
Environmental Impact Assessment Report
Volume 4: Outline Operational Drainage Management Strategy

# MarramWind Offshore Wind Farm

December 2025

MarramWind

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# Contents

# 1. Introduction

## 1.1 Overview

1.1.1.1 This Outline Operational Drainage Management Strategy has been produced along with the Environmental Impact Assessment (EIA) Report and aims to ensure the future design and implementation of the drainage network for the onshore substations aligns with current guidance and best practice. This strategy should be read alongside the EIA Report, and is of particular relevance to **Volume 1, Chapter 20: Water Resources and Flood Risk**.

## 1.2 Project background

1.2.1.1 MarramWind Offshore Wind Farm (hereafter referred to as 'the Project') is wholly owned by ScottishPower Renewables UK Limited (SPR). MarramWind Limited, a subsidiary of SPR, is the Applicant for the Project.

1.2.1.2 The Project is a proposed floating wind farm located in the North Sea, with a grid connection capacity of up to 3 gigawatts (GW). The location of the Project is determined by the Option Area Agreement, which is the spatial boundary of the Northeast 7 (NE7) Plan Option within which the electricity generating infrastructure will be located. The NE7 Plan Option is located north-east of Rattray Head on the Aberdeenshire coast in north-east Scotland, approximately 75 kilometres (km) at its nearest point to shore and 110km at its furthest point. An Option to Lease Agreement for the Project within the NE7 Plan Option was signed in April 2022.

1.2.1.3 In March 2024, NESO published the 'Beyond 2030' report, which presented the ScotWind elements of the Holistic Network Design Follow Up Exercise. This report confirmed that the full 3GW connection for the Project will be connected to the Scottish and Southern Electricity Networks (SSEN) Netherton Hub at Longside, near Peterhead. This update informed further refinement of the Project design envelope following the EIA Scoping Stage in January 2023 (see **Volume 1, Chapter 3: Site Selection and Consideration of Alternatives** for further details).

1.2.1.4 The Project's offshore infrastructure, located seaward of Mean High Water Springs (MHWS), includes the following:

- wind turbine generators, including floating units (platforms and station keeping system);
- array cables;
- subsea distribution centres;
- subsea substations;
- offshore substations;
- reactive compensation platform(s) (if required); and
- offshore export cables to connect the offshore infrastructure to the landfall(s).

1.2.1.5 The Project's onshore infrastructure, located landward of mean low water springs (MLWS) includes:

- landfall(s) - the infrastructure associated with landfall located above MLWS;
- underground onshore export cables running from the landfall(s) to the onshore substations;

- onshore substations, co-located on one site;
- underground grid connection cables (connecting the onshore substations to the grid connection point at SSEN Netherton Hub); and
- tie-in to grid connection point (SSEN substation at the Netherton Hub, which is a separate project and does not form part of the consenting applications which this EIA relates to); and
- associated temporary construction areas, including for example temporary construction compounds, access tracks and haul roads.

1.2.1.6 The EIA Report accompanies applications for offshore consents, licences and permissions for the Project to Marine Directorate - Licensing Operations Team (MD-LOT) under Section 36 (s.36) of the Electricity Act 1989, the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009, for the offshore infrastructure seaward of MHWS.

1.2.1.7 The EIA Report also accompanies an application to Aberdeenshire Council for planning permission in principle consent under The Town and Country Planning (Scotland) Act 1997, for the onshore infrastructure landward MLWS.

1.2.1.8 There are four sets of EIA regulations applicable to the Project: the Electricity Works (EIA) (Scotland) Regulations 2017 for offshore generating stations requiring s.36 consent; the Marine Works (EIA) (Scotland) Regulations 2017 and the Marine Works (EIA) Regulations 2007 for marine licence applications within Scottish territorial waters (0-12 nautical miles) and offshore waters (12-200 nautical miles) respectively; and the Town and Country Planning (EIA) (Scotland) Regulations 2017 for planning applications submitted to Aberdeenshire Council for onshore infrastructure located landward of MLWS.

## 1.3 Purpose of the Outline Operational Drainage Management Strategy

1.3.1.1 The Outline Operational Drainage Management Strategy identifies the proposed operational drainage strategy in relation to the onshore substations for both surface water and foul water and the assessment of increased surface water run-off in accordance with sustainable drainage principles.

1.3.1.2 The Outline Operational Drainage Management Strategy includes:

- **Figure 1** - Topography and resulting catchments, which shows how the local topography effects the resultant catchments, and therefore how it influences the Outline Operational Drainage Management Strategy.
- **Figure 2** - SEPA flood map, which shows the SEPA online flood information for the area. This figure is used to justify certain design decisions that are explained further in **Section 2.5** of this document.
- **Figure 3** - Proposed pond layout, which shows an indicative Sustainable Drainage System (SuDS) Plan for the onshore substations during the operational stage.

1.3.1.3 To satisfy the requirements of current best national / local flood risk and surface water management guidance, SuDS are required to be incorporated into the design proposals to manage, attenuate and treat surface water runoff before discharging from the onshore substation site. This plan will describe the basis of the SuDS for the project.

1.3.1.4 The Outline Operational Drainage Management Strategy will form the basis of the final Outline Operational Drainage Management Strategy. The final Outline Operational Drainage Management Strategy will be finalised and approved post-consent and approved by Aberdeenshire Council as part of condition discharge.

1.3.1.5 The broad objectives of the Outline Operational Drainage Management Strategy are as follows:

- to provide basic principles of design regarding the drainage network specific to the Project's onshore substations. Although the onshore substations will be constructed in phases, the drainage design will be designed and implemented to cover the entirety of the final onshore substation site layout);
- to produce an outline design plan showing the proposed arrangement of the drainage network and required SuDS;
- to provide an overview of potential solutions, explained in hierarchies, for assets and methods in the proposed drainage network; and
- to provide a basis for the implementation of detailed design and eventual implementation.

1.3.1.6 The detailed Outline Operational Drainage Management Strategy shall state the legislative requirements, current standards of practice and best practice measures that define the standard of construction practice adhered to by the Contractors. However, adhering to the detailed Operational Drainage Management Strategy does not absolve the Applicant, Contractors or Subcontractors from complying with legislation and bylaws relevant to their construction activities.

1.3.1.7 The final iteration of the Drainage Management Strategy shall be produced by the approved Principal Contractor post-consent. The Principal Contractor shall use this document to inform the development of the final Operational Drainage Management Strategy following confirmation of the detailed design.

## 1.4 Relevant legislative and policy context and technical guidance

1.4.1.1 This Section identifies the relevant legislation and policy context that has informed the scope of the Outline Operational Drainage Management Strategy. Further information on policies is set out in **Volume 1, Chapter 2: Legislative and Policy Context**, which provides an overview of the relevant legislative and policy context for the Project. **Volume 1, Chapter 2: Legislative and Policy Context** is supported by **Volume 3, Appendix 2.1: Planning Policy Framework**, which provides a detailed summary of international, national, marine and local planning policies of relevance.

1.4.1.2 In order to recognise the legislative and policy basis for this Chapter, **Section 1.4** presents a summary of legislation and policies relevant for the Outline Operational Drainage Management Strategy. This summary provides a foundation for understanding the specific requirements that this Chapter must address in terms of developing an outline design for the drainage management for the onshore substation site.

1.4.1.3 The legislation, policy, and guidance relevant to SuDS, drainage, and surface water management include the following:

### Legislation

- The Water Environment (Controlled Activities) (Scotland) Regulations (2011) (Scottish Government, 2011).

### Policy

- Aberdeenshire Local Development Plan (Aberdeenshire Council, 2023); and
- National Planning Framework 4 (Scottish Government, 2023);

### Relevant Technical Guidance

- Planning Advice Note 61: Sustainable urban drainage systems (Scottish Government, 2001);
- Planning Advice Note 79: water and drainage (Scottish Government, 2006);
- Surface water management planning: guidance (Scottish Government, 2018);
- SuDS Regulatory Method (WAT-RM-08) document (SEPA, 2019);
- Water Assessment and Drainage Assessment Guide (SEPA, 2025);
- Technical Flood Risk Guidance for Stakeholders (SEPA, 2022); and
- SuDS Manual (Woods-Ballard et al., 2015).

1.4.1.4 The final iteration of the Outline Operational Drainage Management Strategy during detailed design shall also be developed using the above legislation, policy and guidance.

## 1.5 Implementation of the Outline Operational Drainage Management Strategy

1.5.1.1 The detailed Operational Drainage Management Strategy approved by Aberdeenshire Council will be incorporated into the contracts for Principal Contractors responsible for the works. All parties involved, including Principal Contractors, Subcontractors and their suppliers, must comply with the relevant provisions of the detailed Operational Drainage Management Strategy. They are obligated to provide documentation outlining how they will guarantee both the implementation and monitoring of the Operational Drainage Management Strategy requirements.

# 2. Outline Operational Drainage Management Strategy

## 2.1 Site description

2.1.1.1 The Project's onshore substations are located approximately 2 kilometres (km) west of Peterhead, Aberdeenshire, on the southern side of the A950. Approximately 58.4 hectares (ha) of land will be required to construct three onshore substations co-located at the onshore substation site, access roads, connecting export cables, any associated drainage and attenuation ponds, and landscaping.

2.1.1.2 The existing land-use across the onshore substation site is predominantly open pasture, though several rows of trees border the wider site boundaries.

2.1.1.3 There is a small watercourse running along the western border of the site. This watercourse is unnamed according to the Scottish Government River Classifications Map (Scottish Government, 2025), but is an apparent tributary of the River Ugie, as shown by the same online maps. This watercourse will henceforth be referred to as 'Unnamed Watercourse'.

2.1.1.4 The total impermeable area of the onshore substation site is up to 15.4ha (up to 15ha for the three onshore substations and up to 0.42ha for the permanent access roads).

## 2.2 Design parameters

2.2.1.1 The need for sustainable surface water management is set out in the SuDS Regulatory Method (WAT-RM-08) document (SEPA, 2019), the Water Assessment and Drainage Assessment Guide (SEPA, 2025), and the Technical Flood Risk Guidance for Stakeholders (SEPA, 2022). Best practice guidance is provided in the Chartered Industry Research and Information Association (CIRIA) SuDS Manual (Woods-Ballard et al., 2015).

2.2.1.2 The Design Return Period for the Project's drainage design will be for a 200-year flood including a Climate Change Allowance, as set out in the above design guidance and Scottish Environment Protection Agency (SEPA) Technical Flood Risk Guidance for Stakeholders (SEPA, 2022). For the Climate Change Allowance refer to **Section 2.4**.

## 2.3 Site topography and overland flow routes

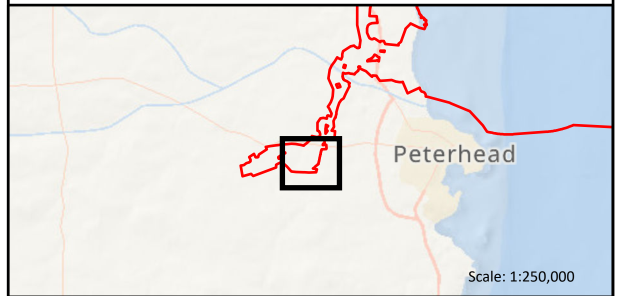
2.3.1.1 The topography of the onshore substation site consists of a crest running north-south, which acts to split any overland flows into two catchments. It also generally falls from south to north, from approximately 58 metres above ordnance datum (mAOD) down to approximately 42m AOD. LiDAR has been used to map the topography for the site, with the resulting catchments shown in **Figure 1 Topography and resulting catchments**.

2.3.1.2 The SEPA online Flood Maps (SEPA, 2025) service also shows that the site is split into two catchments and shows the overland flow routes which are discussed in the following Section. The SEPA Flood Map for the area is shown in **Figure 2 SEPA flood map.**


| Proposed Development | Contributing Area within the Western Catchment (Ha) | Contributing Area within the Eastern Catchment (Ha) |
|---|---|---|
| Substation 1 | 4.41 | 0.93 |
| Substation 2 | / | 2.71 |
| Substation 3 | 0.60 | 6.29 |
| Roads | / | 0.46 |
| **Total Proposed Development** | **5.01** | **10.66** |
| Pre-development Catchment | 23.57 | 31.94 |

Red Line Boundary
Existing Overland Flow Routes
Contour (5m interval)
Pre-development Catchment – East
Pre-development Catchment – West
Proposed Substation – East Catchment
Proposed Substation - West Catchment
Indicative permanent access road

0 250 Meters

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| 2 | 10/09/2025 | SS | LT | MW | NC |
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Figure 1 Topography and resulting catchments

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**Volume 4: Outline Operational Drainage Management Strategy**



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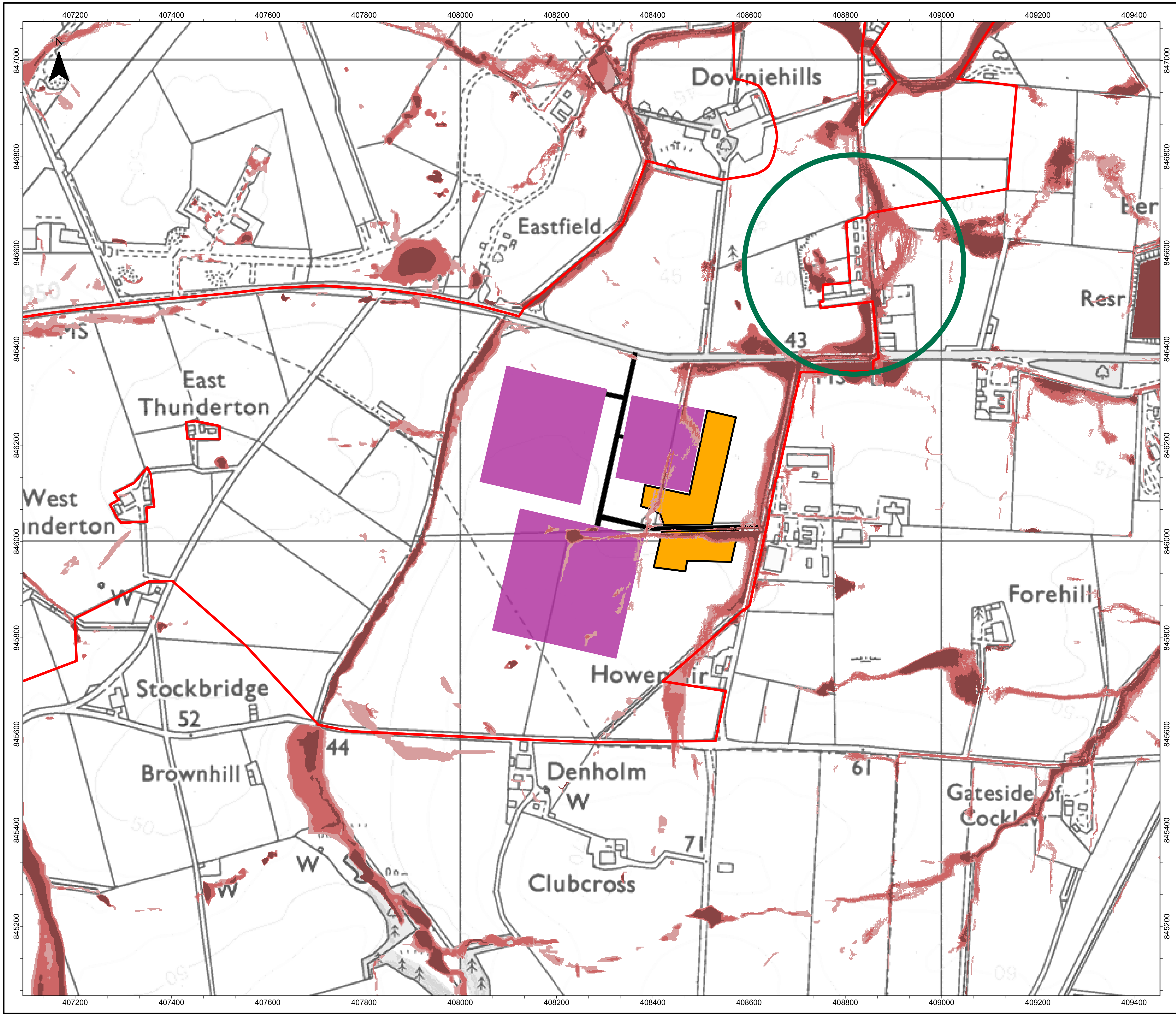


- Red Line Boundary
- Indicative temporary construction compound
- Indicative permanent access road
- Indicative permanent substation footprint
- High - Each year this area has a 10% chance of flooding.
- Medium - Each year this area has a 0.5% chance of flooding.
- Low - Each year this area has a 0.1% chance of flooding.
- Flood risk to properties along Tortorston Road

0 100 200 300 400 Metres

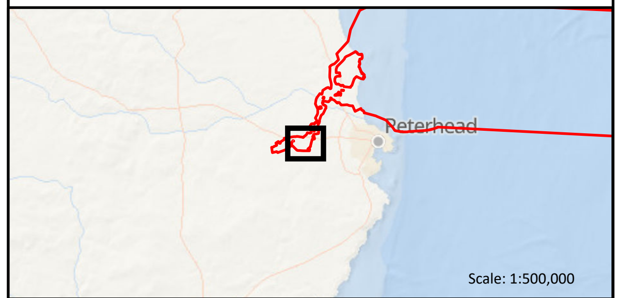


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Figure 2 SEPA flood map

**Environmental Impact Assessment Report**

**Volume 4 Outline Operational Drainage Management Strategy**



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2.3.1.3 The western catchment falls towards the Unnamed Watercourse, which then flows under A950 through a culvert before flowing north and eventually entering the River Ugie. The eastern catchment falls toward the eastern edge of the site and then flows north before pooling near the A950. It then flows under the road, with the Flood Maps showing that there is a flood risk, possibly exacerbated by these overland flows, to properties located within the Blackhills area (green circle in **Figure 2**) along Tortorston Road.

## 2.4 Climate change allowances

2.4.1.1 The Climate Change Allowance for the location of the onshore substations has been identified as 37%. This has been taken from the SEPA 'Climate Change Allowances for Flood Risk Assessment (FRA) in Land Use Planning' webmap.

## 2.5 Allowable discharge rates and required storage volumes

2.5.1.1 Greenfield Runoff has been calculated using the UK SuDS online tool (HR Wallingford, 2023). This gives an Allowable Discharge Rate of 69.06 Liters per Second (l/s) for the 1 in 1 year event.

2.5.1.2 However, SEPA guidance (Water Assessment and Drainage Assessment Guide) states that the maximum Allowable Discharge Rate should be 2 l/s/ha. The total impermeable area of the site is 15.4ha. Therefore, the Allowable Discharge Rate for the site has been calculated as 30.8l/s. As explained is **Section 2.3** the site is split into two catchments. Due to the split of these catchments the Allowable Discharge Rate for the eastern (10.5ha) and western catchments have been calculated as 20.9l/s and 9.9l/s respectively. Due to the pooling on the eastern edge of the onshore substation site, and flood risk to both the A950 and the Blackhills area from the eastern catchment, discussed in **Section 2.3**, it is proposed that the overland flows from impermeable areas in the eastern catchment are diverted to the Unnamed Watercourse and discharged via the same route as the western catchment, therefore reducing flows and flood risk to the A950 and the Blackhills area. This will increase flows into the watercourse by 20.94l/s (the Allowable Discharge Rate for the eastern catchment).

2.5.1.3 Although flows will be increased through this Section of the Unnamed Watercourse, the flood risk downstream and issues surrounding capacity within both the watercourse and the culverted section of the Unnamed Watercourse under the A950 are likely to be negligible. No detailed flood risk analysis or flow capacity checks have been completed at this stage. However, due to several high-level conservative assumptions and design decisions, it is considered that the design will account for the increased flows. The assumptions and design decisions leading to a safe and conservative design have been outlined below:

- the Allowable Discharge Rate from the site has been shown to be less than half of the Greenfield Runoff Rate for a 1 in 1-year storm event, which is a relatively small flood event. The Allowable Discharge Rate being set at this flow rate will greatly reduce the flood risk downstream;
- the attenuation ponds have been sized for a 1 in 200-year plus Climate Change Allowance storm event. This will mean that during this storm event the ponds will not flood, and still only be discharging at half the 1 in 1-year storm event as explained in the previous point;
- the upper limit of the potential required pond sizes has been used to provide an extra degree of safety to the design. This may be reduced at detailed design once the

drainage network has been modelled, and the confirmed required storage volume is known;

- a low estimate for pond depth has been assumed. This could be deepened at detailed design to provide additional storage capacity; and
- the Unnamed Watercourse is likely to have a small catchment, as evidenced by the SEPA Flood Maps shown in **Figure 2**. This map shows that the watercourse does not extend much further south than the onshore substation site and therefore the catchment is likely to only contain those areas. This means that the flows through the watercourse are likely to be small, and therefore any increase in flows can be accommodated within the watercourse cross section.

2.5.1.4 It is also shown in the SEPA Flood Maps in **Figure 2**Figure 2 that the flows from the eastern catchment likely join the Unnamed Watercourse further downstream, and therefore the overall fluvial catchments would remain unchanged. This change to catchment flow paths would have to be agreed with SEPA (to agree to impacts on catchment behaviour), Aberdeenshire Council (to agree to increased risk to the A950 culvert), and the watercourse owner (assumed at this stage to be local landowners) as part of the production of the detailed Operational Drainage Management Strategy required to be produced to discharge associated planning conditions.

2.5.1.5 An FRA for the site has been undertaken, refer to **Volume 3, Appendix 20.2: Flood Risk Assessment**. A detailed analysis of the increase of flows into the Unnamed Watercourse will have to be undertaken once detailed design is undertaken and the flow within the watercourse is known, to ensure that the watercourse and downstream assets have adequate capacity (for example the culvert under the A950 downstream of the discharge location). If they are found to not have sufficient capacity, it may be necessary to reduce the Allowable Discharge Rate and increase the attenuation storage volume in the ponds. However, due to there being no record of flooding from the Unnamed Watercourse or on the A950 in this area, it is likely that there is sufficient capacity for increased flows.

2.5.1.6 The Microdrainage Quick Storage Estimate tool has been used to estimate the required storage volumes for the impermeable area calculated above. The output from the Microdrainage tool gives a total required attenuation volume of between 16,147 metres cubed ($m^3$) and 21,348$m^3$. For the purposes of determining the required area to provide these volumes, and producing a proposed pond layout for the onshore substation site, it has been assumed that there will be a design depth of storage within the ponds of 1m and the upper estimate of required storage will be taken as a conservative estimate at this stage. Therefore, the required pond area which will be achieved across the onshore substation site is calculated as 2.14ha (rounded up to the nearest 0.01ha). The design storage depth may be increased at the detailed design stage and lead to a reduction in the required plan area for the ponds.

## 2.6 Proposed attenuation storage

2.6.1.1 A high-level assessment of possible attenuation solutions has been made by considering the SuDS hierarchy, presented in the CIRIA SuDS Manual (Woods-Ballard et al., 2015), and a suitable technique chosen in line with the aim to address flood reduction, pollution reduction, and amenity/biodiversity (landscape and wildlife benefit). SuDS are defined as drainage systems designed in a way which mimics natural drainage. SuDS are useful for various reasons, including pollution treatment, access for maintenance, increased capacity compared to traditional piped networks (reducing flooding risk), biodiversity enhancement, and long-term ecological management (by using planting either within the pond or surrounding, providing habitats for aquatic life).

2.6.1.2 Ponds have been selected as an appropriate SuDS solution for the onshore substations, due to their ability to attenuate excess flood volumes, provide a level of treatment to contained storage volumes, and also provide a level of amenity which can be utilised.

2.6.1.3 The proposed pond layout at the onshore substation site consists of three ponds arranged as shown in **Figure 3**. The ponds have been labelled with an identification (ID) number for clarity.

2.6.1.4 **Table 2.1** shows the proposed ponds, their plan area, and their proposed storage volume.

### Table 2.1 Pond ID and volume

| Pond ID | Pond footprint area in plan ($m^2$) | Pond volume (storage capacity) ($m^3$) | Comments |
|---|---|---|---|
| **1** | 4500 | 4500 | 1m depth of attenuation volume (freeboard to be included).<br><br>Primarily intended to attenuate flows from onshore substation 3, although due to the large area of this substation, it is likely that part of the attenuation volume of Pond 2 will also be used. |
| **2** | 15600 | 15600 | 1m depth of attenuation volume (freeboard to be included)<br>.<br>Primarily intended to attenuate flows from most permanent access road areas, as well as onshore substations 1 and 2. |
| **3** | 1800 | 1800 | 1m depth of attenuation volume (freeboard to be included).<br><br>Primarily intended to attenuate flows from the permanent access road connecting the site to the A950. |


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Figure 3 Proposed pond layout

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**Volume 4 Outline Operational Drainage Management Strategy**



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## 2.7 Proposed surface water collection and drainage conveyance network

2.7.1.1 It is unknown at this stage what the construction make-up of the onshore substations will be. Multiple options exist including impermeable bitumen surfacing, or a permeable granular raft foundation layer which covers the entire area of each onshore substation and allows for any structures present to be founded directly in this layer. Each option will require consideration of different methods of surface water collection.

2.7.1.2 In the case of an impermeable surface, the likely surface water collection method for the onshore substations will be to use either swales or filter drains surrounding the footprint of the onshore substations. An analysis will be completed once the onshore substations surface levels are known, to determine surface water runoff rates and to prevent pooling / flooding within the footprint of the onshore substations.

2.7.1.3 In the scenario where the onshore substations use a granular layer, the surface water collection method is likely to be based on the use of filter drains within the onshore substations permeable granular layer / foundation to enable drainage by gravity to a discharge point. The onshore substations granular layer is assumed to be lined and will therefore drain towards the lowest point of the granular layer. The filter drains will be arranged to provide minimum flow paths within the granular layer. Filter drains may be required through the centre of the onshore substations, in addition to around the outside perimeter of the onshore substations. Flows will then be discharged to the ponds via connections to either swales, or using carrier pipes, depending on what topography will allow.

2.7.1.4 The proposed surface water collection method for the access roads is to use swales or filter drains (determined by topography and required excavation to achieve positive flows within the swales) running in parallel to the roads, or within the verges of the roads if verges are present. Flows will then be discharged to the ponds via either swales, or using carrier pipes, depending on what topography will allow.

2.7.1.5 **Table 2.2** shows a surface water collection and conveyance hierarchy which is outlined within the SuDS Regulatory Method (WAT-RM-08) document (SEPA, 2019). The collection and conveyance hierarchy describes the preference order of design solution that should be followed when determining the method of collection and conveyance of surface water flows. also shows the surface water collection and conveyance hierarchy that should be followed when determining the best method of conveying surface water flows between the collection point and the ponds, and then from the ponds to the discharge point. **Table 2.2** includes a high-level rating for each method as justification. The surface water collection and conveyance hierarchy should be followed from most preferred to least preferred, and clear justification should be provided for why a more preferred option is not feasible. Possible site-specific constraints are outlined in **Table 2.2** which may lead to the least preferred options for the surface water drainage network being chosen over the more preferred options.

### Table 2.2 Surface water collection and conveyance hierarchy

| Method of collection and conveyance | Use | Pollution reduction | Amenity / biodiversity | Cost | Possible constraints leading to less preferred option being considered or change in design |
|---|---|---|---|---|---|
| **Swale (most preferred)** | Permanent access roads and conveyance. | Very high. | High | High | The onshore substation site connection point levels are low, requiring excessive swale depth and therefore excavation.<br><br>Topography does not align with direction of flow within the swales, leading to excessive swale depth and therefore excavation.<br><br>Permanent excavation not possible through cable corridors.<br><br>Land usage deemed too high (for example, a 1.5m deep swale with 0.5m wide base and 1 in 3 side slopes would require a bank-to-bank width of 9.5m).<br><br>Clash with existing assets near the A950.<br><br>Not possible within the footprint of the onshore substations. |
| **Filter drain** | Onshore substations granular layer, permanent access roads, and conveyance. | High | None | High | The onshore substation site connection point levels are low, requiring excessive trench depth and therefore filter material.<br><br>Section of filter drains not collecting surface water runoff, may be more efficient to transition to carrier pipe.<br><br>Diameter of the filter drain pipe being excessive and leading to overly wide trench width and increased costs (for example, if due to upstream |

| Method of collection and conveyance | Use | Pollution reduction | Amenity / biodiversity | Cost | Possible constraints leading to less preferred option being considered or change in design |
|---|---|---|---|---|---|
| | | | | | flows a 600 millimetre pipe is required, this would require a trench width of 1.05m).<br><br>Clash with existing assets near the A950. |
| **Gully and carrier pipe (least preferred)** | Permanent access roads and conveyance. | Low | None | Medium | Requirement for kerbs leading to increased cost.<br><br>Clash with existing assets near the A950. |

## 2.8 Foul drainage network method of discharge

2.8.1.1 Foul drainage at the onshore substations would be collected in either of the following ways:

- mains connection discharging to the Scottish Water sewer system, if available; or
- septic tank located within the onshore substation site.

## 2.9 Proposed method of discharge from surface water drainage network

2.9.1.1 For the purposes of this Outline Operational Drainage Management Strategy, it is assumed that the method of discharge will be to an open surface water body (the Unnamed Watercourse). The reasoning behind this assumption is explained in **Table 2.3.** Flows will therefore be discharged from the ponds to the watercourse via either swales, or using carrier pipes, depending on what topography will allow.

2.9.1.2 Disposal of surface water should be considered sequentially using the surface water disposal hierarchy, as set out by the Water Assessment and Drainage Assessment Guide (SEPA, 2025). The hierarchy is included below in **Table 2.3**, ordered from most preferable to least preferable.

**Table 2.3 Surface water disposal hierarchy**

| Method of discharge | Site specific justification |
|---|---|
| **Discharge by infiltration to the ground (most preferred)** | No soil infiltration testing has been undertaken at the onshore substation site to date. Reference to the British Geological Survey (BGS) mapping (BGS, 2023) indicates that the onshore substations are underlain by Hatton Till Formation (clay, sand, and gravel) and underlain by Peterhead Pluton (Granite) bedrock.<br>Given the presence of clay and the lack of sufficient geotechnical information, it has been assumed that infiltration is not feasible for the draining of this site. Soakage testing could be undertaken to demonstrate this, but this would be considered unnecessary if ground investigation undertaken to support the wider detailed design of the onshore substations indicates ground conditions unsuitable for infiltration, clay is expected from the desk-based information available at this stage. |
| **Discharge to an open surface water body** | As previously mentioned, there is an Unnamed Watercourse to the west of the site. This provides the opportunity to discharge any collected surface water to an open surface water body. Therefore, within the hierarchy presented, this is the preferred method of discharge for the surface water drainage network. |
| **Discharge to a surface water sewer** | Given the greenfield location of the onshore substation site, it is unlikely that any public sewers intersect the site and no sewer records were available for the purposes of this study. Discharge to a surface water sewer has not been considered on the basis that an open watercourse is available for discharge. |
| **Discharge to a combined sewer (least preferred)** | Due to an open watercourse being available for discharge of surface water, discharge to a combined sewer would not be appropriate. |

## 2.10 Pollution control and treatment

2.10.1.1 It is anticipated that pollution control measures would serve to limit the pollution potential of the onshore substations, but some degree of pollutants would likely still be collected by the surface water run-off and require capture and / or treatment before discharge.

2.10.1.2 The CIRIA SuDS Manual (Woods-Ballard et al., 2015) provides a methodology for assessing requirements and methods of treatment for surface water runoff. The pollution hazard indices for a substation are not provided in Table 26.2 of the CIRIA SuDS Manual but taking a precautionary approach of assuming a high pollution hazard level, would result in indices of 0.8 (total suspended solids), 0.8 (metals) and 0.9 (hydrocarbons). Industry standard pollution control measures may result in a lower hazard level in practice. The appropriate pollution hazard level for the onshore substations will be considered further at the detailed design stage. A precautionary approach has been taken to demonstrate that the worst-case treatment requirements would be addressed by this Outline Operational Drainage Management Strategy.

2.10.1.3 It is anticipated that the onshore substations granular material could provide a similar level of treatment as a permeable pavement (indices of 0.7, 0.6 and 0.7 respectively). Combined with the filter drains (0.4, 0.4 and 0.4) and / or swale (0.5, 0.6 and 0.6), and finally the ponds (0.7, 0.7, and 0.5) it is anticipated that the proposed SuDS plan would provide sufficient treatment capacity regardless of any proprietary treatment systems, which could be implemented to make up any shortfall if required, or indeed could be required as standard for elements of the onshore substations as part of the pollution control requirements.

2.10.1.4 The result of the Water Quality Management methodology within the CIRIA SuDS Manual (Woods-Ballard et al., 2015) is shown in **Table 2.4** Within this methodology, the total treatment provided to surface water runoff is calculated by using the full score of primary treatment and half the secondary. For example, if the surface water runoff is collected by a swale and then enters a pond, the swale would act as the primary treatment method and the pond would act as the secondary treatment method.

2.10.1.5 **Table 2.4** shows that a combination of the onshore substations granular material with any of the other proposed treatment methods would result in acceptable treatment. For example, the worst-case scenario for the design in terms of pollution treatment, would be for the surface water from the onshore substations being conveyed to the ponds using carrier pipes (which would not provide any pollution treatment). Therefore, the two methods of treatment would be the onshore substations granular material (primary) and the ponds (secondary). This would provide a combined treatment indices for total suspended solids, metals, and hydrocarbons of 1.0, 0.9, and 0.9 respectively. This would satisfy the overall treatment requirements.

**Table 2.4 Pollution treatment indices**

| Treatment method | Total suspended solids | Metals | Hydrocarbons |
|---|---|---|---|
| **Onshore substations granular material** | 0.7 | 0.6 | 0.7 |
| **Filter drain** | 0.4 | 0.4 | 0.4 |
| **Swale** | 0.5 | 0.6 | 0.6 |
| **Pond** | 0.7 | 0.7 | 0.5 |
| **Required treatment** | **0.8** | **0.8** | **0.9** |

## 2.11 Sustainable Drainage Systems maintenance

2.11.1.1 The SuDS system will require maintenance to ensure continued functionality of the SuDS system, in accordance with best practice (for example, the SuDS Manual). The maintenance responsibility will be held by the onshore substations' operator.

## 2.12 Conclusion

2.12.1.1 The Outline Operational Drainage Management Strategy discussed above provides a feasible drainage strategy which could be delivered within the scope of works, meeting the various policy and guidance requirements.

2.12.1.2 The Allowable Discharge Rate from the site has been calculated as 30.8l/s, which is based on SEPA guidance of 2l/s/ha of impermeable area. Implementing the design which limits surface water discharge to this value will ensure that flood risk either on or downstream of the site is not increased.

2.12.1.3 Using the Allowable Discharge Rate and a return period of 200 years (including a Climate Change Allowance), the total attenuation storage estimate for the site has been calculated as 21,400$m^3$. This translates to a required pond area in plan of 21.4ha, using the assumption that the ponds will have a design storage depth of 1m. This design storage depth may be increased at the detailed design stage and lead to a reduction in the required plan area for the ponds.

2.12.1.4 The onshore substation site drainage will consist of filter drains within the granular layer / foundations which will direct flows to the lowest point of the onshore substations, before connecting into the wider drainage network. The wider drainage network for the onshore substation site will consist of swales collecting surface water runoff from the permanent access roads and the filter drain connections from the substations. Filter drains may be required if proposed site topography prevents swales being used.

2.12.1.5 The above solution will provide an adequate level of pollution treatment, as shown using the Water Quality Management methodology within the CIRIA SuDS Manual (Woods-Ballard et al., 2015).

2.12.1.6 Using the above outline design assumptions and current plans for the usage of the onshore substation site, a proposed attenuation pond and surface water drainage layout has been produced. This is included as **Figure 3.**

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# 4. Glossary of Terms and Abbreviations

## 4.1 Abbreviations

| Acronym | Definition |
|---|---|
| **BGS** | British Geological Survey |
| **CIRIA** | Construction Industry Research and Information Association |
| **EIA Report** | Environmental Impact Assessment Report |
| **GW** | Gigawatts |
| **ID** | Identification |
| **l/s** | Litres per Second |
| **mAOD** | metres above ordnance datum |
| **MD-LOT** | Marine Directorate – Licensing Operations Team |
| **MLWS** | Mean Low Water Springs |
| **MHWS** | Mean High Water Springs |
| **NE7** | North East 7 |
| **SEPA** | Scottish Environment Protection Agency |
| **SSEN** | Scottish and Southern Electricity Networks |
| **SuDS** | Sustainable Drainage System |

## 4.2 Glossary of terms

| Term | Definition |
|---|---|
| **Allowable Discharge Rate** | The pre-agreed rate at which collected surface water runoff shall be discharged from the site, often determined by Greenfield Runoff or SEPA guidance. |
| **Climate Change Allowance** | A percentage factor of safety added to drainage design and flood risk calculations to account for the increase in flows over time due to climate change. |
| **Crown Estate Scotland** | The public corporation of the Scottish government that is responsible for the management of land and property in Scotland, as owned by the monarch "*in right of the Crown*". |

| Term | Definition |
|---|---|
| **Design Return Period** | The storm event return period which is to be designed for. For example, a 1 in 100-year storm (1%). |
| **Greenfield Runoff** | The rate at which surface water would leave the determined catchment area in pre-development greenfield conditions. |
| **Microdrainage Quick Storage Estimate** | A storage estimation module of the Microdrainage software, which uses Allowable Discharge Rates and total impermeable areas on the specific site to calculate the required attenuation volume to prevent flooding in a certain Design Return Period. Microdrainage is an industry-standard drainage design and modelling software, widely used for designing surface water and wastewater systems. |
| **Offshore** | Pertaining to the seaward side of the MLWS, and typically in reference to locations some distance from the coast. |
| **Onshore** | Pertaining to the landward side of MLWS. |
| **Principal Contractor** | The contractor appointed by the client to manage and coordinate the construction phase of a project when multiple contractors are involved. |
| **Subcontractor** | A subcontractor is any business which has agreed to carry out construction operations for another business or body which is a contractor or deemed contractor - whether by doing the operations itself, or by having them done by its own subcontractors or employees, or in any other way. |
| **Sustainable Drainage System** | A Sustainable Drainage System is defined as drainage systems designed in a way which mimics natural drainage. |

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