-SG-31, 2006;
- SEPA: Land Use Planning System, SEPA Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems, 2017;
- SEPA (2018) Flood Risk and Land Use Vulnerability Guidance, version 3, February 2018;
- SEPA (2010) Regulatory Position Statement – Developments on Peat (SEPA, 2010);
- Forestry Commission (2017) The UK Forestry Standard;
- Scottish Water standards and policies, including Sewers for Scotland 3rd edition, 2015 and Water for Scotland 3rd edition, 2015;
- CIRIA: The SUDS Manual (C753) 2015;
- CIRIA: Control of water pollution from linear construction projects. Technical guidance (C648) 2006;
- CIRIA: Control of water pollution from linear construction projects. Site guide (C649) 2006;
- CIRIA: Control of water pollution from construction sites: Guidance for consultants and contractors (C532) 2001;
- CIRIA: Groundwater Control – design and practice (C515) 2016;
- Peatland Survey. Guidance on Developments on Peatland. Scottish Government, Scottish Natural Heritage (SEPA 2017);
- Good Practice during Windfarm Construction[4] (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
- A Handbook of Environmental Impact Assessment, 5th Edition (SNH, 2018);
- Scottish Government (2017) Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments (Second Edition). Scottish Government;
- Code of Practice for the sustainable use of soils on construction sites (DEFRA, 2009); and
- Marine Scotland: Scoping advice on information required in environmental impact assessment reports in relation to assessing risk to freshwater and diadromous fish and associated fisheries (Scottish Government, April 2018).

Consultation

9.8 In undertaking the assessment, consideration has been given to the scoping responses and other consultation undertaken as detailed in **Table 9.2**.

Table 9.2: Consultation Responses

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
Dumfries and Galloway Council (D&GC), Flood Risk Management Team	Formal Scoping Consultation	D&GC advised that the area proposed for development intersects sections of the Medium Likelihood (0.5% Annual Exceedance Probability) fluvial floodplain from SEPA.	Noted. Fluvial flood risk is described in the existing conditions sections of the chapter.

[4] Whilst this document focusses primarily on wind farm developments, as this document provides good, recent and relevant guidance of the requirements and considerations for constructing infrastructure in remote and rural locations with a variety of land uses including forestry and peatland, it is also considered applicable to the KTR Project.

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
(FRMT), 3 August 2017		The FRMT has no objection to the proposed development but advised that: • surface runoff from the site during and after construction should be managed; • runoff should mimic that of existing conditions and not be increased; and • any significant increase in the rate of runoff into the watercourses may increase the flood risk downstream.	Surface runoff during and after construction will be managed by Sustainable Drainage Systems (SUDS), as described in **Appendix 5.2: Embedded and Additional Mitigation and Monitoring Measures**. This chapters considers potential effects on flood risk.
SEPA, August 2017	Formal Scoping Consultation	SEPA notes that it is likely that construction site licences will be required to be obtained under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended) (CAR). SEPA recommends that discussions take place with them during the period of appointing a construction contractor or earlier.	SP Energy Networks (SPEN) has been in on-going discussions with SEPA and the requirements for a construction site licence (CSL) and a pollution prevention plan are described in this Chapter.
Marine Scotland, Scottish Government, 26 May 2017	Formal Scoping Consultation	Marine Scotland notes that the River Dee catchment supports salmon and trout populations and advises the developer to consider all fish of economic and conservation value throughout the course of the development, including construction and decommissioning stages.	Noted. Fish populations and indirect effects on fish are considered in **Chapter 10**.
		Marine Scotland recommends consulting their generic scoping guidelines in relation to the potential impacts on water quality and fish populations associated with the proposed activities.	The Marine Scotland (2018) guidance was consulted in relation to assessing and mitigating the potential effects on water quality and fish (see **Chapter 10**).
		The potential cumulative impacts on water quality and fish populations as a result of the present proposal and adjacent developments (including fish farms) should be considered.	Impacts on water quality are considered in this chapter. Impacts on fish populations are addressed in **Chapter 10**. Cumulative impacts are scoped out (see **Table 9.1**).
		Marine Scotland advise contacting the Dee District Salmon Fishery Board.	The Dee District Salmon Fishery Board was contacted (see **Chapter 10**).
		Marine Scotland notes that the proposal is unlikely to have a significant impact on the water quality and fish populations along the route of the proposed project provided the above potential impacts are fully addressed and appropriate site-specific mitigation measures are implemented along with adherence to current best practice construction techniques and published guidance.	Potential impacts on water quality and fish are addressed in this chapter and **Chapter 10**. Current best practice construction techniques and relevant guidance have been followed. Site-specific mitigation measures are recommended, where required.
Scottish Government, Energy Consents Unit	Formal scoping opinion of behalf of Scottish Ministers.	Ministers are content with the guidance considered in the scoping report, and that the proposed targeted peat depth surveys are appropriate. They are content with the proposed list of effects and with the organisations the proposed to be approach to inform the EIA.	Noted.
		Ministers re-iterate the concerns of Marine Scotland and recommend consideration of all fish of economic and conservation value, including during construction and decommissioning stages. This includes impacts on water quality.	Noted. Potential impacts on water quality (and mitigation) are addressed in this chapter. Effects on fish are covered in **Chapter 10**.
	Other consultation (20th May email)	Whilst not addressed through the Scoping Opinion, a request was made that consideration is given to the preparation of a Peat Landslide Hazard Risk Assessment (PLHRA) in accordance with the best practice guidance[5].	A PLHRA has been undertaken and a summary of the findings presented in this chapter. The detailed PLHRA is provided as **Appendix 9.6**.
SEPA, Meeting at Dumfries Office, 3 October 2017	Consultation to discuss KTR Project	SEPA clarified that if a watercourse does not appear on the 1:50,000 Ordnance Survey maps, the temporary works (e.g. crossing for construction access) do not require to be registered under CAR. However, standard mitigation measures and good practice should be employed to avoid pollution, sedimentation and bank erosion on all affected watercourses.	Noted. Good practice measures are included as embedded mitigation and are part of the project design. Embedded mitigation measures are described in **Appendix 5.2** and additional mitigation measures are identified in this chapter where required.
		SEPA noted that consideration should be given to the type of materials being imported to site for access track construction. There needs to be certainty material contamination will not be washed into surface water areas during periods of high rainfall.	Noted. Considered and assessed in this chapter.
		Noted that consideration should be given to existing field drain locations when planning access tracks. Past issues with field drains discharging directly on to temporary access tracks leading to pollution issues were highlighted.	Surface watercourses and drains have been identified during the site survey and were taken into account when planning access tracks. Underground field drains will be identified during detailed site investigations prior to construction. A desk-based assessment of catchment areas and flow paths draining towards access tracks was carried out to inform drainage design and will help inform locations of drainage paths (**Appendix 9.2**).
SEPA, Response to Data Request, 23 May 2019	Request for data on groundwater abstractions within the KTR Project area and 1km buffer zone.	SEPA searched the area and provided details of 3 CAR abstraction licenses close the KTR project area: CAR/L/1012323 Galloway Hydros: relates to surface water abstractions	Used to inform baseline assessment. The surface water abstractions were noted. These are related to water

[5] https://www.gov.scot/publications/peat-landslide-hazard-risk-assessments-best-practice-guide-proposed-electricity/pages/4/

Consultee and Date	Scoping/Other Consultation	Issue Raised	Response/Action Taken
		from numerous watercourses and reservoirs for hydropower schemes. CAR/L/1119497 Glenlee Burn: relates to surface water abstraction for Glenlee Power Station. CAR/L/1011302 Kenmure Fish Farm: relates to surface water abstraction from the Water of Ken and a groundwater abstraction for the fish farm hatchery.	abstractions to power the hydropower schemes in the area and will not be impacted by the KTR Project and therefore not considered further. Only one groundwater abstraction licence (at Kenmure Fish Farm) was noted in the area and used to inform baseline and effects assessment.
Environmental Health Officer, D&GC, Emails 21 March 2017, 16 April 2019, 21 April 2019 and 23 May 2019	Request for data on Private Water Supplies (PWS) and groundwater abstractions within 1km either side of the proposed KTR Project. Further data requests were submitted once the accesses and design freeze was determined for the KTR Project.	D&GC provided a list, including national grid coordinates and basic data of 16 PWS close to the project.	Used to inform baseline assessment.
		D&GC noted that there may be other properties served by a PWS within 1km either side of the proposed route that are not known to them.	Noted. Additional PWS data was obtained from the Drinking Water Quality Regulator for Scotland online map[6].
		The council provided further information in 2019 on other PWS close to the project, proposed accesses and the existing R route to be removed.	Used to inform baseline assessment.

Study Area

9.9 The KTR Project is located mainly within the Water of Ken and River Dee catchment (see **Figure 9.1**). The Water of Ken rises in the Carsphairn hills, and flows southward, passing through Carsfad and Earlstoun lochs. From there, the river flows south before widening to form Loch Ken. The River Dee (known as the Black Water of Dee) enters Loch Ken from the west, and south of the loch the river is known as the River Dee. The Water of Deugh enters the Water of Ken at Kendoon.

9.10 A small section of the G-T connection drains to the west towards the Tarff Water catchment. The River Dee and Tarff Water confluence is around 700m downstream of the southern extent of the KTR Project, just downstream of the tidal limit of both watercourses. The tidal reach of the River Dee enters the Solway Firth south of Kirkcudbright.

9.11 The Study Area for the assessment comprises the KTR Project infrastructure and 100m and 250m buffer zones from infrastructure and the watercourses and catchments located upstream and downstream (see **Figure 9.2**). The KTR Project passes over several major tributaries of the Water of Ken/River Dee including the Water of Deugh, which enters the Water of Ken at Kendoon, the Coom Burn, Polharrow Burn and Kenick Burn, as well as numerous other smaller watercourses. These are all within the larger River Dee catchment. A small section of the KTR Project is within the Tarff Water catchment. **Table 9.3** provides an overview of catchment characteristics of representative watercourse in the KTR Project area. Catchment areas are shown in **Figure 9.1**.

Table 9.3: Key Catchment Descriptors and Design Flow Estimates for Watercourses

Catchment Name	ID	X	Y	AREA[1] (km^2)	BFIHOST[2]	FARL[3]	SAAR[4] (mm)	2-year flow[5] (m^3/s)	200-year flow[6] (m^3/s)
Barstobrick Burn	1	268800	561900	0.6	0.36	0.4	1340	0.58	2.14
Gatehouse Burn	2	266650	563850	0.9	0.38	1	1592	1.1	4.2
Kenick Burn	3	265750	565150	5.2	0.37	0.9	1691	6.1	19.9
Knocknairling Burn	4	261450	577400	8.4	0.40	1	1792	9.4	30.1
Mid Burn	5	261750	573200	0.8	0.42	1	1614	0.9	3.2
Craigshinnie Burn (Park Burn)	6	261150	580300	7.2	0.40	0.99	1831	8.0	24.8
Polharrow Burn	7	260050	584500	40.7	0.36	0.9	2087	55.9	158.6
Pultarson Burn	8	261200	575600	1.1	0.43	1	1785	1.2	4.2
River Dee (Black Water)	9	264950	569550	190.7	0.36	0.8	2071	227.4	614.8
Tarff Water	10	268450	554100	60.5	0.44	0.9	1460	35.3	105.9
Water of Deugh	11	260350	587650	38.2	0.33	1	1870	50.2	143.8
Water of Ken (at Loch Ken)	12	263950	576250	450.4	0.36	0.9	1748	379.5	999.2
Coom Burn	13	261250	580350	21.5	0.41	0.9	1889	22.4	65.6
River Dee (at Tongland)	14	269450	553500	899.4	0.38	0.8	1709	617.0	1589.1

[1] AREA represents the total catchment area, according to the FEH Web-service.
[2] BFIHOST is a "base flow index" used to measure the catchment responsiveness, based on the Hydrology of Soil types (HOST) classification.
[3] FARL is the Flood Attenuation by Reservoirs and Lakes index. This provides a guide to the degree of flood attenuation attributable to reservoirs and lakes in the catchment. Values close to unity (1) indicate the absence of attenuation provided by lakes and reservoirs. Values below 0.8 indicate a substantial influence on flood response.
[4] SAAR refers to the average annual rainfall in the standard period (1961-1990) in millimetres.
[5] Design flows were estimated for each catchment for the 2-year and 200-year return period. The 2-year return period, or QMED, is the flow that has an annual exceedance probability of 50%. This is therefore a frequent flood event, roughly equivalent to the river in question reaching "bank-full".
[6] The 1 in 200-year return period flow is the flow that has an annual exceedance probability of 0.5%. This is therefore a far larger event that is statistically less likely to occur within a given year. The area of flooding caused by a 200-year return period flow flood is often considered to be the "functional floodplain" in Scotland, for planning purposes.

9.12 The River Dee (at Tongland) drains a catchment area of 899km^2 and most of the KTR Project infrastructure is located within the River Dee catchment (see **Figure 9.1**). The Tarff Water catchment is smaller, draining a catchment area of 60km^2; several small sections of the KTR Project G-T connection lie within the Tarff Water catchment. The Tarff Water enters the River Dee downstream of the tidal limit.

9.13 The flow estimates provided in **Table 9.3** were estimated using the ReFH2[7] rainfall-runoff method using the "winter" rainfall profile and employing the most up-to-date rainfall database from 2013. This method uses the provided catchment descriptors to calculate a peak flow based on the characteristics of the catchment. This method is not based on measured data. This method was used for all catchments to allow comparison of flows between each catchment. However, the ReFH2 method has limitations and cannot fully account for unusual catchment descriptors. For example, ReFH2 is unlikely to provide best estimates for catchments with FARL values of less than 0.9, due to the unknown impact of the reservoirs and lakes. Therefore, the flow estimates should be used only as a guide to allow comparison between watercourses in the Study Area.

9.14 The average annual temperature within south-west Scotland is around 8.0 to 9.0°C (Met Office website) The average annual rainfall is 1,709mm for the River Dee catchment and 1460mm for the Tarff Water catchment (Flood Estimation Handbook (FEH) web-service) (see SAAR values in **Table 9.3**).

9.15 The internationally designated site, the Loch Ken and River Dee Marshes Special Protection Area (SPA) and Ramsar Site is located within the Water of Ken/River Dee catchment, downstream of the KTR Project infrastructure (**Figure 10.2** in **Chapter 10**). This site is designated for its wintering Greenland white-fronted goose and greylag goose populations. The site is also designated as a Site of Special Scientific

[6] http://dwqr.scot/private-supply/pws-location-map/
[7] Revitalised Flood Hydrograph (ReFH) model.

Interest (SSSI). The catchment also supports important salmon and trout populations (Marine Scotland consultation response; see **Table 9.2**).

Private Water Supplies

9.16 D&GC provided information on PWS from their database. This data was supplemented with data from the Drinking Water Quality Regulator of Scotland online map[8]. Site visits of PWS that were close to or potentially affected by the KTR Project were also undertaken to verify the data, including discussions with the PWS owner where this was possible. For context, a summary of PWS source locations within 1km of the KTR Project are detailed in **Table 9.4** and their locations, along with locations of supplied properties (if known), are shown in **Figures 9.2.1-27**. Of these, only those within 250m of infrastructure are assessed as detailed below.

Table 9.4: Details of Private Water Supplies (PWS) within 1km of the KTR Project

Nat. Grid Ref (source)	KTR Connection[1]	Source Name	Source Ref	Source Type	Type[2] (A or B)	No of Properties and Use[3]	Recent Sample /Result[4]
NX59219 90132	P-G via k	Carminnows Lodge	100395	Borehole	B	1 D	-
NX59167 89959	P-G via K	High Carminnows	103122	Borehole	B	1D	
NX59118 89753	P-G via K	Polquhanity	99844	Spring	B	1 D	-
NX59607 88800	P-G via K	Dalshangan	103096	Borehole	B	1 D	-
NX59769 88406	P-G via K	Hawkrigg	-	Borehole	A	2 D	-
NX59800 87900	P-G via K	Dundeugh	97986	Surface Watercourse	B	16 D	-
NX60035 87804	P-G via K	Phail Barcris	99068	Borehole	B	1 D	-
NX60000 86500	P-G via K & C-K	Stroangassel	99962	Spring	B	1 D	None
NX60300 85400	P-G via K & C-K	Carsfad Cottage	100106	GW Spring	A	1 D, 1 C	P
NX60491 84201	P-G via K	Inverharrow	102598	Borehole	B	1 D	-
NX60680 83230	P-G via K	Barskeoch Mains	99037	Spring	B	1 D	None
NX59885 82911	P-G via K	Hannaston	-	-	B	1 D	-
NX60942 81115	P-G via K & E-G	Waterside	100069	Surface Watercourse	B	1 D	None
NX59894 80974	G-T & BG Deviation	Ford Farm	-	-	B	1 D	-
NX59687 80500	G-T & BG Deviation	Old Glenlee	-	-	B	1 D	-
NX60500 80099	G-T & BG Deviation	Glenlee	97995	GW Spring	A	10 D	P
NX57500 79500	G-T & BG Deviation	Glenlee Kennels	99417	Spring	B	1 D	None
NX60409 78722	G-T	Glenlee Source of 003	-	Spring	B	1 L	-
NX60800 78700	G-T	Airie Cottage	98888	Spring	B	1 D	Micro: F
NX61780 78886	G-T	Sheil	98376	GW Spring	B	8 D	Pass
NX61811 78030	G-T	Achie Farm	98884	Spring	B	1 D	None
NX57000 76800	G-T	Clatteringshaws Complex	97973	Surface Watercourse	A	1 C	P: Apr 2016 (low pH)
NX62200 77500	G-T	Nether Achie	99799	Spring /Surface Watercourse	B	1 D	None
NX62120 77209	G-T	Waulkmill	100075	Spring	B	1 D	None
NX62347 76957	G-T	The Brough	105186	Spring	B	1 D	Micro: F, Chem: P Sep 2017 (low pH)
NX60800 77000	G-T	Darsalloch	99303	Surface Watercourse	B	1 D	Micro: P Mar 2014
NX62200 76200	G-T	Knocknairling	98011	Spring /Surface Watercourse	B	2 D	P: Jul 2012
NX63400 69583	G-T	Airie Mossdale	-	-	A	1 D	-
NX65599 68503	G-T	Harley Cottage	-	-	A	1 D	-
NX64682 68448	G-T	Slogarie	98038	Spring	A	8 D	Micro: F, Chem: P (F on colour) Jan 2019
NX65188 68329	G-T	Woodedge	-	-	B	1 D	-
NX65900 67600	G-T	Nether Crae	99804	Spring	B	1 D	P: May 2017 (low pH)
NX67108 66107	G-T	Summerhill Supply	99966	Well	B	1 D	None
NX63700 64900	G-T	High Lochenbreck	98486	GW Spring	A	4 D	None
NX64782 65024	G-T	Lochenbreck Well	-	Dry	-	0 D	-
NX66431 64779	G-T	Cullenoch	99233	Surface Watercourse	B	1 D	P: Dec 2018
NX67300 64699	G-T	Craigcroft	99259	Spring / Surface Watercourse	B	1 D	P
NX67800 64400	G-T	Gatehouse Farm	99409	Spring	B	1 D	None
NX66703 63359	G-T	Edgarton	99424	Spring / Surface Watercourse	B	1 D	None
NX66931 63364	G-T	Edgarton Cottage	99425	Spring	B	1 D	None
NX66568 63332	G-T	Cot Cottage	104665	Spring	A	1 D	P: Mar 2019
NX68000 63300	G-T	Bargatton	98957	Spring	B	2 D	None
NX68504 60704	G-T	Backfell	-	-	B	3 D	-
NX68710 59338	G-T	Queenshill Cottage	-	-	B	1 D	-
NX68407 59254	G-T	Fellend Ringford	-	-	A	-	-
NX71006 59201	G-T	Barncrosh	-	-	A	11 D	-
NX71511 58802	G-T	East Lodge	-	-	B	1 D	-
NX68877 56956	G-T	Meiklewood	-	-	A	2 D	-
NX70161 56048	G-T	Park of Tongland	-	-	B	1 D	-

[8] http://dwqr.scot/private-supply/pws-location-map/

Nat. Grid Ref (source)	KTR Connection[1]	Source Name	Source Ref	Source Type	Type[2] (A or B)	No of Properties and Use[3]	Recent Sample /Result[4]
NX69800 55300	G-T	Parklea	99827	Spring	B	1 D	Lead: F
NX63381 80085	R route	Grennan - Dalry	98000	Spring / Surface Watercourse	B	5	P: Sep 2011 (low pH)
NX64101 79197	R route	Garplefoot	99395	Spring / Well	B	1	None
NX64473 77808	R route	Cubbox	99296	Spring	B	3	None
NX65725 76386	R route	Barnwalls	98947	Wells x 2	B	1	P: Mar 2018
NX64802 75907	R route	Low Park	99706	Spring / Well	B	1	P: Feb 2018 (low pH)
NX65688 74302	R route	Shirmers Farm	99928	Spring	B	1	None
NX65809 73716	R route	Ringbane	99866	Spring	B	1	None
NX67647 72516	R route	Auchrae Sauchs	-	Unknown	B	1	-
NX67744 72421	R route	Little Drumrash	99670	Spring	B	2	P: Aug 2004
NX69793 71503	R route	Fominoch	99354	Spring	B	1	None
NX70998 70605	R route	Culdoach - Parton	99314	Spring	B	1	None
NX70911 69899	R route	Parton Estate	98408	Surface Loch	B	6	P: Oct 2017 (high colour)
NX72100 69094	R route	Barbershall	98930	Spring	B	1	None
NX72202 66299	R route	Kenholm House	99550	Spring	B	1	None

[1] **KTR Connection**: P-G via K = Polquhanity to Glenlee via Kendoon, C-K = Carsfad to Kendoon, E-G = Earlstoun to Glenlee, G-T = Glenlee to Tongland, BG Deviation = BG route deviation, R route (to be decommissioned)

[2] **Type**: Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[3] **No of Properties and Use**: D = domestic, C = commercial, L = livestock

[4] **Sample Result**: P = pass, F = fail

[x] The source locations for High Carminnows and Dalshangan are unknown assumed to be close to the properties

Desk Based Research and Data Sources

9.17 The following data sources have informed the assessment:

- Ordnance Survey mapping at 1:10,000, 1:25,000 and 1:50,000 scales;
- Aerial Imagery and Google Earth historical images;
- Scotland's Soils website (http://map.environment.gov.scot/Soil_maps/?layer=1);
- SNH Carbon and Peatland Map 2016;
- The James Hutton Institute Soil Information for Scottish Soils;
- British Geological Survey Geology mapping 1:50,000 scale map Sheet 9W New Galloway Solid (1998) and Drift (1979) and Sheet 5W Kirkcudbright Solid (1993) and Drift (1980);
- British Geological Society Geological Mapping and Interactive Map and Boreholes database;
- Hydrogeological Map of Scotland (Scale 1:625,000) (Institute of Geological Sciences, 1988);
- Scottish Aquifer Properties Interim Report (BGS, NERC and Sniffer, June 2006);
- A GIS of aquifer productivity in Scotland explanatory notes (BGS, 2004);
- Groundwater Vulnerability Map of Scotland;
- Multi-Agency Geographic Information for the Countryside (MAGIC) website;
- Flood Estimation Handbook (FEH) Web Service[9];
- SEPA Flood Maps[10]; these show the likely extent of flooding for high, medium and low likelihood for fluvial, pluvial (surface water) and tidal flows[11]. The SEPA flood maps consider watercourses with upstream catchments greater than 3km^2, therefore many of the watercourses crossed by the overhead line (OHL) or proposed access tracks are too small to be considered within the SEPA map;
- Scotland's Environment Website and Interactive Map[12];
- 1m Light Detection and Ranging (LiDAR) topographic data for part of the route and surrounding areas (1m LiDAR available for the part of the route close to the Water of Ken/River Dee valley) (downloaded from Scottish Remote Sensing Portal);
- Ordnance Survey 5m digital terrain data;
- Data on private water supplies (PWS) from D&GC and the Drinking Water Quality Regulator for Scotland online map;
- Scottish Water Utility Information; and
- Details of groundwater abstraction licences from SEPA.

Field Survey

9.18 Walkover surveys by two hydrologists were undertaken along the length of the proposed new connections and at key locations on the existing R route (south) to obtain baseline information and inform constraints mapping for location of infrastructure. The main aims of the field survey were to:

- identify, photograph and measure all watercourse crossings (proposed and existing);
- identify and map other water features such as wetlands and springs;
- undertake overview assessment of areas identified as floodplain within the SEPA Flood Maps;
- ground truth identified water supplies to see if supplies exist and to identify nature of supply (e.g. open or protected); and
- provide general overview of landscape, topography and land cover of importance to hydrology.

9.19 The hydrology walkover surveys were carried out on the following dates:

- 1st February 2017: G-T connection – Slogarie section;
- June and July 2017: Polquhanity to Tongland connection (whole route);
- 4th October 2017: G-T (Bargatton Farm section);
- 15th September 2017: BG deviation and Glenlee Power Station;
- 21st – 25th May 2018: Selected key locations on R route (south);
- 1st and 2nd November 2018: G-T connection (Slogarie section and Glenlee Power Station); and
- 7th and 8th May 2019: KTR Project accesses.

[9] Flood Estimation Handbook Web Service, https://fehweb.ceh.ac.uk/
[10] SEPA flood maps, viewed online at http://map.sepa.org.uk/floodmap/map.htm
[11] Predicted flood extents are updated on a regular basis by SEPA and can be viewed online at http://map.sepa.org.uk/floodmap/map.htm. SEPA do not permit publishing the flood extents.
[12] Scotland Environment Maps https://www.environment.gov.scot/maps/scotlands-environment-map/

9.20 Peat depth surveys were undertaken along those sections of the proposed new OHLs and associated infrastructure (access tracks, construction compounds, quarries etc.) where the soils map of Scotland, the British Geological Survey map of superficial deposits or the SNH Carbon and Peatland 2016 mapping indicated there to be a potential for peat deposits to be present. No peat depth surveys were undertaken along the route of the existing N and R routes on the basis that it is proposed that all tracks required for their removal will be temporary (steel matting or undertaken by low pressure vehicles) and therefore no significant earthworks will be required for the removal of the existing towers.

9.21 Peat depth surveys were undertaken between 2017 and 2019 to gather baseline information, inform constraints mapping and design and to allow quantitative information to be gathered for the draft Outline Peat Management Plan (**Appendix 9.5**) and Peat Slide Risk Assessment (**Appendix 9.6**).

9.22 The peat depth surveys included undertaking peat probe penetration tests and verifying the peat probe accuracy by undertaking peat cores in accordance with Scottish Peat Surveying Guidance (SEPA 2017). Further information on the peat survey is presented within **Appendix 9.4**. Whilst the KTR Project has been designed to minimise disturbance to peatland, noting its importance and level of protection as highlighted in Scottish Planning Policy, it has not been possible to avoid areas of peatland entirely. Where areas of peat were encountered around the infrastructure, these are considered within **Appendix 9.5** which includes the following information:

- estimation of the volume of peat likely to be excavated during construction;
- identification of further opportunities to minimise excavation volumes;
- options for onsite reuse of excavated material; and
- good practice methods to be employed in relation to handling and storage of excavated soil and peat.

9.23 Peat is also considered in **Appendix 9.6** includes the following information:

- calculation of the likelihood of peat instability based on site characteristics (including surveyed peat depth);
- calculation of consequences in the event of a construction induced peat landslide;
- calculation of peat landslide risk as a product of likelihood and consequence; and
- identification of mitigation measures to reduce areas of Moderate risk to Low or Negligible.

Assessing Significance

Sensitivity

9.24 The criteria used to assess the sensitivity of water and geological features are summarised in **Table 9.5**. The sensitivity or the vulnerability of the water features was determined in terms of the physical attributes and processes encompassed by surface water hydrology (including flood risk) and water quality.

Table 9.5: Criteria for Determining the Importance/Sensitivity of the Water and Geological Environment

Sensitivity of Receptor	Typical Indicators
High	• Receptor is of National or International value i.e. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC), Special Protection Area (SPA), and RAMSAR. • Overall water quality classified by SEPA as high and salmonid spawning grounds present. • Abstractions for public water supply. • Groundwater classified under the WFD as 'good' or groundwater resource with numerous sensitive users/receptors. • The flooding of property (or land use of great value) that has been susceptible to flooding in the past. • Watercourse floodplain/hydrological feature that provides critical flood alleviation benefits. • Very deep peat >2.0m depth.
Medium	• Receptor is of Regional or Local value e.g. Local Nature Reserve • Overall water quality classified by SEPA as good or moderate, salmonid species may be present, and may be locally important for fisheries. • Smaller watercourse lying upstream of larger river which is a SSSI or SAC. May be subject to improvement plans by SEPA. • Abstractions for private water supplies. • Groundwater resource with sensitive users/receptors. • Environmental equilibrium copes well with natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. • The flooding of property (or land use of great value) that may be susceptible to flooding. • Watercourse/floodplain/hydrological feature that provide some flood alleviation benefits. • Habitats listed in Regional Biodiversity Action Plans or Annex I habitats. • Unmodified active peatland. • Deep peat (>1.0m depth) unless minor area.
Low	• Receptor is of low environmental importance (e.g. water quality classified by SEPA as bad or poor, fish sporadically present or restricted). • Not subject to water quality improvement plans by SEPA. • Heavily engineered or artificially modified and may dry up during summer months. • Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. • No abstractions for public or private water supplies. • No significant groundwater resource and no identified sensitive users/receptors. • No flooding of property or land use of great value. • Watercourse/floodplain/hydrological feature that provides minimal flood alleviation benefits. • Shallow (0.5m to <1.0m depth) and/or modified peat.

Magnitude

9.25 The magnitude of change has been assessed based on the criteria presented in **Table 9.6**. These criteria are based on professional judgement and experience of other similar studies.

Table 9.6: Criteria for Estimating the Magnitude of Effect

Magnitude	Criteria/Typical Example
Major	• Fundamental (long-term or permanent) to substantial changes to hydrology, water quality, peat, geology or hydrogeology (in terms of quantity, quality and morphology). • A >10% change in average or >5% change in flood flows. • The extent of 'high risk' areas (classified by the Risk Framework contained in Scottish Planning Policy (SPP) – i.e. at risk from flooding by 1 in 200-year or greater event) will be significantly increased. • Change that would render water supply unusable for longer than month. • Impact resulting in total loss of feature or integrity of feature or use.
Moderate	• Material, but non-fundamental or temporary changes to hydrology, water quality, peat, geology or hydrogeology (in terms of quantity, quality and morphology). • A >5% change in average and minimal change in flood flows. • Extent of 'high risk' areas (1 in 200-year - SPP) will be moderately increased/or decreased. • Change that would render water supply unusable for days or weeks with no alternative.

Magnitude	Criteria/Typical Example
Minor	• Detectable but non-material changes to hydrology, water quality, hydrogeology, peat or geology (in terms of quantity, quality and morphology). • A >1% change in average flows and no increase in flood flows. • Change that would render water supply unusable for short period (days) or for longer period if alternative supply put in place.
Negligible	• No perceptible changes to hydrology, water quality, peat, geology or hydrogeology (in terms of quantity, quality and morphology). • A <1% change in average and no change in flood flows. • No change in water supply or minor change (days) where alternative is put in place.

Significance

9.26 The predicted significance of the effect was determined through a standard method of assessment based on professional judgement, considering both sensitivity of receptor and magnitude of change as detailed in **Table 9.7**. **Major** and **moderate** effects are considered **significant** in the context of the EIA Regulations.

Table 9.7: Significance Criteria

Magnitude	Sensitivity		
	High	**Medium**	**Low**
Major	Major	Major - Moderate	Moderate
Moderate	Moderate	Moderate	Minor
Minor	Minor	Minor	Minor - None
Negligible	None	None	None

Secondary Effects

9.27 In relation to the areas of windthrow clearance, **Chapter 3** explains that potential effects arising from windthrow felling are considered as 'indirect' (or secondary) effects. **Chapter 8** explains that proposed windthrow areas are not within the control of SPEN but that statutory obligations requiring the replanting of these areas by landowners qualify as mitigation.

9.28 In relation to potential effects on water quality, run-off and flood risk, it has been assumed that the windthrow areas will be felled in line with good practice guidance and the legal requirements set out in Section 6.7 (Forestry and Water) of the UK Forestry Standard (Forestry Commission 2017). As such, the effects of felling of these areas are covered in the assessment of effects below for each connection.

9.29 In relation to peat, some of the windthrow clearance areas are potentially located on peat[13]:

- Tower 4 to 6 adjacent to watercourse;
- Tower 17 and surrounding area, both sides of the Darsalloch burn;
- Tower 22 and surrounding area; and
- Around Bargatton loch where some areas to be felled forest are on very deep peat in close proximity to the loch.

9.30 Peat where forestry is present is considered to be heavily modified (i.e. not active, drained, with little surface vegetation) and therefore not considered to be highly sensitive. As these areas are likely to be replanted, there will be some potential for peat disturbance where it is present, and as with the effects on hydrology, this is covered in the assessment of effects for each connection.

Assessment Limitations

9.31 The assessment was based on existing, available data, supplemented by field walkover survey of the KTR Project infrastructure locations, surrounding watercourses, PWS and peat surveys. There were some access restrictions, which prevented a small section of the existing accesses proposed to be used for construction and some watercourse crossings from being visited. Details of the watercourse crossings were extracted from Ordnance Survey maps and aerial photographs and included in the assessment. This does not affect the robustness of the overall assessment. For the hydrology surveys, only key selected locations were visited on the existing N and R routes (i.e. those in proximity to watercourses or at watercourse crossings).

9.32 The D&GC PWS data was caveated as the D&GC stated that the information provided cannot be guaranteed to be 100% accurate, up-to-date or comprehensive; in particular the grid references of the supplies may only be approximations so for definitive advice on the location of the supplies and associated PWS infrastructure it was advised that the users be contacted (email from Environmental Health Officer, D&GC, 23rd May 2019). Users were contacted on site where possible to supplement the field surveys and the data is therefore considered appropriate for the purposes of assessment.

9.33 The peat surveys omitted the following areas identified through the desk study as potentially being located on peat as access was not permitted to the land: Points at Polquhanity near Tower 1, Tower 2 and Access 5; and Construction Compound 6 near Bargatton. It should be noted that the land at Construction Compound 6 was observed to mostly comprise of an existing quarry (surveys could not be undertaken at any time due to potential ornithological disturbance).

9.34 Small localised pockets of peat may exist which were not shown on available mapping and therefore the peat survey may not have covered these very small areas. However, it is considered that sufficient peat information has been gathered to represent the baseline peat conditions.

9.35 Overall it is considered that there is sufficient information to enable a robust assessment to be undertaken of the likely significant environmental effects on geology, hydrology, hydrogeology, water resources and peat.

Future Baseline in the Absence of the Development

9.36 Consideration of the future scenario which acknowledges the absence of the KTR Project assumes that the existing N and R routes still require to be removed and replaced (refer to **Chapter 3: Approach to the EIA**). Without the KTR Project, the main change to the future baseline would be as a result of climate change, as described below.

Implications of Climate Change

9.37 Scottish Planning Policy states that "*planning system should promote a precautionary approach to flood risk from all sources, including coastal, watercourse (fluvial), surface water (pluvial), groundwater, reservoirs and drainage systems (sewers and culverts), taking account of the predicted effects of climate change.*"

9.38 Until recently, SEPA recommended a 20% increase in peak flow for the 0.5% AEP (1 in 200 year) event for Scotland, in accordance Department of Environment, Food and Rural Affairs (DEFRA) and recent Scottish Government research.

9.39 In April 2019, SEPA published new guidance on climate change in Scotland which provides a regional based approach[14]. For river catchments over 50km^2, the peak (200 year) design flow should be increased by 44% in the Solway River Basin to account for projected climate change increases to the year 2100. In addition, the peak rainfall intensity allowance for the west region of Scotland is 55% to the year 2100. Thus, this part of Scotland is likely to get wetter with higher peak flows in the rivers in the future.

9.40 Site drainage and watercourse crossing designs will consider future estimates of increased precipitation and flows and will follow an adaptive approach.

[13] Peat surveys were not undertaken for the windthrow felling areas therefore the likely presence of peat has been determined on the basis of a review of available desk based data sources.

[14] SEPA (2019). Climate change allowances for flood risk assessment in land use planning, Land Use Planning System SEPA Guidance. Version 1.

Infrastructure Location Allowance

9.41 A 50m Infrastructure Location Allowance (ILA) will be used for the KTR Project infrastructure (refer to **Chapter 3**), i.e. 50m either side of all infrastructure. However, it should be noted that micrositing of infrastructure within the ILA closer to or within the watercourse buffers will not be undertaken. Micrositing within the ILA will be undertaken to move infrastructure further away from sensitive water features, PWS and deeper peat, where possible.

Embedded Mitigation

9.42 A number of good practice pollution prevention and control measures will be put in place during felling operations and construction. These will be embedded into the project design and reflect best practice guidance and recognised industry standards, as well as SPEN's recent experience of constructing OHLs. Many of the measures mitigate several potential effects (e.g. mitigation to minimise sedimentation and pollution such as Sustainable Drainage Systems (SUDS) which can also serve to attenuate surface water run-off and minimise flood risk). Embedded mitigation measures that are incorporated into project design are described in detail in **Appendix 5.2** and include:

- measures to reduce effects on increased flood risk and increased run-off;
- measures to reduce sedimentation and erosion;
- measures to reduce pollution and accidental spillage;
- measures to be put in place at watercourse crossings;
- peat management measures; and
- measures to reduce sedimentation, erosion, and pollution during forestry felling[15].

9.43 A detailed assessment of drainage flow paths was carried out to identify catchment areas that could drain towards construction access tracks from upgradient areas (see **Appendix 9.2**). Large volumes of surface water runoff from these areas will flow towards the access tracks during heavy rainfall events and will need to be managed to avoid contamination and pollution. The drainage assessment was used to identify areas where embedded SUDS mitigation will be required (see **Appendix 9.2**). Drainage measures for access tracks includes (but is not limited to):

- Appropriately sized culverts passing under the tracks that do not restrict flow and allow small watercourses, intercepted field drains and ephemeral streams/surface water flow to pass under the tracks.
- Drainage ditches on the upslope side to intercept and divert 'clean' surface water run-off draining towards the tracks.
- Ditches in the form of swales parallel to the downslope side of access tracks to capture run-off and sedimentation from the access tracks. These will be used to treat and attenuate surface water run-off before discharge. Larger swales (i.e. 2m base channel width) will be used for areas that are upstream of sensitive receptors (e.g. PWS and/or watercourses). This wider flow/settlement area will allow additional attenuation and settling of silt/pollutants before discharge. In these areas a total width of approximately 20m alongside the track is set aside for SUDS to allow embedded mitigation to be put in place (e.g. check dams, silt fences and settlement ponds in sequence).

9.44 Construction/upgrade of watercourse crossings on minor watercourses of the access tracks will follow general good practice and GBRs 6 and 9 as outlined in **Appendix 5.2**. The type of temporary bridges proposed for new crossings are:

- narrow burns: a mat of timbers will be used, supported by steel beams; and
- larger watercourses: a steel plate decking including safety barriers either side will be used, supported by main support beams with steel cross members.

9.45 Neither of these bridging solutions will affect the bed and banks of watercourses. Fording of watercourse will be avoided. Design and implementation of crossings will follow best practice, including recommendations in SEPA (2010) Engineering in the Water Environment Good Practice Guide – River Crossings.

9.46 During construction, temporary construction SUDS will be put in place at each watercourse crossing to ensure no sedimentation from construction works or pollution from plant or machinery can enter the watercourse. This could be a series of settlement ponds or settlement tanks and silt fences. An area of 20m width either side of the watercourse and 20m upstream and downstream of the crossing (i.e. 40m x 40m) will allow for sufficient temporary SUDS to be put in place during construction as embedded mitigation. This will be sufficient for all crossings and is likely to be an over-estimate of the area required for small watercourses and will allow the contractor space to incorporate the amount of SUDS/settlement ponds required at each location, even in an emergency situation. It will also allow an area to be set aside should SUDS measures be required at the discharge location of swales into watercourses during permanent operation of the drainage system.

9.47 During detailed routeing stage, a buffer of at least 10m was applied to all watercourses identified from Ordnance Survey maps and the site walkover survey. A larger location specific variable buffer was applied to larger watercourses. Therefore, there are no towers (or working areas) within or close to watercourses. GWDTEs were avoided as much as possible.

9.48 A Construction Site Licence (CSL) will be obtained from SEPA under the CAR Regulations in advance of the construction works. This will include a detailed Pollution Prevention Plan (PPP) to ensure that any discharges of water run-off from the site to the water environment do not cause pollution. The drainage assessment and recommendations described in **Appendix 9.2** will feed into the PPP.

9.49 Prior to construction and on completion of ground investigations and micro-siting, a site waste management plan shall be produced, including for site soil and peat management good practice. It will ensure that excavated peat is appropriately managed and re-used.

9.50 A Construction and Decommissioning Environmental Management Plan (CDEMP) will also be developed and agreed with D&GC and SEPA in advance of the works. The CDEMP will establish a framework to ensure that health and safety and environmental best practices are adopted throughout the works. The CDEMP will include the approved PPP and Peat Management Plan. An example CDEMP is provided as **Appendix 5.4: Example Environmental Management Plan**.

9.51 The assessment of effects is undertaken assuming that embedded mitigation is an integral part of project design. Additional mitigation is identified during the assessment to address localised site or issue specific likely significant adverse effects and is described within the 'Proposed Mitigation' section for each connection of the KTR Project.

Polquhanity to Glenlee (via Kendoon)

Existing Conditions

9.52 The existing N and R route (north) 132kV OHLs to be removed following construction of the KTR Project parallels the new proposed 132kV double circuit steel tower OHL from Polquhanity to Glenlee. Hence, the description of the baseline environment in this part of the route covers both the new OHL and existing N and R route (north) and the removal of the relevant N and R towers is assessed below.

Topography

9.53 The topography is shown in **Figures 9.2.1-9.2.4**, based on contours derived from the Ordnance Survey 5m digital terrain data. North of Kendoon, the highest point of the connection infrastructure is around 220m AOD in the north-west approximately 800m along the existing access track from access 1. Ground levels slope down to the south and east towards Polmaddy Burn in the south and the Water of Deugh in the east. The banks of the Water of Ken at Kendoon are at around 103m AOD. In general, there is higher ground to the west of the OHL route.

[15] Forestry felling and removal will follow the good practice guidance and legal requirements set out in Section 6.7 (Forests and Water) of the UK Forestry Standard (Forestry Commission 2017).

9.54 South of Kendoon, ground levels generally fall to the south, as the route follows the valley of the Water of Ken downgradient. Ground levels also fall to the east as the OHL is located on the hillsides on the west side of the Water of Ken valley, which slope down towards the Water of Ken and its associated lochs (Carsfad Loch and Earlstoun Loch).

9.55 The northern part of the OHL (T1 to T17), north of Carsfad, is close to the bottom of a steep slope sloping down from west to east towards Carsfad Loch and the Water of Ken in the east. Ground levels rise to the west of the OHL to Knockclune Hill and Stroangassel Hill beyond. Ground levels along most of this section of the route are between 140m to 120m AOD.

9.56 South of Carsfad, the OHL follows the west side of the Water of Ken and falls to around 80m AOD close to the watercourse at T20. The OHL then rises onto higher land south of the Polharrow Burn crossing and is situated on the hillside of the western side of Earlstoun Loch; ground levels slope down in an easterly direction towards the loch and the Water of Ken.

9.57 South of Earlstoun Loch, the OHL is located on the hillslopes on the western valley side of the Water of Ken and ground levels fall to the east towards the watercourse. As the OHL route reaches Glenlee, ground levels fall down towards the floodplains of Coom Burn and the Water of Ken at around 52m AOD (**Figure 9.2.4**).

Watercourses and Surface Water

9.58 The Water of Deugh flows in a southerly direction to the east of the OHL and the northern part of the KTR Study Area drains either directly or indirectly to the Water of Deugh. The OHL passes over a number of small unnamed watercourses and the larger Polmaddy Burn, all of which drain in an easterly direction towards the Water of Deugh (**Figures 9.2.1-2**). The Polquhanity Burn is another small tributary of the Water of Deugh, which is upstream of the OHL route. A proposed construction access track crosses the burn upstream (PG0 on **Figure 9.2.1**).

9.59 The Water of Ken enters the Water of Deugh from the north-east just upstream of Kendoon (**Figure 9.2.2**). The OHL will cross the watercourse at this confluence to its connection at the Kendoon substation. The Water of Ken continues to flow in a southerly direction to the east of this section of the OHL and the Study Area drains either directly or indirectly to the Water of Ken catchment (**Figures 9.2.2-4**).

9.60 Further downstream, the Polharrow Burn, Glen Strand and the Coom Burn all enter the Water of Ken along this section of the OHL along with numerous other smaller, unnamed watercourses.

9.61 There are two relatively large lochs on the Water of Ken within this section of the connection. Carsfad Loch in the north and Earlstoun Loch further south. Both lochs are dammed at their southern ends with operational hydropower stations. The OHL and access tracks pass over many small unnamed watercourses, which all drain off the western valley side and flow in an easterly direction to enter the Water of Ken or the lochs (**Figures 9.2.2-4**).

9.62 Except for Carsfad and Earlstoun Lochs, no open water bodies (e.g. ponds, lochs) were noted along this section of the connection. However, several areas of wet, boggy ground or marshland were noted during the site walkover and these are shown in **Figures 9.2.1-4**. The marshy areas tend to be on the western side of the A713 road and these were avoided where possible during routeing and iterations of the project design.

Hydrology and Flood Risk

9.63 The Water of Deugh drains a mainly rural catchment area of 38.2 km^2 at its downstream limit at the confluence with the Water of Ken. The combined catchment of the Water of Ken and the Water of Deugh, downstream of the confluence is 303.1km^2. The Polmaddy Burn at the OHL crossing location drains a catchment of 29.4km^2.

9.64 The catchment area of the Water of Ken at Glenlee (the downstream limit of the section of the route) is 373km^2 and here the watercourse is approximately 45m wide.

9.65 The Coom Burn has a catchment area of approximately 21km² and Polharrow Burn drains a rural catchment of 41km^2 (see **Table 9.3** and **Figure 9.1**). The standard percentage runoff (SPR) for the Polharrow catchment is 49% meaning that 49% of rainfall landing within in the catchment contributes to surface water runoff. The remaining 51% infiltrates to the ground. The Coom Burn catchment has an SPR of 46%. Glen Strand is much smaller watercourse, draining a catchment of 0.83km^2.

9.66 There are no SEPA gauging stations on the watercourses in this connection Study Area.

9.67 Review of the SEPA flood maps online indicate fluvial flooding in the following locations:

- Polmaddy Burn: the predicted 200-year flood extent at the OHL crossing is largely contained within the riverbanks and the proposed OHL tower locations are located at least 80m from the burn.
- Water of Deugh and Water of Ken confluence, close to Kendoon: the predicted 200-year flood extent at the confluence is around 120m wide and the water is predicted to flood out of bank on the west bank of the channel. Site observations indicate that the field on the west side of the channel is clearly the floodplain of the Water of Ken. There are existing towers in this field that are to be removed (N239 and R0) and a proposed new tower (T36) close to or within the floodplain (**Figure 9.2.2**).
- Water of Ken downstream of Carsfad Loch: is predicted to flood out of bank on its west bank for a short reach upstream of the confluence with the Polharrow Burn. The 200-year predicted floodplain affects the low-lying land to the west of the A713 in the vicinity of new towers T19 and T20 and existing towers R9 and R10 to be removed.
- Polharrow Burn, at its confluence as it enters the Water of Ken: the 200-year floodplain is approximately 225m wide at the mouth of the burn. T20 is close to or within the 200-year floodplain.
- Water of Ken at the southern extent of this section of the connection: is predicted to flood out of bank close to the mouth of the Coom Burn, just south of T34 and north of T35. The towers and working areas are outside the SEPA floodplain.

9.68 Downstream of Kendoon, the Water of Ken and Carsfad Loch is predicted to stay generally within bank during the 200-year flood, based on the SEPA flood map. The predicted flood extent is well away from the proposed OHL and associated infrastructure. In addition, south of Pollharrow Burn, the OHL rises up onto the valley side west of the Water of Ken and Earlstoun Loch and the predicted flood extents shown on the SEPA flood maps are well away from the OHL and associated infrastructure.

Existing Site Drainage and Surface Water Flooding

9.69 A flow pathway analysis was undertaken in GIS, based on the best available topographic data (1m LiDAR and Ordnance Survey 5m digital terrain data) to assess existing drainage pathways and overland flow routes in the vicinity of the OHL and associated infrastructure.

9.70 North of Kendoon, existing ground levels generally fall to the south and east; hence surface water runoff from the OHL is to the south and east towards the Polmaddy Burn and the Water of Deugh. South of Kendoon, existing ground levels fall to the east; hence surface water runoff from the OHL is to the east towards the Water of Ken, Carsfad and Earlstoun Lochs, either directly via overland flow or indirectly via the network of small watercourses draining the valley slopes. Surface water runoff will flow from the high ground to the west of the site towards the OHL and associated accesses.

9.71 Along most of this section of the connection, the OHL and the proposed access tracks follow the contours and cut across the valley slope. It was noted during the field walkover that there were several ephemeral streams flowing down the slope (due to the heavy rainfall during and preceding the site visit). This will be incorporated into the final drainage design.

9.72 SEPA flood maps identified several localised areas of predicted surface water (pluvial) flooding close to or within this section of the connection (e.g. close to the power station south of Earlstoun Loch and close to Barskeoch Mains). These areas were reviewed during site walkover surveys and the extent of wet ground/marsh areas were mapped (see **Figure 9.2.3-4**) and considered during design iterations.

Watercourse crossings

9.73 The P-G via K connection infrastructure has 90 watercourse crossings; this includes small watercourses mapped in the field and watercourses shown on Ordnance Survey 1:10,000 maps. Some watercourses are crossed more than once, either by existing access tracks, proposed new access tracks, the OHL itself or the underground cable (UGC) (see **Appendix 9.1** and **Figures 9.2.1 - 4**). In this case the crossings are labelled, for example PG38A (unnamed watercourse – OHL crossing) and PG38B (the same unnamed watercourse, but this time an access track crossing).

9.74 Details of all crossings are provided in **Appendix 9.1** and photographs of representative crossings are included in **Appendix 9.1**[16]. Most watercourses to be crossed for this connection are generally small (<2.5m wide) except for the Polmaddy Burn, which is around 20m wide at the OHL crossing location and the Water of Deugh, which is around 36m wide at the OHL crossing location. Polharrow Burn, Glen Strand and Garroch Burn/Coom Burn and the Glenlee Tailrace are also crossed by OHL. Catchment areas draining to each watercourse crossing were calculated based on watershed analysis in Global Mapper GIS software using the LiDAR topographic data. The catchment areas and catchment characteristics of larger watercourses (e.g. Water of Deugh, Polmaddy Burn, Water of Ken crossing) were extracted from the Centre for Ecology and Hydrology: Flood Estimation Handbook web service[17].

9.75 Due to the heavy rainfall during and preceding the site surveys, it is likely that several of the watercourse observed were ephemeral (e.g. crossing PG24 and PG39A and 39B), in response to surface water runoff. Some wide boggy areas were noted with small watercourses (<1m wide) flowing in the centre of the wet area.

Water Supplies, Discharges and Abstractions, and Services

9.76 A summary of PWS source locations within 1km of the KTR Project is shown in **Table 9.4**. Those close to the P-G via K connection are identified in column two of the table and shown in **Figures 9.2.1-4**, along with locations of supplied properties (if available). Further details of each PWS and an assessment are provided in **Appendix 9.3**.

9.77 SEPA provided a list of groundwater abstractions close to the KTR Project. There are no licenced groundwater abstractions in this connection.

9.78 Available data on Scottish Water utilities in the area (i.e. water and waste-water mains and distribution networks) show that the only Scottish Water pipework close to the P-G via K Connection is located on the roads at the Earlston and Glenlee substations. Locations of utilities will be confirmed prior to construction.

Water Quality and Protected Areas

9.79 Under the terms of the WFD, all river basin districts require to be characterised. The characterisation process requires SEPA to produce an initial assessment of the impact of all significant pressures acting on the water environment.

9.80 Surface water bodies are defined as being whole or parts of rivers, canals, lochs, estuaries or coastal waters. The main purpose of identifying water bodies is so that their status can be described accurately and compared with environmental objectives.

9.81 The WFD applies to all surface waters, but for practical purposes SEPA has defined a size threshold above which a river or loch qualifies automatically for characterisation; rivers must have a catchment area of 10km^2 or more. In addition, smaller waters have been characterised where there is justification by environmental concerns and to meet the requirements of regulatory legislation such as for drinking water supplies.

9.82 Classification of status by SEPA considers water quality, hydromorphology, biological elements including fish, plant life and invertebrates, and specific pollutants known to be problematic. The classification grades through High, Good, Moderate, Poor and Bad status. This provides a holistic assessment of ecological health. Heavily modified waterbodies, which can no longer be considered to be natural, are classified on the basis of 'ecological potential'.

9.83 In terms of the Study Area, the following watercourses are large enough to be classified:

- The Polmaddy Burn (Water Body ID10568) was classified by SEPA in 2017 as having Bad ecological potential.
- The Water of Ken downstream of Kendoon Loch to Earlstoun Loch (Water Body ID 10558) and downstream of Earlstoun Loch (Water Body ID 10761) was classified by SEPA in 2017 as having Bad ecological potential.
- Polharrow Burn (Water Body ID 10569) was classified as having Poor ecological potential.
- Earlstoun Loch (Water Body ID 100321) was classified as having Good ecological potential.
- The Coom Burn/Garroch Burn (Water Body ID 10570) was classified as having Moderate ecological potential.

9.84 There are no water related designated sites within or close to this connection, however the Loch Ken and River Dee Marshes SPA/RAMSAR site is located on the Water of Ken approximately 4km downstream of Glenlee (**Figure 10.2**) (refer to **Chapter 10** and **Chapter 11: Ornithology** for further information on the SPA/RAMSAR site).

9.85 The River Dee catchment supports salmon and trout populations and the entire P-G via K connection drains indirectly to the Water of Ken/River Dee catchment.

Soils and Geology

9.86 The Soils and Geology sections are described approximately from north to south for this connection and including the existing N and R routes (north).

9.87 Scottish Soil mapping (**Figure 9.3.1** and **9.3.2**) shows the majority of the connection (including N and R route north) to be underlain by brown earth with some areas of peaty gleys in the northern section between Polquhanity and Kendoon. Alluvial soils are present along the Water of Ken valley between Earlstoun Loch and Glenlee.

9.88 The existing N route is predominantly on Brown earth with the exception of being located on alluvial soils in the Water of Ken valley near Glenlee.

9.89 The SNH Carbon and Peatlands Map 2016 (**Figure 9.4.1** and **9.4.2**) shows the majority of the connection (including N and R route north) to be located on minerals soils with the exception of the following areas of Class 3 and 5 soils that have the potential to be peat:

- Class 3 (blue): Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats. Most soils are carbon-rich soils, with some areas of deep peat: Construction Compound 1 and small section of northern access track.
- Class 5 (green): Soil information takes precedence over vegetation data. No peatland habitat recorded, may also include areas of bare soil. Soils are carbon-rich and deep peat: the majority of the connection length and associated infrastructure between Polquhanity to Kendoon.

9.90 The superficial or drift geology mapping (**Figure 9.5.1** and **9.5.2**) shows the majority of the connection to be underlain by superficial or drift deposits. No superficial deposits are present on most of the access tracks from Access 1 to T4. The northern section of the OHL is underlain by glacial till near Polquhanity and hummocky glacial deposits or moraine between Polquhanity and Kendoon. Some localised alluvial deposits are shown near the Water of Ken. Sections where the connection is underlain by superficial deposits include:

- Glacial Till (Boulder Clay) comprising poorly sorted fragments in clay matrix (blue): Polquhanity northern section;
- Hummocky Glacial Deposits comprising blocky till in a matrix of grit and sand (green): Polquhanity to Kendoon to Carsfad; and
- Alluvium comprising silt, sand, clay, and gravel (yellow): Polharrow Burn Valley to Carsfad; Glenlee; and Water of Ken valley.

9.91 Construction compound 1 is shown to be underlain by Glacial Till and Barlae Hill Quarry and construction compound 2 shows no superficial deposits.

9.92 The solid or bedrock geology mapping (**Figure 9.6.1 and 9.6.2**) shows the majority of the bedrock to comprise of greywackes or metamorphosed turbidite deposits of Ordovician age. From north to south the bedrock of this connection comprises:

- Portpatrick Formation (Ordovician): massive thick bedded turbidities, sandstones rich in andesitic detritus undergone metamorphism to form greywacke.
- Shinnel Formation (Ordovician): Turbidites thick to thinly bedded sandstone and siltstone. Sandstones are quartzose.

[16] Photographs of each watercourse can be provided as a digital download file upon request (due to file size).

[17] Centre for Ecology and Hydrology: Flood Estimation Handbook web service, viewed at https://fehweb.ceh.ac.uk

- Glenlee Formation (Ordovician): Thin, medium to thick bedded turbidites with a thick development of grey siltstone inset (Glenlee Formation – siltstone) containing black graptolitic laminae. Sandstones are mainly quartzose.

9.93 Construction compound 1 and Barlae Hill Quarry are shown to be located on the Portpatrick Formation Greywackes and Construction Compound 2 is shown to be on the Shinnel Formation greywackes.

9.94 The structural geology comprises:

- A fault North-Northwest to South Southeast roughly parallel to Water of Ken valley with a downthrow to the northeast which transects the following faults trending SSW to NNE, downthrow to southeast to the south of Barlae Hill Quarry; Fardingfullach Fault north of Kendoon; and Glenfumart Fault northwest of Earlstoun Loch.
- An un-named north–northwest to south-southeast fault which splits to pass through Glenlee.

9.95 There are no known geological designated areas within this connection or N and R route (north).

Peat

9.96 Peat depth surveying was undertaken where peat was shown to be potentially present on SNH, Scottish Soils and BGS mapping along the route of the new OHL and infrastructure such as access tracks, construction compounds and quarries. The results of the peat survey are shown as peat depth contours in **Figure 9.7.1** to **9.7.31**. The peat survey recorded less peat than was shown to be potentially present on the soils, SNH and geological mapping. The peat results from the early phases of the surveys were used to feed into the design and the requirements for further peat depth surveying.

9.97 Peat is generally 'not present' across much of the route P-G via K route but with some 'deep' peat (>1m in depth) in localised areas. Where peat depths were recorded, they were mostly located in sections within valleys and plateaus. The site design was amended where possible to avoid peat deposits.

9.98 Areas of where the survey recorded peat along the new OHL and associated infrastructure (tracks, construction areas and quarry) include:

- Highly localised pockets of modified peat to the side of the existing forestry track between Polquhanity and Barlae Hill Quarry;
- Modified peat between 0.0m and up to 3.0m deep between T4 to T6;
- Localised modified peat up to 1.5m around T36 west of Kendoon; and,
- Localised modified peat up to 1.5m depth at T15 and R005 between Kendoon and Carsfad.

9.99 The full details of the peat surveys are presented within **Appendix 9.4**.

Groundwater

9.100 The majority of this connection (including N and R route south) is underlain by Ordovician and Silurian greywacke metamorphic rocks which are classified as a non-aquifers or low productivity aquifers that are generally without groundwater except at shallow depths within the weathered zone or fractures.

9.101 Superficial quaternary alluvial deposits within the Loch Ken valley are classified as a perched or concealed low productivity aquifer with limited or local potential.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.102 One area of moderately dependent (dominant) GWDTE habitat has been identified within this connection, at the northern extent of the OHL route. The habitat is M23 grassland (see **Chapter 10** for further details) and is located just to the west of the two northern towers of the P- G via K connection and a new access track (see **Figure 9.2.1**).

Construction Effects

9.103 The following effects have been assessed in full:

- Effects during construction on surface and ground water quality and private drinking water supplies;
- Effects on channel morphology (bank erosion and channel form) during construction;
- Effects during construction on run-off rates and flood risk;
- Effects during construction on GWDTEs; and
- Direct and indirect disturbance of peat during construction.

9.104 The sensitivity of receptors (within the Study Area) has been assessed in **Table 9.8**, using the criteria in **Table 9.5**.

Table 9.8: Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourses/Surface Water Bodies Polquhanity Burn Polmaddy Burn Water of Deugh Water of Ken Carsfad Loch Earlstoun Loch Polharrow Burn Glen Strand Coom Burn Unnamed Watercourses	High	All watercourses drain, either directly or indirectly, to the Water of Ken/River Dee catchment. There is a designated site of international importance (SPA and RAMSAR site) on the Water of Ken approximately 4km downstream of this connection. In addition, the River Dee catchment is known to support salmon and trout populations, hence the sensitivity of all watercourses is high. The Water of Ken, Polmaddy Burn and Polharrow Burn were all classified by SEPA as of bad or poor ecological potential[18]. Earlstoun Loch and the Coom Burn were classified by SEPA as good and moderate potential respectively. There are no properties downstream of the project infrastructure that are at currently at flood risk.
Private Water Supplies	Medium	There are a number of abstractions for private water supplies (**Table 9.4** and **Figures 9.2.1-4**).
Peat	Low	Low where modified (non-active peatland) or shallow peat (0.5m to <1.0m depth) is present or limited area of infrastructure. The majority of the peat deposits are shallow and heavily modified by forestry activities and therefore of Low sensitivity.
Groundwater	Low to medium	The connection is located on low productivity aquifers.
Groundwater Dependent Terrestrial Ecosystems	Medium	A localised area of highly dependent (dominant) GWDTE habitat was identified close to the northern extent of the connection (**Figure 9.2.1**).

Predicted Construction Effects

9.105 The main likely significant environmental effects are predicted to occur during the felling and construction phase, based on the detailed description of the KTR Project provided in **Chapters 4** and **5**.

9.106 The activities that will occur during construction that may have an impact on the water environment and peat, include: site clearance and vegetation (forestry) removal; use of heavy plant machinery; increase of hardstanding areas; construction and upgrading of access tracks; watercourse crossings; associated earthworks/excavation/re-profiling; trenching for undergrounding of cable; storage of materials; use of quarry areas and construction compounds and construction traffic on access tracks.

9.107 There are two construction compounds (compounds 1 and 2) associated with this connection and a proposed new quarry (Q1 Barlae Hill Quarry). Forestry and vegetation within these areas will need to be cleared and felled prior to their use during construction (**Chapter 5**). There is a risk of polluted runoff and sediment from these areas entering surface waters.

9.108 During the detailed routeing stage, a buffer of at least 10m was applied to all watercourses identified from Ordnance Survey maps and during the site walkover survey. A location specific larger buffer was applied to larger watercourses. Therefore, there are no towers (or associated working areas) within or close to watercourses. Undergrounding of a small spur of the LV cable from the A713 public road just north of the Barskeoch Mains property is within 10m of a small, unnamed watercourse.

[18] Sensitivity is classed as high, due to the presence of the SPA and RAMSAR site downstream.

9.109 The design of construction access sought to use existing access tracks as much as possible to avoid new watercourse crossings and land take. However, given the hydrological setting of the OHL route (along the lower slopes of the Water of Deugh/Water of Ken valley), there are a number of unnamed watercourses which were unavoidable. New track watercourse crossings, upgrade of existing track crossings, stringing of the OHL over watercourses and directional drilling or isolated open-cut trenching for UGC installation under watercourses could potentially impact channel morphology during construction.

9.110 There are 38 new crossings of access tracks required for construction of this connection (see **Appendix 9.1**). Most of these are small watercourses (<3m wide) and many are not shown on 1:10,000 Ordnance Survey maps but were identified on site. Several of the larger crossings (PG1; PG3B; PG4B; PG12C, PG13C, PG17C, PG30B, PG33C, PG36B, PG38B, PG41C) will require authorisation under CAR but most of the new crossings are on minor watercourses and will be covered by SEPA's general binding rules (GBRs).

9.111 There are four existing watercourse crossings on existing access tracks that will be used during construction of the connection. These crossings will need to be maintained and/or improved depending on their condition. The need for upgrade will be reviewed in detail at each crossing prior to construction. A CAR authorisation is not likely to be required for minor upgrade works to existing track crossings, however this will be verified prior to construction in consultation with SEPA. Of the four existing crossings, one is on a minor watercourse which will not require authorisation under CAR.

9.112 The OHL crosses 40 watercourses. Again, most are small (<3m wide), however several large named watercourses also require to be crossed; the Polmaddy Burn, which is around 20m wide at the OHL crossing location and the Water of Deugh/Water of Ken, which is around 36m wide at the OHL crossing location. Polharrow Burn, Glen Strand, Coom Burn and the Glenlee Tailrace are also crossed in this section of the route. Details of stringing the OHL over watercourses is described in **Chapter 5** and no works will take place within the watercourses.

9.113 The majority of the underground route of the LV cable is in the verge of public roads (see **Figure 4.12** and will not impact the water environment. However, directional drilling is required under five watercourses where existing road crossing structures do not have suitable ducts for utilities or sufficient depth to install cable/ducts. These crossings are at the Polharrow Burn, Polmaddy Burn, Coom Burn and two locations on the Glenlee Tailrace. Directional drilling involves boring beneath the bed of the watercourse (described in detail in **Chapter 4**) and will not affect the beds and banks of the watercourses; these crossings do not require authorisation under CAR and are covered under SEPA's GBR7 and GBR9 (see **Appendix 5.2**). There are also three small unnamed watercourses to be crossed by the UGC via isolated open-cut techniques (see **Appendix 9.1**). Isolated open-cut requires a trench to be excavated across the bed of the watercourse and the area of working is isolated (kept dry) using methods involving over-pumping and gravity fed pipes and will require registration under the CAR.

Effects during construction on surface and ground water quality and private water supplies

9.114 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, trenching during UGC installation, heavy plant movement on the access tracks and construction compounds and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages. There is also a risk posed by concrete (and other construction material) spillages during the formation of hardstanding areas at the tower bases.
- Pollution/sediment run-off at existing watercourse crossings (where these are being upgraded), during construction of new watercourse crossings for access tracks and during installation of the UGC under watercourses.

9.115 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater and concrete spillages.

9.116 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. The increase in sediment concentration in runoff from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses. This can have an indirect effect on watercourse ecology (see **Chapter 10**).

9.117 Felling can result in increased surface water run-off and sediment run-off. Direct felling of an area of 29.81ha of forestry is required for the OHL wayleave, quarries and access tracks. There is an additional predicted 20.90ha to be felled (or lost) as a result of future windthrow (refer to **Chapter 5**). It is noted that effects associated with the windthrow felling area are indirect effects.

9.118 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles and in the event of an accidental release of concrete or other building materials. Pollutants could enter watercourses directly or via overland flow pathways. Shallow groundwater could also be affected.

9.119 With the embedded mitigation measures detailed in **Appendix 5.2** and **Appendix 9.2** and summarised above in place, the magnitude of the effect of increased sediment/silt runoff causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the site during construction is considered to be **minor** and temporary and the significance of the effect is **minor**.

9.120 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will minimise the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be of short duration and **minor** and the significance of the effect is **minor**.

9.121 There are 13 PWS sources within 1km of this connection P-G via K (see **Table 9.4** and **Figure 9.2.1 – 9.2.4**), which source their water either from groundwater springs, boreholes or surface watercourses. In several cases the source of the supply was unknown at the time of writing. Given that construction can potentially affect both surface and groundwater quality, it follows that construction can potentially affect nearby and downgradient PWS. An assessment of PWS sources and supplied properties was carried out based on proximity to the P-G via K infrastructure and flow path analysis from the infrastructure/ construction areas to the individual PWS (sources and properties) (see **Appendix 9.3**). All known PWS sources and properties will be identified in the CDEMP.

9.122 Based on SEPA Guidance[19] for assessing impacts of development proposals on groundwater abstractions and PWS a 250m buffer zone is used for all new OHL infrastructure, including tracks and trenching for the UGC. This is a conservative approach which considers all ground excavations are deeper than 1m. This will be the case for the tower base installation (see **Chapter 4**). However, construction and/or upgrade of access tracks is likely to require excavations less than 1m and sections of open-cut cable trench for the UGC that are not within the road verge will be ~1m deep. Hence, using a 250m buffer round all the infrastructure is a conservative approach.

9.123 There are 11 PWS sources and 28 known supplied properties within 250m of the P-G via K infrastructure; a detailed assessment of each is provided in **Appendix 9.3** and summarised in **Table 9.9**.

9.124 Flow routing analysis was undertaken in **Appendix 9.3** to infer hydrological and hydrogeological connectivity between proposed infrastructure and each PWS to identify if the KTR Project could potentially impact a PWS. In cases where flow path analysis identified a 'potential impact' the significance of the effect was assessed assuming embedded mitigation measures are in place resulting in an effect significance of either **minor** or **none**. Any additional mitigation measures, including monitoring, required for specific PWS, over and above embedded mitigation are described in **Appendix 9.3** and summarised in the Proposed Additional Mitigation section below.

[19] SEPA (2017) Land Use Planning System SEPA Guidance Note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems.

Table 9-9: Details of Private Water Supplies (PWS) sources and properties within 250m of PG-via K Infrastructure

Nat. Grid Ref	Source or Property Name	Property[1]	Source/ Source Type[2]	Type[3]	Nearby KTR Infrastructure	Distance from closest Infrastructure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX59219 90132	Carminnows Lodge	-	Borehole	B	Construction Compound 1	118	No impact	**None**
NX59267 90032	Carminnows Lodge	Property	-	B	Construction Compound 1	122	No impact	**None**
NX59167 89959	High Carminnows	Source and Property	Borehole	B	Construction Compound 1	60	Potential impact	**Minor**
NX59130 89778	Polquhanity	-	Spring	B	Access Track to Construction Compound 1	187	No impact	**None**
NX59130 89778	Polquhanity	Property	-	B	Access Track to Construction Compound 1	223	No impact	**None**
NX59769 88406	Hawkrigg	-	Borehole	A	Underground Cable	30	No impact	**None**
NX59710 88490	Hawkrigg House	Property	-	A	Underground Cable	86	No impact	**None**
NX59700 88527	Hawkrigg Caravan Site	Property	-	A	Underground Cable	88	No impact	**None**
NX59796 87894	Dundeugh	-	Surface Water	B	Access Track to Tower 7, Tower 7, UGC	80, 269, 130	Potential impact	**None**
NX59726 88009	Dundeugh 2	-	Source Infrastructure	B	Access Track to Tower 7, Tower 7, UGC	54, 252, 118	Potential impact	**None**
Various (see Figure 9.2.1)	16 Properties supplied by Dundeugh	16 properties	-	B	Access Track to Tower N236, UGC	Within 100m of access track, 36	Potential impact	**None**
NX59908 87642	Phail Barcris	Property	Borehole	B	Access Track between towers 8 and 9, Tower 9, UGC	170, 180, 3	Potential impact	**None**
NX60000 86500	Stroangassel	-	Spring	B	Access Track to Tower 13, Tower 13	247, 222	No impact	**None**
NX60374 86749	Stroangassel Farm	Property	-	B	Access Track to Tower 13, Tower 13, UGC	150, 160, 70	Potential impact	**None**
NX60300 85400	Carsfad Cottage	-	GW Spring (well)	A	Access Track to Tower 17, Tower 17, UGC	52, 31, 132	Potential impact	**None**
NX60335 85404	Carsfad Cottage 2	-	Source infrastructure (tank)	A	Access Track to Tower 17, Tower 17, UGC	16, 17, 98	Potential impact	**None**
NX60467 85456	Carfad Cottage	Property	-	A	Access Track to Tower 17, Tower, UGC	116, 28	Potential impact	**None**
NX60561 85436	Carsfad Power Station	Commercial Property	-	A	Access Track to Tower 17, Tower, UGC	208, 125	Potential impact	**None**
NX60491 84201	Inverharrow	-	Borehole	B	Access Track, Tower 21, UGC	20, 196, 28	Potential impact	**Minor**
NX60503 84209	Inverharrow	Property	-	B	Access Track, Tower 21, UGC	35, 21, 43	Potential impact	**Minor**
NX60680 83230	Barskeoch Mains	-	Spring	B	Access Track to Tower 25, Tower 25, UGC	150, 203	Potential impact	**None**
NX60816 83288	Barskeoch Mains	Property	-	B	Access Track to Tower 25, Tower 25, UGC	236, 85	Potential impact	**None**
NX60942 81115	Waterside	-	Surface Water	B	Access Track to Tower 33, Tower 33, UGC	6, 3, 280	Potential impact	**Minor**
NX61240 80996	Waterside	Property	-	B	Access Tracks Tower working areas, UGC	198, 151, 48	Potential impact	**Minor**

[1] **Property:** This column identifies the PWS property location and details.

[2] **Source/Source Type**: This column identifies the PWS source location and details and includes a description of the type of supply (e.g. borehole, spring or surface water).

[3] **Type**: Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[4] **Flow Path Analysis Result**: Likelihood of impact on PWS from infrastructure construction, based on flow paths

Effects on channel morphology (bank erosion and channel form) during construction

9.125 For the majority of watercourses, the effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude, as embedded mitigation measures, including a minimum 10m buffer zone and environmentally sensitive bridge design, have been incorporated into the project design. Isolated open-cut UGC installation in three small (< 2m wide) unnamed watercourses will result in temporary, minor modification to the channel bed during the installation period. The beds and banks of the watercourses will be re-established to their condition immediately after construction, so any impact on channel morphology will be short-lived and the significance of effect is considered **minor**.

Effects during construction on run-off rates, flood risk and ground-water levels/recharge

9.126 In accordance with the Risk Framework within Scottish Planning Policy (SPP), new development should be limited to areas outside the medium risk 200-year (0.5% Annual Probability (AP)) functional floodplain. Floodplains were avoided as far as practicable during the routeing and design process of the KTR Project.

9.127 The KTR Project is 'essential infrastructure' under the SEPA Flood Risk and Land Use Vulnerability Guidance and the guidance notes that essential infrastructure can be in medium to high risk flood areas (i.e. >0.5% AP) if a flood risk location is required for operational reasons and an alternative lower-risk location is not available. In the few situations where towers are located within the 200-year floodplain, they will be designed and constructed to be operational during floods (i.e. the 0.5% AP event), and to not impede water flow.

9.128 Review of SEPA flood maps indicated that three new OHL towers (T19, T20 and T36) are potentially within or close to the edge of the 200-year floodplain (medium likelihood flood) of the Water of Ken within the P-G via K connection. In addition, four existing towers to be removed (N and R route north) are also within or close to the predicted 200-year floodplain (N239, R0, R9, R10). All of the locations are

on fields or grassland above the banks of the channel and construction/removal of the towers is not expected to affect channel morphology. However, works will not take place at these locations when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.

9.129 Compaction of soils and increased areas of hardstanding reduces the infiltration rate leading to a greater rate and volume of surface water runoff. Clear felling forestry and other vegetation can also lead to an increase in surface water runoff rates. This results in a "flashier" catchment response and could increase flood risk downstream. While the magnitude of the change would not be anticipated to be great due to the small area of semi-permeable surfaces compared to the total catchment areas (**Table 9.10**), SEPA and D&GC highlighted in their consultation responses that there should be no increase in flood risk to third parties as a result of the KTR Project.

9.130 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local runoff rate and volume and potentially resulting in the change in contributing catchment areas. This would also have an effect on the rate and volume of water reaching receiving watercourses and other downstream receptors.

9.131 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for tower foundations and in the quarries during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas.

9.132 The KTR Project design incorporates SUDS and other embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Appendix 5.2** for details) and the discharge of attenuated surface water runoff from the working areas and access tracks into the watercourses will be limited to greenfield runoff rates entering each watercourse from the site at present. The catchment area of the Water of Ken at Glenlee (the downstream limit of this connection) is 373km^2. The total area of hardstanding or semi-permeable surfaces is 27.8ha (0.28km^2) which represents 0.07% of the total catchment.

9.133 The effect of site clearance, felling and construction on run-off rates and flood risk is considered to be of **negligible** magnitude and the significance will be **none** on watercourses downstream of the connection.

9.134 Excavations for tower foundations and the quarry could impact groundwater recharge levels. The effect is considered to be of short duration and reversible and is considered to be of **minor** magnitude and **minor** significance.

Table 9-10: Areas of Land-take in P-G via K Connection

Type	Area (ha)
Permanent	
Estimated Tower Base	0.2
Total Permanent	**0.2**
Temporary	
Construction compounds	2.3
Existing access	1.1
Existing Access - Widening	0.7
New access	5.5
Quarry	8.1
Work Area/Pulling Area	5.8
Low voltage UGC working area	3.9
Work Area/Pulling Area for NR Removal	0.2
Total Temporary	**27.6**
Grand Total	**27.8**

Effects during construction on GWDTEs

9.135 The GWDTE Assessment is set out in detail in **Appendix 9.7** and summarised below. The SEPA Guidance[20] for assessing impacts of development on GWDTEs recommends a 250m buffer zone from all excavations deeper than 1m and a 100m buffer for excavations less than 1m deep. While towers T1 and T2 and the new access track do not directly impinge on the GWDTE and are located on higher ground to the west, they are within 100m (and 250m) of the moderately dependent GWDTE habitat (see **Figure 9.2.1**). At the time of writing the proposed route for undergrounding of the 11kV distribution cable is shown to pass directly through the GWDTE. However, SPEN have noted that the final UGC route design will aim to avoid the GWDTE area during construction, the route has not been finalised at present. For the purposes of the assessment, the UGC route is assumed to pass directly through the GWDTE, as a conservative (worst-case) scenario.

9.136 Installation of the distribution UGC will result in a temporary loss of a small area of habitat along the working area of the trench and a temporary effect on subsurface flows during construction. However, as the native material will be replaced in the trench and the surface re-instated immediately after installation, the effects will be short-lived and there is not considered to be any significant effects on the GWDTE during operation.

9.137 Surface water flow paths based on topography (see **Figure 1, Appendix 9.7**) indicate that the flow paths feeding the GWDTE are in different sub-catchments to T1 and T2. However, given the uncertainty regarding sub-surface flow paths and the proximity of the excavations (including trenching for the underground cable) to the GWDTE and the moderate groundwater dependence of the GWDTE, the effect on the GWDTE is considered to be of **moderate** magnitude, but temporary, resulting in an effect of **moderate** significance during construction. There is not expected to be any long-term effect on hydrology and sub-surface flows to the GWDTE, although monitoring will be put in place to confirm this.

9.138 Excavation for the tower bases and access track will be temporary and additional mitigation measures, including monitoring (described below) will be put in place during construction to maintain and monitor the baseline subsurface flows towards the GWDTE.

Direct and indirect disturbance of peat during construction

9.139 The alteration of the geological environment by the excavation of the subsoil and peat required to build the infrastructure such as tower bases, construction compounds, working areas, access tracks and quarries and forestry removal will result in some alteration of the geological environment. In particular, any underlying topsoil and peat may be temporarily removed and will need to be managed appropriately.

9.140 Activities, or effects of activities, that have the potential to alter the geological environment include:

- earthworks and site drainage;
- reduction in water table resulting in the drying out, oxidation and potential erosion of peat;
- excavation and removal of peat;
- the disturbance and loading of peat by vehicle tracking; and,
- forest felling activities.

9.141 In the absence of detailed foundation design and ground investigations for foundation **Appendix 9.5** has assumed a worst-case scenario based on the data available at this stage. The calculations assume that all peat will be removed for the tower foundations, working areas, existing track widening, temporary track construction, construction compound construction and quarries. This results in an over estimation of the peat volumes likely to be excavated and in reality, the peat volumes excavated will be less.

9.142 The detailed peat volumes excavated for each section of the OHL route and associated infrastructure are presented in **Appendix 9.5**. The total volume of peat excavated for this connection based on a worst-case scenario that excavation is required along the whole footprint is 7,104m^3:

- 2,413m^3 for the towers and associated working areas;
- 226m^3 for construction compounds;
- 76m^3 for quarry;

[20] SEPA (2017) Land Use Planning System SEPA Guidance Note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems.

- 606m^3 for temporary widening of existing tracks; and,
- 3,783m^3 for new temporary access tracks.

9.143 Temporary storage of any soils or peat will be close to where it is to be reused, within the working areas and not located on existing peat deposits or within 25m of a watercourse or sensitive ecological habitats.

9.144 The total volume of peat that could be reused for this connection based on the assumptions within **Appendix 9.5** is 7,113m^3, so slightly greater than the estimated extracted peat volume. Essentially all peat will be reinstated back to where it was excavated after construction is complete with the exception of the peat related to the tower foundations. This additional peat of approximately 200m^3 will be reinstated in the Barlae Hill Quarry along with the existing peat from that location to extend the habitat and link to the existing peat habitat adjacent to the quarry. Peat will be reused or reinstated sequentially as quickly as possible. **Appendix 9.5** demonstrates that the peat excavated from this connection can be appropriately re-used on site.

9.145 Adherence to the Outline PMP will enable the excavated soil and peat to be appropriately managed and re-used onsite. It is anticipated that all excavated peat can be reused for reinstatement of ground, at the point of excavation. Prior to construction and on completion of ground investigations and micro-siting within the ILA, the Outline PMP will be refined and agreed with SEPA and SNH.

9.146 Prior to construction and on completion of ground investigations and micro-siting, a site waste management plan shall be produced, including for site soil and peat management good practice. It will ensure that excavated peat is appropriately managed and re-used.

9.147 Assuming embedded mitigation measures detailed in **Appendix 5.2** and **Appendix 9.5** and summarised above are incorporated into project design and are effective, the magnitude of the effect on peat is **none** for the majority of the connection as peat is not present or **minor** where shallow or modified/not active peatland peat is present. Overall, the effect on peat is **minor**.

Proposed Additional Mitigation

9.148 With embedded mitigation measures incorporated into project design, including SUDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality, morphology or PWS. Details of the embedded mitigation will be set out in detail prior to construction in the PPP, CDEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure comprising the connection and the contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL.

9.149 As described in **Appendix 9.2** and Embedded Mitigation section above, parts of the KTR Project that are up-gradient of sensitive receptors (e.g. PWS, watercourses) have been identified based on analysis of flow paths and additional areas for SUDS will be incorporated within the project design to mitigate any potential effects. In addition, further investigation of the location of PWS pipework and infrastructure will be carried out prior to construction and micro-siting of the P-G via K infrastructure within the ILA will be undertaken where necessary to avoid damaging any PWS pipework/infrastructure.

9.150 The results of flow path analysis, which was undertaken to establish potential hydrological connectivity between PWS and KTR Project infrastructure (**Appendix 9.3**), was used to determine which PWS will require water quality monitoring to ensure no contamination of supply during the work. Details of the proposed monitoring and emergency contingency measures are described in the Monitoring section below.

9.151 Dewatering and physical cut-offs will be avoided where possible and not undertaken close to water supplies and drainage measures will be designed to minimise the effect on the lowering of the groundwater table. Permanent physical cut-offs will be avoided with the exception of routing groundwater flows around the proposed quarry areas.

9.152 Additional mitigation measures to maintain baseline subsurface flows towards the GWDTE habitat identified west of towers PG1 and PG2 will be put in place during construction. Excavated material during tower base and UG cable trench construction will be replaced without compaction and the final design of the UGC route will aim to avoid the GWDTE habitat as far as possible during construction. In addition, the new temporary access track will be designed with suitable drainage under the track to allow subsurface flows to be maintained. Monitoring will be put in place to assess groundwater flow and quality to the GWDTE, as per SEPA guidance. Details of proposed monitoring is described in the Monitoring section below.

9.153 Any excavated peat will be stored appropriately nearby and re-used as soon as possible for reinstatement. Further ground investigation will be undertaken for the foundation and temporary track locations to determine the most suitable foundation and temporary track type so that the volumes of excavated peat can be reduced further.

Residual Construction Effects

9.154 With embedded mitigation, additional mitigation and monitoring described above, the residual construction effects are either **minor** or **not significant** and are summarised in **Table 9.11**.

9.155 Additional mitigation and monitoring measures put in place to maintain baseline subsurface flows towards the GWDTE habitat will reduce any significant effects on the localised GWDTE and the residual effect is considered to be **minor**.

9.156 The construction effects on peat are direct loss by peat excavation and indirect loss by temporary infrastructure located on the peat. The peat volume calculations make a worst-case scenario that all the peat is excavated, where present, from existing track widening, new temporary track, construction compounds, the towers and working areas and the Barlae Hill Quarry. However, on the basis that all of the temporary infrastructure located on peat will be reinstated with the excavated peat at the earliest opportunity and the remainder reinstated in the Barlae Hill Quarry there will be no net loss of peat. Therefore, no residual significant effects are predicted, and the residual effects are considered to be **minor**.

Removal of Existing 132kV OHL and associated towers (N and R route removal)

Predicted Effects during removal operations

9.157 Removal of the N and R (north) towers and OHL will primarily take place approximately one year after the new OHL is operational but will commence whilst construction of the P-G via K connection is ongoing (see **Chapter 5** for further details on the programme of works). The access tracks for the N and R removal are shown in **Figures 9.2.1-4**. South of Kendoon, the accesses are spurs off the active tracks for the P-G via K connection. North of Kendoon, the accesses are direct from the A713 road.

9.158 A review of the N and R north tower locations and access tracks in relation to the water environment and PWS indicate that no new watercourse crossings are required for their removal and there are no watercourses or waterbodies within 10m of the towers. Embedded good practice mitigation measures (e.g. SUDS) will be employed during tower removal to minimise potential effects on the water environment. Given the low impact of the removal works and the absence of watercourses in the immediate vicinity of the towers, the effect on water quality, hydrology and GWDTEs is **none**.

9.159 Several of the towers to be removed are located up-gradient of PWS (source and properties), as follows:

- Dundeugh PWS (tower 236N);
- Carsfad Cottage PWS (tower 7R);
- Barskeoch Mains PWS (towers 16R and 17R); and
- Waterside PWS (towers 25R and 26R).

9.160 The potential effects on tower removal on PWS has been assessed in **Appendix 9.3** and is summarised in the discussion of individual PWS above. Tower removal is considered to be relatively low impact with excavation down to a maximum of 1m depth and temporary, as tower removal takes approximately ten days per tower (refer to **Chapter 5**) and any excavated soils will be reinstated promptly. The potential effect on PWSs during tower removal is assessed to be of **negligible** magnitude resulting in an effect significance of **none**.

Proposed Additional Mitigation

9.161 No additional mitigation is proposed during removal of the existing OHL towers.

Residual Effects during removal operations

9.162 The are no significant residual effects during removal operations.

Operational Effects

Predicted Operational Effects

9.163 The potential operational effects of the P-G via K connection are associated with the permanent infrastructure, tower bases and any required maintenance work during operation, which will be infrequent.

9.164 There will be three new towers within or close to the functional floodplain of the Water of Ken required for this connection. These have been designed, and will be constructed, to be operational during floods (i.e. the 0.5% AP event) and to not impede water flow and hence will not increase flood risk downstream. Four existing towers will be removed from the floodplain which will compensate for the three new ones.

9.165 During operation, the increase in hardstanding areas (tower legs) within the river catchment could result in a very slight increase in the rate and volume of surface water runoff, leading to an increase in flood risk in watercourses downstream. However, given the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses, the magnitude of the effect on flood risk downstream is considered to be **negligible** and the effect is **none**.

Proposed Mitigation

9.166 No specific mitigation is proposed during operation other than the use of temporary matting or low-pressure vehicles to access tower locations during any operational maintenance.

Residual Operational Effects

9.167 There are no residual operational effects on the water and soil environment.

Monitoring

9.168 Monitoring of water quality of the following PWS will be undertaken before, during and after construction to ensure no contamination of the supply. Monitoring will be undertaken by an Ecological Clerk of Works (ECoW) (or equivalent) and monitoring locations will be identified in the CDEMP:

- High Carminnows PWS;
- Phail Barcris PWS (if required - will depend on the confirmed location of the borehole, which will be clarified at pre-construction stage);
- Carsfad Cottage PWS;
- Inverharrow PWS (during underground cable installation); and
- Waterside PWS.

9.169 If the water quality deteriorates during construction (e.g. discoloured, high sediment content, hydrocarbons) an alternative water supply will be installed at the PWS property, such as portable bowsers, to ensure minimal disruption of supply. The contractors will have a supply of bowsers ready to deploy to affected PWS, if required.

9.170 Monitoring will be put in place to assess the quantitative and chemical effect of the infrastructure to ensure that the groundwater flow and quality to the GWDTE are not statistically significantly changed post construction. Monitoring will be carried out based on SEPA guidance and will comprise a representative number of hand-driven groundwater monitoring wells. Pre-construction monitoring will commence at least six months before construction commences. Monitoring reports will be prepared, and remedial actions identified if statistically significant changes to the groundwater flow or chemistries to sensitive receptors are identified.

9.171 An ECoW will be on site throughout construction to monitor and ensure the effectiveness of the embedded and additional mitigation measures.

Summary of Effects

9.172 The main effects will occur during felling and construction of the KTR infrastructure and ancillary works (e,g. access tracks). There are no residual effects during operation. With embedded and additional mitigation, the residual effects on the water environment were assessed to be of **minor** or **no** significance (**Table 9.11**)

Table 9-11: Summary of Residual Construction and Operational Effects (PG via K Connection)

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Construction			
Effect on water quality of downstream watercourses and waterbodies	**Minor**	None	**Minor**
Effect on water quality in PWS	**Minor**	Monitoring of PWS before and during construction; Confirmation of location of PWS pipework; Provision of alternative water supply, if required.	**None**
Effects on channel morphology (bank erosion and channel form)	**Minor**		**Minor**
Effects on run-off rates, flood risk	**None**		**None**
Effects on ground-water levels and recharge	**Minor**	Avoid dewatering and physical cut-offs as much as possible.	**Minor**
Effects on GWDTEs	**Moderate**	Maintain baseline subsurface flows towards the GWDTE habitat. Excavated material around the tower bases and trenches will be replaced without compaction. The final design of the UGC route will aim to avoid the GWDTE habitat as far as possible during construction. The access track will have sufficient subsurface drainage to ensure subsurface flows are maintained. A monitoring program will be agreed with SEPA and put in place.	**Minor**
Peat loss/disturbance	**Minor**	Appropriate peat excavation, storage and re-use/reinstatement in accordance with the PMP.	**Minor**
Removal of N and R towers and existing OHL			
Effect on water quality in PWS	**None**		**None**
Operation			
Effects on run-off rates, flood risk	**None**		**None**

Carsfad to Kendoon

Existing Conditions

Topography

9.173 The topography of the C-K connection is shown in **Figure 9.2.2**. The new wood pole OHL follows the same route as the existing R route (south) and is located just to the west of the A713 road, paralleling the road. The route is located close to the bottom of a steep slope sloping down from west to east towards Carsfad Loch and the Water of Ken in the east. Ground levels rise to the west of the OHL to Knockclune Hill and Stroangassel Hill beyond. Ground levels along most of this section of the route are between 130 to 140m AOD but are lower at the northern (Kendoon) and southern (Carsfad) ends of the connection, as ground levels fall to the Water of Ken with levels of around 103m AOD in the north and 90m AOD in the south.

Watercourses and Surface Water

9.174 The Water of Ken flows in a southerly direction to the east of the OHL and the Study Area drains either directly or indirectly to the Water of Ken or Carsfad Loch, which is located on the Water of Ken (**Figure**

9.2.2). The OHL passes over many small unnamed watercourses, which all drain off the steep slopes to the west of the OHL in an easterly direction to enter the Water of Ken/Carsfad Loch after passing under the A713 road (**Figure 9.2.2**).

9.175 With the exception of Carsfad Loch, no other open water bodies of water (e.g. ponds, lochs) were noted along this section of the connection. However, several areas of wet, boggy ground or marshland were noted during the site walkover and these are shown in **Figure 9.2.2**. The marshy areas tend to be on the western side of the A713 road. These were avoided where possible during iterations of the project design and routeing.

Hydrology and Flood Risk

9.176 The catchment area of the Water of Ken at the downstream point of this section of the route is 313km^2.

9.177 There are no SEPA gauging stations on the watercourses in this connection Study Area.

9.178 SEPA flood maps show some fluvial flooding from the Water of Ken in the upstream section of this connection close to Kendoon and the river is predicted to flood out of bank on the west bank of the channel in a 200-year return period event. Site observations confirm that the field on the west side of the channel is clearly the floodplain of the Water of Ken. There are existing towers in this field and a proposed new tower (Tower R002R) is located close to or within the floodplain. Further downstream the Water of Ken and Carsfad Loch are predicted to stay generally within bank during the 200-year flood event, based on SEPA's indicative maps. The predicted flood extent is well away from the proposed OHL route.

9.179 There is no surface water (pluvial) flooding predicted within this connection.

Existing Site Drainage and Surface Water Flooding

9.180 A flow pathway analysis was undertaken in GIS, based on the 1m LiDAR data to assess potential overland flow routes within and outside of the OHL and associated infrastructure.

9.181 Existing ground levels of this section of the connection fall to the east; hence surface water runoff from the OHL is to the east towards the Water of Ken and Carsfad Loch. Surface water runoff will flow from the high ground to the west towards the OHL and associated accesses. The proposed access tracks follow the contours and cuts across the base of the slope. It was noted during the field walkover that there were several ephemeral streams flowing down the slope (due to the heavy rainfall during and preceding the site visit). This will be incorporated into the final drainage design.

Watercourse crossings

9.182 The C-K connection infrastructure has 13 watercourse crossings; several of the watercourses are crossed by both the OHL and access tracks at a similar location (as the access track parallels the OHL route) (see **Appendix 9.1** and **Figure 9.2.2**).

9.183 Details of the crossings are provided in **Appendix 9.1**. Most watercourses to be crossed are generally small (<2.5m wide) except for the Water of Ken, which is approximately 36m wide at the OHL crossing location. Catchment areas draining to each crossing were estimated based on watershed analysis in Global Mapper GIS software using the LiDAR topographic data. Catchment areas and catchment characteristics of larger watercourses (e.g. Water of Ken crossing) were extracted from the Centre for Ecology and Hydrology: Flood Estimation Handbook web service[21]. Due to the heavy rainfall during and preceding the site surveys, it is likely that several of the watercourses observed were ephemeral in response to surface water runoff.

Water Supplies, Discharges and Abstractions, and Services

9.184 A summary of PWS source locations within 1km of the KTR Project are shown in **Table 9.4**. Those close to the C-K connection are identified in column two of the table and shown in **Figure 9.2.2**, along with locations of supplied properties (if available). Further details of each PWS and an assessment are provided in **Appendix 9.3**.

9.185 SEPA provided a list of groundwater abstractions within a 1km buffer of the KTR Project. There are no licenced groundwater abstractions in this connection.

9.186 Available data on Scottish Water utilities in the area (i.e. water and waste-water mains and distribution networks) indicate that there is no Scottish Water pipework close to the C-K Connection. Locations of utilities will be confirmed before construction.

Water Quality and Protected Areas

9.187 Under the WFD and SEPA's classification system, only the Water of Ken downstream of Kendoon Loch (Water Body ID 10558) has been classified by SEPA (classified as Bad ecological potential in 2017).

9.188 The Loch Ken and River Dee Marshes SPA/RAMSAR site is located on the Water of Ken approximately 10km downstream of this connection.

9.189 The River Dee catchment supports salmon and trout populations and the C-K connection drains indirectly to the Water of Ken/River Dee catchment.

Soils and Geology

9.190 The soils and Geology sections are described approximately from north to south for this section of the connection route.

9.191 Scottish Soil mapping (**Figure 9.3.1**) shows the majority of the connection route to be underlain by brown earth with some areas peaty gleys in the northern section of the connection route near Kendoon within the Water of Ken valley.

9.192 The SNH Carbon and Peatlands Map 2016 (**Figure 9.4.1**) shows the majority of the connection route to be located on minerals soils with the exception of the northern areas near Kendoon being of Class 3 and 5 soils:

- Class 3 (blue) - Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats. Most soils are carbon-rich soils, with some areas of deep peat: Track near Kendoon to east of Water of Ken.
- Class 5 (green) - Soil information takes precedence over vegetation data. No peatland habitat recorded, may also include areas of bare soil. Soils are carbon-rich and deep peat: Track and towers near Kendoon within the Water of Ken valley.

9.193 The superficial or drift geology mapping (**Figure 9.5.1**) shows the majority of the connection route to be underlain by superficial or drift deposits. The northern section by Kendoon is located on alluvial deposits associated with the Water of Ken. The remaining northern half is underlain by hummocky glacial deposits or moraine. The southern section is shown not to be underlain by superficial deposits and the power station area is shown to be located on hummock glacial deposits and localised alluvium. Sections where the route is underlain by superficial deposits includes:

- Hummocky Glacial Deposits comprising blocky till in a matrix of grit and sand (green) – Northern half of the connection route.
- Alluvium comprising silt, sand, clay, and gravel (yellow) – Extreme north and south associated with Water of Ken and Carsfad Loch.

9.194 The solid or bedrock geology mapping (**Figure 9.6.1**) shows the majority of the bedrock to comprise of greywackes or metamorphosed turbidite deposits of Ordovician age. From north to south the bedrock of this connection route comprises:

- Shinnel Formation (Ordovician)– Turbidites thick to thinly bedded sandstone and siltstone. Sandstones are quartzose.

9.195 The structural geology comprises:

- A fault North-Northwest to South South-east roughly parallel to Water of Ken valley with a downthrow to the north-east.

9.196 There are no known geological designated areas within this connection.

Peat

9.197 Peat depth surveying was undertaken where peat was shown to be potentially present on SNH, Scottish Soils and BGS mapping along the route of the new OHL and infrastructure such as access tracks,

[21] Centre for Ecology and Hydrology: Flood Estimation Handbook web service, viewed at https://fehweb.ceh.ac.uk

construction compounds and quarries. The results of the peat survey are shown as peat depth contour in **Figure 9.7.2**.

9.198 The peat survey indicated there are minimal peat deposits along the route of the C-K connection. The results from the early phases of the surveys were used to feed into the design and to inform the requirements for further peat depth surveying.

9.199 Peat is generally not present across much of the C-K route with the exception of the potential for some modified peat (not considered active) west of Kendoon in the water of Ken Valley for the track to R003R and near wooden poles R016R and R017R. The design was amended where possible to avoid peat deposits.

9.200 The full details of the peat surveys for the new OHL are presented within **Appendix 9.4**.

Groundwater

9.201 The majority of this section of the OHL and removal route is underlain by Ordovician and Silurian greywacke metamorphic rocks which are classified as a non-aquifers or low productivity aquifers that are generally without groundwater except at shallow depths within the weathered zone or fractures.

9.202 Superficial quaternary alluvial deposits within the Loch Ken valley are classified as a perched or concealed low productivity aquifer with limited or local potential.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.203 There are no GWDTEs present in this connection (see **Chapter 10: Ecology**).

Construction Effects

9.204 The following effects have been assessed in full:

- Effects during construction on surface and ground water quality and private drinking water supplies;
- Effects on channel morphology (bank erosion and channel form) during construction;
- Effects during construction on run-off rates and flood risk;
- Direct and indirect disturbance of peat during construction.

9.205 The sensitivity of receptors (within the Study Area) has been assessed in **Table 9.12**, using the criteria in **Table 9.5**.

Table 9-12: Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourses/Surface Water Bodies Water of Ken Carsfad Loch Unnamed Watercourses	High	All watercourses drain, either directly or indirectly, to the Water of Ken/River Dee catchment. There is a designated site of international importance (SPA and RAMSAR site) on the Water of Ken approximately 10km downstream of this connection. In addition, the River Dee catchment is known to support salmon and trout populations, hence the sensitivity of all watercourses is high. The Water of Ken was classified by SEPA as of bad ecological potential. There are no properties downstream of the project infrastructure that are at currently at flood risk.
Private Water Supplies	Medium	Two abstractions for private water supplies (**Table 9.13** and **Figures 9.2.2-3**).
Peat	Low	Low where modified (not considered to be active peatland) or shallow peat is present and infrastructure area is limited. The majority of the peat deposits are shallow and heavily modified by forestry activities on this connection route. Removal, disturbance, oxidation or erosion of peat can release carbon. The excavation or disturbance of peat involves volumes of peat that must be carefully managed and appropriately re-used onsite. Any peat requiring removal off site will be classified as waste and require the relevant licencing.
Groundwater	Low to Medium	The connection is located on low productivity aquifers.

Predicted Construction Effects

9.206 The main likely significant environmental effects are predicted to occur during felling and construction. The activities that will occur during construction that may have an impact on the water environment and peat, include: site clearance and vegetation (forestry) removal; use of heavy plant machinery; increase of hardstanding areas; construction and upgrading of access tracks; watercourse crossings; associated earthworks/excavation/re-profiling and construction traffic on access tracks.

9.207 The C-K section of OHL comprises wood poles, which require an excavation of around 2m deep. Erection of a wood pole is undertaken in a single operation (i.e. one day). There is one construction compound (compound No. 2) within this connection.

9.208 During the detailed routeing stage, a buffer of at least 10m was applied to all watercourses identified from Ordnance Survey maps and during the site walkover survey. A location specific larger buffer was applied to larger watercourses. Therefore, there are no towers (or associated working areas) within or close to watercourses.

9.209 The design of construction access sought to use existing access tracks as much as possible to avoid new watercourse crossings and land take. However, given the hydrological setting of the OHL route (along the lower slopes of the Water of Ken valley), there are a number of unnamed watercourses which were unavoidable. New watercourse crossings, upgrade of existing watercourse crossings and stringing of the OHL over watercourses could potentially impact channel morphology during construction.

9.210 Access tracks for the C-K section of the route use the same access tracks as the P-G via K route, with small spurs off to access the wood pole locations and working areas (**Figure 9.2.2**). There are no additional watercourse crossings for tracks required for the C-K route; the track crossings have been assessed as part of the P-G via-K connection. However, as this is a separate application for section 37 consent, the assessment is also set out for this connection. There are 13 track crossings in the C-K connection (**Appendix 9.1**), which are mainly small watercourses (<3m wide) and will be covered by SEPA's GBRs. Three of the larger crossings (PG12C, PG13C, PG17C) in the C-K connection will require authorisation under the CAR.

9.211 The OHL crosses 14 watercourses; all of which are small and unnamed with the exception of the Water of Ken, which is around 36m wide at the OHL crossing location. Details of stringing the OHL over watercourses is described in **Chapter 5**.

Effects during construction on surface and ground water quality and private water supplies

9.212 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, heavy plant movement on the access tracks and construction compound and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages. There is also a risk posed by concrete (and other construction material) spillages during the formation of hardstanding areas at the tower bases.
- Pollution/sediment run-off during construction of new watercourse crossings for access tracks.

9.213 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater and concrete spillages.

9.214 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. The increase in sediment concentration in runoff from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses. This can have an indirect effect on watercourse ecology (see **Chapter 10**).

9.215 Felling can result in increased surface water run-off and sediment run-off. Felling of an area of 0.98 of forestry is required for the OHL wayleave.

9.216 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles and in the event of an accidental release of concrete or other building materials. Pollutants could enter watercourses directly or via overland flow pathways. Shallow groundwater could also be affected.

9.217 With the embedded mitigation measures detailed in **Appendix 5.2** and **Appendix 9.2** and summarised above in place, the magnitude of the effect of increased sediment/silt runoff causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the site during construction is considered to be **minor** and temporary and is considered to be of **minor** significance.

9.218 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will minimise the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be of short duration and **minor** and is the effect is considered to be of **minor** significance.

9.219 There are two PWS sources within 1km of this connection (**Table 9.4**), which source their water from groundwater springs. Given that construction can potentially affect both surface and groundwater quality, it follows that construction can potentially affect nearby and downgradient PWS. An assessment of PWS was carried out based on proximity to the C-K infrastructure and flow path analysis from the infrastructure/construction areas to the individual PWS (sources and properties) (**Appendix 9.3**).

9.220 Based on SEPA Guidance[22] for assessing impacts of development proposals on groundwater abstractions and PWS a 250m buffer zone is used for all new OHL infrastructure, including tracks. This is a conservative approach which considers all ground excavations are deeper than 1m. This will be the case for the wood pole base installation (see **Chapter 4**). However, construction and/or upgrade of access tracks will likely require excavations less than 1m. Hence, using a 250m buffer round all the infrastructure is a conservative approach.

9.221 There are two PWS sources and three supplied properties within 250m of the C-K project infrastructure; a detailed assessment of each is provided in **Appendix 9.3** and summarised in **Table 9.13**.

9.222 Flow routing analysis was undertaken in **Appendix 9.3** to infer hydrological and hydrogeological connectivity between proposed infrastructure and each PWS to identify if the KTR Project could potentially impact a PWS. In cases where flow path analysis identified a 'potential impact' the significance of the effect was assessed assuming embedded mitigation measures are in place resulting in an effect significance of **none**. Any additional mitigation measures, including monitoring, required for specific PWS, over and above embedded mitigation are described in **Appendix 9.3** and summarised in the Proposed Additional Mitigation section below.

Table 9-13: Details of Private Water Supplies (PWS) sources and properties within 250m of C-K infrastructure

Nat. Grid Ref	Source Name	Property[1]	Source/ Source Type[2]	Type[3]	Nearby KTR Infrastructure	Distance from closest Infra-structure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX60000 86500	Stroangassel	-	Spring	B	Access Track, Wood Pole 12R	247, 250	No impact	**None**
NX60374 86749	Stroangassel Farm	Property	-	B	Access Track, Wood Pole 10R	150, 110	Potential impact	**None**
NX60300 85400	Carsfad Cottage	-	GW Spring (well)	A	Access Track, Wood Pole	52, 71	Potential impact	**None**
NX60335 85404	Carsfad Cottage 2[5]	-	Source infra-structure (tank)	A	Access Track, Wood Pole	16, 35	Potential impact	**None**
NX60467 85456	Carfad Cottage	Property	-	A	Access Track, Wood Pole	70	Potential impact	**None**
NX60561 85436	Carsfad Power Station	Commercial Property	-	A	Access Track, Wood Pole	108	Potential impact	**None**

[1] **Property:** This column identifies the PWS property location and details

[2] **Source/Source Type**: This column identifies the PWS source location and details and includes a description of the type of supply (e.g. borehole, spring or surface water)

[3] **Type**: Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[4] **Flow Path Analysis Result**: Likelihood of impact on PWS from infrastructure construction, based on flow paths

[5] Carsfad 2 is supply infrastructure related to the Carfad Cottage PWS

Effects on channel morphology (bank erosion and channel form) during construction

9.223 The effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude, as embedded mitigation measures, including a minimum 10m buffer zone and environmentally sensitive bridge design, have been incorporated into the project design. This will result in an effect significance of **none**.

Effects during construction on run-off rates, flood risk and ground-water levels/recharge

9.224 In accordance with the Risk Framework within Scottish Planning Policy (SPP), new development should be limited to areas outside the medium risk 200-year (0.5% Annual Probability (AP)) functional floodplain. Floodplains were avoided as far as practicable during the routeing and design process of the KTR Project.

9.225 The KTR Project is 'essential infrastructure' under the SEPA Flood Risk and Land Use Vulnerability Guidance and the guidance notes that essential infrastructure can be in medium to high risk flood areas (i.e. >0.5% AP) if a flood risk location is required for operational reasons and an alternative lower-risk location is not available. In the few situations where towers are located within the 200-year floodplain, they will be designed and constructed to be operational during floods (i.e. the 0.5% AP event), and to not impede water flow.

[22] SEPA (2017) Land Use Planning System SEPA Guidance Note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems.

9.226 A review of SEPA flood maps indicated that one new OHL wood pole (R002R) close to Kendoon is within the 200-year floodplain (medium likelihood flood) of the Water of Ken. It is located in a field approximately 20m from the riverbank and is approximately 2m higher than the bank. Wood pole P002R will be designed and constructed to be operational during floods (i.e. the 0.5% AP event), and to not impede water flow. Thus, construction of the wood pole is not expected to affect channel morphology and works will not take place at this location when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.

9.227 Compaction of soils and increased areas of hardstanding reduces the infiltration rate leading to a greater rate and volume of surface water runoff. Clear felling forestry and other vegetation can also lead to an increase in surface water runoff rates. This results in a "flashier" catchment response and could increase flood risk downstream. While the magnitude of the change would not be anticipated to be great due to the small area of semi-permeable surfaces compared to the total catchment areas (**Table 9.14**), SEPA and D&GC highlighted in their consultation responses that there should be no increase in flood risk to third parties as a result of the KTR Project.

9.228 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local runoff rate and volume and potentially resulting in the change in contributing catchment areas. This would also affect the rate and volume of water reaching receiving watercourses and other downstream receptors.

9.229 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for tower foundations during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas.

9.230 The KTR Project design incorporates SUDS and other embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Appendix 5.2** for details) and the discharge of attenuated surface water runoff from the working areas into the watercourses will be limited to greenfield runoff rates entering each watercourse from the site at present. The catchment area of the Water of Ken at Carsfad (the downstream limit of the section of the route) is 313km^2. The total area of hardstanding or semi-permeable surfaces is 3.1ha (~0.03km^2) which represents approximately 0.01% of the total catchment.

9.231 The effect of site clearance, felling and construction on run-off rates and flood risk is considered to be of **negligible** magnitude and the significance of the effect will be **none** on watercourses downstream of the connection.

9.232 Excavations for the wood pole foundations could impact groundwater levels. The effect is considered to be of short duration and reversible and is considered to be of **negligible** magnitude and the significance of the effect is **none**.

Table 9-14: Areas of Land Take in C-K Connection

Type	Area (ha)
Permanent	
Wood poles	negligible
Temporary	
New access	1.6
Work Area/Pulling Area	1.5
Grand Total	**3.1**

Direct and indirect disturbance of peat during construction

9.233 The alteration of the geological environment by the excavation of the subsoil and peat required to build the infrastructure such as working areas, access tracks and woodland removal will result in some alteration of the geological environment. In particular any underlying topsoil and peat may be temporarily removed and will need to be managed appropriately.

9.234 Activities, or effects of activities, that have the potential to alter the geological environment include:

- earthworks and site drainage;
- reduction in water table resulting in the drying out, oxidation and potential erosion of peat;
- excavation and removal of peat;
- the disturbance and loading of peat by vehicle tracking; and,
- forest felling activities.

9.235 In the absence of detailed foundation design and ground investigations for foundation **Appendix 9.5** has assumed a worst-case scenario based on the data available at this stage. The calculations assume that all peat will be removed for the tower foundations, work areas, existing track widening, temporary track construction, construction compound construction and quarries. This results in an over estimation of the peat volumes likely to be excavated and in reality, the peat volumes excavated will be much less. The detailed peat volumes excavated for each section of the OHL route and associated infrastructure is presented in **Appendix 9.5**.

9.236 The total volume of direct peat loss for this section of the OHL and associated infrastructure, based on a worst-case scenario that excavation is required along the whole footprint is 394m^3:

- 140m^3 for the towers and associated working areas; and
- 254m^3 for the temporary access tracks.

9.237 Temporary storage of any soils or peat will be close by to where it is to be reused, within the working areas and not located on existing peat deposits, within 25m of a watercourse or sensitive ecological habitats.

9.238 The total volume of peat that can be reused for this connection is 389m^3. Essentially all peat will be reinstated in the working areas and access tracks so only the small wood pole foundations will have peat excavated that requires reuse. This peat can be used around the infrastructure to tie in to the existing peat habitat as it is a very minor amount (5m^3) and is based on a worst case scenario. Peat will be reused or reinstated sequentially and as quickly as possible.

9.239 **Appendix 9.5** demonstrates that the peat excavated from this section of the new OHL can be appropriately re-used on site.

9.240 Adherence to the draft PMP will ensure that excavated soil and peat is appropriately managed and re-used onsite. It is anticipated that all excavated peat can be reused for reinstatement of ground, at the point of excavation. Prior to construction and on completion of ground investigations and micro-siting, the outline PMP will be refined and agreed with SEPA and SNH.

9.241 Prior to construction and on completion of ground investigations and micro-siting, a site waste management plan shall be produced, including for site soil and peat management good practice. It will ensure that excavated peat is appropriately managed and re-used.

9.242 Assuming the embedded mitigation measures detailed in **Appendix 5.2** and **Appendix 9.5** and summarised above are incorporated into project design and are effective, the magnitude of the effect on peat ranges from **none** to **minor** for the majority of the connection as peat is not present or is shallow, modified or not considered to be active peatland. Overall, the significance of the effect on peat is **minor.**

Proposed Additional Mitigation

9.243 With embedded mitigation measures incorporated into project design, including SUDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality or PWS. Details of the embedded mitigation will be set out in detail prior to construction in the PPP, CDEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure comprising the connection and the contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL.

9.244 As described in **Appendix 9.2** and Embedded Mitigation section above, parts of the KTR Project that are up-gradient of sensitive receptors (e.g. PWS, watercourses) have been identified based on analysis of flow paths and additional areas for SUDS will be incorporated within the project design to mitigate any potential effects. In addition, further investigation of the location of PWS pipework and infrastructure will be carried out prior to construction and micro-siting of the C-K infrastructure within the ILA will be undertaken where necessary to avoid damaging any PWS pipework/infrastructure.

9.245 The results of flow path analysis, which was undertaken to establish potential hydrological connectivity between PWS and KTR Project infrastructure (**Appendix 9.3**), was used to determine which PWS will require water quality monitoring to ensure no contamination of supply during the work. Details of the proposed monitoring and emergency contingency measures are described in the Monitoring section below.

9.246 Dewatering and physical cut-offs will be avoided where possible and not undertaken close to water supplies and drainage measures will be designed to minimise the effect on the lowering of the groundwater table. Permanent physical cut-offs will be avoided.

9.247 The construction effects on peat are direct loss by peat excavation and indirect loss by temporary infrastructure located on the peat. The peat volume calculations use a worst-case scenario that all the peat is excavated, where present, from existing track widening, new temporary track, construction compound and working areas. The reality is that there is very little peat present in this connection and all of the temporary sections located on peat will be reinstated with excavated peat at the earliest opportunity. Therefore, there will be a net balance for peat excavation and peat reuse for this connection route.

9.248 Any excavated peat will be stored appropriately nearby and re-used as soon as possible for reinstatement. Further ground investigation should be undertaken for the foundation and temporary track locations to determine the most suitable foundation and temporary track type so that the volumes of excavated peat can be reduced further.

Residual Construction Effects

9.249 With embedded mitigation and the additional mitigation described above, the significance of residual construction effects is either **minor** or **none** as summarised in **Table 9.15**.

Operational Effects

Predicted Operational Effects

9.250 The potential operational effects of the C-K connection are associated with the permanent infrastructure, wood poles and any required maintenance work during operation, which will be infrequent.

9.251 There will be one new wood pole within or close to the functional floodplain of the Water of Ken required for this connection. This has been designed, and will be constructed, to be operational during floods (i.e. the 0.5% AP event) and to not impede water flow and hence will not increase flood risk downstream.

9.252 During operation, the increase in hardstanding areas (wood poles) within the river catchment could result in a very slight increase in the rate and volume of surface water runoff, leading to an increase in flood risk in watercourses downstream. However, given the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses, the magnitude of the effect on flood risk downstream is considered to be **negligible** and thus the effect is **none**.

Monitoring

9.253 Monitoring of water quality of the Carsfad Cottage PWS will be undertaken before, during and after construction to ensure no contamination of the supply. Monitoring will be undertaken by an ECoW (or equivalent) and monitoring locations will be identified in the CDEMP.

9.254 If the water quality deteriorates during construction (e.g. discoloured, high sediment content, hydrocarbons) an alternative water supply will be installed at the PWS property, such as portable bowsers, to ensure minimal disruption of supply. The contractors will have a supply of bowsers ready to deploy to affected PWS, if required.

9.255 An ECoW will be on site throughout construction to monitor and ensure the effectiveness of the embedded and additional mitigation measures.

Summary of Effects

9.256 The main effects will occur during felling and construction of the KTR infrastructure and ancillary works (e.g. access tracks). There are no residual effects during operation. With embedded and additional mitigation, the significance of the residual effects on the water environment and peat is assessed to be **minor** or **none** (**Table 9.15**).

Table 9-15: Summary of Residual Construction and Operational Effects (C-K Connection)

Effect	Significance before additional mitigation (including embedded mitigation measures)	Additional Mitigation	Significance after additional mitigation
Construction			
Effect on water quality of downstream watercourses and waterbodies	**Minor**		**Minor**
Effect on water quality in PWS	**None**	Monitoring of PWS before and during construction; Confirmation of location of PWS pipework; Provision of alternative water supply, if required	**None**
Effects on channel morphology (bank erosion and channel form)	**None**		**None**
Effects on run-off rates, flood risk	**None**		**None**
Effects on ground-water levels and recharge	**None**	Avoid dewatering and physical cut-offs as much as possible	**None**
Peat loss/disturbance	**None** to **Minor**	Appropriate peat excavation, storage and re-use/reinstatement Further ground investigation to review track options	**None** to **Minor**
Operation			
Effects on run-off rates, flood risk	**None**		**None**

Earlstoun to Glenlee

Existing Conditions

Topography

9.257 The topography of the Earlstoun to Glenlee (E-G) connection is shown in **Figure 9.2.4**. The new wood pole OHL begins at the Earlstoun substation, which is located between the two channels of the Water of Ken approximately 400m downstream of Earlstoun Loch. Here ground elevations are around 60m AOD close to the watercourse. The OHL route crosses the offtake channel of the Water of Ken, downstream of the dam at the hydro power station. Further south, the OHL follows a similar route to the P-G via K OHL (**Figure 9.2.4**).

9.258 Ground levels along most of this connection are between 60m to 80m AOD; the OHL is located on the gentle hillslopes on the western valley side of the Water of Ken and ground levels fall to the south-east towards the watercourse. As the OHL reaches Glenlee, ground levels fall down towards the floodplains of Coom Burn and the Water of Ken at around 52m AOD (**Figure 9.2.4**).

Watercourses and Surface Water

9.259 The Water of Ken flows in a southerly direction to the east of this connection and the Study Area drains either directly or indirectly to the Water of Ken. The OHL passes over several small unnamed watercourses and the Coom Burn and Glenlee Tailrace channel in the south.

9.260 No open water bodies of water (e.g. ponds, lochs) were noted along this connection.

Hydrology and Flood Risk

9.261 The catchment area of the Water of Ken at Glenlee (the downstream limit of this connection) is 373km^2 and here the watercourse is approximately 45m wide. The Coom Burn has a catchment area of approximately 21km^2.

9.262 SEPA flood maps show some predicted flooding of the Water of Ken in a 1 in 200 year event in the north of this connection close to the Earlstoun substation (and wood pole EG0016) and also close to southern extent of this connection, where the Water of Ken is predicted to flood out of bank close to the mouth of the Coom Burn, close to Towers EG003 and EG004.

9.263 There is no surface water (pluvial) flooding predicted within this connection.

Existing Site Drainage and Surface Water Flooding

9.264 Existing ground levels of this section of the connection fall to the south and east; hence surface water runoff from the OHL is to the south-east towards the Water of Ken. Surface water runoff will flow from the high ground to the west of the Study Area towards the OHL and associated infrastructure.

Watercourse crossings

9.265 The E-G connection infrastructure has 15 watercourse crossings; several of the watercourses are crossed by both the OHL and access tracks at a similar location (as the access track parallels the OHL route) (see **Appendix 9.1** and **Figure 9.2.4**). The underground cable (UGC) section passes under a small unnamed watercourse (EG1), just upstream of where it is culverted under the Glenlee Power Station. The UGC will also pass below the existing culvert within the substation at a sufficient depth to avoid any impact on the culvert.

9.266 Details of the crossings are provided in **Appendix 9.1**. Most watercourses to be crossed are generally small (<2.5m wide) except for spillway channel downstream of the dam for the hydro power scheme. At the OHL crossing location, the channel is approximately 8m wide.

Water Supplies, Discharges and Abstractions, and Services

9.267 A summary of PWS source locations within 1km of the KTR Project are shown in **Table 9.4**. There is one PWS (Waterside) close to the E-G connection, identified in column two of the table and shown in **Figure 9.2.4**, along with locations of the supplied property. Further details of the PWS and a detailed assessment are provided in **Appendix 9.3**.

9.268 SEPA provided a list of groundwater abstractions within a 1km buffer of the KTR Project. There are no licenced groundwater abstractions within 1km of the E-G connection.

9.269 Available data on Scottish Water utilities in the area (i.e. water and waste-water mains and distribution networks) show that the only Scottish Water pipework close to the E-G Connection is located on the roads at the Earlston and Glenlee substations. Locations of utilities will be confirmed before construction.

Water Quality and Protected Areas

9.270 Under the WFD and SEPA's classification system, only two water bodies are large enough to be classified within this section of the route. The Water of Ken downstream of Kendoon Loch (Water Body ID 10558) was classified by SEPA in 2017 as having Bad ecological potential. The Coom Burn/Garroch Burn (Water Body ID 10570) was classified as having Moderate ecological potential.

9.271 The Loch Ken and River Dee Marshes SPA/RAMSAR site is located on the Water of Ken approximately 4km downstream of the E-G connection (**Figure 10.2**) (see **Chapter 10** and **Chapter 11** for further details).

9.272 The entire E-G connection drains to the Water of Ken/River Dee catchment which supports salmon and trout populations.

Soils and Geology

9.273 The soils and Geology sections are described overall and then described approximately from north to south for the connection route.

9.274 Scottish Soil mapping (**Figure 9.3.2**) shows the majority of the connection route to be underlain by alluvial soils with some brown soils to the west.

9.275 The SNH Carbon and Peatlands Map 2016 (**Figure 9.4.2**) shows all of this connection route section to be located on minerals soils (grey).

9.276 The superficial or drift geology mapping (**Figure 9.5.2**) shows the majority of the route is not underlain by superficial or drift deposits. Sections where the route is underlain by superficial deposits includes:

- Alluvium comprising silt, sand, clay, and gravel (yellow): Extreme north at Earlstoun Loch associated with the Water of Ken and the southern section EG001 to EG004 associated with the Coom Burn and Water of Ken valley.

9.277 The solid or bedrock geology mapping (**Figure 9.6.2**) shows the following from north to south roughly:

- Glenlee Formation (Ordovician): Thin, medium to thick bedded turbidites with a thick development of grey siltstone inset (Glenlee Formation – siltstone) containing black graptolitic laminae. Sandstones are mainly quartzose.

9.278 The structural geology comprises:

- A fault North-Northwest to South Southeast roughly parallel to Water of Ken valley with a downthrow to the northeast.
- Two un-named faults North-Northwest to South Southeast downthrow to northeast at Glenlee.

9.279 There are no known geological designated areas within this section of the new connection.

Peat

9.280 Peat depth surveys were undertaken where peat was shown to be potentially present on SNH, Scottish Soils and BGS mapping along the route of the new OHL and infrastructure such as access tracks, construction compounds and quarries. The results of the peat survey are shown as peat depth contour in **Figure 9.7.4**.

9.281 Little peat was anticipated in this section, therefore the survey reflects this. The peat results from the early phases of the surveys were used to feed into the design and the requirements for further peat depth surveying.

9.282 Peat is absent along the majority of this section with the exception in the south where peat between 1.5m to up to 3.0m is present within the Coom Burn and Water of Ken valley at towers EG002 and EG003. This area of peat is modified and not active peatland as the ecology surveys recorded it as marshy grassland, rather than blanket or raised bog.

9.283 The full details of the peat surveys for the new OHL are presented within **Appendix 9.4.**

Groundwater

9.284 The majority of the connection route is underlain by Ordovician and Silurian greywacke metamorphic rocks which are classified as a non-aquifer or low productivity aquifers that are generally without groundwater except at shallow depths within the weathered zone or fractures.

9.285 Superficial quaternary alluvial deposits within the Coom Water and Water of Ken valley are classified as a perched or concealed low productivity aquifer with limited or local potential.

9.286 Some superficial deposits are present that are have the potential to be productive aquifers, these are the Quaternary Fluvio-glacial deposits south of Woodhall Loch, comprising of sands and gravels. These are locally important aquifers with the potential to be productive through intergranular flow.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.287 There are no GWDTEs present in this connection (see **Chapter 10** for details).

Construction Effects

9.288 The following effects have been assessed in full:

- Effects during construction on surface and ground water quality and private drinking water supplies;
- Effects on channel morphology (bank erosion and channel form) during construction;
- Effects during construction on run-off rates and flood risk; and
- Direct and indirect disturbance of peat during construction.

9.289 The sensitivity of receptors (within the Study Area) has been assessed in **Table 9.16**, using the criteria in **Table 9.5**.

Table 9-16: Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourses/Surface Water Bodies Water of Ken Coom Burn Unnamed Watercourses	High	All watercourses drain, either directly or indirectly, to the Water of Ken/River Dee catchment. There is a designated site of international importance (SPA and RAMSAR site) on the Water of Ken approximately 4km downstream of this connection. In addition, the River Dee catchment is known to support salmon and trout populations, hence the sensitivity of all watercourses is high. The Water of Ken and the Coom Burn were classified by SEPA as of bad ecological and moderate potential respectively. There are no properties downstream of the project infrastructure that are at currently at flood risk.
Private Water Supplies	Medium	One abstraction for private water supplies (**Table 9.17** and **Figure 9.2.1.4**).
Peat	Low	Low where modified / non-active peatland (EG002 and EG003 in Coom Burn and Water of Ken valley) or shallow peat is present and of limited infrastructure area. The majority of the peat deposits are shallow and heavily modified by forestry activities on this connection route. The excavation or disturbance of peat involves volumes of peat that must be carefully managed and appropriately re-used onsite. Any peat requiring removal off site will be classified as waste and require the relevant licencing.
Groundwater	Low	The connection is located on low productivity aquifers.

Predicted Construction Effects

9.290 The main likely significant environmental effects are predicted to occur during the felling and construction phase, based on the detailed description of the project provided in **Chapters 4** and **5**.

9.291 The activities that will occur during the construction phase that may have an impact on the water environment and peat, include: site clearance and vegetation (forestry) removal; use of heavy plant machinery; increase of hardstanding areas; construction and upgrading of access tracks; watercourse crossings; open cut trenching for short section of underground cable; associated earthworks/excavation/ re-profiling and construction traffic on access tracks.

9.292 The E-G connection comprises 16 wood poles, which require an excavation of around 2m deep. Erection of a wood pole is undertaken in a single operation (i.e. 1 day). There is also a short section of underground cable (approximately 250m) from the terminal pole to the Glenlee substation. The proposed route of the underground cable is mainly within the existing power station and will be installed in a backfilled trench of suitable width and depth (refer to **Chapter 4** and **Figure 4.11** for details).

9.293 During the detailed routeing stage, a buffer of at least 10m was applied to all watercourses identified from Ordnance Survey maps and during the site walkover survey. A location specific larger buffer was applied to larger watercourses. Therefore, there will be no wood poles (or working areas) within or close to watercourses. However, an exception to this was noted close to wood pole EG0014. There is a small unnamed (minor) watercourse on the footprint of a proposed working area to the south-west of the pole location. The watercourse is not shown on the 1:10,000 scale Ordnance Survey maps and is a minor feature identified during the site walkover to be ~1m wide with banks ~0.3m high, with a small upstream catchment area of ~4ha.

9.294 The design of construction access sought to use existing access tracks as much as possible and avoid new watercourse crossings. However, there are a number of unnamed watercourses which were unavoidable. New watercourse crossings, upgrade of existing watercourse crossings, underground cable crossings and stringing of the OHL over watercourses could potentially impact channel morphology during construction.

9.295 Access tracks for the E-G section of the route use the similar access tracks as the P-G via K route with additional spurs off to access the E-G wood pole locations and working areas (**Figure 9.2.4**). There are eight track crossings in the E-G section of the route (**Appendix 9.1**), which are mainly minor watercourses (<3m wide) and will be covered by SEPA's GBRs. Two new crossings (PG41C, PG41D) in the E-G route section will require authorisation under the CAR.

9.296 The OHL crosses seven watercourses. Most are small and unnamed with the exception of the offtake channel of the Water of Ken (~10m wide), the Coom Burn (~12m wide) and the Glenlee Tailrace (~16m wide). Details of stringing the OHL over watercourses is described in **Chapter 5**. The UGC route passes under a small unnamed watercourse (EG1), just upstream of where it is culverted under the Glenlee Power Station (**Figure 9.2.4**). It is understood that the cable will be installed under the watercourse by isolated open cut, which will require registration under the CAR.

Effects during construction on surface and ground water quality and private water supplies

9.297 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, heavy plant movement on the access tracks and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages.
- Pollution/sediment run-off during construction of new watercourse crossings for access tracks and during installation of the underground cable watercourse crossing.

9.298 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater.

9.299 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. The increase in sediment concentration in runoff from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses. This can have an indirect effect on watercourse ecology (see **Chapter 10**).

9.300 Felling can result in increased surface water run-off and sediment run-off. Direct felling of an area of 1.9ha of forestry is required for the OHL wayleave and access tracks. There is an additional predicted 0.68ha to be felled (or lost) as a result of future windthrow (refer to **Chapter 5**). It is noted that effects associated with the windthrow felling area are indirect effects.

9.301 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles or an accidental release of concrete or other building materials. Pollutants could enter watercourses directly or via overland flow pathways. Shallow groundwater could also be affected.

9.302 With the embedded mitigation measures detailed in **Chapter 5** and **Appendix 9.2** and summarised above in place, the magnitude of the effect of increased sediment/silt runoff causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the site during construction is considered to be **minor** and temporary and the effect is considered to be of **minor** significance.

9.303 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will reduce the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be of short duration and **minor** and the effect is considered to be of **minor** significance.

9.304 The Waterside PWS is within 1km of this section of the route (**Table 9.4**) which is understood to source its water from a surface watercourse. Given that construction can potentially affect both surface and groundwater quality, it follows that construction can potentially affect nearby and downgradient PWS. An assessment of PWS was carried out based on proximity to the E-G infrastructure and flow path analysis from the infrastructure/construction areas to the individual PWS (sources and properties) (**Appendix 9.3**).

9.305 Based on SEPA Guidance for assessing impacts of development proposals on groundwater abstractions and PWS a 250m buffer zone is used for all new OHL infrastructure, including tracks. This is a conservative approach which considers all ground excavations are deeper than 1m. This will be the case for the wood pole base installation (**Chapter 4**). However, construction and/or upgrade of access tracks is likely to require excavations less than 1m. Hence, using a 250m buffer round all the infrastructure is a conservative approach.

9.306 The Waterside PWS is within 250m of the E-G project infrastructure; a detailed assessment is provided in **Appendix 9.3** and is summarised in **Table 9.17**.

9.307 Flow routing analysis was undertaken in **Appendix 9.3** to infer hydrological and hydrogeological connectivity between proposed infrastructure and the Waterside PWS to identify if the Project could potentially impact the PWS. The flow path analysis identified a 'potential impact' and the significance of the effect was assessed assuming embedded mitigation measures are in place resulting in an effect significance of **none**. Additional mitigation measures, including monitoring, are described in **Appendix 9.3** and summarised in the Proposed Additional Mitigation section below.

Table 9-17: Details of Private Water Supplies (PWS) sources and properties within 250m of E-G infrastructure

Nat. Grid Ref	Source Name	Property[1]	Source /Source Type[2]	Type [3]	Nearby KTR Infrastructure	Distance from closest Infrastructure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX60942 81115	Waterside	-	Surface Water	B	Access Track Wood Pole	65 111	Potential impact	**None**
NX61240 80996	Waterside	Property	-	B	Access Track Wood Pole	198 151	Potential impact	**None**

[1]**Property:** This column identifies the PWS property location and details
[2]**Source/Source Type**: This column identifies the PWS source location and includes a description of the type of supply (e.g. borehole, spring or surface water)
[3]**Type**: Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[4]**Flow Path Analysis Result**: Likelihood of impact on PWS from infrastructure construction, based on flow paths

Effects on channel morphology (bank erosion and channel form) during construction

9.308 For the majority of watercourses, the effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude, as embedded mitigation measures, including a minimum 10m buffer zone and environmentally sensitive bridge design, have been incorporated into the project design. Construction of the underground cable watercourse crossing (EG1) (via isolated open-cut trenching) could temporarily affect the bed and banks local to the works resulting in a temporary effect of **minor** magnitude and an overall effect of **minor** significance.

Effects during construction on run-off rates, flood risk and ground-water levels/recharge

9.309 In accordance with the Risk Framework within Scottish Planning Policy (SPP), new development should be limited to areas outside the medium risk 200-year (0.5% Annual Probability (AP)) functional floodplain. Floodplains were avoided as far as practicable during the routeing and design process of the KTR Project.

9.310 The KTR Project is 'essential infrastructure' under the SEPA Flood Risk and Land Use Vulnerability Guidance and the guidance notes that essential infrastructure can be in medium to high risk flood areas (i.e. >0.5% AP) if a flood risk location is required for operational reasons and an alternative lower-risk location is not available. In the few situations where wood poles are located within the 200-year floodplain, they will be designed and constructed to be operational during floods (i.e. the 0.5% AP event), and to not impede water flow.

9.311 A review of SEPA flood maps indicated that Earlstoun substation (and wood pole EG0016) is close to the 200-year floodplain (medium likelihood flood) of the Water of Ken. Further south, wood poles EG003 and EG002 are within the SEPA 200-year floodplain. These poles will be designed and constructed to be operational during floods and to not impede water flow. Thus, construction of the wood poles are not expected to effect channel morphology and works will not take place at this location when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.

9.312 Compaction of soils and increased areas of hardstanding reduces the infiltration rate leading to a greater rate and volume of surface water runoff. Clear felling forestry and other vegetation can also lead to an increase in surface water runoff rates. This results in a "flashier" catchment response and could increase flood risk downstream. While the magnitude of the change would not be anticipated to be great due to the small area of semi-permeable surfaces compared to the total catchment areas (**Table 9.18**), SEPA and D&GC highlighted in their consultation responses that there should be no increase in flood risk to third parties as a result of the KTR Project.

9.313 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local runoff rate and volume and potentially resulting in the change in contributing catchment areas. This would also have an effect on the rate and volume of water reaching receiving watercourses and other downstream receptors.

9.314 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for tower foundations during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas. Open cut trenching for the underground section of the route could also result in changes to local groundwater levels and could potentially affect surface water flow paths.

9.315 The project design incorporates SUDS and other embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Chapter 5** for details) and the discharge of attenuated surface water runoff from the working areas into the watercourses will be limited to greenfield runoff rates entering each watercourse from the site at present. The catchment area of the Water of Ken at Glenlee (the downstream limit of this connection) is 373km^2. The total area of hardstanding or semi-permeable surfaces is 2.6ha (~0.03km^2) which represents less than 0.01% of the total catchment.

9.316 The effect of site clearance, felling and construction on run-off rates and flood risk is considered to be of **negligible** magnitude and the significance of effect on watercourses downstream of the connection will be **none**.

9.317 Excavations for the wood pole foundations and open cut trenching for the short underground section of cable could impact groundwater levels. The effect is considered to be of short duration and reversible and is considered to be of **negligible** magnitude and the significance of effect is **none**.

Table 9-18: Areas of Land-take in E-G Connection

Type	Area (ha)
Permanent	
Wood poles	negligible
Temporary	
Existing access	0.04
Existing Access - Widening	0.03
New access	1.28
Underground Cable	0.04
Work Area/Pulling Area	1.26
Total	**2.65**

Direct and indirect disturbance of peat during construction

9.318 The alteration of the geological environment by the excavation of the subsoil and peat required to build the infrastructure such as working areas, access tracks and in the areas of woodland removal will result in some alteration of the geological environment. Any underlying topsoil and peat may be temporarily removed and will need to be managed appropriately.

9.319 Activities, or effects of activities, that have the potential to alter the geological environment include:

- earthworks and site drainage;
- reduction in water table resulting in the drying out, oxidation and potential erosion of peat;
- excavation and removal of peat;
- the disturbance and loading of peat by vehicle tracking; and
- forest felling activities.

9.320 In the absence of detailed foundation design and ground investigations for foundation the initial calculation presented in **Appendix 9.5** has assumed a worst-case scenario based on the data available at this stage. The calculations assume that all peat will be removed for the tower foundations, working areas, existing track widening, temporary track construction, construction compound construction and quarries. This results in an over estimation of the peat volumes likely to be excavated and in reality, the peat volumes excavated will be much less. The detailed peat volumes excavated for each section of the OHL route and associated infrastructure is presented in **Appendix 9.5**.

9.321 The total volume of direct peat loss for this section of the OHL and associated infrastructure, based on a worst-case scenario that excavation is required along the whole footprint is 4,438m^3:

- 2,920m^3 for the wood poles and associated working areas; and
- 1,518m^3 for new temporary access tracks.

9.322 Temporary storage of any soils or peat will be close to where it is to be reused, within the working areas and not located on existing peat deposits, within 25m of a watercourse or sensitive ecological habitats.

9.323 The total volume of peat that can be reused for this connection is 4,423m^3. Essentially all peat will be reinstated in the working areas and access tracks so only the small wood pole foundations will have peat excavated that requires reuse. This peat can be used around the infrastructure to tie in to the existing peat habitat as it is a very small amount (15m^3). Peat will be reused or reinstated sequentially and as quickly as possible. **Appendix 9.5** demonstrates that the peat excavated from this connection can be appropriately re-used on site.

9.324 It is anticipated that all excavated peat can be reused for reinstatement of ground, at the point of excavation. Prior to construction and on completion of ground investigations and micro-siting, the Outline PMP will be refined and agreed with SEPA and SNH.

9.325 Prior to construction and on completion of ground investigations and micro-siting, a site waste management plan shall be produced, including for site soil and peat management good practice. It will ensure that excavated peat is appropriately managed and re-used.

9.326 Assuming embedded mitigation measures detailed in **Appendix 5.2** and **Appendix 9.5** and summarised above are incorporated into project design and are effective, the magnitude of the effect on peat is **none to minor** for the majority of the route as peat is not present or is shallow and modified (i.e. not considered to be active peatland). Where peat was recorded and excavation of peat is required it is considered to be **minor** for these areas**.** The significance of the overall effect on peat is **minor.**

Proposed Additional Mitigation

9.327 With embedded mitigation measures incorporated into project design, including SUDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality or PWS. Details of the embedded measures will be set out in detail prior to construction in the PPP, CDEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure comprising the connection and the contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL.

9.328 As described in **Appendix 9.2** and Embedded Mitigation section above, parts of the KTR Project that are upgradient of sensitive receptors (e.g. PWS, watercourses) have been identified based on analysis of flow paths and additional areas for SUDS will be incorporated within the project design to mitigate any potential effects. In addition, further investigation of the location of PWS pipework and infrastructure will be carried out prior to construction and micro-siting of the E-G infrastructure within the ILA will be undertaken where necessary to avoid damaging any PWS pipework/infrastructure.

9.329 The minor watercourse which impinges on the working area south-west of EG0014 will either be avoided during micro-siting or diverted around the working area to avoid potential pollution/silt entering the water environment.

9.330 The results of flow path analysis, which was undertaken to establish potential hydrological connectivity between PWS and KTR Project infrastructure (**Appendix 9.3**), was used to determine which PWS require water quality monitoring before and during construction to ensure no contamination of supply during the work. Details of the proposed monitoring and emergency contingency measures are described in the Monitoring section below.

9.331 Dewatering and physical cut-offs will be avoided where possible and not undertaken close to water supplies and drainage measures will be designed to minimise the effect on the lowering of the groundwater table. Permanent physical cut-offs will be avoided.

9.332 Potential construction effects on peat include direct loss of peat through excavation and indirect loss by locating temporary infrastructure on peat. The peat volume calculations use a worst-case scenario that all the peat is excavated, where present, from existing track widening, new temporary track, construction compounds and working areas. The reality is that there is very little peat present in this connection route and all of the temporary sections located on peat will be reinstated with excavated peat at the earliest opportunity. Therefore, there will be a net balance for peat excavation and peat reuse for this connection.

9.333 Any excavated peat will be stored appropriately nearby and re-used as soon as possible for reinstatement. Further ground investigation should be undertaken for the foundation and temporary track locations to determine the most suitable foundation and temporary track type so that the volumes of excavated peat can be reduced further.

Residual Construction Effects

9.334 With embedded mitigation and the additional mitigation described above, the residual construction effects are either **minor** or **none** and are summarised in **Table 9.19**.

Operational Effects

Predicted Operational Effects

9.335 The potential operational impacts of the KTR Project are associated with the permanent infrastructure, wood poles and any required maintenance work during operation, which will be infrequent.

9.336 There will be two new wood poles within or close to the functional floodplain of the Water of Ken in this section of the route. These will be designed and constructed to be operational during floods (i.e. the 0.5% AP event) and to not impede water flow and hence will not increase flood risk downstream.

9.337 During operation, the increase in hardstanding areas (wood poles) within the river catchment could result in a very slight increase in the rate and volume of surface water runoff, leading to an increase in flood risk in watercourses downstream. However, given the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses, the magnitude of the effect on flood risk downstream is considered to be **negligible** and the significance of the effect is **none**.

9.338 All peat identified as being potentially excavated or disturbed during construction phase will be have been appropriately reinstated or re-used within the site and therefore there is no requirement for further earthworks for the operation phase. The magnitude of effect is considered to be **negligible** and thus the significance of the effect is **none**.

Proposed Mitigation

9.339 No specific mitigation is proposed during operation other than the use of temporary matting or low-pressure vehicles to access tower locations after the construction tracks have been reinstated.

Residual Operational Effects

9.340 There are no residual operational effects on the water and soil environment as no excavations are required as part of the operation and maintenance.

Monitoring

9.341 Monitoring of water quality of the Waterside PWS will be undertaken before, during and after construction to ensure no contamination of the supply. Monitoring will be undertaken by an ECoW (or equivalent) and monitoring locations will be identified in the CDEMP.

9.342 If the water quality deteriorates during construction (e.g. discoloured, high sediment content, hydrocarbons) an alternative water supply will be installed at the PWS property, such as portable bowsers, to ensure minimal disruption of supply. The contractors will have a supply of bowsers ready to deploy to affected PWS, if required.

9.343 An ECoW will be on site throughout construction to monitor and ensure the effectiveness of the embedded and additional mitigation measures.

Summary of Effects

9.344 The main effects will occur during felling and construction of the KTR infrastructure and ancillary works (e.g. access tracks). There are no significant residual effects during operation. With embedded and additional mitigation, the significance of the residual effects on the water environment and peat was assessed to be of **minor** or **none** (**Table 9.19**)

Table 9-19: Summary of Residual Construction and Operational Effects (E-G Section)

Effect	Significance before additional mitigation, but including embedded mitigation measures (e.g. SUDS)	Additional Mitigation	Significance after mitigation
Construction			
Effect on water quality of downstream watercourses and waterbodies	**Minor**	None	**Minor**
Effect on water quality in PWS	**None**	Monitoring of PWS before and during construction; Confirmation of location of PWS pipework; Provision of alternative water supply, if required	**None**
Effects on channel morphology (bank erosion and channel form)	**None** to **Minor**	None	**None** to **Minor**
Effects on run-off rates, flood risk	**None**	None	**None**
Effects on ground-water levels and recharge	**None**	Avoid dewatering and physical cut-offs as much as possible	**None**
Peat loss/disturbance	**None** to **Minor**	Appropriate peat excavation, storage and re-use/reinstatement	**None** to **Minor**
Operation			
Effects on run-off rates, flood risk	**None**	None	**None**
Effect on peat	**None**	No peat excavation	**None**

BG Deviation

Existing Conditions

Topography

9.345 The topography of the BG Deviation OHL connection is shown in **Figures 9.2.4-5**. The northern tower of the BG deviation is at 68m OD, just south of Glenlee Power Station. Ground levels along the route rise to the south-west as the OHL traverses up the side of Glenlee Hill reaching a maximum elevation of 176m AOD before falling to 144m AOD as it descends towards Craigshinnie Burn.

Watercourses and Surface Water

9.346 The BG Deviation connection traverses the south-eastern side of Glenlee Hill and passes over several small unnamed watercourses which drain the hillslopes. The Craigshinnie Burn flows in an easterly direction south of the BG Deviation connection and enters the Water of Ken around 700m to the east. The downstream reach of the Craigshinnie Burn is also known as the Park Burn.

9.347 The Coom Burn and Tailrace Channel (from Glenlee Power Station) are around 300m and 350m north of the BG Deviation connection, respectively.

9.348 No open water bodies of water (e.g. ponds, lochs) were noted along this connection. However, several areas of wet, boggy ground or marshland were noted during the site walkover, these are shown in **Figure 9.2.5**.

Hydrology and Flood Risk

9.349 The Craigshinnie Burn (Park Burn) has a catchment area of 7.2km^2 and design flows were estimated as 8 m^3/s and 24.8 m^3/s for the 2-year flow and 200-year events, respectively (**Table 9.3**).

9.350 There are no SEPA gauging stations on the watercourses in this connection.

9.351 SEPA flood maps show fluvial flooding on the Craigshinnie Burn (Park Burn) and the predicted 200-year floodplain is approximately 30m wide. The nearest BG Deviation infrastructure (Tower BG97) is at around 100m north of the burn and at least 15m higher than the burn, hence there is no risk of flooding associated with the BG Deviation connection.

Existing Site Drainage and Surface Water Flooding

9.352 A flow pathway analysis was undertaken in GIS, based on the 1m LiDAR data to assess potential overland flow routes within and outside of the connection.

9.353 Existing ground levels of this connection fall to south and east; hence surface water runoff is to the south and east towards Craigshinnie Burn or the Coom Burn.

9.354 There is a low point just west of tower BG97, which is shown in the SEPA flood maps as at risk of surface water (pluvial) flooding.

Watercourse crossings

9.355 There are nine watercourse crossings associated with the BG Deviation connection (four crossings of the OHL, four new access track crossings and one existing track crossing).

9.356 Details of the crossings are provided in **Appendix 9.1** and **Figures 9.2.4-5**. Most watercourses to be crossed by tracks are generally small (<2.5m wide) except for the existing access track crossing of the approximately 10m wide Craigshinnie Burn. The track crosses the burn via a bridge which is approximately 10m wide and 3m high (Crossing BG52).

Water Supplies, Discharges and Abstractions, and Services

9.357 A summary of PWS source locations within 1km of the KTR Project are shown in **Table 9.4**. There are four PWS close to the BG connection, identified in column two of the table and shown in **Figure 9.2.5**, along with locations of the supplied properties. Further details of the PWS and an assessment are provided in **Appendix 9.3**.

9.358 SEPA provided a list of groundwater abstractions within a 1km buffer of the KTR Project. There are no licenced groundwater abstractions in this connection.

9.359 Available data on Scottish Water utilities in the area (i.e. water and waste-water mains and distribution networks) show that the only Scottish Water pipework close to the BG Deviation Connection is located on the local road at Glenlee substation. Locations of utilities will be confirmed before construction.

Water Quality and Protected Areas

9.360 Under the WFD and SEPA's classification system, only two water bodies are large enough to be classified within this connection. The Water of Ken downstream of Kendoon Loch (Water Body ID 10558) was classified by SEPA in 2017 as having Bad ecological potential. The Coom Burn/Garroch Burn (Water Body ID 10570) was classified as having Moderate ecological potential.

9.361 The Loch Ken and River Dee Marshes SPA/RAMSAR site is located on the Water of Ken approximately 4km downstream of this connection (**Figure 10.2**) (refer to **Chapter 10** and **Chapter 11** for further details). Part of the Water of Ken Woods SSSI is located approximately 400m from the BG deviation infrastructure and comprises a woodland area on the Park Burn (the downstream reach of the Craigshinnie Burn) (**Figure 10.2**).

9.362 The BG Deviation connection drains to the Water of Ken/River Dee catchment which supports salmon and trout populations.

Soils and Geology

9.363 The soils and Geology sections are described overall and then described approximately from north to south for the connection route.

9.364 Scottish Soil mapping (**Figure 9.3.2**) shows the majority of the connection route to be underlain by brown soils with some alluvium in the north at Glenlee in the Coome Water and Water of Ken valleys.

9.365 The SNH Carbon and Peatlands Map 2016 (**Figure 9.4.2**) shows all of the BG connection as located on minerals soils (grey).

9.366 The superficial or drift geology mapping (**Figure 9.5.2**) shows the majority of the route is not underlain by superficial or drift deposits. Sections where the route is underlain by superficial deposits includes:

- Glacial till (Boulder Clay) comprising poorly sorted fragments in clay matrix (blue) in the northern and southern sections on the sides of the Coome Burn and Craigshinnie Burn.

9.367 The solid or bedrock geology mapping (**Figure 9.6.2**) shows the following from north to south roughly:

- Gala 1 Formation (Silurian) – Medium to thick bedded turbidites. Sandstones are mainly quartzose and coarse grained. Mostly within the thermal aureole of the Cairnsmore of Fleet granite, where metamorphosed and foliated.

9.368 The structural geology of this connection comprises no known significant faults.

9.369 There are no geological designated areas within the BG connection.

Peat

9.370 No peat was indicated on mapping and therefore no peat survey points were undertaken.

Groundwater

9.371 The majority of the connection route is underlain by Ordovician and Silurian greywacke metamorphic rocks which are classified as a non-aquifer or low productivity aquifers that are generally without groundwater except at shallow depths within the weathered zone or fractures.

9.372 Superficial quaternary alluvial deposits within the Coom Water and Water of Ken valley are classified as a perched or concealed low productivity aquifer with limited or local potential.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.373 There are no GWDTEs present in this connection (see **Chapter 10** for details).

Construction Effects

9.374 The following effects have been assessed in full:

- Effects during construction on surface and ground water quality and private drinking water supplies;
- Effects on channel morphology (bank erosion and channel form) during construction; and
- Effects during construction on run-off rates and flood risk.

9.375 The sensitivity of receptors was assessed in **Table 9.20**, using the criteria in **Table 9.5**.

Table 9-20: Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourses/Surface Water Bodies Water of Ken Coom Burn Craigshinnie Burn Unnamed Watercourses	High	All watercourses drain, either directly or indirectly, to the Water of Ken/River Dee catchment. There is a designated site of international importance (SPA and RAMSAR site) on the Water of Ken approximately 4km downstream of this connection and the Water of Ken Woods SSSI is 400m from the route. In addition, the River Dee catchment is known to support salmon and trout populations, hence the sensitivity of all watercourses is high. Water of Ken and the Coom Burn were classified by SEPA as of bad ecological and moderate potential respectively. There are no properties downstream of the project infrastructure that are at currently at flood risk.
Private Water Supplies	Medium	Two abstractions for private water supplies (**Table 9.21** and **Figure 9.2.4-5**).
Groundwater	Low to Medium	The route is located on low productivity aquifers.

Predicted Construction Effects

9.376 The main likely significant environmental effects are predicted to occur during the felling and construction phase of the project. The activities that will occur during the site clearance and construction phases that may have an impact on the water environment and peat, include site clearance and vegetation (forestry) removal; use of heavy plant machinery; increase of hardstanding areas; construction and upgrading of access tracks; watercourse crossings; and associated earthworks/ excavation/re-profiling and construction traffic on access tracks.

9.377 During the detailed routeing stage, a buffer of at least 10m was applied to all watercourses identified from Ordnance Survey maps and during the site walkover survey. A location specific larger buffer was applied to larger watercourses. Therefore, there are no towers (or associated working areas) within or close to watercourses. An exception to this was noted south of BG097, where a small unnamed (minor) watercourse passes through the footprint of a proposed working area. The minor watercourse is not shown on the 1:10,000 scale Ordnance Survey maps, but was identified during the site walkover to be ~1m wide with banks ~0.4m high, with a small upstream catchment area of ~1.5ha.

9.378 The design of construction access sought to use existing access tracks as much as possible to avoid new watercourse crossings and land take. However, there are a number of unnamed watercourses which were unavoidable. New watercourse crossings, upgrade of existing watercourse crossings and stringing of the OHL over watercourses could potentially impact channel morphology during construction.

9.379 Track crossings in the BG Deviation connection (**Appendix 9.1**) are mainly minor watercourses (<2.5m wide) and will be covered by SEPA's GBRs. One new crossing (BG49B) will require authorisation under the CAR. The OHL crosses four watercourses in this section of the route; all of which are small and unnamed. The existing track over the Craigshinnie Burn crosses via a 10m wide bridge (Crossing BG52).

Effects during construction on surface and ground water quality and private water supplies

9.380 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, heavy plant movement on the access tracks and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages.
- Pollution/sediment run-off during construction of new watercourse crossings for access tracks.

9.381 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater.

9.382 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. The increase in sediment concentration in runoff from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses. This can have an indirect effect on watercourse ecology (see **Chapter 10**).

9.383 Felling can result in increased surface water run-off and sediment run-off. Felling can result in increased surface water run-off and sediment run-off. Direct felling of an area of 2.12ha of forestry is required for the OHL wayleave.

9.384 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles and in the event of an accidental release of concrete or other building materials. Pollutants could enter watercourses directly or via overland flow pathways. Shallow groundwater could also be affected.

9.385 With the embedded mitigation measures detailed in **Chapter 5** and **Appendix 9.2** and summarised above in place, the magnitude of the effect of increased sediment/silt runoff causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the site during construction is considered to be **minor** and temporary and is considered to be of **minor** significance.

9.386 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will minimise the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be of short duration and **minor** and is considered to be of **minor** significance.

9.387 There are four PWS sources within 1km of this connection (see **Table 9.4**). Given that construction can potentially affect both surface and groundwater quality, it follows that construction can potentially affect nearby and downgradient PWS. An assessment of PWS was carried out based on proximity to the BG infrastructure and flow path analysis from the infrastructure/construction areas to the individual PWS (sources and properties) (see **Appendix 9.3**).

9.388 Based on SEPA Guidance[23] for assessing impacts of development proposals on groundwater abstractions and PWS a 250m buffer zone is used for all new OHL infrastructure, including tracks. This is a conservative approach which considers all ground excavations are deeper than 1m. This will be the case for the tower base installation (see **Chapter 4**). However, construction and/or upgrade of access tracks is likely to require excavations less than 1m. Hence, using a 250m buffer round all the infrastructure is a conservative approach.

9.389 There are two PWS sources (Ford Farm PWS and Glenlee PWS) within 250m of the BG connection infrastructure and accesses); a detailed assessment is provided in **Appendix 9.3** and summarised in **Table 9.21**.

9.390 Flow routing analysis was undertaken in **Appendix 9.3** to infer hydrological and hydrogeological connectivity between proposed infrastructure and each PWS to identify if the KTR Project could potentially impact a PWS. In cases where flow path analysis identified a 'potential impact' the significance of the effect was assessed assuming embedded mitigation measures are in place resulting in an effect significance of **minor** or **none**. Any additional mitigation measures, including monitoring, required for specific PWS, over and above embedded mitigation are described in **Appendix 9.3** and summarised in the Proposed Additional Mitigation section below.

Table 9-21: Details of Private Water Supplies (PWS) sources and properties within 250m of BG deviation connection

Nat. Grid Ref	Name	Property[1]	Source/ Source Type[2]	Type[3]	Nearby KTR Infrastructure	Distance from closest Infrastructure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX5989480974	Ford Farm	-	Source type unknown	B	Existing Access Track to BG deviation and several GT towers	226	No impact	**None**
NX6050080099	Glenlee	-	GW Spring	A	Access Track between BG towers, Tower BG101	84, 130	Potential impact	**Minor**
Various (see Figure 9.2.5)	10 Properties supplied by Glenlee	10 Properties	-	A	Access Track between BG towers, Tower BG101	200, 210	Potential impact	**Minor**

[1] **Property:** This column identifies the PWS property location and details

[2] **Source/Source Type:** This column identifies the PWS source location and details and includes a description of the type of supply (e.g. borehole, spring or surface water)

[3] **Type:** Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[4] **Flow Path Analysis Result:** Likelihood of impact on PWS from infrastructure construction, based on flow paths

Effects on channel morphology (bank erosion and channel form) during construction

9.391 The effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude, as embedded mitigation measures, including a minimum 10m buffer zone and environmentally sensitive bridge design, have been incorporated into the project design. This will result in an effect significance of **none**.

Effects during construction on run-off rates, flood risk and ground-water levels/recharge

9.392 In accordance with the Risk Framework within Scottish Planning Policy (SPP), new development should be limited to areas outside the medium risk 200-year (0.5% Annual Probability (AP)) functional floodplain. Floodplains were avoided as far as practicable during the routeing and design process of the KTR Project. None of the BG deviation route is within or close to any mapped fluvial floodplains. There is a low point just west of tower BG97, which is shown in the SEPA flood maps as at risk of surface water (pluvial) flooding. There was noted as a marshy area during the site walkover (**Figure 9.2.5**) and has been avoided as much as possible during project design.

9.393 Compaction of soils and increased areas of hardstanding reduces the infiltration rate leading to a greater rate and volume of surface water runoff. Clear felling forestry and other vegetation can also lead to an increase in surface water runoff rates. This results in a "flashier" catchment response and could increase flood risk downstream. While the magnitude of the change would not be anticipated to be great due to the small area of semi-permeable surfaces compared to the total catchment areas (**Table 9.22**), SEPA and D&GC highlighted in their consultation responses that there should be no increase in flood risk to third parties as a result of the KTR Project.

9.394 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local runoff rate and volume and potentially resulting in the change in contributing catchment areas. This would also have an effect on the rate and volume of water reaching receiving watercourses and other downstream receptors.

9.395 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for tower foundations during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas.

9.396 The KTR Project design incorporates SUDS and other embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Appendix 5.2** for details) and the discharge of attenuated surface water runoff from the working areas into the watercourses will be limited to greenfield runoff rates entering each watercourse from the site at present. The catchment area of the Water of Ken at Glenlee (the downstream limit of this connection) is 373km^2. The total area of hardstanding or semi-permeable surfaces is 2.2ha (~0.02km^2) which represents less than 0.01% of the total catchment.

9.397 The effect of site clearance, felling and construction on run-off rates and flood risk is considered to be of **negligible** magnitude and the significance will be **none** on watercourses downstream of the connection.

9.398 Excavations for the tower foundations could impact groundwater levels. The effect is considered to be of short duration and reversible and is considered to be of **negligible** magnitude with an effect significance of **none**.

Table 9-22: Areas of Land-take in BG Deviation Connection

Type	Area (ha)
Permanent	
Estimated Tower Base	0.01
Total Permanent	**0.01**
Temporary	
New access	0.65
Existing Access - Widening	0.32
Work Area/Pulling Area	1.19
Total Temporary	**2.16**
Grand Total	**2.17**

[23] SEPA (2017) Land Use Planning System SEPA Guidance Note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems.

Proposed Additional Mitigation

9.399 With embedded mitigation measures incorporated into project design, including SUDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality or PWS. Details of the embedded mitigation measures will be set out in detail prior to construction in the PPP, CDEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure comprising the connection and the contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL.

9.400 As described in **Appendix 9.2** and Embedded Mitigation section above, parts of the KTR Project that are upgradient of sensitive receptors (e.g. PWS, watercourses) will be identified based on analysis of flow paths and additional areas for SUDS have been incorporated within the project design to mitigate any potential effects. In addition, further investigation of the location of PWS pipework and infrastructure will be carried out prior to construction and micro-siting of the BG infrastructure within the ILA will be undertaken where necessary to avoid damaging any PWS pipework/infrastructure.

9.401 The results of flow path analysis, which was undertaken to establish potential hydrological connectivity between PWS and KTR Project infrastructure (**Appendix 9.3**), was used to determine which PWS require water quality monitoring before and during construction to ensure no contamination of supply during the work. Details of the proposed monitoring and emergency contingency measures are described in the Monitoring section below.

9.402 The minor watercourse which impinges on the proposed working area south of BG097 will either be avoided during micro-siting or diverted around the working area to avoid potential pollution/silt entering the water environment.

9.403 Dewatering and physical cut-offs will be avoided where possible and not undertaken close to water supplies and drainage measures will be designed to minimise the effect on the lowering of the groundwater table. Permanent physical cut-offs will be avoided.

Residual Construction Effects

9.404 With embedded mitigation, additional mitigation and monitoring described above, the residual construction effects are either **minor** or **none** and are summarized in **Table 9.23**.

Operational Effects

Predicted Operational Effects

9.405 The potential operational effects of the BG Deviation connection are associated with the permanent infrastructure, tower bases and any required maintenance work during operation, which will be infrequent.

9.406 During operation, the increase in hardstanding areas (tower legs) within the river catchment could result in a very slight increase in the rate and volume of surface water runoff, leading to an increase in flood risk in watercourses downstream. However, given the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses, the magnitude of the effect on flood risk downstream is considered to be **none** and **not significant**.

Monitoring

9.407 Monitoring of water quality of the Glenlee PWS will be undertaken before, during and after construction to ensure no contamination of the supply. Monitoring will be undertaken by an ECoW (or equivalent) and monitoring locations will be identified in the CDEMP.

9.408 If the water quality deteriorates during construction (e.g. discoloured, high sediment content, hydrocarbons) an alternative water supply will be installed at the PWS property, such as portable bowsers, to ensure minimal disruption of supply. The contractors will have a supply of bowsers ready to deploy to affected PWS, if required.

9.409 An ECoW will be on site throughout construction to monitor and ensure the effectiveness of the embedded and additional mitigation measures.

Summary of Effects

9.410 The main effects will occur during felling and construction of the KTR infrastructure and ancillary works (e.g. access tracks). There are no residual effects during operation. With embedded and additional mitigation, the significance of the residual effects on the water environment was assessed to be **minor** or **none** (**Table 9.23**).

Table 9-23: Summary of Residual Construction and Operational Effects (BG Deviation Connection)

Effect	Significance before additional mitigation, but including embedded mitigation measures (e.g. SUDS)	Additional Mitigation	Significance after mitigation
Construction			
Effect on water quality of downstream watercourses and waterbodies	**Minor**	Avoidance of the minor watercourse which impinges on the proposed working area south of BG097 during micro-siting	**Minor**
Effect on water quality in PWS	**Minor**	Monitoring of PWS before and during construction; Confirmation of location of PWS pipework; Provision of alternative water supply, if required	**None**
Effects on channel morphology (bank erosion and channel form)	**None**	None	**None**
Effects on run-off rates, flood risk	**None**	None	**None**
Effects on ground-water levels and recharge	**None**	Avoid dewatering and physical cut-offs as much as possible	**None**
Operation			
Effects on run-off rates, flood risk	**None**		**None**

Glenlee to Tongland

Existing Conditions

Topography

9.411 The topography of the G-T connection is shown in **Figures 9.2.4-18**. The OHL rises up to the south from a low point of 52m AOD at Glenlee in the north, close to the Water of Ken, up to around 240m AOD in the upland area of Galloway Forestry Park. Close to Mossdale, the connection falls to around 75m AOD close to the River Dee crossing (Tower 49) before rising again to the south as it passes south through the hills of Galloway Forest Park, again reaching elevations of 240m AOD. Further south, as the OHL leaves the upland forest park, the topography falls down towards the Water of Ken, with ground levels of around 37m AOD at Tongland.

9.412 The existing OHL (R route south) runs eastwards from Glenlee, crossing the Water of Ken (**Figure 9.2.4**) and then rises up onto the valley slopes on the north-eastern side of the Water of Ken and Loch Ken (**Figures 9.2.19 - 27**). Towers R31 to R37 are located on low-lying fields close to the Water of Ken at around 50-52m AOD. As the existing OHL rises up onto the valley hillside, ground levels gradually increase to 105m AOD at tower R54. Ground levels fall again to around 65m AOD as the line passes lower on the hillside before rising up again to 178m AOD at tower R78 on Barend Hill. Further south ground levels fall as the OHL passes over low-lying ground close to Loch Ken and then crosses the loch; tower R100A is in an area of marsh at 45m AOD right on the eastern bank of the loch and tower R101R is on the western bank of the loch at 46m AOD. Ground levels rise gradually to 101m AOD where the existing OHL (R route) meets the new G-T OHL at Tower 94 and then traverses south, running parallel to the new OHL to Tongland.

Watercourses and Surface Water

9.413 The Water of Ken/River Dee flows in a southerly direction to the east of this connection and most of the Study Area drains either directly or indirectly to the Water of Ken/River Dee catchment (see **Figure 9.1**). A small part of the upland area of this connection near Bargatton Hill is within the Tarff Water catchment.

9.414 The Water of Ken is known as the River Dee downstream of Loch Ken at the confluence with the Black Water of Dee.

9.415 The OHL is close to the Water of Ken/River Dee at both endpoints of this connection; Glenlee in the north and Tongland in the south. In the central part of the connection, it is up to 6km west of the river as it passes over the upland area in Galloway Forest Park (see **Figures 9.2.11-15**).

9.416 The large narrow reservoir of Loch Ken extends for around 15km along the Water of Ken/River Dee. The Glenlochar Barrage at the downstream end of the loch controls water levels as part of the Galloway Hydroelectric Scheme.

9.417 The Craigshinnie Burn (also known as the Park Burn), Knocknairling Burn, Darsalloch Burn, Pultarson Burn, Mid Burn, Acre Burn, Clachrum Burn, River Dee (or Black Water of Dee), Slogarie Burn, Kenick Burn and Gatehouse Burn all flow in a south-easterly direction towards the Water of Ken/River Dee in this connection along with many other smaller, unnamed watercourses.

9.418 The Barstobrick Burn and several other small watercourses flow in a south-westerly direction to enter the Tarff Water catchment.

9.419 The OHL passes close to several small lochs, namely:

- Stroan Loch (on the Black Water of Dee);
- Lochenbreck Loch;
- Edgarton Loch;
- Bargatton Loch; and
- Meiklewood Loch.

9.420 Several areas of wet, boggy ground or marshland were also noted during the site walkover and these are shown in **Figures 9.2.4-18**. These were avoided where possible during iterations of the routeing and detailed alignment design.

9.421 The existing OHL (R route, south of Glenlee) is located on the eastern side of the Water of Ken/Loch Ken for part of this route and crosses the Water of Ken/Loch Ken twice (**Figures 9.2.4 and Figures 9.2.19-27**). The existing R route also passes over several watercourses draining off the eastern valley side to Loch Ken and large parts of the R route were noted to be marshy and boggy during the site walkover surveys (e.g. between towers 58R and 62R where a watercourse known as Ged Strand drains a large area of marsh). Many of the watercourses are small and unnamed, however larger named watercourses that are crossed by the existing OHL include the Garple Burn, Aquavitae Burn, Maukinhowe Burn, Ged Strand, Shirmers Burn, Arvie Burn, Boreland Burn and Craichie Burn.

Hydrology and Flood Risk

9.422 The catchment area of the River Dee at Tongland (the downstream limit of this connection) is 899km^2. Key catchment characteristics and flow estimates of the River Dee at Tongland, along with the larger rivers within this connection are provided in **Table 9.3**.

9.423 There is a SEPA gauging station on the River Dee at Glenlochar (Gauge 80002) located at NGR 273300 564100. This is the only gauge on the highly regulated River Dee and has been operating since 1977. The flows at this location are controlled by Glenlochar Barrage, which is located approximately 500m upstream of the gauge. The mean flow at the gauge is 41.51m^3/s, based on the period of record from 1977[24].

9.424 SEPA flood maps show some fluvial flooding from the Water of Ken/River Dee along the watercourse. However, most of the OHL and associated infrastructure is location well away from the 200-year predicted floodplain. Tower GT1 at Glenlee Power Station is close to the predicted flood extent, but not within the SEPA floodplain.

9.425 Several sections of the existing OHL (R route south), east of the Water of Ken/Loch Ken are within the SEPA predicted 200-year floodplain. These include towers 31R-36R close to the Water of Ken, just east of Glenlee and towers 98R to 101R in the low-lying floodplain where the existing OHL (R route south) crosses Loch Ken.

9.426 SEPA flood maps also show fluvial flooding on the Craigshinnie Burn. At the location of the OHL crossing the 200-year floodplain is approximately 30m wide. The nearest tower to the Craigshinnie Burn is tower GT5; the tower and working area is set back form the watercourse by over 100m, so is not considered to be at risk of flooding.

9.427 The SEPA 200-year flood extent on the Knocknairling Burn at the location of the OHL crossing is confined to the channel and is not predicted to go out of bank at this location, likely due to the relatively steep sided banks at the crossing location. Tower GT13 is located around 20m south of the watercourse but is at the top of the steep sided valley banks and sits approximately 10m higher than the watercourse. The proposed working area is located around 20m south of the watercourse.

9.428 SEPA Flood Maps show fluvial flooding on the Black Water of Dee in the vicinity of the Study Area. The only location where the OHL is close to or within the predicted 200-year floodplain is at the OHL crossing location (**Figure 9.2.11**). The 200-year floodplain is approximately 85m wide at the crossing location. Towers GT49 and GT50 are located outside of the predicted flood extent. GT49 is the closest to the watercourse and is approximately 75m north-east of the watercourse.

9.429 Further south, the predicted 200-year floodplain of the Kenick Burn is approximately 45m wide at the OHL crossing location. Tower GT68 is located around 50m north of the watercourse and there are no towers or working areas in the predicted floodplain.

9.430 Just south of Tongland, the River Dee is tidal. The Normal Tidal Limit (NTL) on the river is located around 100m south of the existing hydro-electric power station. SEPA Flood Maps were reviewed online to assess coastal flood risk. The mapped extent of the 200-year coastal floodplain is largely confined to the river valley at Tongland and does not extend to the A711 road and does not impinge on the OHL or associated infrastructure.

Existing Site Drainage and Surface Water Flooding

9.431 SEPA flood maps identified several localised areas of predicted surface water (pluvial) flooding close to or within this connection. Some of these may be related to flooding in low lying areas along small watercourses (e.g. in the south close to Argrennan Mains). These areas were reviewed during the site walkover surveys and the extent of wet ground/marsh areas were mapped (see **Figures 9.2.4-18**) and considered during design iterations.

9.432 A flow pathway analysis was undertaken in GIS, based on the 5m topographic data to assess potential overland flow routes within and outside of the connection. Most of this connection drains towards the Water of Ken/River Dee catchment in the east, via a network of small and larger watercourses and lochs. A small section of the OHL drains towards the south-west to the Tarff Water catchment (see **Figure 9.1**).

9.433 Along some sections of the connection, the OHL and the proposed access tracks follow the contours and cut across existing surface water flow paths.

Watercourse Crossings

9.434 The G-T connection infrastructure has 186 watercourse crossings (see **Appendix 9.1** and **Figures 9.2.4-18**). Of these, 70 are crossings of the OHL itself, 52 are new access track crossing, two are timber extraction spurs and 62 are existing track crossings. Some watercourses are crossed more than once, either by existing access tracks, proposed new access tracks or the OHL itself.

9.435 Details of the crossings are provided in **Appendix 9.1**. Most watercourses to be crossed are generally small (<2.5m wide) except for the Craigshinnie Burn (also known as the Park Burn), Knocknairling Burn, Darsalloch Burn, Pultarson Burn, Mid Burn, Acre Burn, Clachrum Burn, River Dee (or Black Water of Dee), Slogarie Burn, Kenick Burn, Gatehouse Burn and Camelon Lane. Channel dimensions and catchment areas upstream of the crossings are provided in **Appendix 9.1**.

9.436 Access routes to remove the towers of the existing OHL (R route) are temporary and existing accesses will be used as much as possible (**Figures 9.2.4-18**). The design team sought to avoid watercourse and

[24] National River Flow Archive https://nrfa.ceh.ac.uk/data/station/meanflow/80002

marsh crossings as best as possible, however some temporary crossings of minor watercourses and marsh areas were unavoidable. These are described in the assessment below.

Water Supplies, Discharges and Abstractions, and Services

9.437 A summary of PWS within 1km of this connection are shown in **Figures 9.2.4-27** and **Table 9.4**. There are 14 PWS (source and properties) identified close to either side of existing OHL (R route) on the eastern side of Loch Ken (**Table 9.7**). Further details of each PWS and an assessment are provided in **Appendix 9.3**.

9.438 SEPA provided details of one licenced groundwater abstraction in this connection at Kenmure Fish Farm where groundwater is abstracted for the fish farm hatchery at NGR 263500 576210. This is over 2km east of the new OHL and over 900m from any access tracks, thus it will not be affected by the development and is not considered further.

9.439 Available data on Scottish Water utilities in the area (i.e. water and waste-water mains and distribution networks) show that there are Scottish Water utilities close to the connection in the following locations:

- Pipework on the local road at Glenlee substation;
- A covered reservoir (NGR 270390 559950) located approximately 150m west of the proposed OHL (tower GT95) and 80m west of the existing OHL tower 128R;
- Underground water pipes from the covered reservoir pass under the OHL close to tower GT95 and under the proposed access tracks;
- Pipework on the local road near Upper Balannan, close to towers GT95-GT101;
- Pipework from the A75 road to the Barstibly property (NGR 270715 558000); the OHL crosses this pipework close to tower GT101;
- Pipework on the local road close to Argrennan Mains Steading. The OHL crosses the road close to tower GT107; and
- Pipework on the road at Tongland substation.

9.440 Locations of the Scottish Water utilities will be confirmed on site prior to construction and taken into consideration and avoided during the construction works. Further discussions with Scottish Water will be undertaken if required.

Water Quality and Protected Areas

9.441 Nine water bodies are large enough to be classified by SEPA under the Water Framework Directive. The classifications by SEPA in 2017 are as follows:

- The Water of Ken (downstream of Earlstoun Loch) (Water Body ID 10761) was classified as having Bad ecological potential.
- The Knocknairling Burn (Water Body ID 10571) was classified as having Moderate ecological potential.
- Loch Ken/River Dee Marshes (Water Body ID 100326) was classified as Moderate.
- Black Water of Dee (Pullaugh Burn to Loch Ken) (Water Body ID 10546) was classified as having Poor ecological potential.
- Crae Lane (downstream of Woodhall Loch) (Water Body ID 10554) was classified as Good.
- Woodhall Loch (Water Body ID 100333) was classified as Moderate.
- Camelon Lane (upstream of Woodhall Loch) (Water Body ID 10555) was classified as Good.
- Tarff Water (Water Body ID 10544) was classified as having Good ecological potential.
- River Dee (Loch Ken Outlet to Tongland) (Water Body ID 10545) was classified as having Moderate ecological potential.

9.442 There are several protected sites within or close to this connection, the locations are shown in **Figure 10.2**, **Chapter 10**:

- Water of Ken Woods SSSI. This comprises several woodland sites along the Water of Ken valley. Two sites are close to the G-T connection (and R route). A woodland area on the Park Burn (downstream reach of the Craigshinnie Burn) is part of the SSSI and is located approximately 400m from the G-T infrastructure. The woodland along the downstream reach of the Garple Burn on the east side of Loch Ken is also part of this SSSI. The existing R route OHL passes through this part of the SSSI.
- Loch Ken and River Dee Marshes SPA and Wetlands of International Importance (RAMSAR) site is located on Loch Ken and the River Dee within this connection. The site is over 3.5km west of the G-T OHL, however the existing OHL (R route) is within the SPA/RAMSAR site as it crosses Loch Ken. Towers 99R to 100AR are within the designated site and towers 98R and 101R are just outside the boundary of the site.
- Kenmure Holms SSSI is a wetland area on the Water of Ken at the north side of Loch Ken designated for biological interests (fen meadow and invertebrates) It is approximately 2.5km east of the G-T OHL and 1.3km west of the R route and is within the Loch Ken and River Dee Marshes SPA site
- River Dee (Parton to Crossmichael) SSSI. This SSSI is within the Loch Ken and River Dee Marshes SPA and Wetlands of International Importance (RAMSAR) site described above and the R route passes through this SSSI.
- Woodhall Loch SSSI. This is approximately 1km east of the G-T connection at its closest.
- Laughenghie and Airie Hills SSSI (this includes Stroan Loch). The site is approximately 200m west of the G-T connection at its closest.
- Threave and Carlingwark Loch SSSI. Part of this site is on the River Dee at Threave Island. This reach of the River Dee is approximately 5.2 and 3.2km east of the G-T connection and R route respectively.

Soils and Geology

9.443 The soils and Geology sections are described overall and then described approximately from north to south for the G-T connection and R route (R30 to R153).

9.444 Scottish Soil mapping (**Figure 9.3.2-7**) shows the majority of the G-T connection is underlain by brown soils with some areas peaty gleys, peaty podsols and peat. Alluvial soils are present at Glenlee and along the water of Ken and Loch Ken. Some humus-iron podzols are shown around Benbrack Hill and an area of peat is shown between Benbrack and Cairn Edward Hill and by the Dee of Black water at Mossdale. Peaty gleys are shown in the forestry and moor areas between the west of Cairn Edward Hill and Bennan Hill. Peaty podzols are shown in the Laurieston forestry area between Slogarie Hill, Tormollan Hill and to the south. The majority of the rest of the OHL down to Tongland is located on Brown Earths.

9.445 The R route is predominantly on Brown earth with the exception of the Water of Ken valley near Glenlee which is located on alluvial soils.

9.446 The SNH Carbon and Peatlands Map 2016 (**Figure 9.4.2-9.4.7**) show the majority of the G-T connection and R route to be located on minerals soils with the exception of the following areas of Class, 1, 3 and 5 soils that have the potential to be peat:

- Class 1 (pink) - Nationally important carbon-rich soils, deep peat and priority peatland habitat. Areas likely to be of high conservation value: Along existing access track to Bargatton and the northeastern corner of Construction Compound 6; and R route at Shirmers Moss.
- Class 3 (blue) - Dominant vegetation cover is not priority peatland habitat but is associated with wet and acidic type. Occasional peatland habitats. Most soils are carbon-rich soils, with some areas of deep peat: south of Stroan Loch; between Slogarie Hill and Tormollan Hill; Beoch Moor; and R route at Mosscroft.
- Class 5 (green) - Soil information takes precedence over vegetation data. No peatland habitat recorded, may also include areas of bare soil. Soils are carbon-rich and deep peat: forestry area between Benbrack and along eastern and southern side of Cairn Edward Hill; north of Stroan Loch; by the Water of Dee around Mossdale; Bennan Hill; and Laurieston Forest.

9.447 The superficial or drift geology mapping (**Figure 9.5.2-9.5.7**) shows the majority of the connection is not underlain by any superficial or drift deposits. Sections where the connection is underlain by superficial deposits include:

- Glacial Till (Boulder Clay) comprising poorly sorted fragments in clay matrix (blue): along the Knocknairting Burn valley, Kenick Burn valley; and Upper Balannan.

- Hummocky Glacial Deposits comprising blocky till in a matrix of grit and sand (green): south of Stroan Loch.
- Glaciofluvial deposits comprising and gravel, locally with lenses of silt, clay or organic material (pink): Beoch Moor north of Bargatton Loch.
- Peat carbon rich soil greater than 0.5m in depth (Brown): Between Benbrack and Cairn Edward Hill; Localised pockets in Lauriston Forest; Beoch Moor north of Bargatton Loch, west and south of Bargatton Loch and R route at Shirmers Moss and Mosscroft.
- Alluvium comprising silt, sand, clay, and gravel (yellow): Glenlee; Water of Ken valley; Glenshinnie valley; Access 45 and 46; Dee of Blackwater; and R removal Glenlee, localised areas by Loch Ken and within River Dee valley.

9.448 The solid or bedrock geology mapping (**Figure 9.6.2 to 9.6.7**) shows the following from north to south roughly:

- Gala 1 Formation (Silurian), Medium to thick bedded turbidites. Sandstones are mainly quartzose and coarse grained. Mostly within the thermal aureole of the Cairnsmore of Fleet granite, where metamorphosed and foliated.
- Gala 2 Formation (Silurian), turbidites of thin to thick sandstones and siltstones undergone metamorphism to form greywacke. Mostly within the thermal aureole of the Cairnsmore of Fleet granite, where metamorphosed and foliated.
- Cairnharrow Granite pluton (Cairnsmore of Fleet granite) (Late Silurian to Early Devonian), Course grained granite formed as an igneous intrusion.
- Gala 4, Gala 5, Gala 7, Cairnharrow Formation, Kirkmaiden Formation, Carghidown Formation all comprising metamorphosed turbidite greywacke deposits. The Kirkmaiden formation is more calcareous in composition and the Carghidown Formation contains minor intrusion of porphyritic microdiorite.

9.449 The structural geology comprises:

- Fault North-Northwest to South-southeast roughly parallel to Water of Ken valley with a downthrow to the northeast;
- Fardingfullach Fault SSW to NNE, down throw to southeast to north of Kendoon;
- Several faults Southwest to northeast trending faults including Gillespie Burn Fault, Garheugh Fault, Lauriston Fault, Inverwell Fault and Garlieston Fault.

9.450 There are no known geological designated areas within this connection.

Peat

9.451 Peat depth surveys were undertaken where peat was shown to be potentially present on SNH, Scottish Soils and BGS mapping along the route of the new OHL and infrastructure such as access tracks, construction compounds and quarries. The results of the peat survey are shown as peat depth contours in **Figure 9.7.5-9.7.18**.

9.452 The initial phases of the peat survey encountered peat in localised sections, in particular, between Stroan Loch and Bennan Hill. The results from the early phases of the surveys was used to feed into the design and the requirements for further peat depth surveying.

9.453 Whilst peat is absent across much of the connection, there are some deeper peat deposits in localised areas, mostly within valleys and plateaus.

9.454 Where possible the route was designed to avoid peat deposits including in the following locations:

- to the west of Peel Hill;
- to the north and south of Stroan Loch; and
- to the east of Slogarie Hill.

9.455 Peat was not recorded at the majority of the connection infrastructure. Areas of peat >1.0m in depth were recorded at the following main locations along the new OHL route and associated infrastructure (tracks, construction areas and quarries):

- Localised modified peat in forestry on access track 40 ranging from 0.0m to up to 3.0m;
- Modified peat in forestry up to 3.0m deep at tower 17 and working area;
- Localised modified, deep peat in forestry up to 2.0m between towers 17 and 18;
- Modified peat in forestry from 0.0m to 2.0m depth at Construction compound 3 and section of existing track widening;
- Modified peat in forestry from 0.5m to 2.0m depth at tower 22, working area and associated temporary access spur;
- Deep peat from 0.5m to 4.0m at tower 23, working area and temporary access track section (classified as dry heath/grassland by ecology survey);
- Peat from 0.0m to 1.5m deep at tower 24 and working area (classified as dry heath/grassland by ecology survey);
- Localised pocket of modified peat within forestry up to 1.5m deep on existing access track 43;
- Localised pocket of modified peat within forestry/bracken area up to 1.5m deep on temporary track to tower 27;
- Modified peat in forestry up to 1.5m on temporary track by tower 30;
- Localised pockets of modified peat (shown as wet modified bog within a forestry area) up to 2.0m depth existing track to tower 36, at tower 36 and construction compound 4;
- Localised of modified peat (shown as wet modified bog/marshy grassland) up to 1.5 between towers 38 and 39;
- Modified peat (shown as modified bog) in forestry area up to 1.5m at tower 42 and working area;
- Tower 48, 50 and 51 and associate tracks up to 3.0m deep peat (Classified as Dry Heath in the Phase I ecological survey) located on plateaus;
- Existing track north of Lockenbreck Quarry pocket up to 4.0m of deep modified peat within forestry area;
- Existing track, access 50, north of Craigelwhan pockets up to 2m deep modified peat within forestry area;
- Existing track, access 48, to Craigelwhan quarry west mostly no peat present with pockets up to 4.0m of modified peat within the forestry area;
- Track to tower 69 up to 2.0m modified peat (marshy grassland) in forestry area;
- Track between tower 69 and 70 there is a peat pocket up to 3.0m modified peat (marshy grassland) in forestry area;
- Temporary track between tower 71 and 72 up to 3.0m modified peat within forestry area;
- Pockets on existing track tower 74 to south of Craigelwhan Quarry up to 3.0m partially modified peat within forestry area;
- Very deep peat (dry and wet modified bog) on track north of tower 79 up to 6.0m in depth;
- Very deep peat (dry modified bog) on track between tower 82 and 83 up to 5.0m in depth;
- Deep peat (dry modified bog/ felled forestry) at tower 85, working area and track up to 3.0m;
- Very deep peat (felled forestry) at tower 85 to 86 up to 6.0m deep;
- Very deep peat (felled forestry) at tower 86 and working area, over 6.0m in depth in places;
- Very deep peat (wet dwarf scrub) between towers 88 to 89 up to 4.0m deep; and
- Pockets of modified peat (acid grassland) up to 2.0m between tower 90 and 91.

9.456 The full details of the peat surveys are presented within **Appendix 9.4**. Areas of continuous peat along the connection sufficient in size to accommodate peat instability have been assessed in **Appendix 9.6**.

Groundwater

9.457 The majority of the connection is underlain by Ordovician and Silurian greywacke metamorphic rocks which are classified as a non-aquifer or low productivity aquifers that are generally without groundwater except at shallow depths within the weathered zone or fractures.

9.458 The Cairnharrow granite pluton is also classified as a non-aquifer or low productivity aquifer.

9.459 Superficial quaternary alluvial deposits within the Loch Ken valley are classified as a perched or conceal low productivity aquifer of limited or local potential.

9.460 Some superficial deposits are present that are have the potential to be productive aquifers, these are the Quaternary Fluvio-glacial deposits south of Woodhall Loch, comprising of sands and gravels. These are locally important aquifers with the potential to be productive through intergrannular flow.

Groundwater Dependent Terrestrial Ecosystems (GWDTE)

9.461 There are two areas of moderately dependent GWDTEs present within the Study Area (see **Chapter 10** and **Appendix 9.7** for further details). The GWDTE communities are considered to have a potential groundwater dependency of no greater than **moderate** and are associated with NVC M23 *Juncus effusus/acutiflorus - Galium palustre* rush-pasture, a mire community. The location of the moderately dependent GWDTEs are in the northern part of the G-T connection between towers 7 and 11 (**Figure 9.2.5**).

Construction Effects

9.462 The following effects have been assessed in full:

- Effects during construction on surface and ground water quality and private drinking water supplies;
- Effects on channel morphology (bank erosion and channel form) during construction;
- Effects during construction on run-off rates and flood risk;
- Effects during construction on GWDTEs; and
- Direct and indirect disturbance of peat during construction, including in association with peat instability.

9.463 The sensitivity of receptors (within the Study Area) was assessed in **Table 9.24**, using the criteria in **Table 9.5**.

Table 9-24: Sensitivity of Receptors

Receptor	Sensitivity	Comment
Watercourses/Surface Water Bodies Water of Ken/River Dee Craigshinnie Burn (also known as the Park Burn) Knocknairling Burn Darsalloch Burn Pultarson Burn Mid Burn Acre Burn Clachrum Burn Black Water of Dee Kenick Burn Gatehouse Burn Barstobrick Burn Stroan Loch (on the Black Water of Dee); Lochenbreck Loch Edgarton Loch Bargatton Loch Meiklewood Loch Unnamed Watercourses	High	All watercourses except for the Barstobrick Burn drain, either directly or indirectly, to the Water of Ken/River Dee catchment. There is a designated site of international importance (SPA and RAMSAR site) within this connection and other SSSIs close to the infrastructure. In addition, the River Dee catchment is known to support salmon and trout populations. The sensitivity of all watercourses is high. The Barstobrick Burn drains to the Tarff Water, which enters the River Dee just downstream of the Normal Tidal Limit (NTL). The watercourses and waterbodies within this section of the route were all classified by SEPA as either good or moderate ecological potential, with the exception of the Water of Ken (downstream of Earlstoun Loch) and Black Water of Dee, which were classified as bad and poor ecological potential, respectively. There are no properties downstream of the project infrastructure that are currently at flood risk.
Private Water Supplies	Medium	Several abstractions for private water supplies (**Table 9.25**).
Peat	Low to Medium	Medium where Annex I or BAP habitat and /or deep peat (>1m depth): south of Stroan Loch; Beoch Moor; west and south of Bargatton Loch are on very deep peat in SNH Class 1,3, or 5 peatlands. Low where modified or shallow peat or limited area extent. The majority of the peat deposits are heavily modified by forestry activities on this connection route.
Groundwater	Low to Medium	The connection is located on low productivity aquifers with the exception of important localised aquifers in the southern section, to the South of Woodhall Loch.
Groundwater Dependent Terrestrial Ecosystems	Medium	Two localised area of highly dependent (dominant) GWDTE habitat were identified close to the northern extent of the connection (**Figure 9.2.5**).

Predicted Construction Effects

9.464 The main likely significant environmental effects are predicted to occur during the felling and construction phase. The activities that will occur during the construction phase that may have an effect on the water environment and peat, include: site clearance and vegetation (forestry) removal; use of heavy plant machinery; increase of hardstanding areas; construction and upgrading of access tracks; watercourse crossings; associated earthworks/excavation/re-profiling; use of quarry areas and construction compounds and construction traffic on access tracks.

9.465 There are four construction compounds (compounds 3, 4, 5 and 6) in this connection and six quarries (Q2, Q3, Q4, Q5, Q6 and Q7; see **Table 5.5**, **Chapter 5**). All of the proposed quarries have been worked previously, except for Q6 (Craigelwhan), and these will be excavated following excavation practices at each site. For the new quarry (Q6)site clearance (including felling) will be required before stone can be excavated. There is a risk of polluted runoff and sediment from these areas entering surface waters and potential effects on groundwater recharge rates and levels during excavation.

9.466 During the detailed routeing stage, a buffer of at least 10m was applied to all watercourses and surface water features (i.e. lochs) identified from Ordnance Survey maps and during the site walkover survey. A location specific larger buffer was applied to larger watercourses. Therefore, there are no towers (or associated working areas) within or close to watercourses and/or surface waterbodies.

9.467 Tower GT13 is located around 20m south of Knocknairling Burn at the location of the OHL crossing (see **Figure 9.2.7**). The valley sides are steep and the tower and working area is at the top of the steep sided valley bank and sits approximately 10m higher than the watercourse. The tower and working area are not at risk of flooding, however given the proximity of the working area to the watercourse additional mitigation is proposed at this location to reduce the risk of sediment/silt run-off to the watercourse (see Proposed Mitigation section below).

9.468 Between towers GT55 and GT58, the proposed new access track runs parallel to two watercourses for two short lengths of track (approximately 175m and 140m respectively, **Figure 9.2.11**) before the track crosses the watercourses at crossings GT111B and GT112A. In places, the new access track is within 5m of the edge of the small watercourses. Additional mitigation measures will be put in place during construction to avoid pollution/siltation of these watercourses.

9.469 The timber extraction spur south of Tower GT68 extends almost to the edge of the Kenick Burn (**Figure 9.2.13**). There is a timber storage area close to the burn.

9.470 The edge of the working area for tower T86 is ~22m west of Bargatton Loch and impinges on a small unnamed watercourse which flows from north to south away from the loch (**Figure 9.2.5**). A new access track will extend along the southwestern edge of the loch for ~400m, which at its closest is 62m from the loch edge. The loch outlet is the Barstobrick Burn at western side of the loch. Watershed analysis based on topographic data indicates that most of surface water runoff from the KTR infrastructure would tend to flow east and then north towards the Barstobrick Burn and will not enter the loch. However, there is still a risk that silt/sediment runoff from forestry felling and construction works could enter the loch. Embedded mitigation along this section of the connection, including swales and cut-off ditches will reduce the risk.

9.471 There is a culverted watercourse close to the OHL between towers GT96 and GT99 (**Figure 9.2.16**). The exact location of the culvert is not known, and the approximate location of the watercourse is plotted on the figure. This will be avoided during micro-siting of the towers.

9.472 Most of the proposed quarries and construction areas within the G-T connection do not impinge on any watercourses or waterbodies, with the exception of:

- Hind Craig Quarry (Q4): The potential working area for the proposed quarry contains a 130m reach of the Pultarson Burn (see **Figure 9.2.8**). This was identified as a potential issue (for both water quality and channel morphology) at the design stage. It has been confirmed that this is an indicative working area and a buffer of at least 25m from the watercourse will be maintained for the working quarry area.
- Construction Compound No. 3: A small unnamed watercourse of ~1m width was mapped flowing through the forestry area that has been identified as the proposed location of construction area no. 3 (**Figure 9.2.8**). The catchment of the watercourse is small (0.2km^2) hence flows are fairly low.

9.473 The design of construction access sought to use existing access tracks as much as possible and avoid new watercourse crossings. However, there are a number of unnamed watercourses which were unavoidable. New watercourse crossings, upgrade of existing watercourse crossings and stringing of the OHL over watercourses could potentially impact channel morphology during construction.

9.474 There are 52 new crossings of access tracks required for construction of this connection (see **Appendix 9.1**), and two new crossings of timber extraction spurs. Most of these are small watercourses (<3m wide) and many are not shown on 1:10000 Ordnance Survey maps but were identified on site. 17 of the new crossings will require authorisation under the CAR (see **Appendix 9.1**) but most of the new crossings are on minor watercourses and will be covered by SEPA's GBRs.

9.475 There are 61 watercourses crossed by existing tracks that will be used during construction. These crossings will need to be maintained and/or improved depending on their condition. The need for upgrade will be reviewed in detail at each crossing prior to construction. A CAR authorisation is not likely to be required for minor upgrade works to existing track crossings, however this will be verified prior to construction in consultation with SEPA. Of the 61 existing crossings, 29 are on minor watercourses which will not require any authorisations under CAR, although GBRs and good practice will be followed. Existing crossings GT128A and GT128B are not on minor watercourses and will both need new crossings (GT128A is currently a ford crossing), the construction of which will require authorisation under CAR.

9.476 There OHL crosses 70 watercourses. Again, most are small (<3m wide) and may be crossed several times, however several large named watercourses also require to be crossed; Craigshinnie Burn (also known as the Park Burn), Knocknairling Burn, Darsalloch Burn, Pultarson Burn, Mid Burn, Acre Burn, Clachrum Burn, River Dee (or Black Water of Dee), Slogarie Burn, Kenick Burn, Gatehouse Burn and Camelon Lane. Details of stringing the OHL over watercourses is described in **Chapter 5** and no works will take place within the watercourses.

Effects during construction on surface and ground water quality and private water supplies

9.477 The potential effects on surface water quality during construction are:

- Pollution of surface waters caused by the release of sediment to watercourses from excavated material during construction, heavy plant movement on the access tracks, use and excavation at construction compounds and quarries and the felling of forestry/vegetation.
- Pollution of surface water caused by the release of hydrocarbon pollution resulting from accidental oil or fuel leaks or spillages. There is also a risk posed by concrete (and other construction material) spillages during the formation of hardstanding areas at the tower bases.
- Pollution/sediment run-off at existing watercourse crossings (where these are being upgraded) and during construction of new watercourse crossings for access tracks.

9.478 The potential effects on groundwater quality include:

- The risk of hydrocarbon pollution of groundwater resulting from accidental oil or fuel leaks from construction traffic and construction works, including quarries. There are also potential pollution effects caused by silt and sediment disturbed during construction infiltrating into the groundwater and concrete spillages.

9.479 Risks to surface water quality will be greatest during construction when works involve the exposure of bare earth which could result in increased erosion and sedimentation. The increase in sediment concentration in runoff from construction areas and access tracks may result in excessive levels of suspended sediment in watercourses. This can have an indirect effect on watercourse ecology (see **Chapter 10**).

9.480 Felling can result in increased surface water run-off and sediment run-off. Direct felling of an area of 207.97ha of forestry is required for the OHL wayleave, quarries, compounds and access tracks. There is an additional predicted 91.94ha to be felled (or lost) as a result of future windthrow (refer to **Chapter 5**).

9.481 Pollutants can enter the watercourses in the event of accidental spills or leaks from machinery and vehicles and in the event of an accidental release of concrete or other building materials. Pollutants could enter watercourses directly or via overland flow pathways. Shallow groundwater could also be affected.

9.482 With the embedded mitigation measures detailed in **Chapter 5** and **Appendix 9.2** and summarised above in place, the magnitude of the effect of increased sediment/silt runoff causing a deterioration in surface water quality in waterbodies and watercourses within and downstream of the site during construction is considered to be **minor** and temporary and is considered to be of **minor** significance.

9.483 Embedded mitigation measures to minimise the risk of pollution and accidental spillage will minimise the likelihood and severity of such incidents happening, however, there is still a residual risk. The magnitude of effect of pollution of surface water and groundwater caused by the release of hydrocarbon pollution and concrete resulting from accidental oil or fuel leaks or spillages is considered to be of short duration and **minor** and is considered to be of **minor** significance.

9.484 Additional site-specific pollution control measures during forestry felling and construction will be put in place for specific areas described above as at risk (e.g. Knocknairling Burn, unnamed watercourses between towers GT55 and GT58, Kenick Burn, tower T86 close to Bargatton Loch, Pultarson Burn and unnamed watercourse close to construction compound 3) (see Proposed Additional Mitigation section below). However, without this additional mitigation there is **not considered to be a significant** effect on any receptors and the effects on water quality is assessed to be **minor**.

9.485 There are 37 PWS sources within 1km of this connection (see **Table 9.4**), which source their water either from groundwater springs or surface watercourses. Given that construction can potentially affect

both surface and groundwater quality, it follows that construction can potentially affect nearby and downgradient PWS. An assessment of PWS sources and supplied properties was carried out based on proximity to the G-T infrastructure and flow path analysis from the infrastructure/construction areas to the PWS (sources and properties) (**Appendix 9.3**). All known PWS sources and properties will be identified in the CDEMP.

9.486 Based on SEPA Guidance[25] for assessing impacts of development proposals on groundwater abstractions and PWS a 250m buffer zone is used for all new OHL infrastructure, including tracks. This is a conservative approach which considers all ground excavations are deeper than 1m. This will be the case for the tower base installation (see **Chapter 5**). However, construction and/or upgrade of access tracks is likely to require excavations less than 1m. Hence, using a 250m buffer round all the infrastructure is a conservative approach.

9.487 There are 14 PWS sources and 30 supplied properties within 250m of the project infrastructure; a detailed assessment of each is provided in **Appendix 9.3** and summarised in **Table 9.25**.

9.488 Flow routing analysis was undertaken in **Appendix 9.3** to infer hydrological and hydrogeological connectivity between proposed infrastructure and each PWS to identify if the KTR Project could potentially impact a PWS. In cases where flow path analysis identified a 'potential impact' the significance of the effect was assessed assuming embedded mitigation measures are in place resulting in an effect significance of **minor** or **none**. Any additional mitigation measures, including monitoring, required for specific PWS, over and above embedded mitigation are described in **Appendix 9.3** and summarised in the Proposed Additional Mitigation section below.

Table 9-25: Details of Private Water Supplies (PWS) sources and properties within 250m of G-T infrastructure

Nat. Grid Ref	Name	Property[1]	Source/ Source Type[2]	Type [3]	Nearby KTR Infra-structure	Distance from Infra-structure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX59894 80974	Ford Farm	-	Source type unknown	B	Existing Access Track to G-T towers	226	No impact	**None**
NX60500 80099	Glenlee	-	GW Spring	A	Access Track between towers 2 and 3 Tower 2	84, 100	Potential impact	**Minor**
Various (see Figure 9.2.5)	10 Properties supplied by Glenlee	10 Properties	-	A	Access Track between towers 2 and 3 Tower 2	200, 190	Potential impact	**Minor**
NX60409 78722	Glenlee Source of 003	-	Spring	-	Access Track to tower 7, Tower 7	186	PWS not likely impacted	**None**
NX60810 78676	Glenlee Sheep Dip	Property (for Livestock)	-	-	Access Track to tower 8, Tower 8	82	Potential impact	**None**
NX60800 78700	Airie Cottage	-	Spring	B	Access Track to tower 8, Tower 8	86	Potential impact	**None**
NX61053 78546	Airie Cottage	Property	-	B	Access Track to tower 9 Tower 9	265, 251	Potential impact	**None**
NX60800 77000	Darsalloch	-	Surface Water-course	B	Access Track to G-T connection	121	Potential impact	**Minor**
NX60788 77021	Darsalloch	Property	-	B	Access Track to G--T connection	145	Likely impact on PWS	**Minor**
NX64682 68448	Slogarie	-	Spring	A	Access Track, Tower 55	360	PWS not likely impacted	**None**
NX64700 68437	Slogarie 2	-	Spring	A	Access Track, Tower 55	360	PWS not likely impacted	**None**
Various (see Figure 9.2.11)	8 Properties supplied by Slogarie	8 Properties	-	A	Access Track, Towers 55-57	Properties at least 600m away	PWS properties not likely impacted	**None**
NX65973 66773	Nether Crae[5]	-	Spring	B	Existing Access Track to G-T connection	14	PWS not likely impacted	**None**
NX66776 66142	Summerhill PWS[6]	-	Source location from DWQRS website possibly incorrect	B	Existing Access Track to G-T connection	25	Source not identified during site survey	**None**
NX67108 66107	Summerhill Supply	-	Well	B	Existing Access Track to G-T connection	222	PWS not likely impacted	**None**
NX67063 66112	Summerhill	Property	-	B	Existing Access Track to G-T connection	185	Potential impact	**None**
NX64755 65073	Ramerish Retreat	Property	-	A	Existing Access Track to G-T connection	25	PWS not likely impacted	**None**
NX64803 65076	Lochenbreck Cottage	Property	-	A	Existing Access Track to G-T connection	80	PWS not likely impacted	**None**
NX64782 65024	Lochenbreck Well[7]	-	Dry	-	Existing Access Track to G-T connection	57	Source no longer in use	**None**
NX66431 64779	Cullenoch 1	-	Surface Water-course	B	Access Track to G-T connection	22	Potential impact	**Minor**
NX66569 65011	Cullenoch 2	-	Surface Water-course	B	Access Track to G-T connection	118	Potential impact	**Minor**
NX66706 65014	Cullenoch	Property	-	B	Access Track to G-T connection	18	Potential impact	**Minor**
NX67800 64400	Gatehouse Farm	-	Spring	B	Access Track to G-T connection	40	PWS not likely impacted	**None**
NX67981 64354	Gatehouse Farm	Property	-	B	Access Track to G-T connection	9	PWS not likely impacted	**None**

[25] SEPA (2017) Land Use Planning System SEPA Guidance Note 31. Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems.

Nat. Grid Ref	Name	Property[1]	Source/ Source Type[2]	Type [3]	Nearby KTR Infra-structure	Distance from Infra-structure (m)	Flow Path Analysis Result[4]	Likely Significant Effect
NX66568 63332	Cot Cottage	-	Spring	A	Access Track to G-T connection	165	PWS not likely impacted	**None**
NX66571 63367	Cot Cottage	Property	-	A	Access Track to G-T connection	165	PWS not likely impacted	**None**
NX66703 63359	Edgarton	-	Spring / Surface Water-course	B	Access Track to G-T connection	280	PWS not likely impacted	**None**
NX68000 63300	Bargatton	-	Spring	B	Access Track to tower 79, Tower 79	225, 180	Potential impact	**Minor**
NX68782 63270	Bargatton Bungalow	Property	-	B	Access Track to Construction Compound 6	167	Potential impact	**Minor**
NX70161 56048	Park of Tongland[8]	-	Source – no longer in use	B	Existing Access Track to G-T connection	38	Source no longer in use	**None**
NX69800 55299	Parklea	-	Spring	B	Access Track to tower 112, Tower 112	94, 158	Potential impact	**None**
NX70111 55322	Parklea	Property	-	B	Access track to tower 112	215	Potential impact	**None**

[1] **Property:** This column identifies the PWS property location and details

[2] **Source/Source Type:** This column identifies the PWS source location and details and includes a description of the type of supply (e.g. borehole, spring or surface water)

[3] **Type:** Type A supplies are larger PWS, or those with a commercial activity, and are defined as Regulated supplies, which supply either a commercial activity or 50 or more people in domestic premises. These supplies are subject to regular testing by D&GC. Type B supplies are smaller supplies that serve only domestic properties (<50 persons).

[4] **Flow Path Analysis Result:** Likelihood of impact on PWS from infrastructure construction, based on flow paths.

[5] The source location for the Nether Crae PWS shown on the DWQRS online map is thought to be incorrect, based on additional information provided by D&GC. However, given its suggested proximity to a proposed access track the actual location of the source will be confirmed prior to construction.

[6] The source of the Summerhill PWS will be confirmed prior to construction.

[7] The Lochenbreck Well is not in use and was dry and dirty. Clarification will be made prior to construction that the well will continue to be dry and in disuse during the extent of the KTR Project construction. This is not considered further.

[8] The Park of Tongland PWS is no longer used, as the properties are now on the Scottish Water system. This is not considered further.

Note: Several PWS have more than one more than one location of supply infrastructure close to their source (e.g. Carsfad 2, Dundeugh 2, Slogarie 2 and Cullenoch 2)

Effects on channel morphology (bank erosion and channel form) during construction

9.489 The effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude, as embedded mitigation measures, including a minimum 10m buffer zone and environmentally sensitive bridge design, have been incorporated into the project design. The significance of the effect will therefore be **none**.

Effects during construction on run-off rates, flood risk and ground-water levels/recharge

9.490 In accordance with the Risk Framework within Scottish Planning Policy (SPP), new development should be limited to areas outside the medium risk 200-year (0.5% Annual Probability (AP)) functional floodplain. Floodplains were avoided as far as practicable during the routeing and design process of the KTR Project.

9.491 The KTR Project is 'essential infrastructure' under the SEPA Flood Risk and Land Use Vulnerability Guidance and the guidance notes that essential infrastructure can be in medium to high risk flood areas (i.e. >0.5% AP) if a flood risk location is required for operational reasons and an alternative lower-risk location is not available. No towers of the G-T connection are located within the 200-year floodplain.

9.492 Compaction of soils and increased areas of hardstanding reduces the infiltration rate leading to a greater rate and volume of surface water runoff. Clear felling forestry and other vegetation can also lead to an increase in surface water runoff rates. This results in a "flashier" catchment response and could increase flood risk downstream. While the magnitude of the change would not be anticipated to be great due to the small area of semi-permeable surfaces compared to the total catchment areas (**Table 9.26**), SEPA and D&GC highlighted in their consultation responses that there should be no increase in flood risk to third parties as a result of the KTR Project (including G-T connection).

9.493 The construction of infrastructure, such as access tracks, could affect (block or realign) natural flow pathways, resulting in changes to the local runoff rate and volume and potentially resulting in the change in contributing catchment areas. This would also affect the rate and volume of water reaching receiving watercourses and other downstream receptors.

9.494 Changes to the rate and volume of infiltration due to the construction of infrastructure could also affect recharge rates to the groundwater body. Excavations for tower foundations and in the quarries during construction could also result in local changes to groundwater levels, as water would tend to fill up the excavated areas.

9.495 The KTR Project design incorporates SUDS and embedded good practice mitigation measures to minimise the risk of increased run-off and flood risk (see **Chapter 5** for details) and the discharge of attenuated surface water runoff from the working areas into the watercourses will be limited to greenfield runoff rates entering each watercourse from the site at present. The catchment area of the River Dee at Tongland (the downstream limit of this connection) is 899km^2. The total area of hardstanding or semi-permeable surfaces is 132.4ha (1.32km^2) which represents approximately 0.15% of the total catchment.

9.496 The effect of site clearance, felling and construction on run-off rates and flood risk is considered to be of **negligible** magnitude and the significance of the effect on watercourses downstream of the connection will be **none**.

9.497 Excavations for tower foundations and the quarries could affect groundwater levels locally. The effect is considered to be local in extent, of short duration and reversible and is considered to be of **minor** magnitude and **minor** significance. Groundwater abstractions (for PWS) have been assessed separately where PWSs are within 250m of proposed excavations.

Table 9-26: Areas of Land-take in G-T Connection

Type	Area (ha)
Permanent	
Estimated Tower Base	0.3
Total Permanent	**0.3**
Temporary	
Construction compounds	8.1
New access	16.5
Existing access	13.4
Existing Access - Widening	9.0
Quarry	66.4
Work Area/Pulling Area	16.6
Work Area/Pulling Area for NR Removal	2.1
Total Temporary	**132.1**
Grand Total	**132.4**

Effects during construction on GWDTEs

9.498 The GWDTE Assessment is set out in detail in **Appendix 9.7** and summarised below. The SEPA Guidance for assessing impacts of development on GWDTEs recommends a 250m buffer zone from all excavations deeper than 1m and a 100m buffer for excavations less than 1m deep. Towers 8 and 10 are located within the GWDTEs and construction of the tower bases will result in direct loss of the habitat. The new access track also passes directly through the GWDTEs, which again will result in direct loss of habitat (see **Figure 9.2.5 and Figure 2, Appendix 9.7**).

9.499 Based on the project description and construction methods outlined in **Chapters 4 and 5** of the EIA Report, excavation for the tower foundations will be deeper than 1m, and there may be some excavation associated with the construction of the new access track, although this is likely to be less than 1m deep. There is also a risk that the access track could block sub-surface flow paths to the GWDTE or runoff from the tracks could result in increased sediment/pollution draining towards the habitat.

9.500 Given that towers 8 and 10 are within GWDTE habitat and towers 9 and 11 are close to the GWDTE, there is a risk that excavations during construction of the tower bases may temporarily affect sub-surface flows to the habitat. The hydrological data indicates that the GWDTE may be partially fed by surface water and the dependency on groundwater is considered to be no greater than moderate (**Appendix 9.7**). However, given the direct loss of a small area of GWDTE habitat, the effect on both GWDTEs is considered to be of **moderate** magnitude, resulting in an effect of **moderate** significance during construction.

9.501 Embedded mitigation measures (e.g. SUDS and good practice construction) will minimise the risk of pollution/sediment to the GWDTE. Best practice construction techniques as set out in the guidance document 'Good Practice during Wind Farm Construction' (2019)[26] will be employed to minimise the effects on groundwater flow or chemistry to sensitive receptors. Additional mitigation measures (described below) will be put in place during construction to maintain baseline subsurface flows towards the GWDTE and minimise effects on the natural drainage conditions of the site. Specific measures will be implemented on a case by case basis as directed by the ECoW during construction.

9.502 Monitoring (described below) will be put in place before and after construction to monitor the baseline subsurface flows towards the GWDTE.

Direct and indirect disturbance of peat during construction

9.503 The alteration of the geological environment by the excavation of the subsoil and peat required to build the infrastructure such as tower bases, construction compounds, working areas, access tracks and quarries and forestry removal will result in some alteration of the geological environment. In particular any underlying topsoil and peat may be temporarily removed and will need to be managed appropriately.

9.504 Activities, or effects of activities, that have the potential to alter the geological environment include:

- earthworks and site drainage;
- reduction in water table resulting in the drying out, oxidation and potential erosion of peat;
- excavation and removal of peat;
- the disturbance and loading of peat by vehicle tracking; and,
- forest felling activities.

9.505 Prior to detailed foundation design informed by ground investigations the initial calculation presented in **Appendix 9.5** have assumed a 'worst-case' scenario based on the data available at this stage. The calculations assume that all peat will be removed for the tower foundations, working areas, existing track widening, temporary track construction, construction compound construction and quarries. This results in an over estimation of the peat volumes likely to be excavated and in reality the peat volumes excavated will be less.

9.506 The total volume of direct peat loss for the G-T connection, based on a worst-case scenario that excavation is required along the whole footprint where peat is present, is 102,024m^3 comprising:

- 43,747m^3 for the towers and associated working areas;
- 13,658m^3 for construction compounds;
- 17,920m^3 for quarries;
- 5,419m^3 for temporary widening of existing tracks; and,
- 21,280m^3 for new temporary access tracks.

9.507 Temporary storage of any soils or peat will be close by to where it is to be reused, within the working areas and not located on existing peat deposits, within 25m of a watercourse or sensitive ecological habitats.

9.508 The total volume of peat that can be reused for this connection is 102,060m^3 which is achieved by reinstating peat in the Craigelwhan West Quarry over a slightly larger area but equivalent depth to the current peat in that area. The majority of peat excavated will be reinstated at the infrastructure footprint including the 14,685m^3 extracted from an area of 13,676m^2 at the Craigelwhan quarry. The peat associated with the tower foundations, approximately 750m^3, will be reused in the Craigelwhan West Quarry to extend the peat habitat by 744m^2 at the same depth as it currently exists (1.07m) and to provide improved linkage to the peat habitat adjacent to the quarry. Peat will be reused or reinstated sequentially and as quickly as possible. **Appendix 9.5** demonstrates that the peat excavated from the G-T connection can be appropriately re-used on site.

9.509 Adherence to the outline PMP will enable the excavated soil and peat to be appropriately managed and re-used onsite. It is anticipated that all excavated peat can be reused for reinstatement of ground at the point of excavation. Prior to construction and on completion of ground investigations and micro-siting, the outline PMP will be refined and agreed with SEPA, SNH and D&GC.

9.510 Assuming the embedded mitigation measures detailed in **Appendix 5.2** and summarised above are incorporated into project design and are effective, the magnitude of the effect on peat is **none** to **minor** for the majority of the connection where peat is not present or where shallow heavily modified peat is present and the significance of the effect is **none** to **minor**. Where active unmodified peat, Annex I/BAP habitat and/or deep peat (>1.0m depth) was recorded, and there is a relatively large area of infrastructure (i.e. the largest working areas), the magnitude of effect is considered to be **moderate** due to the associated volume of peat to be excavated. Given the moderate sensitivity of the peatland and peat deposits, the significance of the effect is **moderate** for the following areas where infrastructure is located on deep peat (>1m depth):

- Deep peat from 0.5m to 4.0m at tower 23, working area and temporary access track section (classified as dry heath/grassland by ecology survey);
- Peat from 0.0m to 1.5m deep at tower 24 and working area (classified as dry heath/grassland by ecology survey);
- Localised pockets of modified peat (shown as wet modified bog within a forestry area) up to 2.0m depth existing track to tower 36, at tower 36 and construction compound 4;
- Pockets on existing track that will be widened to the north and south of tower 74 up to 3.0m partially modified peat within forestry area;
- Very deep peat (dry and wet modified bog) on track north of tower 79 up to 6.0m in depth;
- Very deep peat (dry modified bog) on track between tower 82 and 83 up to 5.0m in depth;
- Deep peat (dry modified bog/ felled forestry) at tower 85, working area and track up to 3.0m;
- Very deep peat (felled forestry) at tower 85 to 86 up to 6.0m deep;
- Very deep peat (felled forestry) at tower 86 and working area, over 6.0m in depth in places;
- Very deep peat (wet dwarf scrub) between towers 88 to 89 up to 4.0m deep.

Peat Instability

9.511 A peat slide risk assessment undertaken for eleven sections of the G-T connection identified one area of Moderate likelihood of peat landslide in close proximity to Knocknairling Burn. The area lies on the north side of Darsalloch Hill and is part of the access route from the A712. Due to the High sensitivity of Knocknairling Burn, the potential consequences of a landslide led to an initial calculation of "Substantial" risk at this location. Given the **High** sensitivity of the Knocknairling Burn and **Moderate** magnitude of effect (any impacts on the watercourse would be temporary and relate to water quality and minor changes to flood flows), the significance of the effect would be **moderate**.

[26] https://www.nature.scot/sites/default/files/2019-05/Guidance%20-%20Good%20Practice%20during%20wind%20farm%20construction.pdf

Proposed Additional Mitigation

9.512 With embedded mitigation measures incorporated into project design, including SUDS pollution control and attenuation measures, there are no potentially significant effects on hydrology, water quality or PWS. Details of the embedded mitigation measures will be set out in detail prior to construction in the PPP, CDEMP and construction method statements. The PPP will require approval by SEPA to obtain a CAR CSL. The PPP will also contain details of the location specific additional mitigation for relevant infrastructure comprising the connection and the contractor will be legally obliged to comply with the pollution control and drainage measures agreed in the PPP and CSL.

9.513 As described in **Appendix 9.2** and Embedded Mitigation above, parts of the KTR Project that are up-gradient of sensitive receptors (e.g. PWS, watercourses) have been identified based on analysis of flow paths and additional areas for SUDS will be incorporated within the project design to mitigate any potential effects. In addition, further investigation of the location of PWS pipework and infrastructure will be carried out prior to construction and micro-siting of the G-T infrastructure within the ILA will be undertaken where necessary to avoid damaging any PWS pipework/infrastructure.

9.514 The results of flow path analysis, which was undertaken to establish potential hydrological connectivity between PWS and KTR Project infrastructure (**Appendix 9.3**), was used to determine which PWS require water quality monitoring before and during construction to ensure no contamination of supply during the work. Details of the proposed monitoring and emergency contingency measures are described in the Monitoring section below.

9.515 Additional SUDS (e.g. silt fences, settlement ponds) will be put in place during the construction of Tower GT13 to reduce the risk of sediment/silt run-off to the nearby Knocknairling Burn watercourse.

9.516 The timber extraction spur/timber stacking area south of Tower GT68 will be set back by at least 10m from the Kenick Burn and no working will be undertaken within 10m of the burn.

9.517 Additional mitigation measures (including silt fences, settlement ponds, sensitive drainage design) will be put in place during the construction of the new access track between towers GT55 and GT58 where it runs parallel to two small watercourses. In places the access track is within 5m of the watercourse and additional site-specific mitigation measures will be required during construction to avoid pollution/siltation of the watercourses.

9.518 A buffer of at least 25m from the Pultarson Burn will be maintained for the working quarry area at Hind Craig Quarry.

9.519 The minor watercourses which impinge on the proposed working areas of Tower G86 and Construction Compound No. 3 will either be avoided during micro-siting or diverted around the working area to avoid potential pollution/silt entering the water environment.

9.520 The route of the culverted reach of the watercourse close to towers GT97, GT98 and GT99 will confirmed prior to construction and the towers will be microsited to avoid the culvert, if necessary.

9.521 Dewatering and physical cut-offs will be avoided where possible and not undertaken close to water supplies and drainage measures will be designed to minimise the effect on the lowering of the groundwater table. Permanent physical cut-offs will be avoided with the exception of routing groundwater flows around the proposed quarry areas.

9.522 Additional mitigation measures to maintain baseline subsurface flows towards the GWDTE habitats identified around towers GT8 and GT10 will be put in place during construction. The additional mitigation will include excavated material during tower base construction to be replaced without compaction. In addition, the new temporary access track will be designed with suitable drainage under the track to ensure subsurface flows are maintained. Monitoring will be put in place to assess groundwater flow and quality to the GWDTEs, as per SEPA guidance. Details of proposed monitoring is described in the Monitoring section below.

9.523 It is assumed that in most cases where deep peat (i.e. >1m) is present that floated infrastructure will be used so that no peat will be excavated. Where deep peat is present and floated infrastructure is not possible then piled foundations will be used which will reduce the peat that will be excavated and eliminate the issues of peat reinstatement in very deep peat areas (i.e. >2m). These construction methods will eliminate or substantially reduce the impact on deep peat.

9.524 The construction effects on peat are direct loss due to peat excavation and indirect loss due to temporary infrastructure located on peat. The peat volumes are based on a worst-case scenario that assumes that all of the peat is excavated, where present, in the construction of widening existing tracks, new temporary track, construction compounds, quarries and working areas. All temporary sections of infrastructure located on peat will however be reinstated with excavated peat at the earliest opportunity and the excess peat in areas where foundations are permanent will be reinstated in the Craigelwhan West Quarry to extend the peat habitat that currently is present. There will therefore be a net balance of excavated and re-used peat on this connection.

9.525 Any excavated peat will be stored appropriately nearby and re-used as soon as possible for reinstatement. Further ground investigation should be undertaken for the foundation and temporary track locations to determine the most suitable foundation and temporary track type so that the volumes of excavated peat can be reduced further.

9.526 Review of the depth of peat in this area and consideration of the factors driving the Moderate likelihood of failure indicate that landslide likelihood will be reduced to Low through good engineering practice, primarily through careful drainage management, work phasing (e.g. working downslope if excavating or upslope if floating tracks) and installation of temporary catch-fences at the toe of the slope during construction.

Residual Construction Effects

9.527 With embedded mitigation, additional site-specific mitigation and monitoring, the residual construction effects are either **minor** or **none** and are summarised in **Table 9.28**. In relation to peat slide risk, the mitigation measures will reduce the likelihood of failure to Low, calculated risk to Low and the magnitude of effect to **minor**. The associated significance of peat landslide at the access location would be **minor**.

9.528 Additional mitigation measures, including monitoring, put in place to maintain baseline subsurface flows towards the GWDTE habitat will help to reduce any significant effects on the localised GWDTEs however the residual effect is considered to be **moderate** and **significant**.

Removal of Existing 132kV OHL and associated towers (R route removal)

Predicted Effects during removal operations

9.529 The existing OHL (R route south) is located on the eastern side of the Water of Ken/Loch Ken for part of the route and crosses the Water of Ken/Loch Ken twice (**Figure 9.2.4** and **Figures 9.2.19-27**). The existing R route also passes over several watercourses draining off the eastern valley side to Loch Ken and large parts of the route were noted to be marshy and boggy during the site walkover surveys (e.g. between towers 58R and 62R where a watercourse known as Ged Strand drains a large area of marsh). Many of the watercourses are small and unnamed, however larger named watercourses that are crossed by the existing OHL include the Garple Burn, Aquavitae Burn, Maukinhowe Burn, Ged Strand, Shirmers Burn, Arvie Burn, Boreland Burn and Craichie Burn.

9.530 Several sections of the existing OHL (R route south), east of the Water of Ken/Loch Ken are within the SEPA predicted 200-year floodplain. These include towers 31R-36R close to the Water of Ken, just east of Glenlee, and towers 98R to 101R in the low-lying marsh area where the existing OHL crosses Loch Ken. All of the locations are on fields or grassland above the banks of the channel or loch and removal of the towers is not expected to affect channel morphology. However, works will not take place at these locations when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.

9.531 The proposed access routes for removal of the existing OHL towers (R route south) are shown in **Figures 9.2.19-27**. At the early design and planning of access route to the towers for removal, a targeted site visit was undertaken to key sensitive locations at watercourse crossings or marsh areas where access was required. Results from the site walkover were used to inform SPEN of the most appropriate access route to take to avoid watercourses and other water features. The design team sought to avoid watercourse and marsh crossings where possible, however some crossings of minor watercourses and marsh areas were unavoidable and mitigation measures are described in the Proposed Additional Mitigation section below. Wherever possible, access for tower removal will be undertaken using low ground pressure plant and vehicles to avoid the requirements for stone roads. However, dependent on weather conditions prior to access being required, there may be a requirement to stone some sections of the proposed accesses for removal. Temporary crossings will also be required for certain towers.

9.532 The proposed G-T OHL route parallels the existing OHL line (R route) south of GT94 and access routes for tower removal use the same access tracks as for G-T construction and are therefore not considered further in this assessment.

9.533 Embedded good practice mitigation measures (e.g. SUDS) will be employed during tower removal to minimise potential effects on the water environment.

9.534 Due to the need for temporary crossings of watercourses and marshes in some specific areas, the following effects have been assessed for the removal of the R route south towers:

- Effects during construction on surface water quality and private drinking water supplies; and
- Effects on channel morphology (bank erosion and channel form) during construction.

9.535 The sensitivity of the unnamed watercourses is 'High' given that they are all tributaries of the Water of Ken/River Dee catchment (which has a designated SPA and RAMSAR site close to the OHL line (R route)). Given the short duration of the works at each location for tower removal, the effect on surface water quality, assuming good practice measures are in place, is assessed to be of **negligible** magnitude resulting in an effect significance of **none**.

9.536 Towers 99R to 100AR are within the Loch Ken and River Dee Marshes SPA and Wetlands of International Importance (RAMSAR) site. Towers 98R and 101R are just outside the boundary of the SPA/RAMSAR site. Removal of these towers may have minor magnitude, short-term temporary effects on the marshlands and wetlands during removal which are assessed to be of **minor** significance. Consultation will be undertaken with SNH in advance of the works and appropriate additional mitigation put in place (e.g. timing of removal, see **Chapter 5** and **Chapter 11**).

9.537 Given that temporary bridges that do not affect the banks or bed of the channel or existing crossings are to be used for tower removal, the effect on channel morphology (bank erosion and channel form) during construction is assessed to be of **negligible** magnitude resulting in an effect significance of **none**.

9.538 The potential effects of removal of the R towers on PWS was assessed in detail in **Appendix 9.3** and summarised in **Table 9.27**. Access routes for removal will only be used for a short period of time and excavations for tower removal will not exceed a depth of 1m. On this basis, a 100m buffer zone from the R route was considered appropriate. Of the PWS identified, only seven PWSs are within 100m of the removal towers and associated accesses. All sources are for domestic use only.

9.539 The likely significant effect of tower removal on the PWS was assessed to be **none** for all PWS, with the exception of Babershall PWS where the effect was assessed to be of **minor** significance given that the PWS source is ~55m north-west of tower R94. The duration of effect will be very short-lived as tower removal takes approximately ten days per tower. The access routes for tower removal close to the PWSs use existing farm tracks, where there are already existing informal crossings. Hence, it is considered unlikely that there will be any damage or contamination of the PWS pipework to the properties. However, for all PWS shown in **Table 9.27**, pipework between the PWS and the associated properties will be identified and avoided during the works to avoid damage.

Table 9-27: Details of Private Water Supplies (PWS) sources and properties within 100m of the R route

Nat. Grid Ref	Source Name	Property[1]	Source /Source Type[2]	Distance from Removal Route (m)	Flow Path Analysis Result[3]	Likely Significant Effect
NX63381 80085	Grennan-Dalry	-	Spring	85	PWS not likely impacted	**None**
NX63718 79668	Curlew Cottage	Property	-	17	PWS not likely impacted	**None**
NX63727 79675	Plover Cottage	Property	-	17	PWS not likely impacted	**None**
NX63524 79884	Grennan Cottage	Property	-	15	PWS not likely impacted	**None**
NX63510 79847	Dairy Cottage	Property	-	40	PWS not likely impacted	**None**
NX63477 79866	Grennan Farm	Property		22	PWS not likely impacted	**None**
NX64321 77550	Cubbox Bungalow*	Property	-	22	Potential impact on PWS	**None**
NX64321 77602	Cubbox Farmhouse*	Property	-	51	Potential impact on PWS	**None**
NX64368 77606	Cubbox Farm Dairy*	Property	-	61	Potential impact on PWS	**None**
NX69445 71275	Fominoch Cottage*	Property	-	26	PWS not likely impacted	**None**
NX71445 70609	Culdoach*	Property	-	5	PWS not likely impacted	**None**
NX72100 69094	Barbershall (PWS)	-	Spring	57	Potential impact on PWS	**Minor**
NX72160 69135	Barbershall	Property	Spring	14	Potential impact on PWS	**Minor**
NX72202 66299	Kenholm House (PWS)	-	Spring	65	PWS not likely impacted	**None**
NX72179 66324	Kenholm House	Property	Spring	65	PWS not likely impacted	**None**
NX69800 55299	Parklea	-	Spring	94	PWS not likely impacted	**None**

[1]**Property:** This column identifies the PWS property location and details

[2]**Source/Source Type**: This column identifies the PWS source location and details and includes a description of the type of supply (e.g. borehole, spring or surface water)

[3]**Flow Path Analysis Result**: Likelihood of impact on PWS from OHL removal.

* The sources supplying the three Cubbox properties, Fominoch Cottage and Culdoach are outside the 100m buffer of the existing R route. Details of the sources of each are provided in Table 3 and described in the text and figures below.

9.540 No peat surveying was undertaken for R tower locations and access tracks specifically as the access tracks will be temporary and it is assumed that no earthworks are required.

Proposed Additional Mitigation

9.541 Additional SUDS and pollution control mitigation will be put in place during construction of temporary watercourse and marsh crossings and during removal of Tower R94 close to Babershall PWS. Monitoring of the Babershall PWS during tower removal will be undertaken, with an emergency supply of temporary bowsers of tanks in place and ready to be brought in if the supply becomes contaminated.

9.542 Specific additional mitigation will be put in place at sensitive areas, including marsh/watercourse crossings as follows:

- Towers R58 to R60 – the area is marshland and traversed by small watercourses and there are no formal crossings. Temporary roads and crossings will be necessary to pass through this area. Ground investigation and reconnaissance on foot prior to vehicular access will be undertaken.
- Towers R63 to R64 - requires crossing two watercourses at existing ford crossing locations (on farm tracks). Temporary crossings are recommended in these locations to mitigate against the risk of erosion, as fording is not recommended. There are also some small areas of marshland after crossing the watercourses. Temporary crossings/roads will be used in these areas. There is also an area of wet ground/ marshy area on the access to R64 which will be avoided if possible.
- Towers R69 to R71 - will require temporary crossings at three watercourse crossings; all of which are existing fords. While there are some areas of marsh nearby, most of these will be avoidable if the existing farm track is followed.
- Towers R75 and R76 – there is an existing watercourse crossing allowing access to R75 and R76. Existing farm tracks will be followed where possible as there were some short stretches of marshland. Temporary roads/crossings may be required in these areas, where applicable.
- Tower R81 - access to R81 will require a temporary crossing over a small unnamed watercourse.

- Tower R83 - there is currently a ford crossing across the watercourse. Ideally, a new temporary crossing will be required in this location.
- Tower R100A - there is no route to access this tower without crossing marshland. It will be necessary to choose a route across the marshland using temporary crossings, based on ground inspections prior to the works.
- Tower R112 – access is not possible without the use of temporary crossings. The surrounding area is marshy and a number of water features drain this boggy area. There is a poorly maintained existing crossing on the proposed route, but this has subsided and is now only around 1.2m in width and a second crossing would also be required to reach the tower. The majority of the area is marshy meaning temporary roads/crossings will be required to minimise the impact on this area. The exact route and need for temporary crossings should be based on ground inspections prior to the works.

9.543 Removal works will not take place at towers 31R-36R and towers 98R-101R when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.

9.544 Additional pollution control measures will be put in place during the removal of Towers 99R to 100AR, as these are located within the Loch Ken and River Dee Marshes SPA and Wetlands of International Importance (RAMSAR) site. Towers 98R and 101R are located just outside the designated site and will also require additional mitigation to ensure no impacts to the designated sites. Discussions with Scottish Natural Heritage (SNH) will take place to plan appropriate mitigation for the removal of the towers within and close to the designated site and timing of the removal will be scheduled to avoid any effects on the SPA interest for birds (refer to **Chapter 11**).

Residual Effects during removal operations

9.545 With mitigation, monitoring and the provision of an alternative emergency drinking water supply, if required, the residual effect on PWS is considered to have a significance of **none**.

9.546 The residual effect on surface water quality at sensitive locations (where temporary crossings may be required) is considered to have a significance of **none**.

Operational Effects

Predicted Operational Effects

9.547 The potential operational impacts of the G-T connection are associated with the permanent infrastructure, tower bases and any required maintenance work during operation, which will be infrequent.

9.548 During operation, the increase in hardstanding areas (towers legs) within the river catchment could result in a very slight increase in the rate and volume of surface water runoff, leading to an increase in flood risk in watercourses downstream. However, given the size of the areas of hardstanding compared to the catchment areas of the downstream watercourses, the magnitude of the effect on flood risk downstream is considered to be **negligible** with an effect significance of **none**.

Proposed Mitigation

9.549 No specific mitigation is proposed during operation.

Residual Operational Effects

9.550 There are no residual operational effects on the water environment.

Monitoring

9.551 Monitoring of water quality of the following PWS will be undertaken before, during and after construction to ensure no contamination of the supply. Monitoring will be undertaken by an ECoW (or equivalent) and monitoring locations will be identified in the CDEMP:

- Glenlee PWS;
- Airie Cottage PWS;
- Darsalloch PWS;
- Cullenoch PWS;
- Bargatton PWS;
- Parklea PWS; and
- Babershall PWS (R route south).

9.552 If the water quality deteriorates during construction (e.g. discoloured, high sediment content, hydrocarbons) an emergency water supply will be installed at the PWS property, such as portable bowsers, to ensure minimal disruption of supply. The contractors will have an emergency supply of bowsers ready to deploy to impacted PWS, if required.

9.553 Monitoring will be put in place to assess the quantitative and chemical effect of the infrastructure to ensure that the groundwater flow and quality to the two GWDTEs are not statistically significantly changed post construction. Monitoring will be carried out based on SEPA guidance and will comprise a representative number of hand-driven groundwater monitoring wells. Pre-construction monitoring will commence at least six months before construction commences. Monitoring reports will be prepared, and remedial actions identified if statistically significant changes to the groundwater flow or chemistries to sensitive receptors are identified.

9.554 Monitoring of the excavation, appropriate storage and reuse of peat will be undertaken in accordance with the embedded mitigation measures detailed in **Appendix 5.2** and the outline PMP in **Appendix 9.4**.

9.555 Installation of temporary catch fences and the monitoring of ground conditions above Knocknairling Burn during construction of Access 40 (in relation to peat slide risk).

9.556 An ECoW (or equivalent) will be on site throughout the construction to monitor and ensure the effectiveness of the embedded and additional mitigation measures.

Summary of Effects

9.557 The main effects will occur during felling and construction of the KTR infrastructure and ancillary works (e.g. access tracks). There are no residual effects during operation. With embedded and additional mitigation measures in place, the significance of the residual effects on the water and soil environment are assessed to be **minor** or **none**, with the exception of the effects on two small areas of GWDTE which was assessed to be **moderate** (**Table 9.28**).

Table 9-28: Summary of Residual Construction and Operational Effects (G-T connection)

Effect	Significance before additional mitigation, but including embedded mitigation measures (e.g. SUDS)	Additional Mitigation	Significance after mitigation
Construction			
Effect on water quality of downstream watercourses and waterbodies	**Minor**	Additional SUDS (e.g. silt fences, settlement ponds) will be put in place during the construction of: • Tower GT13; • the new access track between towers GT55 and GT58. A buffer of at least 25m from the Pultarson Burn will be maintained for the working quarry area at Hind Craig Quarry. The minor watercourses close to Tower G86 and Construction Compound No. 3 will either be avoided during micro-siting or diverted around the working area to avoid potential pollution/silt entering the water environment.	**Minor**

Effect	Significance before additional mitigation, but including embedded mitigation measures (e.g. SUDS)	Additional Mitigation	Significance after mitigation
		The route of the culverted reach of the watercourse close to towers GT97, GT98 and GT99 will confirmed prior to construction and the towers will be micro-sited to avoid the culvert, if necessary.	
Effect on water quality in PWS	**None - Minor**	Monitoring of PWS before and during construction; confirmation of location of PWS pipework and avoidance; and provision of alternative water supply, if required.	**None**
Effects on channel morphology (bank erosion and channel form)	**None**	n/a	**None**
Effects on run-off rates, flood risk	**None**	n/a	**None**
Effects on ground-water levels and recharge	**Minor**	Avoid dewatering and physical cut-offs as much as possible.	**Minor**
Effects on GWDTEs	**Moderate**	Maintain baseline subsurface flows towards the GWDTE habitat. Excavated material around the tower bases will be replaced without compaction. The access track will have sufficient subsurface drainage to ensure subsurface flows are maintained. A monitoring program will be agreed with SEPA and put in place.	**Moderate**
Peat loss/disturbance	**None** - **Moderate**	Appropriate peat excavation, storage and re-use/reinstatement. Further ground investigation to review foundation and track options. Piled foundations and floating working areas and track will be considered at Mossdale/Bennan Hill, Bargatton Loch and to the north of Edgarton Loch areas.	**None - Minor**
Peat instability	**Moderate**	Installation of temporary catch fences and monitoring of ground conditions above Knocknairling Burn during construction of Access 40 (in relation to peat slide risk).	**Minor**
Removal of R towers and existing OHL			
Effect on surface water quality of watercourses (to be crossed)	**Minor**	Sensitive crossing design of marsh areas and watercourse.	**None**
Effect on wetlands/marshland in the Loch Ken and River Dee Marshes SPA and RAMSAR site	**Minor**	Additional pollution control and low impact access to marshes; appropriate timing of removal to avoid effects on SPA/RAMSAR interests.	**None**
Effect on water quality in PWS	**None** - **Minor**	Monitoring of PWS before and during construction; Confirmation of location of PWS pipework and avoidance; and provision of alternative water supply, if required.	**None**
Effects on channel morphology (bank erosion and channel form) and flood risk	**None**	Removal works will not take place at towers 31R-36R and towers 98R-101R when the river is in flood. The contractor will sign up to SEPA Floodline which provides advance warning for flooding in the Dumfries and Galloway, including the Water of Ken/River Dee.	**None**
Operation			
Effects on run-off rates, flood risk	**None**	n/a	**None**

KTR Project as a Whole: Assessment of Effects

9.558 Residual effects for the individual connections comprising the KTR Project in isolation are either minor or none, with the exception of the residual effect on two localised GWDTE in the G-T connection where direct loss of habitat is predicted resulting in a residual effect of **moderate** significance

9.559 A combined assessment of the residual effects of all connections to assess the effects of KTR Project as a Whole is described below for each element.

9.560 The residual effects on water quality were assessed to be minor for all connections and are local to individual watercourses. Given that the effects are local and spatially and temporally varied, the combined effect of the KTR Project as a Whole is also assessed as minor. The majority of the KTR Project eventually drains to the Water of Ken/River Ken, which is a large watercourse with a bank-full flow of ~379m^3/s, which will provide substantial dilution. The Water of Ken/River Ken/River Dee has been assessed as a receptor for all connections and given the spatial and temporal variation the combined effect on the downstream water environment will be no greater than **minor**.

9.561 The effects on PWS are local/specific to the property assessed, and the significance of residual effects on PWS for all is none for all connections. Hence, the KTR Project as a whole is considered to have a residual effect of significance **none** on PWS assuming mitigation and monitoring is put in place as described.

9.562 The residual effects on channel morphology (bank erosion and channel form) was assessed to be of minor or no significance for each connection individually. The only predicted effects on channel morphology will be temporary during UGC installation and localised to four small watercourses where the cable will be installed via isolated open-cut trenching techniques as part of the undergrounding works (i.e. undergrounding the existing distribution OHLs as part of the P-G via K connection and the small section of cable required at Glenlee for the E-G connection). Given the local nature of morphology effects the KTR Project as a Whole will have a temporary effect of no more than **minor** significance.

9.563 Given the small areas of hardstanding during both construction and operation, and the implementation of SuDS to treat and attenuate surface runoff, the predicted residual effects on run-off rates and flood risk was none for all connections, resulting in an effect significance of **none** for the KTR Project as a whole.

9.564 Effects on ground-water levels and recharge are related to excavations for tower foundations and quarries, which are considered to effect groundwater levels locally and for short durations, with a residual effect of minor significance for the P-G via K and G-T connections. Given the local nature of effects, the overall effects of the KTR Project as a whole will be no greater than **minor**.

9.565 Over the whole KTR Project area only three localised areas of moderately dependent GWDTEs will be impacted. The residual localised effect on the individual GWDTEs was assessed to be of minor significance for the P-G via K connection (one localised area) and moderate significance in the G-T connection (two localised areas). On this basis, for the KTR Project as a whole, the effect on GWDTE is

considered to be no more than **moderate** and highly localised, with a small potential loss of GWDTE habitat over the entire KTR Project area.

9.566 The total volume of direct peat loss for the KTR Project as a whole, based on a worst-case scenario that excavation is required along the whole footprint where peat is present, is 113,960m^3. The total volume of peat that can be reused for the KTR as a Whole is 113,985m^3. On the basis of implementation of the embedded mitigation measures detailed in **Appendix 5.2** and the outline PMP, the magnitude of the effect on peat for the KTR Project as a Whole is none to minor respectively, where peat is not present or where shallow, heavily modified peat is present and the significance of the effect is **minor** to **none**. Where active unmodified peat, Annex I/BAP habitat and/or deep peat (>1.0m depth) was recorded, and there is a relatively large area of infrastructure (i.e. the largest working areas), the magnitude of effect was considered to be moderate due to the associated volume of peat to be excavated. However, with additional mitigation, including further ground investigation, micrositing of working areas and use of piled foundations to reduce the volumes of peat excavated the residual effect is reduced to **minor** to **none**.

9.567 Prior to mitigation potential moderate effects on peat were identified for the KTR Project as a Whole (associated with peat loss/disturbance and peat instability on the G-T connection), however the residual effect of peat slide on the water and soil environment is **minor** to **none** with additional mitigation put in place, and minor for peat instability during the construction of access to tower 40.

Interrelationship between Effects

9.568 Excessive levels of suspended sediment in watercourses as a result of construction activities can have an indirect effect on watercourse ecology and fish (see **Chapter 10 – Ecology**)**.** However, with embedded mitigation (e.g. management of construction runoff including appropriately sized SuDS timing of excavation works and pollution control measures) and additional site-specific mitigation, there is considered to be no significant residual effect on water quality of the downstream watercourses.

Summary of Significant Effects

9.569 **Table 9.29** below summarises the predicted **significant effects prior to mitigation** of the development on geology, hydrology, hydrogeology, water resources and peat.

9.570 The **significant** effects (**moderate** or **major)** for any of the connections on geology, hydrogeology, hydrology and water resources prior to additional mitigation are:

- The P-G via K connection, relating to the effect on the one localised GWDTE which was predicted to be of **moderate** significance. Additional mitigation measures to maintain baseline subsurface flows towards the GWDTE and monitoring will be undertaken and the significance of the residual effect on the GWDTE is considered to be of **minor** significance; and
- The G-T connection, relating to the effect on the two localised GWDTEs which was predicted to be of **moderate** significance. Additional mitigation measures to maintain baseline subsurface flows towards the GWDTE and monitoring will be undertaken. However, given the direct loss of GWDTE during construction the significance of the residual effect is considered to be of **moderate** significance.
- The G-T connection, relating to the effect on peat which was predicted to be **moderate** significance. These residual effects were reduced to **minor** significance through the use of floating infrastructure where possible, piled foundations and extension of existing peat habitats within the Craigelwhan West Quarry and the installation of temporary catch fences above Knocknairling Burn.

9.571 All other predicted effects prior to mitigation were either of **none** or **minor significance**, assuming embedded good practice mitigation measures are in place during construction.

Table 9-29: Summary of Significant Effects

Receptor	Predicted Effect	Additional Mitigation Proposed	Significance of Residual Likely Effect
PG (via K)			
GWDTE	**Moderate**	Maintain baseline subsurface flows towards the GWDTE habitat. Excavated material around the tower bases and trench will be replaced without compaction. The final design of the distribution UGC route will aim to avoid the GWDTE habitat as far as possible during construction. The access track will have sufficient subsurface drainage to ensure subsurface flows are maintained. A monitoring program will be agreed with SEPA and put in place.	**Minor**
G-T			
GWDTE	**Moderate**	Maintain baseline subsurface flows towards the GWDTE habitat. Excavated material around the tower bases will be replaced without compaction. The access track will have sufficient subsurface drainage to ensure subsurface flows are maintained. A monitoring program will be agreed with SEPA and put in place.	**Moderate**
Peat loss/disturbance	**None** to **moderate**	Appropriate peat excavation, storage and re-use/reinstatement Further ground investigation to review foundation and track options. Piled foundations and floating working areas and track will be considered at Mossdale/Bennan Hill, Bargatton Loch and to the north of Edgarton Loch areas.	**None** to **Minor**
Peat instability	**Moderate**	Installation of temporary catch fences above Knocknairling Burn during construction of Access 40 (in relation to peat slide risk).	**Minor**
KTR Project as a Whole			
GWDTE	**Moderate**	Maintain baseline subsurface flows towards the GWDTE habitat. Excavated material around the tower bases and UGC trench (for undergrounding of existing distribution OHL) will be replaced without compaction. The final design of the UGC route will aim to avoid the GWDTE habitat as far as possible during construction. Access tracks will have sufficient subsurface drainage to ensure subsurface flows are maintained. A monitoring program will be agreed with SEPA and put in place.	**Moderate** to **Minor**
Peat loss/disturbance	**None** to **moderate**	Appropriate peat excavation, storage and re-use/reinstatement Further ground investigation to review foundation and track options. Piled foundations and floating working areas and track will be considered at Mossdale/Bennan Hill, Bargatton Loch and to the north of Edgarton Loch areas.	**None** to **Minor**
Peat instability	**Moderate**	Installation of temporary catch fences above Knocknairling Burn during construction of Access 40 (in relation to peat slide risk).	**Minor**

Appendix 9.1: Watercourse crossings

Appendix 9.1: Watercourse crossings

Introduction

9.1.1 Watercourse crossings of access tracks, underground cable and the overhead line (OHL) have been identified from OS 1:10,000 scale maps and in the field. Data for each crossing is provided in **Table 1**, based on field data and desk-based analysis of catchments. The data is presented in sections in the table for 'existing' access track crossings, 'new' access track crossings, OHL crossings, and 11kV underground cable crossings based on the proposed KTR infrastructure.

9.1.2 The locations of the watercourse crossings are illustrated on **Figure 9.2** in the EIA Report. Some watercourses are crossed more than once, either by existing access tracks, proposed new access tracks, underground cable or the OHL itself. In this case the crossings are labelled, for example PG38A (unnamed watercourse – OHL crossing) and PG38B (the same unnamed watercourse, but this time it is to be crossed by a new access track). A section of the E-G underground cable route is within Glenlee Power Station and will pass below an existing culvert at a sufficient depth to avoid any impact on the culvert. Further south, the EG underground cable will pass under an open reach of the same watercourse, just upstream of the culvert.

9.1.3 A number of watercourse crossings locations could not be accessed at the time of writing due to access restrictions. This is noted in the final column of **Table 1** and in these cases information about the watercourse was obtained from desk-based sources (e.g. Ordnance Survey maps, aerial photography, terrain data and observations from nearby watercourses and catchments). Prior to construction all identified watercourse crossings will be visited on site and identified in the CDEMP.

9.1.4 Photographs of all watercourses to be crossed can be provided as a digital download file upon request (due to file size). Photographs of representative crossings are included at the end of this report.

Table 1: Watercourse crossings

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km²)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
Existing access track watercourse crossings																
PG0	Polquhanity Burn	PG	258625	590102	1.91	2	Existing Access	2m diameter	-	Yes	Vegetation	Shallow	No	No	228	Existing track crossing
PG26B	Polharrow Burn	PG	260325	584362	41.5	25	Existing Access	2 x arches 5 x 3m approx.	No	Yes	Boulders	Shallow	No	YES	909 & 290	Estimated and measured from bridge
PG27B	Unnamed	PG	260308	584255	0.22	1	Existing Access	0.15m diameter	No	Yes	Boulders	Steep	Yes	No	948 & 250	WC passes under road
PG28B	Unnamed	PG	260250	584226	0.22	1	Existing Access	0.3m diameter	No	Yes	Mixed Sediment	Shallow	No	No	952 & 251	-
PG40X	Unnamed	EG	261415	582001	0.01	2.5	Existing Access	-	-	-	-	-	No	No	No photo	No access
BG52	Craigshinnie Burn	BG	259509	579374	4.99	10	Existing Access	high raised 10m wide x 3m high	No	Yes	Gravel	Shallow	No	No	No photo	small dam upstream, 1m crest, watercourse flows alongside road
GT47V	Unnamed	GT	260353	580741	0.36	-	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT47W	Unnamed	GT	260029	580730	0.08	-	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT47X	Unnamed	GT	260029	580598	0.11	-	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT47Y	Unnamed	GT	260269	580438	0.02	-	Existing Access	-	-	-	-	-	Yes	No	No photo	No access
GT47Z	Unnamed	GT	260313	580387	0.04	-	Existing Access	-	-	-	-	-	No	No	1959	No access
GT65	Unnamed	GT	258155	578688	0.47	2	Existing Access	-	-	-	-	-	No	No	No photo	No access, estimated from map
GT68A	Unnamed	GT	261137	576946	0.03	2	Existing Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	1110	follows route on map; culverted under existing track
GT68X	Darsalloch Burn	GT	260781	576855	1.46	2.5	Existing Access		No	Yes	Gravel	Shallow	No	No	No photo	estimated
GT71	Unnamed	GT	261110	575680	0.15	1	Existing Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1118	culverted under road
GT72B	Pultarson Burn	GT	261115	575496	0.98	2	Existing Access	-	No	Yes	Gravel	Steep	No	No	1119	river 2m, bog 15m width, it flows east next to gravel pit
GT73	Unnamed	GT	261108	575374	0.26	1	Existing Access	-	No	Yes	Sand/Silt	Shallow	Yes	No	1120	-
GT73T	Unnamed	GT	262182	575892	0.2	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT73U	Unnamed	GT	262450	575595	0.02	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT73V	Unnamed	GT	262743	575485	0.28	2	Existing Access	-	-	-	-	-	No	No	No photo	No access

[1] KTR Connection: PG = Polquhanity to Glenlee, CK = Carsfad to Kendoon, EG = Earlstoun to Glenlee, GT = Glenlee to Tongland, BG = BG route deviation.

[2] A minor watercourse is defined by SEPA as one that is not shown on 1:50,000 scale Ordnance Survey maps. SEPA do not normally require an authorisation for engineering activities on minor watercourses with the exception of culverting for land-gain, dredging and permanent diversions/realignments.

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km^2)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
GT73W	Unnamed	GT	263191	575333	0.05	2	Existing Access	-	-	-	-	-	Yes	No	No photo	No access
GT73X	Unnamed	GT	263425	575343	0.19	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT73Y	Unnamed	GT	263543	575144	0.21	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT74	Unnamed	GT	261029	575147	0.13	1	Existing Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1122	foam in water
GT75	Unnamed	GT	261194	574847	0.04	1	Existing Access	-	No	Yes	Vegetation	Shallow	Yes	No	1124	culverted under road, flows from south
GT78	Unnamed	GT	260991	574265	0.1	2	Existing Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1126	drains new forest and road. flows west
GT79	Unnamed	GT	261316	574000	0.05	2	Existing Access	-	No	Yes	Vegetation	Shallow	Yes	No	1129	incoming river from east from forest
GT80	Unnamed	GT	261486	573771	0.16	2	Existing Access	-	No	Yes	Gravel	Steep	Yes	No	1132	-
GT82B	Unnamed	GT	261503	573524	0.02	2	Existing Access	-	No	Yes	Sand/Silt	Steep	Yes	No	1136	flows north-east to south-west
GT87	Unnamed	GT	262185	572760	0.03	2	Existing Access	0.3m diameter	No	Yes	Boulders	Shallow	Yes	No	1163	ditch along road from north to south - drains under road and flows south-west
GT89	Unnamed	GT	262423	572232	0.03	2	Existing Access	-	No	Yes	Vegetation	Shallow	Yes	No	1162	drains forest to north-east via ditch, drains south-west
GT90C	Acre Burn	GT	262882	572063	0.24	2	Existing Access	-	No	Yes	Mixed Sediment	Steep	No	No	1161	deforestation upstream, flows south-west
GT91B	Unnamed	GT	263215	571883	0.01	2	Existing Access	-	No	Yes	Boulders	Steep	Yes	No	1160	-
GT92B	Acre Burn	GT	263239	571832	0.58	2	Existing Access	0.6m diameter	No	Yes	Boulders	Steep	No	No	1160	-
GT93B	Unnamed	GT	263301	571785	0.07	1	Existing Access	0.3m diameter	No	Yes	Vegetation	Shallow	Yes	No	1159	culverted under road
GT94B	Unnamed	GT	263452	571671	0.04	2	Existing Access	0.3m diameter	No	Yes	Boulders	Steep	Yes	No	1158	flows south-west, culverted
GT95B	Unnamed	GT	263516	571607	0.05	1	Existing Access	0.3m diameter	No	Yes	Vegetation	Shallow	Yes	No	1157	stagnant flow
GT96	Unnamed	GT	263627	571533	0.03	1.5	Existing Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1156	flows south-west, some foam, culverted under road
GT97B	Unnamed	GT	263678	571519	0.03	1.5	Existing Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1156	flows south-west, some foam, culverted under road
GT98B	Unnamed	GT	263760	571473	0.05	1	Existing Access	-	No	Yes	Vegetation	Shallow	Yes	No	1155	flows south-west
GT100B	Unnamed	GT	264389	571195	0.01	2.5	Existing Access	-	No	Yes	Vegetation	Flat	Yes	No	1153	flows north-east
GT101B	Clachrum Burn	GT	264445	571205	1.47	3	Existing Access	-	No	Yes	Gravel	Shallow	No	No	1152	culverted under road, flows south-west
GT103A	Unnamed	GT	264588	571197	0.01	1	Existing Access	-	No	Yes	Gravel	Shallow	Yes	No	1150	culverted under road, flows south-west

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km^2)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
GT103B	Unnamed	GT	264578	571198	0.01	1	Existing Access	-	No	Yes	Boulders	Shallow	Yes	No	1151	culverted under road
GT104	Unnamed	GT	264693	571140	0.26	2	Existing Access	-	No	Yes	Mixed Sediment	Shallow	No	No	1149	follows route on map
GT105B	Unnamed	GT	264713	570852	0.01	1	Existing Access	0.4m diameter	No	Yes	Vegetation	Shallow	Yes	No	252	ditch from north to south along road
GT117	Unnamed	GT	265168	566363	1.35	20m wide bog	Existing Access	No culvert identified	No	Yes	Vegetation	Flat	Yes	No	1187	bog to the south of a watercourse
GT117X	Unnamed	GT	265429	566509	0.09	2	Existing Access	-	-	-	-	-	No	No	No photo	No access. Flows north, tributary of Slogarie Burn
GT117Y	Unnamed	GT	266146	566664	0.29	2	Existing Access	-	-	-	-	-	No	No	No photo	No access. Flows north-east to Woodhall Loch
GT118B	Unnamed	GT	265103	565831	0.08	0.5	Existing Access	-	No	Yes	Vegetation	Shallow	Yes	No	1182	-
GT118X	Kenick Burn	GT	264675	565243	3.02	3	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT118Y	Unnamed	GT	266660	566269	0.09	2	Existing Access	-	-	-	-	-	No	No	No photo	No access. Flows south-east to Kenick burn
GT119X	Kenick Burn	GT	267022	565530	6.7	3.5	Existing Access	3.5 wide x 1.8m high span	No	Yes	Gravel	Shallow	No	No	236	large span bridge crossing. Road is 2.8m wide at crossing
GT120X	Unnamed	GT	265272	564886	0.45	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT120Y	Unnamed	GT	265299	564676	0.36	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT120Z	Unnamed	GT	265162	564408	0.21	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT121X	Unnamed	GT	266685	564995	0.16	1.5	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT123	Unnamed	GT	266153	564342	0.2	2	Existing Access	0.45	No	Yes	Gravel	Steep	No	No	1202	
GT124	Gatehouse Burn	GT	266519	563863	0.83	7	Existing Access	-	No	Yes	Boulders	Steep	No	No	1208	-
GT124X	Unnamed	GT	266802	564090	0.11	2	Existing Access	-	-	-	-	-	No	No	No photo	
GT125	Unnamed	GT	266521	563718	0.07	1.5	Existing Access	0.45	No	Yes	Mixed Sediment	Shallow	Yes	No	1205	culverted under road
GT125X	Unnamed	GT	266451	563483	0.17	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT125Y	Unnamed	GT	265685	563286	0.08	2	Existing Access	-	-	-	-	-	No	No	No photo	No access
GT128A	Gatehouse Burn	GT	267473	564179	1.9	2	Existing Access	ford crossing and narrow bridge	No	Yes	Sand/Silt	Shallow	No	Yes	242	ford with footbridge or small car bridge; adjacent ford is 4m wide.
GT128B	Unnamed	GT	267554	563861	0.09	1.2	Existing Access	no culvert	No	Yes	Gravel	Shallow	No	Yes	243	will need crossing
GT139	Unnamed	GT	269742	560424	0.07	1	Existing Access	-, very small WC in large marsh	No	Yes	Mixed Sediment	Steep	Yes	No	No photo	we cannot see the WC due to it being partially culverted and covered with vegetation

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km^2)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
GT151	Unnamed	GT	269860	557710	0.01	2.5	Existing Access	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1234	watercourse goes into culvert DS and passes through wall just US
GT157	Unnamed	GT	269366	553757	0.07	1.5	Existing Access	-	No	Yes	Gravel	Shallow	No	No	1239	Possibly culverted upstream
Proposed new access track watercourse crossings																
PG1	Unnamed	PG	259157	589440	0.21	2	New Access	0.5m diameter	No	Yes	Mixed Sediment	Shallow	No	Yes	877	Marsh on either side.
PG3B	Unnamed	PG	259460	588180	0.23	1	New Access	-	No	Yes	Mixed Sediment	Shallow	No	Yes	889	boggy here
PG4B	Unnamed	PG	259654	587640	0.21	1.5	New Access	-	Yes	Yes	Gravel	Flat	No	Yes	894	confluence with another watercourse here
PG5A	Unnamed	PG	259849	587470	0.09	2	New Access	-	Yes	Yes	Sand/Silt	Shallow	Yes	No	895	varies in width
PG12C	Unnamed	PG/CK	260174	587268	0.03	2	New Access	-	Yes	Yes	Mixed Sediment	Shallow	No	Yes	944	braided floodplain is 10m wide, watercourse 2m
PG13C	Unnamed	PG/CK	260197	587030	0.09	3	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	941	floodplain width 10m watercourse (WC) 3m
PG14C	Unnamed	PG/CK	260211	586876	0.03	1	New Access	-	No	Yes	Sand/Silt	Shallow	Yes	No	939	WC has its source upstream, boggy downstream, WC 1m wide
PG15C	Unnamed	PG/CK	260225	586729	0.04	ephemeral runoff ~5m wide	New Access	-	Yes	Yes	Sand/Silt	Steep	Yes	No	937	runoff has destroyed wall; maybe ephemeral
PG16C	Unnamed	PG/CK	260240	586579	0.04	1	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	936	WC undefined and boggy in places, WC only 1m wide, Bog 5m
PG17C	Unnamed	PG/CK	260268	586277	0.13	1	New Access	-	No	Yes	Mixed Sediment	Steep	No	Yes	935	WC and marsh area, WC 1m wide, marsh 10m
PG18C	Unnamed	PG/CK	260274	586223	0.09	1	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	934	WC is 1m but valley more like 18m wides; trees within WC
PG19C	Unnamed	PG/CK	260284	586109	0.26	2	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	933	WC is 2m wide, valley more like 8m
PG20B	Unnamed	PG/CK	260301	585935	0.07	1	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	932	WC flows into marsh of 20m width.
PG21C	Unnamed	PG/CK	260316	585780	0.09	2	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	931	-
PG22C	Unnamed	PG/CK	260341	585515	0.02	ephemeral runoff ~1.5m wide	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	930	Rain leads to overland flow, ephemeral
PG23C	Unnamed	PG/CK	260350	585417	0.03	1	New Access	-	No	No	Gravel	Shallow	Yes	No	927	WC that possibly supplies PWS, runs east
PG24	Unnamed	PG/CK	260456	585355	0.03	2	New Access	-	Yes	Yes	Mixed Sediment	Steep	Yes	No	926	WC from rain, ephemeral wide wet area of 20m width, braided undefined channel
PG25B	Unnamed	PG	260449	584995	0.05	2	New Access	-	No	Yes	Sand/Silt	Shallow	Yes	No	919	WC flows down from hill and then goes in two directions: east and south. South WC feeds

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km²)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
																the marsh and is culverted downstream. East WC passes under road to Water of Ken.
PG28A	Unnamed	PG	260207	584227	0.22	1	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	949	-
PG29	Unnamed	PG	260195	584178	0.22	1	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	956	comes from hill on west
PG30B	Unnamed	PG	260271	584092	0.1	1	New Access	-	No	Yes	Mixed Sediment	Shallow	No	Yes	952	-
PG31B	Unnamed	PG	260295	583747	0.02	2	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	962	head of WC, culverted through wall upstream
PG33C	Unnamed	PG	260694	582984	0.48	2	New Access	1m diameter	Yes	Yes	Boulders	Steep	No	Yes	969	culvert is 1 diameter. Defined valley. There is erosion in the right bank downstream.
PG34B	Unnamed	PG	260736	582852	0.05	10m wide bog	New Access	-	No	Yes	Vegetation	Flat	Yes	No	972	No defined watercourse upstream. Downstream is boggy and 10 metres wide
PG35B	Unnamed	PG	260805	582650	0.05	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	975	this flow is diverted and conveyed down farm track
PG36B	Unnamed	PG	260822	582570	0.03	1	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	977	WC has been diverted along farm track to north
PG37B	Unnamed	PG	260855	582425	0.01	40m wide bog	New Access	-	No	Yes	Vegetation	Steep	Yes	No	976	bog inside valley; small WC present
PG37C	Unnamed	PG	260853	582416	0.01	40m wide bog	New Access	-	No	Yes	Vegetation	Steep	Yes	No	976	bog inside valley; small WC present
PG38B	Unnamed	PG	260981	582284	0.06	1.5	New Access	-	Yes	Yes	Gravel	Steep	No	Yes	978	WC is max 2m wide; WC is in valley; ford crossing will need upgraded.
PG39A	Unnamed	PG	261116	581972	0.11	10m wide bog	New Access	-	No	Yes	Vegetation	Flat	Yes	No	982	small boggy area, very low flow
PG39B	Unnamed	PG	261099	582012	0.11	ephemeral runoff ~3m wide	New Access	-	No	Yes	Vegetation	Steep	Yes	No	981	ephemeral WC
PG41C	Unnamed	PG/EG	261153	581572	0.18	1	New Access	-	No	Yes	Boulders	Steep	No	Yes	985	well defined, follows route as per OS map
PG41D	Unnamed	EG	261134	581587	0.18	1	New Access	-	No	Yes	Boulders	Steep	No	Yes	985	well defined, follows route as per OS map
PG42A	Unnamed	PG/EG	260951	581107	0.07	30m wide marsh	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	988	Marsh at head of downstream WC
PG42C	Unnamed	PG/EG	260954	580982	0.07	10m wide marsh	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	990	WC is vegetated in valley, valley is 10m width
PG42D	Unnamed	PG/EG	261113	580854	0.07	10m wide marsh	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	990	WC is vegetated in valley, valley is 10m width
PG42E	Unnamed	PG/EG	261192	580841	0.02	15m wide marsh	New Access	No culvert identified; ford crossing	No	Yes	Sand/Silt	Shallow	Yes	No	229	tiny burn, but large bog of 15m wide

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km^2)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
PG44C	Unnamed	PG	260832	580819	0.03	4	New Access	-	No	No	Vegetation	Flat	Yes	No	992	drains wood (forest) not natural ditch
PG44D	Unnamed	PG/EG	260888	580808	0.03	4	New Access	-	No	No	Vegetation	Flat	Yes	No	992	drains wood (forest) not natural ditch
GT48C	Unnamed	GT	260412	580132	0.06	4	New Access	-	No	Yes	Sand/Silt	Shallow	No	Yes	No photo	Estimated can't survey
BG49B	Unnamed	BG	260047	579729	0.03	1	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1966	flows north to south, bog alongside river (boggy area is min 70m long and 20m width)
BG50B	Unnamed	BG	259927	579715	0.02	1.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1965	flows north to south
BG50C	Unnamed	BG	259973	579672	0.02	1.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1965	flows north to south
BG51B	Unnamed	BG	259856	579567	0.03	1	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1964	culverted under track, flows north to south
GT58	Unnamed	GT	260360	579156	0.1	1.5	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1092	culverted under road to the north
GT59B	Unnamed	GT	260466	578954	0.1	1	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1086	WC close to road
GT60B	Unnamed	GT	260539	578859	0.004	1	New Access	-	No	Yes	Sand/Silt	Shallow	Yes	No	1085	-
GT60C	Unnamed	GT	260619	578741	0.004	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1083	culvert blocked on road
GT60D	Unnamed	GT	260615	578748	0.004	1	New Access	-	No	No	Vegetation	Shallow	Yes	No	1084	farmer has dredged the channel
GT61B	Unnamed	GT	260660	578677	0.04	1	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1083	culvert blocked on road
GT62	Unnamed	GT	260725	578634	0.003	1	New Access	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1082	
GT63C	Unnamed	GT	260737	578555	0.04	1	New Access	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1082	
GT63D	Unnamed	GT	260717	578588	0.01	1	New Access	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1082	
GT64B	Unnamed	GT	260973	578153	0.003	0.5	New Access	-	No	Yes	Sand/Silt	-	Yes	No	1100	fast flow
GT67X	Knocknairling Burn	GT	259402	577382	3.66	4	New Access	-	-	Yes	Boulders	Shallow	No	Yes	234	Knocknairling Burn, dimensions estimated based on downstream site and OS map
GT68B	Unnamed	GT	261169	576901	0.01	2	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	1110	follows route on map; culverted under existing track
GT68Y	Darsalloch Burn	GT	260753	576586	1.32	2.5	New Access		No	Yes	Gravel	Shallow	No	Yes	No photo	estimated
GT69B	Unnamed	GT	260927	576281	0.02	1.5	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1111	flows stagnant north to west
GT70	Unnamed	GT	261057	575975	0.22	1.5	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	1115	WC comes from north downhill along route of road

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GT73Z	Unnamed	GT	263630	575104	0.05	2	New Access	-	-	-	-	-	No	Yes	No photo	Estimated from OS map
GT76C	Unnamed	GT	261296	574594	0.01	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1125	flows north to south
GT76D	Unnamed	GT	261298	574584	0.01	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1125	flows north to south
GT77B	Unnamed	GT	261314	574452	0.01	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1125	flows north to south
GT82A	Unnamed	GT	261500	573521	0.01	1	New Access	-	No	Yes	Sand/Silt	Shallow	Yes	No	No photo	WC flows from north to south close to road
GT84B	Mid Burn	GT	261788	573253	0.79	3	New Access	-	No	Yes	Gravel	Steep	No	Yes	1140	waterfall, WC follows route on map
GT85B	Unnamed	GT	262164	572950	0.05	2.5	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1164	ditch along road then flows under road and west, deforestation uphill
GT99B	Unnamed	GT	264090	571295	0.03	1.5	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1154	flows south-east
GT102B	Unnamed	GT	264521	571081	1.47	3	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1152	Culverted under road, flows south-west. This WC appears to be connected to Clachrum Burn.
GT106B	Unnamed	GT	264867	570675	0.01	7m wide bog	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1168	boggy area surrounding the river
GT107A	Unnamed	GT	264964	570585	0.01	1	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1169	-
GT107B	Unnamed	GT	264954	570568	0.01	1	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1169	-
GT111B	Unnamed	GT	264394	568091	0.05	1	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1981	burn with bog running in road
GT112A	Unnamed	GT	264494	567778	0.15	1.5	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1982	burn with bog running in road
GT113B	Slogarie Burn	GT	264637	567214	0.82	50m wide bog	New Access	-	No	Yes	Sand/Silt	Shallow	No	Yes	No photo	50m wide bog by 20m long or more
GT114	Unnamed	GT	264642	566989	0.38	2	New Access	-	-	-	-	-	No	Yes	No photo	No access. Tributary of Slogarie Burn.
GT115B	Unnamed	GT	264912	566592	0.06	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1190	-
GT120B	Unnamed	GT	265907	564884	0.03	0.5	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1196	flows east
GT121B	Unnamed	GT	266011	564726	0.02	1.5	New Access	-	Yes	Yes	Vegetation	Shallow	Yes	No	1198	-
GT122	Unnamed	GT	266073	564630	0.001	2	New Access	-	No	Yes	Gravel	Steep	Yes	No	1202	-
GT127	Unnamed	GT	266719	563737	0.02	0.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1210	cannot see WC, but it is culverted under stones, likely flows to WC downstream
GT127A	Unnamed	GT	266790	563724	0.02	0.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1210	cannot see WC, but it is culverted under stones, likely flows to WC downstream

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GT129B	Camelon Lane	GT	267697	563276	0.32	1.5	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	1214	-
GT130	Unnamed	GT	268662	562542	0.2	1	New Access	-	No	No	Vegetation	Flat	No	Yes	2008	WC follows field fence
GT131B	Unnamed	GT	268521	562278	0.44	5m wide bog	New Access	-	No	Yes	Vegetation	Flat	No	Yes	2006	WC is not maintained, full of water, bog on either side
GT132B	Barstonbrick Burn	GT	268808	561905	0.73	3	New Access	-	No	Yes	Vegetation	Shallow	No	Yes	2014	WC from loch. follows line on map
GT134B	Unnamed	GT	269342	561418	0.01	1	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	2023	WC flows west to east into forest land. potential source of wetness in forestry land
GT135B	Unnamed	GT	269934	560887	0.03	1	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1224	could not directly access; width estimated from nearby
GT136B	Unnamed	GT	269957	560857	0.03	1	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1224	could not directly access; width estimated from nearby
GT137B	Unnamed	GT	270078	560714	0.12	1.5	New Access	-	No	Yes	Mixed Sediment	Steep	Yes	No	1222	Estimated, we cannot see the WC due to it being partially culverted and covered with vegetation
GT138	Unnamed	GT	269905	560748	0.04	1	New Access	-	No	Yes	Vegetation	Flat	Yes	No	1224	could not directly access; width estimated from nearby
GT145	Unnamed	GT	270139	558603	0.31	1.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1218	flows south-west. Not culverted, flows along hedge
GT149	Unnamed	GT	270222	558305	0.4	1	New Access	-	Yes	Yes	Vegetation	Shallow	No	Yes	1232	WC flows to north (but it is very dry) - Likely culverted.
GT152B	Unnamed	GT	269948	557277	0.06	1	New Access	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1246	dry at this point and flows north
GT153B	Unnamed	GT	269864	556773	0.03	1.5	New Access	-	No	Yes	Gravel	Shallow	Yes	No	1244	flows south-east towards farm
GT156B	Unnamed	GT	269528	553857	0.01	0.5	New Access	-	No	Yes	Vegetation	Shallow	Yes	No	1238	Upstream and downstream WC. Culverted route hard to ascertain – route estimated
GT86B	Unnamed	GT	262194	572833	0.03	2	Timber Extraction Spur	-	No	Yes	Boulders	Shallow	Yes	No	1163	ditch along road from north to south - drains under road and flows south-west
GT115C	Unnamed	GT	264940	566615	0.06	1	Timber Extraction Spur	-	No	Yes	Vegetation	Shallow	Yes	No	1190	-
Underground Cable Watercourse Crossings																
PG4B	Polmaddy Burn	PG	259850	588054	0.23	18	UG cable	-	No	Yes	Boulders	Shallow	No	No	892	Crossing is upstream of A713 road bridge. Width measured across bridge at 18m

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km^2)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
PG26C	Polharrow Burn	PG	260313	584367	41.5	25	UG cable		No	Yes	Boulders	Shallow	No	No	909	Crossing is upstream of A713 road bridge.
PG40W	Unnamed	PG	261288	582019	0.04	2	UG cable	-	-	-	-	-	Yes	No	No photo	No access, estimated from map
PG40Z	Unnamed	PG	261296	581841	0.003	1	UG cable	-	-	-	-	-	Yes	No	No photo	No access, estimated from map
PG45C	Coom Burn	PG	261101	580373	21.5	12	UG cable	-	No	No	Mixed Sediment	Shallow	No	No	995	Crossing is upstream of A762 road bridge. Not natural, straightened watercourse
PG46C	Glenlee Tailrace	PG	261100	580371	NA	16	UG cable	-	No	No	Gravel	Shallow	No	No	1000	Crossing is upstream of A762 road bridge
PG46D	Glenlee Tailrace	PG	260634	580575	NA	16	UG cable	-	No	No	Gravel	Shallow	No	No	1000	Crossing is downstream of public road bridge
PG47	Unnamed	PG	260712	580502	0.21	1.5	UG cable	-	No	No	Mixed sediment	Shallow	No	Yes	No photo	Crossing downstream of culverted watercourse under power station
EG1	Unnamed	EG	260610	580426	0.21	1.5	UG cable	-	No	Yes	Mixed Sediment	Shallow	No	No	1557	Watercourse just upstream of culverted reach under Glenlee Substation. The downstream culvert under the substation is 0.45m diameter.
Overhead Line Watercourse Crossings																
PG2	Unnamed	PG	259137	588998	0.21	10m wide bog	OHL	-	No	Yes	Vegetation	Flat	No	No	882	WC is marsh (bog)
PG3A	Unnamed	PG	259344	588226	0.23	1	OHL	-	No	Yes	Mixed Sediment	Shallow	No	No	889	boggy here
PG4	Polmaddy Burn	PG	259473	587915	0.23	20	OHL	-	Yes	Yes	Boulders	Shallow	No	No	892	width measured across bridge at 18m and adjusted
PG4A	Unnamed	PG	259634	587632	0.21	1.5	OHL	-	Yes	Yes	Gravel	Flat	Yes	No	894	confluence with another WC here
PG5B	Unnamed	PG	259840	587459	0.09	2	OHL	-	Yes	Yes	Sand/Silt	Shallow	Yes	No	895	varies in width
PG6	Unnamed	PG	260113	587421	0.03	1	OHL	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	900	Marsh; 4m refers to total braided width of marsh; channel is narrower
PG7	Unnamed	PG	260334	587572	0.03	1	OHL	-	No	Dredged	Sand/Silt	Flat	Yes	No	905	dredged WC at pylons runs south to north turns to bog
PG8	Water of Deugh/ Water of Ken confluence	PG	260403	587609	303	36	OHL	-	Yes	Yes	Boulders	Shallow	No	No	901	measured from bridge
PG9	Water of Ken upstream confluence	PG	260442	587629	303	16	OHL	-	Yes	Yes	Boulders	Shallow	No	No	903	measured across bridge
PG10	Water of Deugh/ Water of Ken confluence	CK	260432	587577	303	36	OHL	-	Yes	Yes	Boulders	Shallow	No	No	901	measured from bridge

ID	Watercourse Name	KTR Connection[1]	NGR Easting	NGR Northing	Upstream Catchment Area (km²)	Approx. channel width (m)	Type of crossing	Existing culvert/ bridge dimensions	Bank erosion identified (yes/no)	Natural channel (yes/no)	Bed sediment type	Channel slope	Minor Watercourse[2] (yes/no)	CAR Engineering Authorisation Likely Required (yes/no)	Photo Ref	Field notes/ Description
PG11	Unnamed	CK	260368	587526	0.03	1	OHL	-	No	Dredged	Sand/Silt	Flat	Yes	No	905	dredged WC at pylons, runs south to north, turns to bog
PG12A	Unnamed	CK	260198	587276	0.03	2	OHL	-	Yes	Yes	Mixed Sediment	Shallow	No	No	944	braided floodplain is 10m wide, WC 2m wide
PG12B	Unnamed	PG	260154	587261	0.03	2	OHL	-	Yes	Yes	Mixed Sediment	Shallow	No	No	944	braided floodplain is 10m wide, WC 2m wide
PG13A	Unnamed	CK	260220	587048	0.09	3	OHL	-	No	Yes	Vegetation	Shallow	No	No	941	floodplain width 10m, WC 3m wide
PG13B	Unnamed	PG	260183	587026	0.09	3	OHL	-	No	Yes	Vegetation	Shallow	No	No	941	floodplain width 10m, WC 3m wide
PG14A	Unnamed	CK	260235	586893	0.03	1	OHL	-	No	Yes	Sand/Silt	Shallow	Yes	No	939	Bog downstream, WC 1m wide
PG14B	Unnamed	PG	260201	586839	0.03	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	939	head of watercourse, downstream is a bog
PG15A	Unnamed	CK	260252	586727	0.04	ephemeral runoff ~5m wide	OHL	-	Yes	Yes	Sand/Silt	Steep	Yes	No	937	runoff has destroyed wall, maybe ephemeral
PG15B	Unnamed	PG	260212	586730	0.04	ephemeral runoff ~5m wide	OHL	-	Yes	Yes	Sand/Silt	Steep	Yes	No	937	runoff has destroyed wall, maybe ephemeral
PG16A	Unnamed	CK	260267	586577	0.04	1	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	936	WC undefined and boggy in places WC only 1m wide Bog 5m wide
PG16B	Unnamed	PG	260226	586581	0.04	1	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	936	WC undefined and boggy in places, WC only 1m wide Bog 5m wide
PG17A	Unnamed	CK	260299	586244	0.09	1	OHL	-	No	Yes	Mixed Sediment	Steep	No	No	935	WC and marsh area, WC 1m wide marsh 10m wide
PG17B	Unnamed	PG	260252	586307	0.13	1	OHL	-	No	Yes	Mixed Sediment	Steep	No	No	935	WC and marsh area, WC 1m wide marsh 10m wide
PG18A	Unnamed	CK	260302	586222	0.09	1	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	934	WC is 1m but valley more like 18m trees within WC
PG18B	Unnamed	PG	260260	586220	0.09	1	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	934	WC is 1m but valley more like 18m trees within WC
PG19A	Unnamed	CK	260313	586107	0.26	2	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	933	WC is 2m wide, valley more like 8m
PG19B	Unnamed	PG	260270	586118	0.26	2	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	933	WC is 2m wide, valley more like 8m
PG20A	Unnamed	PG	260289	585922	0.07	1	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	932	WC flows into marsh of 20m width
PG20C	Unnamed	CK	260327	585960	0.07	1	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	932	WC flows into marsh of 20m width
PG21A	Unnamed	CK	260343	585808	0.09	2	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	931	-
PG21B	Unnamed	PG	260304	585759	0.09	2	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	931	-
PG22A	Unnamed	CK	260368	585552	0.02	ephemeral runoff	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	930	Rain leads to overland flow, ephemeral

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						~1.5m wide										
PG22B	Unnamed	PG	260328	585517	0.02	ephemeral runoff ~1.5m wide	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	930	Rain leads to overland flow, ephemeral
PG23A	Unnamed	CK	260397	585433	0.03	1	OHL	-	No	No	Gravel	Shallow	Yes	No	927	WC that possibly supplies PWS, runs east
PG23B	Unnamed	PG	260338	585414	0.03	1	OHL	-	No	No	Gravel	Shallow	Yes	No	927	WC that possibly supplies PWS, runs east
PG25A	Unnamed	PG	260378	585032	0.05	2	OHL	-	No	Yes	Sand/Silt	Shallow	Yes	No	919	WC flows down from hill and then goes in two directions: east and south. South WC feeds the marsh and is culverted downstream. East WC passes under road to Water of Ken.
PG26A	Polharrow Burn	PG	260304	584399	41.5	25	OHL	-	No	Yes	Boulders	Shallow	No	No	909	estimated and measured from bridge
PG27A	Unnamed	PG	260273	584261	0.22	1	OHL	-	No	Yes	Mixed Sediment	Shallow	No	No	952	-
PG30A	Unnamed	PG	260276	584097	0.1	1	OHL	-	No	Yes	Mixed Sediment	Shallow	No	No	952	-
PG31A	Unnamed	PG	260328	583753	0.02	2	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	962	head of WC, culverted through wall upstream
PG32	Glen Strand	PG	260370	583471	0.8	3	OHL	-	No	Yes	Boulders	Steep	No	No	964	incised valley, WC is only 3m wide, heavy vegetation
PG33A	Unnamed	PG	260660	582942	0.48	1.5	OHL	-	Yes	Yes	Boulders	Steep	No	No	970	-
PG33B	Unnamed	PG	260634	582985	0.48	1.5	OHL	-	Yes	Yes	Boulders	Steep	No	No	971	Erosion US, riffles and pools
PG34A	Unnamed	PG	260728	582831	0.05	10m wide bog	OHL	-	No	Yes	Vegetation	Flat	Yes	No	972	No defined watercourse upstream. Downstream is boggy and 10 metres wide
PG35A	Unnamed	PG	260832	582659	0.03	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	974	-
PG36A	Unnamed	PG	260880	582581	0.03	1	OHL	-	No	Yes	Vegetation	Shallow	No	No	977	WC has been diverted along farm track to north
PG37A	Unnamed	PG	260931	582498	0.03	40m wide bog	OHL	-	No	Yes	Vegetation	Steep	Yes	No	976	bog inside valley, small WC present
PG38A	Unnamed	PG	261035	582328	0.06	1.5	OHL	-	Yes	Yes	Gravel	Steep	No	No	978	river is max 2 metres, WC is in valley
PG40A	Unnamed	EG	261194	581812	0.04	1	OHL	-	No	Yes	Vegetation	Steep	Yes	No	983	-
PG40B	Unnamed	PG	261059	581862	0.04	1	OHL	-	No	Yes	Vegetation	Steep	Yes	No	983	-
PG40Y	Water of Ken (Resv. Outfall)	EG	261337	581894	reservoir outfall	7	OHL	-	-	-	-	-	No	No	No photo	not surveyed, estimated from OS map
PG41A	Unnamed	PG	261045	581651	0.18	1	OHL	-	No	Yes	Boulders	Steep	No	No	985	well defined, it corresponds with OS map
PG41B	Unnamed	EG	261121	581600	0.18	1	OHL	-	No	Yes	Boulders	Steep	No	No	985	well defined, it corresponds with OS map

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PG42B	Unnamed	EG	261014	580952	0.07	10m wide marsh	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	990	WC is vegetated in valley; valley is 10 m wide
PG43	Unnamed	PG	260848	580888	0.01	1	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	No photo	WC is vegetated in valley; valley is 10 m wide
PG44A	Unnamed	EG	260912	580809	0.03	4	OHL	-	No	No	Vegetation	Flat	Yes	No	992	drains wood (forest) not natural ditch
PG44B	Unnamed	PG	260818	580824	0.03	4	OHL	-	No	No	Vegetation	Flat	Yes	No	992	drains wood (forest) not natural ditch
PG45A	Coom Burn	EG	260800	580653	21.5	12	OHL	-	Yes	No	Mixed Sediment	Shallow	No	No	995	not natural, straightened, erosion on right bank
PG45B	Coom Burn	PG	260745	580688	21.5	12	OHL	-	Yes	No	Mixed Sediment	Shallow	No	No	995	not natural, straightened, erosion on right bank
PG46A	Glenlee Tailrace	EG	260752	580586	NA	16	OHL	-	Yes	No	Gravel	Shallow	No	No	1000	-
PG46B	Glenlee Tailrace	PG	260690	580584	NA	16	OHL	-	Yes	No	Gravel	Shallow	No	No	1000	-
BG48A	Unnamed	BG	260312	580098	0.06	4	OHL	-	No	Yes	Sand/Silt	Shallow	No	No	No photo	Estimated
GT48B	Unnamed	GT	260361	580100	0.06	4	OHL	-	No	Yes	Sand/Silt	Shallow	No	No	No photo	Estimated
BG49A	Unnamed	BG	260021	579757	0.03	1	OHL	-	No	Yes	Vegetation	Shallow	No	No	1966	flows north to south, bog alongside river (boggy area is min 70m long and 20m wide)
BG50A	Unnamed	BG	259962	579688	0.02	1.5	OHL	-	No	Yes	Gravel	Shallow	Yes	No	1965	flows north to south
BG51A	Unnamed	BG	259874	579555	0.02	1	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1964	culverted under track, flows north to south
GT55	Unnamed	GT	260316	579865	0.03	ephemeral runoff ~2.5m wide	OHL	-	No	Yes	Sand/Silt	Shallow	Yes	No	1094	ephemeral WC
GT56	Craigshinnie Burn	GT	260346	579542	5.99	14	OHL	-	No	Yes	Gravel	Shallow	No	No	1093 & 247	-
GT57A	Unnamed	GT	260363	579365	0.43	1.5	OHL	-	No	Yes	Vegetation	Shallow	No	No	1092	culverted under road to the north
GT57B	Unnamed	GT	260366	579328	0.43	1.5	OHL	-	No	Yes	Vegetation	Shallow	No	No	1092	culverted under road to the north
GT57C	Unnamed	GT	260368	579308	0.43	1.5	OHL	-	No	Yes	Vegetation	Shallow	No	No	1092	culverted under road to the north
GT59A	Unnamed	GT	260470	578983	0.1	1	OHL	-	No	Yes	Vegetation	Shallow	No	No	1086	WC close to road
GT60A	Unnamed	GT	260546	578873	0.004	1	OHL	-	No	Yes	Sand/Silt	Shallow	Yes	No	1085	-
GT60E	Unnamed	GT	260620	578767	0.004	1	OHL	-	No	No	Vegetation	Shallow	Yes	No	1084	farmer has dredged channel
GT60F	Unnamed	GT	260635	578746	0.004	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1083	culvert blocked on road
GT61A	Unnamed	GT	260679	578684	0.04	1	OHL	-	No	Yes	Vegetation	Shallow	No	No	1083	culvert blocked on road
GT63A	Unnamed	GT	260740	578591	0.01	1	OHL	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1082	
GT63B	Unnamed	GT	260748	578578	0.04	1	OHL	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1082	

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GT64A	Unnamed	GT	260984	578157	0.003	0.5	OHL	-	No	Yes	Sand/Silt	-	Yes	No	1100	fast flow
GT67	Knocknairling Burn	GT	261471	577400	8.4	8	OHL	-	No	Yes	Gravel	Shallow	No	No	1108	Knocknairling Burn
GT69A	Unnamed	GT	260931	576323	0.02	1.5	OHL	-	No	Yes	Vegetation	Flat	Yes	No	1111	flows stagnant north to west
GT72A	Pultarson Burn	GT	261206	575577	0.98	2	OHL	-	No	Yes	Gravel	Steep	No	No	1119	river 2m, bog 15m width, it flows east next to gravel pit
GT76A	Unnamed	GT	261311	574594	0.01	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1125	this river does not appear on the map; flows north to south
GT76B	Unnamed	GT	261312	574587	0.01	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1125	this river does not appear on the map; flows north to south
GT77A	Unnamed	GT	261326	574453	0.01	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1125	this river does not appear on the map; flows north to south
GT81	Unnamed	GT	261415	573627	0.47	2	OHL	-	No	Yes	Gravel	Steep	Yes	No	1132	-
GT83	Unnamed	GT	261488	573471	0.02	2	OHL	-	No	Yes	Sand/Silt	Steep	Yes	No	1136	flows north east to south-west
GT84A	Mid Burn	GT	261779	573237	0.79	3	OHL	-	No	Yes	Gravel	Steep	No	No	1140	Waterfall, follows route on OS map
GT85A	Unnamed	GT	262140	572932	0.05	2.5	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1164	ditch along road then flows under road and west, deforestation uphill
GT86A	Unnamed	GT	262199	572841	0.03	2	OHL	-	No	Yes	Boulders	Shallow	Yes	No	1163	ditch along road from north to south - drains under road and flows south-west
GT88	Unnamed	GT	262436	572477	0.03	2	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1162	drains forest to north-east via ditch, drains south-west
GT90A	Acre Burn	GT	262796	572143	0.24	2	OHL	-	No	Yes	Mixed Sediment	Steep	No	No	1161	deforestation upstream, flows south-west
GT90B	Acre Burn	GT	262861	572101	0.24	2	OHL	-	No	Yes	Mixed Sediment	Steep	No	No	1161	deforestation upstream, flows south-west
GT91A	Unnamed	GT	263212	571878	0.01	2	OHL	-	No	Yes	Boulders	Steep	Yes	No	1160	-
GT92A	Acre Burn	GT	263253	571853	0.58	2	OHL	-	No	Yes	Boulders	Steep	No	No	1160	-
GT93A	Unnamed	GT	263287	571831	0.07	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1159	culverted under road
GT94A	Unnamed	GT	263481	571708	0.04	2	OHL	-	No	Yes	Boulders	Steep	Yes	No	1158	flows south-west, culverted
GT95A	Unnamed	GT	263537	571672	0.05	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1157	stagnant flow
GT97A	Unnamed	GT	263676	571584	0.03	1.5	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1156	flows south-west, some foam, culverted under road
GT98A	Unnamed	GT	263774	571522	0.05	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1155	flows south-west
GT99A	Unnamed	GT	264030	571360	0.03	1.5	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1154	flows south-east
GT100A	Unnamed	GT	264317	571173	0.01	1.5	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1154	flows south-east

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GT101A	Clachrum Burn	GT	264441	571066	1.47	2.5	OHL	-	No	Yes	Vegetation	Flat	No	No	1153	flows north-east
GT102A	Unnamed	GT	264570	570956	1.47	2	OHL	-	No	Yes	Mixed Sediment	Shallow	No	No	1149	follows route on OS map
GT105A	Unnamed	GT	264690	570852	0.01	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	252	ditch from north to south along road
GT106A	Unnamed	GT	264851	570714	0.01	7m wide bog	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1168	boggy area surrounding the river
GT108	River Dee (Black Water)	GT	264994	569523	190.7	60	OHL	-	Yes	Yes	Gravel	Shallow	No	No	1058	-
GT110	Unnamed	GT	264497	569216	0.01	0.5	OHL	-	Yes	No	Vegetation	Shallow	Yes	No	2201	-
GT111A	Unnamed	GT	264415	568067	0.05	1	OHL	-	No	Yes	Vegetation	Shallow	No	No	1981	burn with bog running in road
GT112B	Unnamed	GT	264503	567772	0.15	1.5	OHL	-	No	Yes	Vegetation	Shallow	No	No	1982	burn with bog running in road
GT113A	Slogarie Burn	GT	264673	567241	0.82	50m wide bog	OHL	-	No	Yes	Sand/Silt	Shallow	No	No	No photo	50m wide bog by 20m long or more
GT115A	Unnamed	GT	264929	566604	0.06	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1190	-
GT118A	Unnamed	GT	265149	565899	0.08	0.5	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1185	-
GT119A	Kenick Burn	GT	265742	565160	5.1	4	OHL	-	No	Yes	Gravel	Steep	No	No	1173	pictures taken on the footbridge downstream
GT120A	Unnamed	GT	265920	564887	0.03	0.5	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1196	flows east
GT121A	Unnamed	GT	266018	564737	0.02	1.5	OHL	-	Yes	Yes	Vegetation	Shallow	Yes	No	1198	-
GT126A	Unnamed	GT	266624	563807	0.07	1.5	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1205	culverted under road upstream
GT126B	Gatehouse Burn	GT	266611	563826	0.83	7	OHL	-	No	Yes	Boulders	Steep	No	No	1208	-
GT129A	Camelon Lane	GT	267706	563296	0.32	1.5	OHL	-	No	Yes	Vegetation	Shallow	No	No	1214	-
GT131A	Unnamed	GT	268529	562287	0.44	5m wide bog	OHL	-	No	Yes	Vegetation	Flat	No	No	2006	WC is not maintained, full of water, bog on either side
GT132A	Barstonbrick Burn	GT	268817	561914	0.73	3	OHL	-	No	Yes	Vegetation	Shallow	No	No	2014	WC from loch. follows route on OS map
GT133	Unnamed	GT	269016	561659	0.003	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	No photo	flows north to south
GT134A	Unnamed	GT	269373	561412	0.01	1	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	2023	WC flows west to east into forest land. potential source of wetness in forestry land
GT135A	Unnamed	GT	269931	560916	0.03	1	OHL	-	No	Yes	Vegetation	Flat	Yes	No	1224	could not directly access; width estimated from nearby
GT136A	Unnamed	GT	269968	560873	0.03	1	OHL	-	No	Yes	Vegetation	Flat	Yes	No	1224	could not directly access; width estimated from nearby
GT137A	Unnamed	GT	270095	560726	0.12	1.5	OHL	-	No	Yes	Mixed Sediment	Steep	Yes	No	1222	Estimated, we cannot see the WC due to it being partially culverted and covered with vegetation

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GT143	Unnamed	GT	270579	559739	0.1	1.5	OHL	-	-	No	-	-	Yes	No	No photo at location ; photo 1219 is ~700m downstream	Watercourse enters a culvert just downstream of OHL crossing.
GT148A	Unnamed	GT	270255	558360	0.4	1	OHL	-	Yes	Yes	Vegetation	Shallow	Yes	No	1232	WC flows to north (but it is very dry) - Likely culverted
GT148B	Unnamed	GT	270263	558407	0.4	1	OHL	-	Yes	Yes	Vegetation	Shallow	Yes	No	1232	WC flows to north (but it is very dry) - Likely culverted
GT148C	Unnamed	GT	270274	558465	0.4	2	OHL	-	Yes	Yes	Mixed Sediment	Shallow	Yes	No	1217	WC flows north to south, has been straightened, it is culverted under A75 or possibly to south-west to another culvert
GT150	Unnamed	GT	270181	558188	0.4	1	OHL	-	No	Yes	Mixed Sediment	Shallow	No	No	1246	dry at this point and flows north
GT152A	Unnamed	GT	269978	557380	0.06	1	OHL	-	No	Yes	Mixed Sediment	Shallow	Yes	No	1246	dry at this point and flows north
GT153A	Unnamed	GT	269865	556697	0.03	1.5	OHL	-	No	Yes	Gravel	Shallow	Yes	No	1244	flows south-east towards farm
GT155	Unnamed	GT	269494	553979	0.09	1.5	OHL	-	No	Yes	Gravel	Shallow	No	No	1239	Possibly culverted US
GT156A	Unnamed	GT	269514	553872	0.01	0.5	OHL	-	No	Yes	Vegetation	Shallow	Yes	No	1238	US and DS watercourse - culverted route hard to ascertain

Photographs of selected watercourse crossings

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<td>Crossing PG0 - Polquhanity Burn
(Existing Access Track)</td>
<td>PG1 – Unnamed
(New Access Track)</td>
<td>PG4 - Polmaddy Burn
(OHL Crossing) (Photo from footbridge 200m upstream of crossing)</td>
<td>PG5A & 5B – Unnamed
(New Access Track and OHL Crossing)</td>
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<td>PG8 & PG10 - Water of Deugh and Water of Ken.
(Two OHL Crossings) Photo taken from footbridge on Water of Deugh upstream of OHL crossing location. Water of Ken confluence immediately downstream.</td>
<td>PG13A, 13B & 13C
(New Access Track and two OHL Crossings)</td>
<td>PG16A, 16B & 16C
(New Access Track and two OHL Crossings)</td>
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PG21A, 21B & 21C – Unnamed **(New Access Track and two OHL Crossings)**	**PG24 – Unnamed** **(New Access Track)**	**PG26A & 26B - (Polharrow Burn)** **(Existing Access Track and OHL Crossing)**	**PG29 – Unnamed** **(New Access Track)**
			
PG32 – Glen Strand **(OHL Crossing)**	**PG38A & PG38B – Unnamed** **(New Access Track and OHL Crossing)**	**EG1 – Unnamed** **(Underground Cable Crossing)**	

		
BG50A, B & C – Unnamed **(New Access Tracks and OHL Crossing)**	**BG52 – Craigshinnie Burn** **(New Access Tracks and OHL Crossing)**	**GT57A, B & C & GT58 – Unnamed** **((New Access Track and three OHL Crossings)**
		
GT60D & E – Unnamed **(New Access Track and OHL Crossing)**	**GT67X - Knocknairling Burn** **(New Access Track)**	**GT71 – Unnamed** **(Existing Access)**

			
GT73 – Unnamed **(Existing Access)**	**GT80 and GT81 - Unnamed** **(Existing Access and OHL Crossing)**	**GT84 A & B – Mid Burn** **(New Access Track and OHL Crossing)**	**GT88 and 89- Unnamed** **(Existing Access and OHL Crossing)**
			
GT94A & B – Unnamed **(Existing Access and OHL Crossing)**	**GT100B & GT101A - Clachrum Burn** **(Existing Access and OHL Crossing)**	**GT108 – Black Water of Dee** **(OHL Crossing)**	

		
GT115A, B & C – Unnamed **(New Access, Timber Extraction Spur and OHL Crossing)**	**GT119X - Kenick Burn** **(Existing Access)**	**GT121A & B – Unnamed** **(New Access Track and OHL Crossing)**
		
GT122 & GT123 – Unnamed **(New Access and Existing Access)**	**GT128A - Gatehouse Burn** **(Existing Access)**	**GT130 – Unnamed** **(New Access)**

		
GT132A & B - Barstobrick Burn **(New Access Track and OHL Crossing)**	**GT135A & B & GT136A & B & GT138 – Unnamed** **(New Access Tracks and OHL Crossings)**	**GT134A & B – Unnamed** **(New Access Track and OHL Crossing)**
		
GT143 – Unnamed **(OHL Crossing)**	**GT148A & B & GT149 – Unnamed** **(New Access and two OHL Crossings)**	**GT151 – Unnamed** **(Existing Access)**