Appendix 8-1

Site Drainage Report

Timahoe North Solar Farm

ESB Generation & Wholesale Markets / Bord na Móna

Site Drainage Report

Document No.: QS-000218-01-R450-009

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Change History of Report

Date	New Revision	Author	Summary of Change
25/10/2018	04	A.Downey	Change to Table 5.2
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1. Introduction

ESB Generation and Wholesale Markets (GWM) and Bord na Móna (BNM) has engaged ESB International to produce a drainage design for a planning application to construct a Solar Farm at Timahoe North. The site is a former BNM peat production bog which remains in the ownership of BNM.

It will consist of a solar photovoltaic array and associated infrastructure, inverters, access roads and parking, site compounds and security fencing, amenity trails and landscaping, peat and spoil storage areas, site drainage and all associated works. The proposed development will also include the construction of a 110 kV substation within the site with a 20MW battery storage compound adjacent this. It is then envisaged to connect from this substation to the Derryiron-Maynooth 110 kV overhead line that traverses the southern section of the Timahoe North site.

It is important that stormwater runoff from development is managed and clearly documented early in the planning process. This provides a framework for actions and measures to achieve the desired outcomes at the planning stage. The development of this drainage report is considered to be the appropriate mechanism to establish the concept designs and management measures for flood mitigation and effective stormwater management.

Historical land use within the site has been peat harvesting. Changing land use from peat to solar can have implications for the quality and quantity of stormwater generated which can affect the local and downstream environments. In addition, the development of the site will require the sustainable use of water resources. The overall aim of the drainage design is to ensure that any potential impacts on the local and downstream environments from land use change, and subsequent development, are minimised.

1.1. Drainage Strategy

The drainage strategy for the site has been developed to meet the following major objectives:

- Develop a stormwater management strategy for the site and downstream environments.
- Incorporate appropriate Sustainable Drainage Systems (SuDS) Best Management Practices (BMP) into the drainage system that addresses erosion and sediment transport within the site.
- Develop a site water conservation strategy.
- Ensure that social, aesthetic and cultural values are recognised and maintained.
- Ensure that the proposed method to manage stormwater across the site and potential impacts on the site and downstream environments is in line with the requirements of Kildare County Council.

2 Pre-Development Environment

2.1 Location

The proposed development site is located in north County Kildare, approximately 6.5km (kilometres) north of the village of Allenwood, 6km east of Carbury and 3km south of Johnstownbridge. The site is accessed from the south via the Derrymahon-Drehid local road L1019, which adjoins the R402 Regional Road to the west of the site. The lands surrounding the site consist of primarily rural, undeveloped land or one off residential properties. A site location plan can be viewed in Figure 2-1.

The entire Timahoe North bog occupies a total area of approximately 807 hectares (ha) with an area of 325 ha delineated as the 'Black Line Area'. This area was previously delineated from the remainder of the site during a process summarised by the 'Timahoe North – Black Line Area Delineation' report (refer to report no. QS-000218-01-R450-101). A workable area of 219 ha was further delineated within the 'Black Line Area' to take account of ecological constraints on the site.

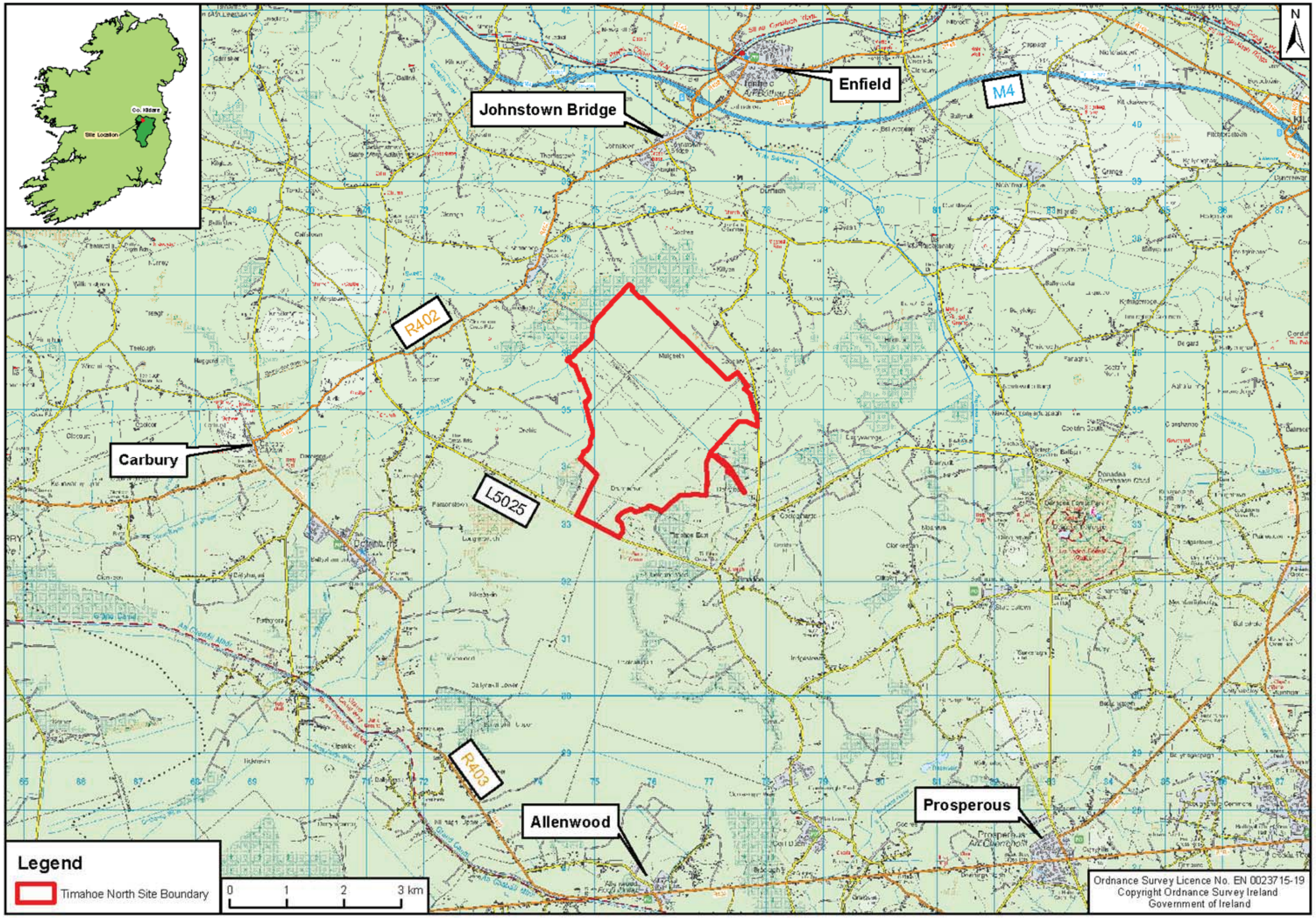

Figure 2-1: Site Location Plan

2.2 Topography

Topography across the site indicates a reasonably flat site with generally gently undulating ground levels which contain multiple hollows and depressions. Levels range from approximately 78 – 85 m OD across the majority of the site with a small area in the southern part of the site where levels approach 89 m OD. The nature of the historical conditions at the site, including peat extraction operations and subsequent rehabilitation, have resulted in generally uneven ground surfaces.

2.3 Climate

Long term climatic averages indicate that the site is located in an area of low to moderate rainfall, receiving a Standard Average Annual Rainfall (SAAR) of 795 mm per annum (Flood Studies Update, OPW, 2017), with the majority of rainfall received between December and February. The region experiences rainfall on average 150 days a year.

2.4 Hydrology

There is a single watercourse, the Mulgeeth, located within the Timahoe North site as illustrated by Figure 2-2 in addition to a number of nearby watercourses located in close proximity to the site boundary.

The entire site is located within the River Boyne catchment. The River Boyne predominantly runs in a south west to north east direction. It joins the River Blackwater in Navan, Co. Meath before discharging to the Irish Sea east of Drogheda along the border of Co. Louth and Co. Meath. The discharge location of the River Boyne is within the Boyne Coast and Estuary Special Area of Conservation (SAC) and the Boyne Estuary Special Protected Area (SPA), designated Natura 2000 sites under the EU Habitat's Directive. This SAC and SPA is located more than 56 km from the Timahoe North site as the crow flies.

Figure 2-3 illustrates an area of the Boyne catchment, within which the Timahoe North site is located. It identifies the Office of Public Works (OPW) Castlerickard gauge downstream of the site, in close proximity to where the catchment meets the River Boyne.

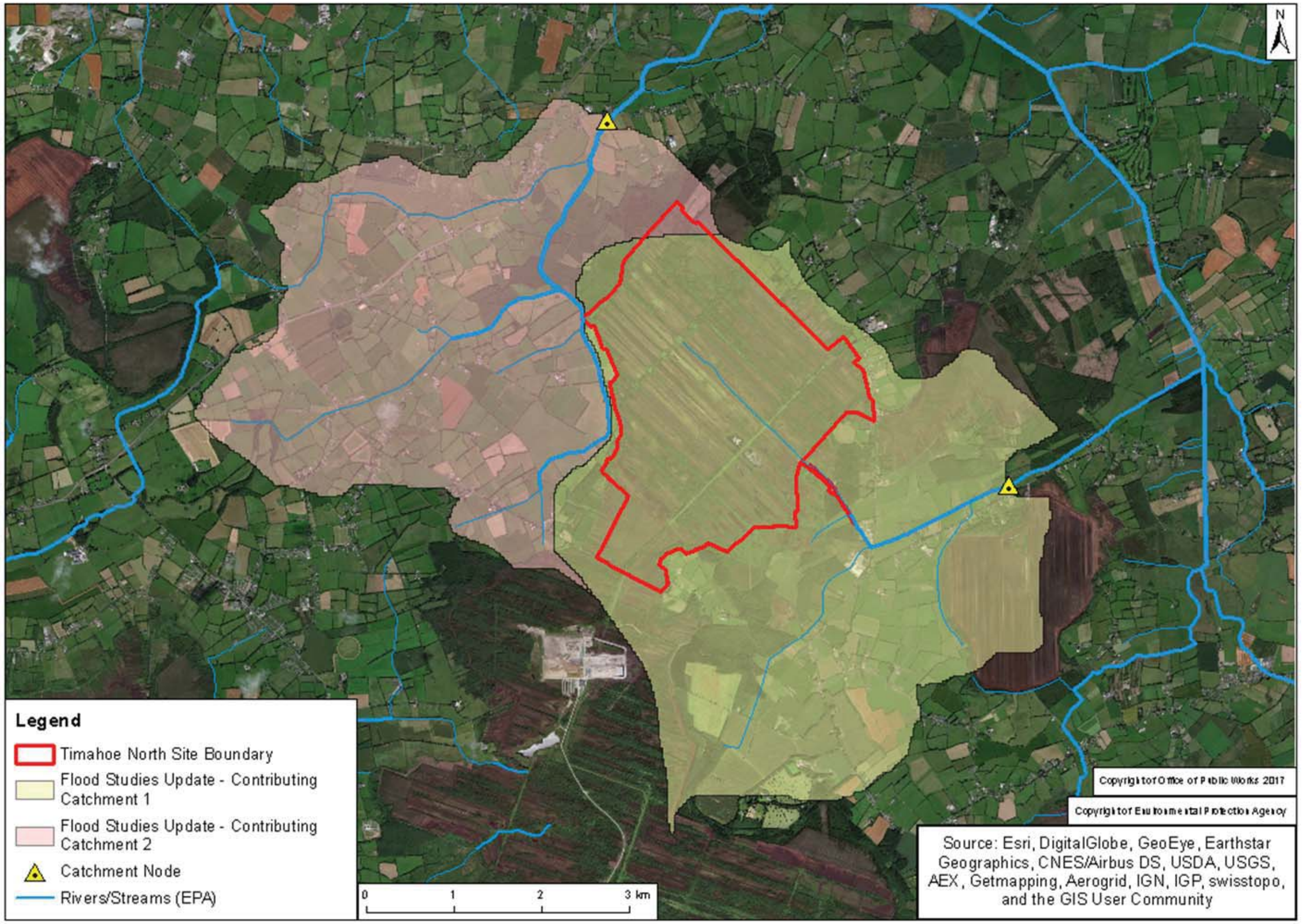

Figure 2-2: Timahoe North Catchments

Figure 2-3: Timahoe North – Contributing catchments and overall downstream catchment

2.4.1 Historical Drainage - 1984

A historical map of the site, made available by BNM, illustrates the on-site drainage management measures which were used during peat extraction operations at Timahoe North. This historical map, from 1984, is illustrated by Figure 2-4 which also highlights the pump and discharge locations shown on the 1984 map. The discharge locations are identified by Table 2-1 in addition to the receiving watercourse.

The historical drainage onsite included the construction of large field ditches which were dug at approximately 250 metre centres. There are 11 longitudinal field ditches inside the site boundary. The ditches mostly flow in a northwest to southeast direction towards the southern railway line. It is presumed that the ditches flowed under the railway line through 300 / 450 mm culverts where they continued flowing southeast towards the southern boundary (discharge location 3 to 8). A small section of the sites ditches and lands, south of the northern railway line, flowed in the opposite direction towards discharge points (discharge location 1 and 2 on Figure 2-4) to the north of the site. Large screw pumps were used to pump waters to discharge points along the boundary drains where invert levels restricted the drains to discharge via gravity flow. The screw pump locations can be viewed in Figure 2-4.

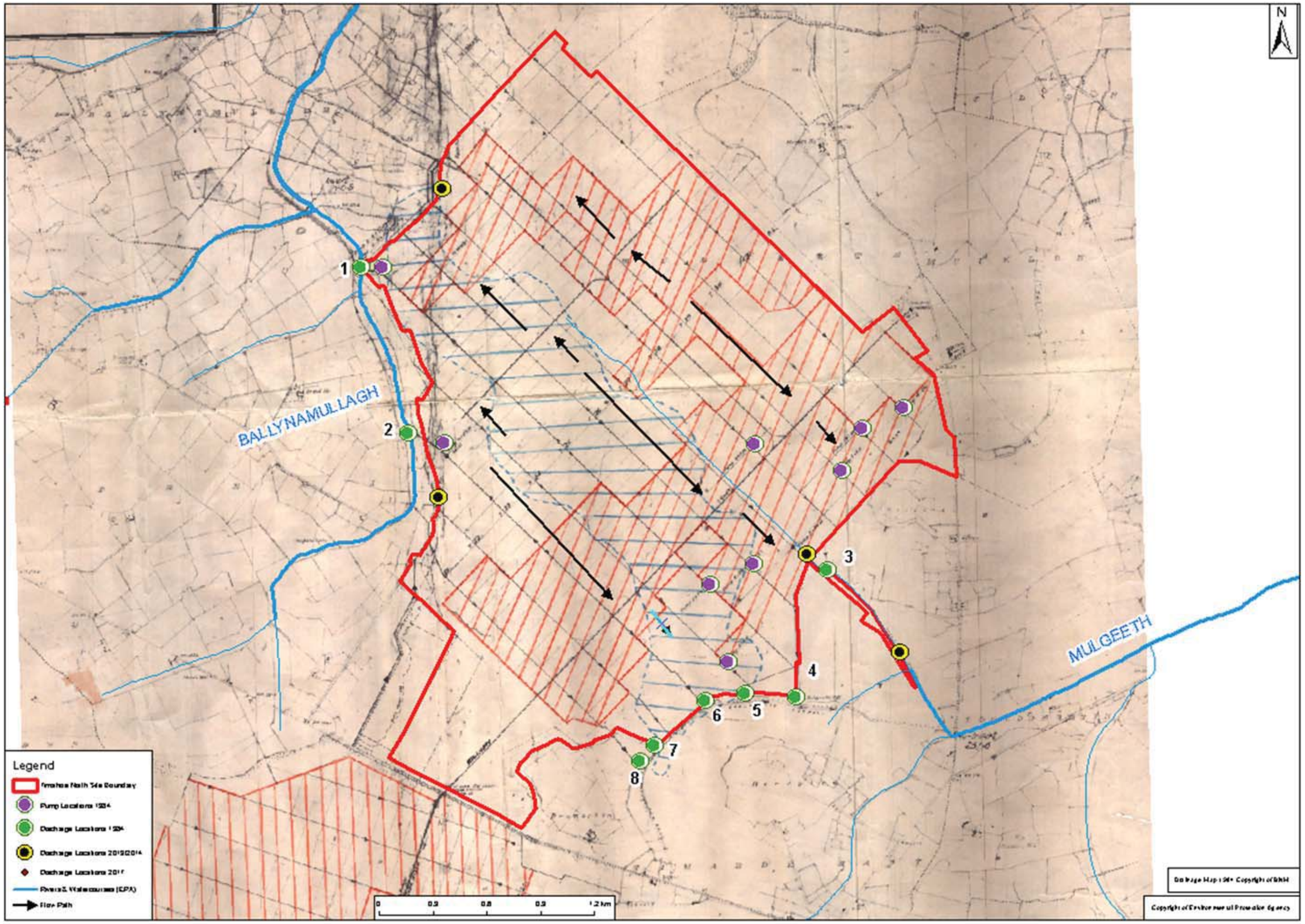

Figure 2-4: Historical Drainage Map - 1984

Discharge Location		Receiving Watercourse (EPA Water Framework Directive)
Easting (ITM)	Northing (ITM)	
674467	735902	Ballynamullagh
674732	734980	Ballynamullagh
677071	734214	Mulgeeth
676894	733507	Mulgeeth
676611	733530	Mulgeeth
676388	733486	Mulgeeth
676104	733235	Mulgeeth
676024	733146	Mulgeeth

Table 2-1: Historical Drainage Locations - 1984

2.4.2 Historical Drainage – 2013/ 2014

In 2013 / 2014 BNM undertook a survey of the then part rehabilitated site at Timahoe North. This survey identified the surface water discharge locations at the site as illustrated by Figure 2-5. Table 2-2 identifies the location of each of the discharge locations and the receiving watercourse.

Figure 2-5: Historical Drainage Map – 2013/ 2014

Discharge Location		Receiving Watercourse (EPA Water Framework Directive)
Easting (ITM)	Northing (ITM)	
674917.448	736340.042	Ballynamullagh
674900.441	734620.415	Ballynamullagh
676957.993	734304.472	Mulgeeth
677477.878	733757.587	Mulgeeth

Table 2-2: Historical Drainage Locations – 2013/ 2014

2.4.3 Present Day Drainage

Site visits were undertaken on 14th March 2017 and 1st November 2016 in addition to a peat probing exercise undertaken during the week of 24th October 2016. During these site visits multiple existing field ditches were identified across the site.

Image 2-1 illustrates a typical drainage field ditch identified during the site visit. Most field ditches identified during the site visit contained standing water with no clear evidence of discharge locations or water flow / movement. A figure illustrating the location of the field ditches is provided in Figure 2-6. At present it is difficult to assess the condition of the culverts which provide a flow route through the existing railway lines. The drains outfall into an outflow collector drain located along the northwest and southeast boundaries via small pipe culverts. There is a permanent wetland area located around the Mulgeeth watercourse and the southern railway line. This area acts as a storage area during wetter times of the year when the Mulgeeth backs up. As field ditches onsite are not free draining and pumping is no longer required, there is a significant amount of standing water which remains onsite throughout the year.

Image 2-1: Photo of Typical Field Ditch

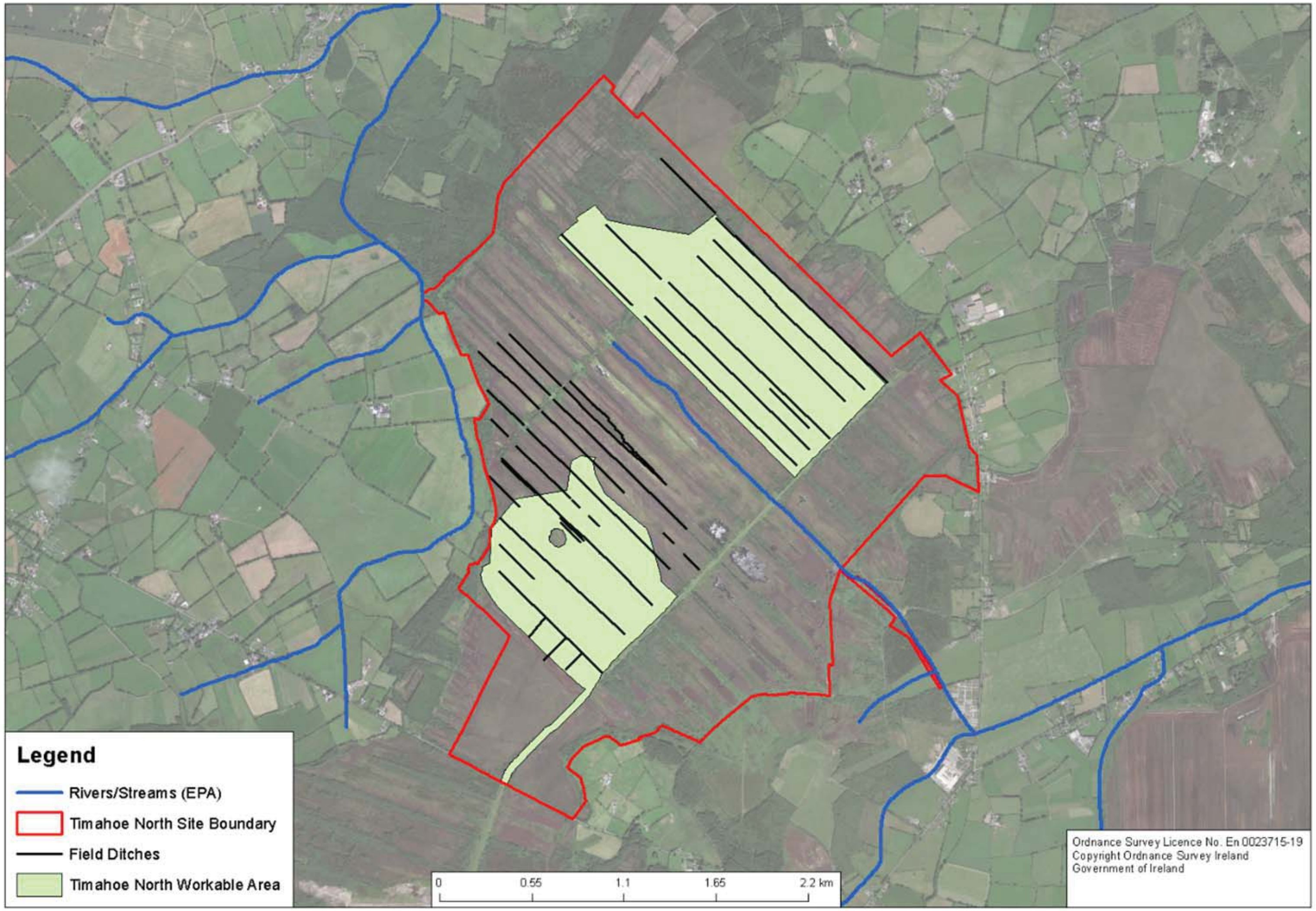

Figure 2-6: Location of Field Ditches

2.4.4 Mulgeeth Watercourse

The Mulgeeth watercourse flows in a south east direction through the middle of the proposed development (identified by the Environmental Protection Agency (EPA) Water Framework Directive (WFD) directory) and is not illustrated on Ordinance Survey (OS) 6-inch mapping. It is assumed that this watercourse was created during the operation of peat extraction activities at the site and has since remained in-situ. The Mulgeeth is identified on the EPA database of rivers and the OPW Flood Studies Update (FSU) database.

The Mulgeeth drains to the east of the site where it joins a tributary of the River Boyne within the Blackwater Longwood catchment (part of the overarching Boyne catchment). This tributary joins the River Boyne approximately 27.71 km from the overall Timahoe North site boundary.

The Mulgeeth generally consists of a 2.5 m to 4 m deep channel (to top of water) with either vertical or steep banks however at local positions along the length of the Mulgeeth the river becomes shallower to an approximate depth of 1 m (to top of water). Along most inspected locations the Mulgeeth appears to be approximately 2.5 m to 3 m in width. Water did not appear to be moving along most of the length of the Mulgeeth during the site visits undertaken and the river appears to be largely flat.

During the site visit undertaken on the 14th March 2017 no physical constraints (e.g. culverts) were identified at the downstream end of the Mulgeeth, near where it meets the site boundary. However, not all areas were accessible during the site visit due to the overgrown nature of the site. There were a number of blockages, check dams and debris identified in the channel within the site, as illustrated by Image 2-2 with further photographs of the Mulgeeth provided in Image 2-3 to Image 2-5.

Image 2-2: Mulgeeth – Screw Pump Blockage

Image 2-3: Mulgeeth – Upstream end

Image 2-4: Mulgeeth – Downstream end near boundary

Image 2-5: Mulgeeth – Downstream end outside boundary

2.4.5 Flood Risk Assessment

A Flood Risk Assessment (FRA) prepared by Hydro Environmental Ltd was produced for the proposed Timahoe North Solar Farm. The document will be submitted as a standalone document as part of the planning pack.

The FRA provided a greenfield runoff rate for the site using the OPW Flood Study Update method for estimating flood flow magnitudes. For Timahoe North's catchment area of 7.5km², the annual flood discharge is 0.47m³/s and at a statistical standard error this discharge rate at 67% confidence interval will vary from 0.33 to 0.64m³/s. The estimated 100 year and 1000 year flows from the bog are 1.25 and 1.71m³/s. More information on the procedure for estimating the greenfield runoff rate is provided in the FRA.

During the production of the FRA, a 2-Dimensional model of the Timahoe Bog was constructed. More information on the hydraulic model is provided in the FRA. The hydraulic model predicted pluvial flooding across sections of the site in the 100 year and 1000 year flooding. Predicted inundated areas are illustrated in the FRA. Under the existing 100 year and 1000 year flood events the peak water levels in the drains at the Solar Farm sites located upstream of the access track varies from 78.23 to 81.10 for the 100 year and 78.88 to 81.67 at the 1000 year events. The lower levels are predicted in the central area of the Bog. Flood inundation maps are provided in the FRA.

3 Proposed Development

The development of the solar farm will consist of two sites, Site 1 and Site 2 (see Figure 3-1), linked by an access road and an amenity walkway. The makeup of the two sites is provided below with engineering drawings available for viewing in Appendix A.

Site 1 will consist of:

- Approximately 0.85 km^2 of solar panels
- A 110 kV Substation including transformers, switchgears and a battery storage area
- A site compound for use during the construction phase
- 12 electrical inverters
- Four peat storage areas totalling 0.082 km^2 during the construction phase

Site 2 will consist of:

- Approximately 1.17 km^2 of solar panels
- An enclosed container containing switchboard gear
- 17 electrical inverters
- Three peat storage areas totalling 0.015 km^2 during the construction phase

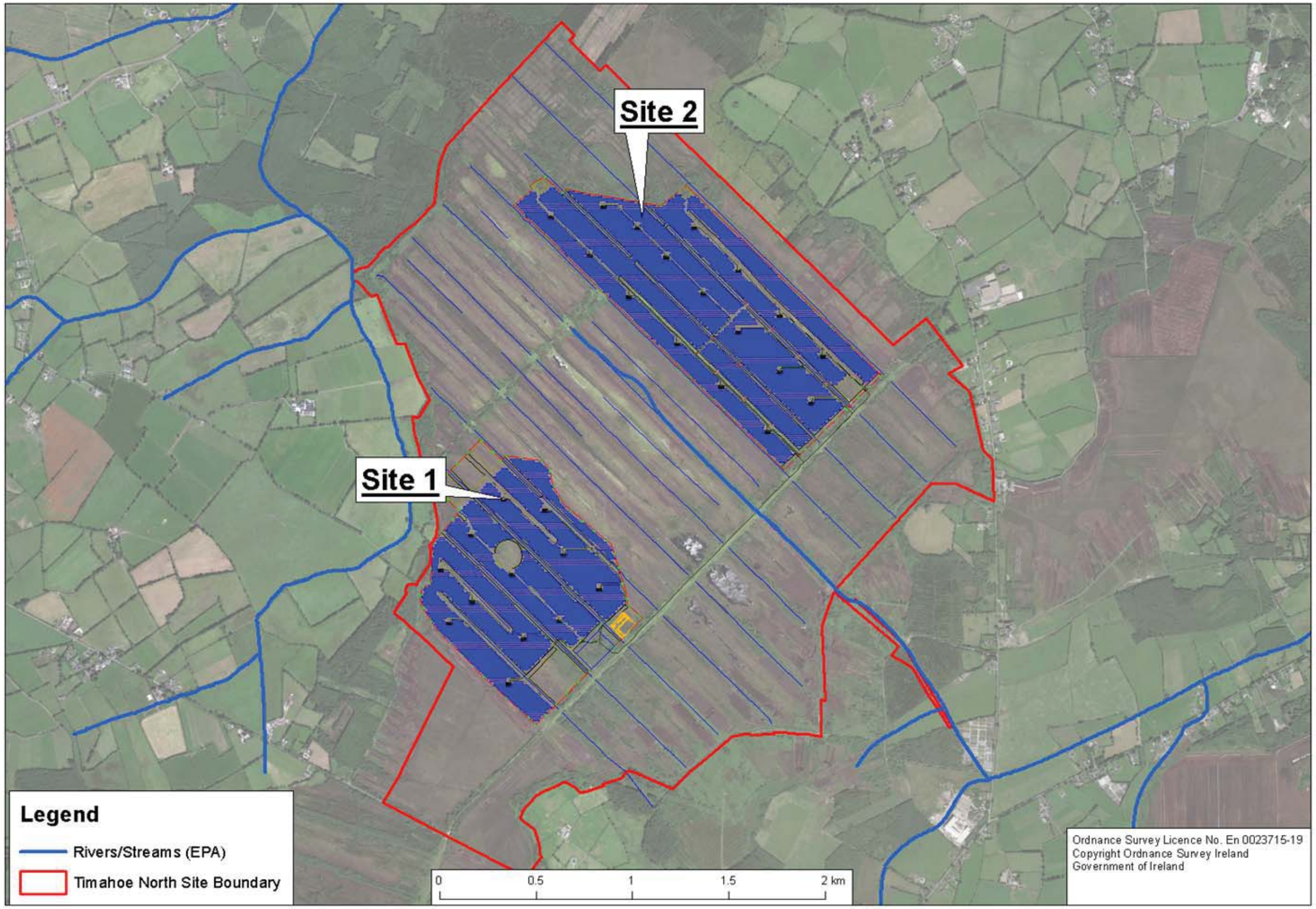

Figure 3-1: Post Development Layout

3.1 Change of Land Use

Although the overall site area is approximately 807 ha, the two workable sites within this boundary are approximately 219 ha in size. The majority of the workable sites will consist of solar panels. The solar panels will be raised from the ground by a minimum of 0.5 m on a steel frame. In areas identified by the FRA this may increase to circa. 1.5 m above ground level. As the panels are not completely covering the ground, rainfall will run off the top of the panels onto the bog underneath. Thus, the same hydrological regime in the pre-development environment will be maintained in the post development environment. To stop erosion at locations where runoff from the panels falls to the ground, proposed planted vegetation will provide adequate protection to the bog.

It is proposed to construct all access roads throughout the site as floating roads. A floating road on peat in its simplest form is a road that is constructed directly on top of the peat relying on the strength of the in-situ peat for its support. The roads will consist of a geogrid and permeable stone. Rainfall will penetrate the road and seep into the underlying peat. This allows for the current hydrologic regime to be maintained.

There are changes to the current peat land use proposed at the substation and inverter locations. The substation is proposed to consist of a stone and concrete hardstanding area approximately 1.90 ha. The 29 electrical inverter locations will consist of a concrete hardstanding area. It is proposed to store extra runoff created from changing the land use from peat to hardstanding in the wetlands around the Mulgeeth and in the proposed connector drain (see Section 4.5). The minimal change in land use over the whole development and the available adequate storage in the connecter drain and the wetland area around the Mulgeeth watercourse ensure the proposed development will not significantly alter the current hydrologic regime or negatively affect downstream flooding.

4 Proposed Drainage

4.1 Drainage Design Criteria

Surface water drainage systems developed in line with the ideals of sustainable development are collectively referred to as Sustainable Drainage Systems (SuDS). These systems are designed both to manage the environmental risks resulting from development runoff and to contribute wherever possible to environmental enhancement.

It is proposed that SuDS techniques are utilised wherever possible to manage surface water runoff from the development. Surface water management proposals for the proposed development have been formulated to mimic the natural drainage patterns of the site.

4.2 The SuDS Management Train

The ‘management train approach’ is central to the surface water drainage strategy of the proposed development. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- Prevention – the use of good site design, construction practices and housekeeping measures to prevent runoff and pollution;
- Source Controls – control of runoff at source or as close to source as possible (e.g. permeable or semi-permeable surfacing); and
- Site Control – management of water in a local area and can include ponds, silt fences and filter strips.

The drainage techniques proposed for this site include all three measures.

An assessment of the proposed solar farm site has been carried out so that local SuDS limitations and opportunities could be determined and the most suitable SuDS identified.

The following design philosophy has been adopted:

- Surface Water Treatment using the ‘Management Train’ approach to remove and isolate contamination at source.
- Aim to limit, where possible, the impermeable fraction of the development.
- Maximise the benefits of existing site characteristics to achieve the SuDS objectives.
- Integrate SuDS with landscape and habitat.
- Restrict development runoff peak flow rates to pre-development rates.
- Site control treatment providing conditions for settlement of suspended solids through detention.
- Use of swales and open channels in lieu of pipelines wherever acceptable and practical.
- Create and maintain buffer strips of vegetation in conjunction with constructed SuDS features.

The following drainage strategy and treatment train is proposed for Timahoe North:

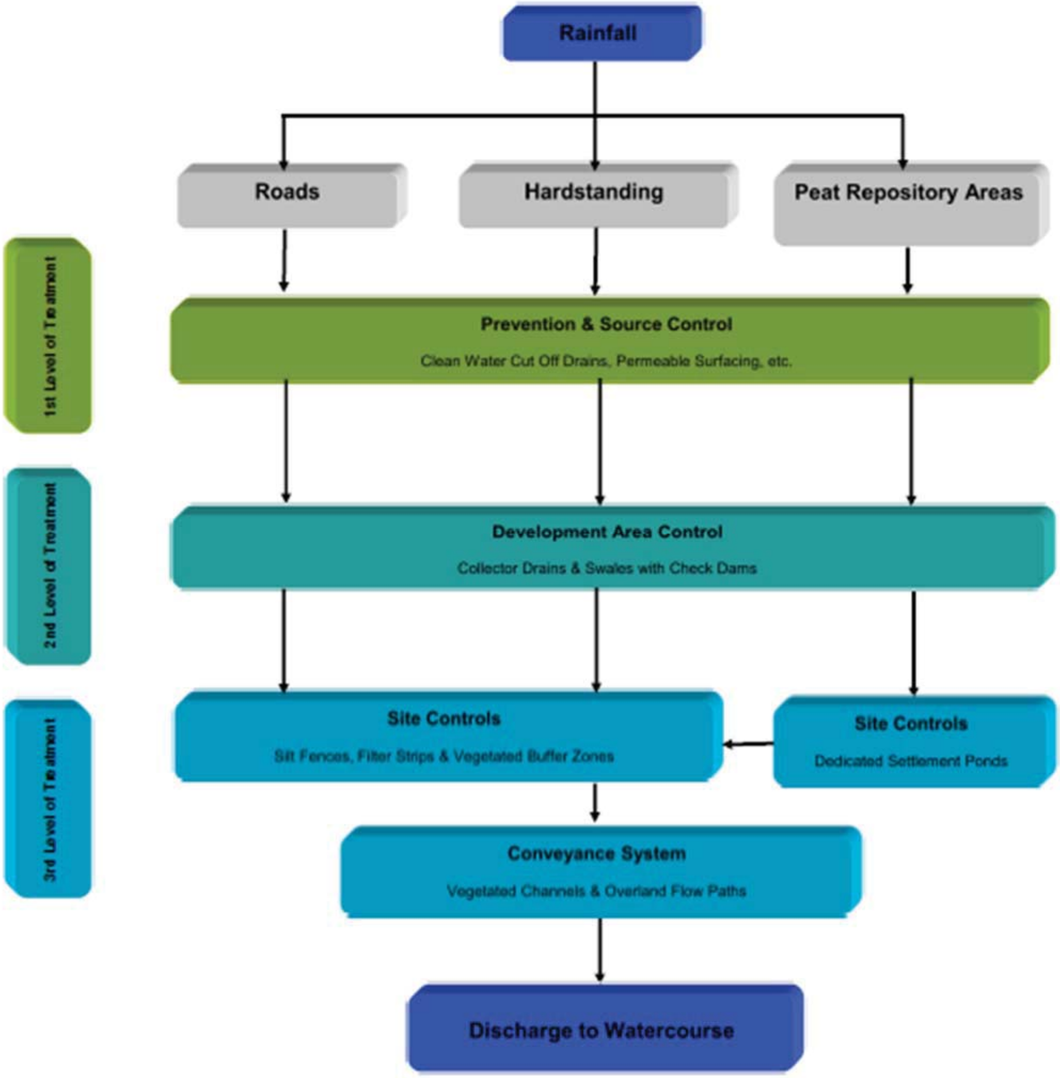

Figure 4-1: SuDS Strategy

4.3 Relevant SuDS Guidance Documents

A number of industry reference guides have been utilised in the formulation of the SuDS proposals. Construction Industry Research and Information Association (CIRIA) guidance documents will be further utilised during the detailed design and during the implementation of SuDS on the proposed solar farm development. The following is a non-exhaustive list of industry guidance relevant to the site:

- The SuDS Manual – C753
- Planning for SuDS – C687
- SUDS Best Practice Manual – C523
- Site handbook for the construction of SUDS – C698
- Control of water pollution from linear construction projects – C648
- Designing for exceedance in urban drainage – C635

National Planning Policy Guidance, where relevant to drainage, has also informed the proposals.

4.4 Drainage Design Criteria

The principle criteria adopted for the solar farm are outlined below:

- Minimise any change to the surface water and groundwater conditions within the site;
- Mimic the existing drainage onsite;
- Maintain the current hydrological regime in the area;
- Minimise sediment loads in the runoff, with particular attention being given to the construction phase of the project;
- Maintain runoff rates and volumes at Greenfield rate thus not negatively influencing flooding downstream; and
- Utilise the Mulgeeth watercourse as the main discharging location from site.

4.5 Solar Field Drainage

In order to mimic the existing drainage on site the large field drains will be utilised throughout the site. In the areas between the field drains it is proposed to capture rainfall within the solar fields in small collector swales. The collector swales will be spaced approximately every 30 m. They will be located between the solar panels and will flow towards an adjacent field ditch. It is proposed that the collector swale locations are finalised onsite as they may be required in low lying areas or at lesser intervals depending on the topography of the area. An illustration of the proposed drainage system for the solar panels is provided in Figure 4-3. A typical example of a collector drain/swale is shown in Figure 4-2.

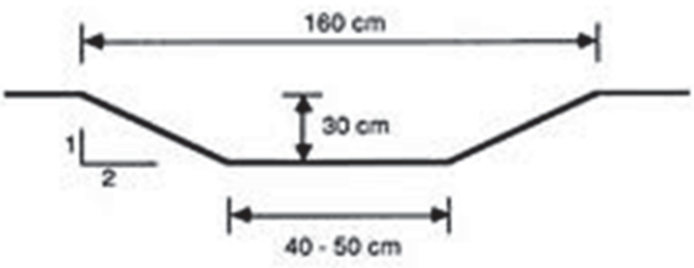

Figure 4-2: Typical example of a collector drain

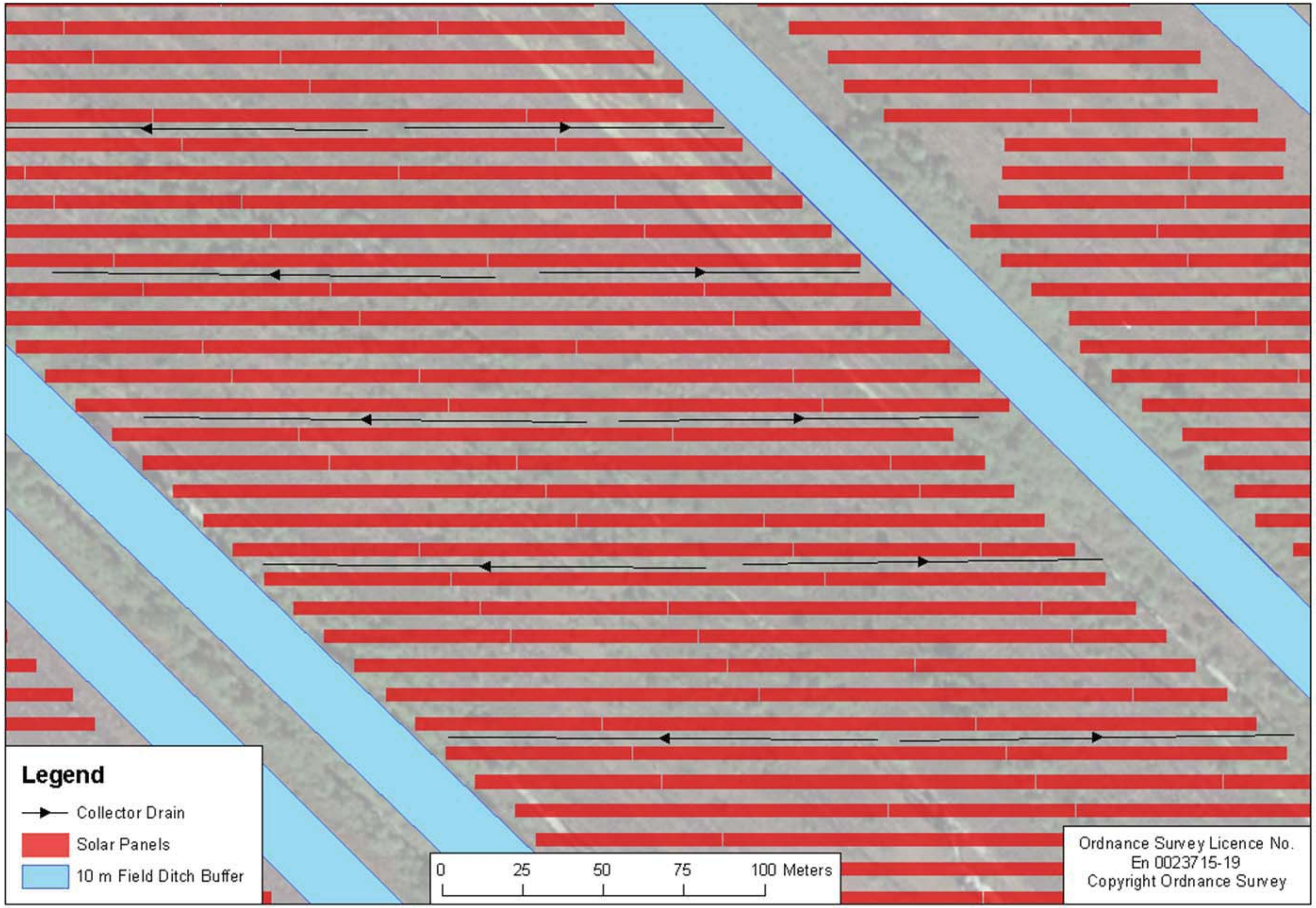

Figure 4-3: Solar Field Drainage

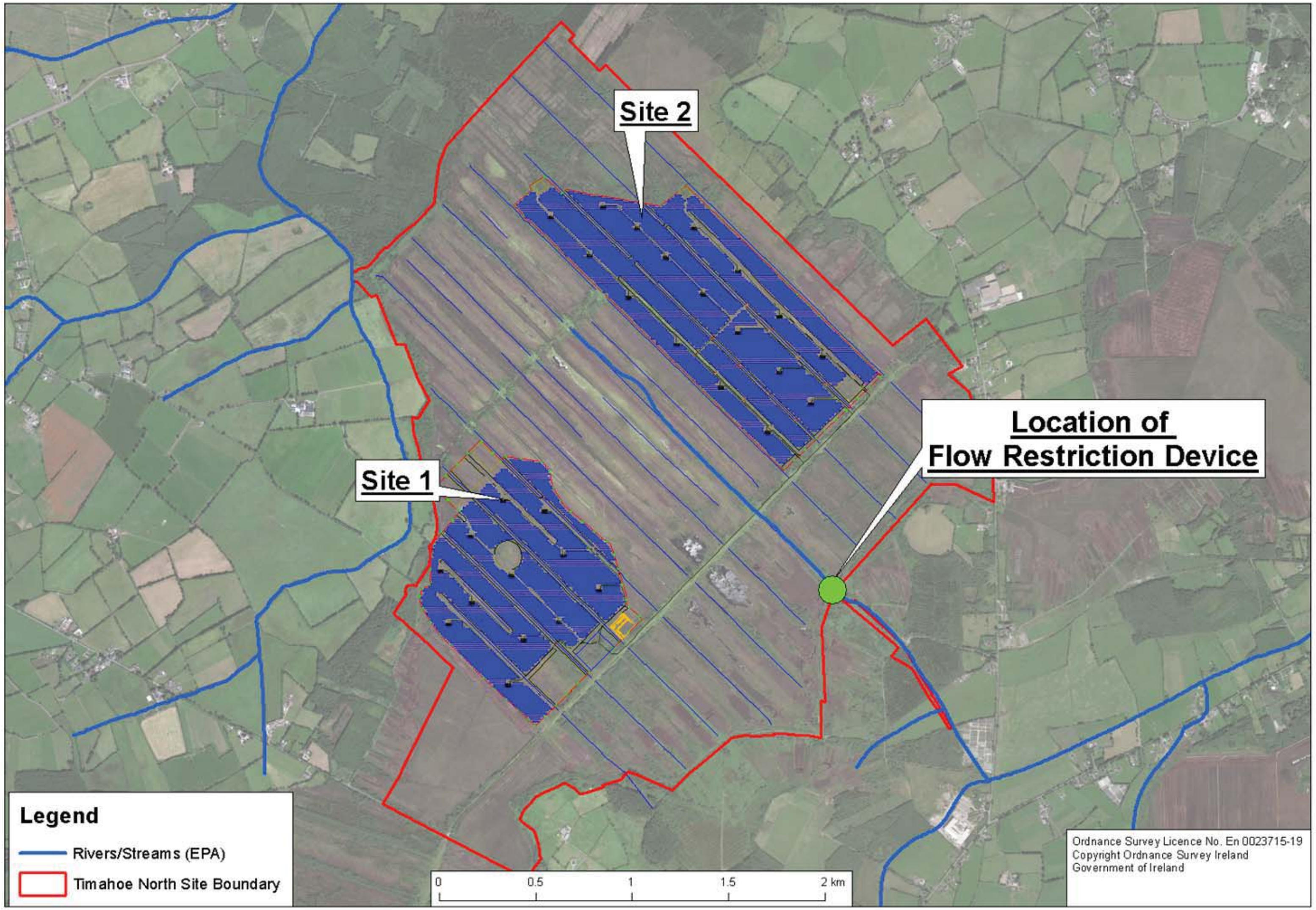

Figure 4-4: Location of Flow Restriction Device

4.6 Connector Drain

The existing field ditches will feed into a proposed connector drain which is to be constructed along the access road. This drain will flow towards the Mulgeeth watercourse. Currently the field ditches flow in a south east direction towards the existing railway line but are not free flowing. The construction of the connector drain will allow for all the field ditches within both sites to become free flowing. This will also allow for the field ditches to drain towards the Mulgeeth watercourse and flow offsite at a controlled rate. Cleaning of vegetation within the field ditches may also be required to ensure they are free flowing. It is proposed that the connector drain be a V shaped ditch, approximately 1 m to 1.5 m deep with a top width of 6 m to 10 m depending on the depth of the peat. A plan view of the connector drain is provided in Appendix A. It is proposed to install culverts where the connector drain crosses under the access road. Six culverts are required in total with three at both sites.

It is proposed that the peat excavated during the construction of the drain be side casted if possible. A number of sediment control measures should be implemented during the construction of the drain which should include clean water drains, silt fences (see Section 5). No peat should be stored close to any field ditch or watercourse. A buffer zone around field ditches and watercourses where no peat can be stored should be implemented. A 25 m buffer around field ditches and a 50 m buffer around the Mulgeeth watercourse is recommended.

4.7 Substation Drainage

The substation drainage will consist of a surface water, foul water and potable water system as outlined in this section.

4.7.1 Surface Water System

The substation drainage will consist of an underground surface water pipe system. This system will include a number of surface water manholes, rain water pipes for the compound building roof, Class 1 Full Retention Oil Separator, an oil sensitive bund dewatering system and ACO Drains. The system will discharge in an adjacent field ditch.

It is also proposed to construct a land drain, 150 mm in diameter, around the perimeter of the substation. The land drain will discharge in the same location as the surface water system.

In accordance with SuDS best practice, it is proposed to include two rainwater harvesting tanks within the surface water system which will comprise of a filter, an underground tank and a pump. The system allows rainwater to run down the roof and into the guttering and downpipes in the normal way before passing through the filter, which removes any leaves and debris. Rainwater is then stored in the underground tank for reuse. The proposed tanks will have a capacity of 3,800 litres.

Rainwater harvesting has a number of benefits for sustainable designs:

- The development’s water demand is reduced, delivering sustainability and climate resilience;
- The volume of runoff is reduced;
- The attenuation storage volume required is reduced.

The surface water system can be view in Appendix A.

4.7.2 Foul Water System

A foul system is proposed within the station to cater for the wastewater generated in the welfare facilities of the control building. The foul system will consist of an underground pipe network, foul manholes and an 18 m³ full retention foul effluent storage tank. The tank will have an associated high level alarm which will be connected to the control building. A foul holding tank to be maintained and emptied bi-annually is the most preferable means of treating and disposing of foul waste from the site. The licensed contractor charged to empty and dispose of the waste will be the holder of a valid waste collection permit.

The foul holding tank proposed will have the capacity of 18 m³ which is a multiple of the foul water generated over the six months of normal operation. The foul holding tank will also be inspected by a suitably qualified and indemnified person at these intervals and records of the inspections will be held on site for inspection by the Local Authority.

A freeboard in excess of 300 mm will be provided for and the foul holding tank will be fitted with a high level alarm. The alarm will be connected back to the station control panel which is connected to a manned control centre via the stations' Supervisory Control and Data Acquisition (SCADA) telecom relay system. This will allow for a non-scheduled maintenance and emptying of the tank between the regular six month intervals in the very unlikely event that this is required.

The foul holding tank will also be vented to the atmosphere to avoid the build-up of noxious and dangerous gases.

4.7.2.1 Foul Water Volumes

The station will be unmanned and as such will generate small quantities of foul waste. There will be visits to the station for scheduled and unscheduled visits for inspections, maintenance and repairs as necessary. A four man crew visiting the site for three days a week would be the most that would be expected on the site. In such circumstances the operatives could be expected to use each facilities four times a day. This would result in a weekly contribution of 60 litres of foul waste per week. The breakdown of usage is included in Appendix B. In the very unlikely event that such a high visitation rate would be extrapolated throughout the year, this would result in 18,970 litres per annum. While such a consistently high visitation rate is improbable, there is the possibility of increased numbers of staff being present on site for short durations of one to two weeks for the commissioning of electrical elements of the station from time to time. It is envisaged that these extraordinary occurrences would balance out with the ordinary operation of the unmanned station to produce foul flows no greater than the 18,970 litres per annum.

It is common for much lower usage of the facilities on unmanned stations and therefore a much lower foul loading. A common problem on such unmanned stations is odours in the toilet areas due to the drying out of the water trap in the WC through evaporation resulting from the lack of use. For this reason it is proposed to use self-flushing toilets in the station, which would flush automatically twice a week. The station will include 2 no. 6 litres flush WC's so a minimum weekly foul of 24 litres can be expected. The self-flushing WC's will therefore contribute 1,248 litres per annum.

Combining the automatic flush and maximum user demand figures would result in a maximum annual generation of 20,218 litres of fouls.

The maximum and minimum foul flows are set out in Appendix B of this report.

4.7.3 Potable Water System

The proposed substation site is remote from the public roadway and the public water supply system. It is proposed to provide the required potable water demand of the station with a well on the site.

The potable water demand within the site will be low as the proposed station is to be unmanned. To avoid problems like stagnation in the water supply line and problems resulting from this there will be continual water demand of 24 litres per week resulting from the automatically flushing WC's within the station.

As per Section 4.7.1 two rainwater harvesting systems are proposed for the development. The systems will each have a capacity of 3,800 litres which will be used in servicing the non-potable water demand. If water levels in the well are low bottled water will be provided for consumption.

4.7.3.1 Potable Water Volumes

The water demand within the proposed development will be low and will be similar to the figures for the foul water generation as set out in Section 4.7.2.1. The water demand will be slightly higher than the figure for the foul consumption within the tea making station or mess room located within one of the buildings in the proposed substation.

Potable water supply demand calculations are set out in Appendix C of this report.

4.7.4 Battery Storage Area

The battery storage area will consist of 20 transformer bunds, 20 inverter frames and 10 batteries concealed within shipping containers. Each transformer bund will be fitted with an approved oil sensitive bund dewatering system and with 1 l/s low shear vortex pump with oil separation detection. An underground surface water pipe system will collect runoff from the transformers and discharge through an oil separator before entering the substations surface water system. A Klargester NSFA010 or similar separator is proposed. The separator must have the capacity for 460 m² of surface area.

4.8 Inverter Drainage

The inverter stations will be equipped with an approved oil sensitive bund dewatering system and with 1 l/s low shear vortex pump with oil separation detection. An approved integrated class 1 full retention oil separator with independent certification of compliance to BS EN 858 will also be installed at each inverter location. Pumped clean water will flow out into the surrounding stone and flow via the surrounding topography into an adjacent collector drain.

4.9 Amenity Area Drainage

The amenity area drainage will mimic the current drainage of the area. Pedestrian pathways will be constructed as floating roads and will have minimal effect on the site. The pathways will be culverted over the existing drains.

4.10 Surface Water Attenuation and Inundation

A 2-Dimensional model of the proposed drainage system including the large connector drain was constructed for the FRA. The proposed drainage system for both sites discharges underneath the existing railway line through a 2.4 m x 2.4 m box culvert located in the Mulgeeth. A 900 mm culvert at the outlet to the bog is also proposed to throttle flows discharging from the bog.

The computed peak outflow rate for the proposed case with the 900 mm diameter throttle at the single outlet point is 1.49cumec and 1.78cumec which are slightly lower than the existing case.

Under the proposed case the computed peak water level in the drains at the Solar Farm sites for the 100 year and 1000 year flood events vary from 78.73m to 79.07m for the 100 year and 79.11m to 79.45m for the 1000 year.

For Flood Risk Management on the site the FRA recommended that the solar Panels, access roads/tracks should be placed above a minimum design flood level of 79.5m OD, the compound, parking and peat repository areas be elevated above a level of 80m OD (design level plus freeboard allowance of 0.5m) and the critical infrastructure that includes the inverters and the substation be set above 80.5mOD malin which provides for suitable freeboard in excess of 1m above the design flood level. Further inundation mapping is presented in the FRA. The FRA concluded:

- That the proposed drainage scheme for the site suitably mitigates flood risk on the site both potential and residual flood risk without impacting the flood risk to adjacent and downstream third party lands.
- Residual flood risk to the development can be minimised through active management of the proposed drainage infrastructure on the site.
- The proposed development is considered sustainable and flood management measures designed to cater for recommended future climate change allowances. Management of Flood Risk on the site for the proposed development can be carried out not to cause unacceptable impact on the ecology of the Timahoe North Bog.

5 Water Quality

During and after construction of the solar farm, sediment laden runoff from access tracks, substation, hardstanding areas and inverters must be controlled. Release of suspended solids to all watercourses will be kept to a minimum. In addition, existing surface water regimes on the site will be preserved where possible.

To manage stormwater surface runoff onsite during periods of heavy rainfall, a number of measures have been included in the construction of the solar farm. These include silt traps, silt fences, settlement ponds and check dams.

Proposed mitigation measures included in the design and construction of the solar farm are included in this section. Drainage layouts and typical details are presented in the following drawings:

- QS-000218-01-D453-016
- QS-000218-01-D453-017
- QS-000218-01-D453-018
- QS-000218-01-D453-019
- QS-000218-01-D453-020
- QS-000218-01-D453-021
- QS-000218-01-D453-022

5.1 Flow Separation during Construction

Two distinct methods should be employed in the management of construction surface water runoff. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, and to route them towards stilling ponds prior to controlled diffuse release over vegetated natural surfaces. There should be no direct discharge to surface waters; and where possible all release of solar farm drainage should be done outside of hydrological buffer zones.

Therefore, surface water onsite has been separated into "clean" and "sediment laden" or "dirty" networks, minimising the volume of contaminated water to treat.

Clean drainage is defined as water which has not been contaminated when running over the operational parts of the site.

Construction runoff is defined as runoff from the working areas and access tracks.

Where possible natural drainage patterns have been restored after the completion of track construction / upgrading by allowing surface drainage to pass under the new access track at existing natural drainage lines.

To intercept the clean surface water runoff before it reaches the construction and operational parts of the site, clean water drains have been installed on the "up-hill" boundary of the access tracks, hardstanding areas and peat storage areas. These clean water drains generally follow the natural contour of the ground at relatively low gradients and convey drainage to nearby field ditches.

The layout design for the development has minimised the area to be disturbed by construction through rationalising the access track network serving inverter locations and the peat storage areas. Proposals to manage the potential for erosion of sediment and the control of activated sediment are set out herein and will be incorporated into the Construction Environmental Management Plan which will be a requirement for site construction.

During the construction phase sediment laden water runoff drains will be constructed around areas where peat is proposed to be disturbed. The drains will collect sediment laden runoff and discharge through a serious of SuDS measures. Each drain will pass through a settlement pond before entering any of the local field ditches or watercourses

The SuDS measures to be used onsite are outlined below:

5.1.1 Buffer Zones

A key mitigation measure is to protect the existing watercourse and field drains on site. A self-imposed buffer zone for peat storage will be established around the existing field drains on site. This will allow sufficient room for the silt mitigation measures described below to function.

Also, a buffer zone around field ditches and watercourses where no peat can be stored should be implemented. A 25 m buffer around field ditches and a 50 m buffer around the Mulgeeth watercourse is recommended as per industry best practice.

5.1.2 Vegetation Filter Strips

A key mitigation measure installed for flow and sediment control is the use of vegetation filter strips. A vegetation filter strip may be:

- a constructed flat area of vegetation at a point discharge that traps sediment, enhances filtration and can slow down runoff that could enter the local surface waters,
- or an area that is left undisturbed alongside existing streams.

This measure allows the vegetation to act as a drainage area for the stormwater and operational surface runoff throughout some areas of the site. This method of collecting and treating operational runoff is the preferred method wherever possible.

5.1.3 Swales/ Collector Drain

A swale or collector drain is an open gently sloping grassed drainage channel. Collector drains are incorporated into the design to convey drainage water, trap sediment, enhance filtration and slow down the rate and magnitude of runoff that could enter the local watercourses.

5.1.4 Settlement Ponds

Provision is made for additional protection measures in areas where vegetation filter strips and swales are not considered sufficient on their own, due to the nature or availability of the vegetation and the volume of surface runoff that needs to be treated. In these cases, settlement ponds will be constructed.

Settlement ponds reduce the turbulence of drainage discharges and facilitate the settlement of solid particles entrained in the water. Settlement ponds may be built in-situ and sized depending on expected flows. They need relatively flat areas for construction.

The settlement ponds were sized individually based on expected flows derived from Return Period Rainfall depth estimates for Timahoe supplied by Met Éireann. Each settlement pond has been designed for a rainfall return period of 30 years and for the first flush (15 mm) of rainfall across the contributing area.

The ponds have been sized so that the time of travel through the pond, for the design rainstorm, is sufficient to allow a high percentage of suspended solids to settle within the pond, followed by further removal across the vegetated area downstream. The required time of travel depends on the vertical settling velocity of eroded peat excavated during construction. During operation, most of the particle sizes and settling velocities are likely to be higher than for peat.

The settling velocity for peat is given in the publication "Erodibility of Hill Peat" by J. Mulqueen, by M. Rodgers, N. Marren and M.G. Healy of NUIG in *Irish Journal of Agricultural and Food Research* 45**:** 103–114, 2006. Measurements indicate that 75 to 85% of eroded peat will settle, depending on the concentration, at a vertical velocity of 1 mm/s. This velocity has been applied in the initial calculation for each pond and in addition, an extra margin is provided in the final efficiency chosen.

The calculations for particle size settlement for the ponds do not take into account the higher roughness coefficient of the pond surfacing. The stone lining in the ponds will further slow the flow through velocity. The check dams in the ponds will also reduce turbulence and promote settlement and provide filtering of runoff at low flow.

Four types of settlement ponds have been designed for the solar farm. Settlement pond types can be viewed in Table 5-1 with the number of settlement ponds and associated sizes available for viewing in Table 5-2.

Pond Type	Area (m²)	Width (m)	Length (m)
1	500	2	10
2	2,500	3.5	17.5
3	10,000	7	35
4	15,000	9	45

Table 5-1: Settlement Pond Types

ID	Area (m²)	Number of Ponds	Pond Type
Peat Storage – PR7	42,232	3	4
Peat Storage – PR6	13,168	1	4
Peat Storage – PR5	15,084	1	4
Peat Storage – PR4	10,057	1	3
Peat Storage – PR1	2,500	1	2
Peat Storage – PR2	2,500	1	2
Peat Storage – PR3	9,804	1	3
Substation	26,243	2	4
Inverters	500	1	1

Table 5-2: Settlement Pond Sizes

5.1.5 Check Dam

Check dams are small temporary barriers which can be constructed across areas of concentrated flow. The purpose of check dams is to reduce the velocity in areas of concentrated flow. Examples of soil erosion are apparent due to the action of existing natural streams on the site.

Check dams can be installed in drainage channels at steep areas on the site. Their purpose in clean drainage channels is to minimise erosion and to slow the rate of runoff. Criteria connected with the design of check dams include drainage area, height, side slopes, spacing and geotextile requirements. However, engineering judgement on site determined the final design and layout of the check dams. Due to the relatively flat topography within the solar farm it is not foreseen that a significant number of check dams will be needed.

5.1.6 Silt Fence

Silt fences will be emplaced along drains and parallel to access roads edges as required and at stream / watercourse crossings. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of peat and entrained in surface water runoff.

5.2 Maintenance of Drainage

It is critical that the drainage measures listed above are regularly inspected and maintained during both the construction and operational phases of the solar farm. During construction the Contractor shall produce a drainage inspection and maintenance plan as part of the CEMP to ensure that measures function effectively.

In the operational phase of the solar farm a site specific O&M plan shall be established.

6 Conclusion

This report outlines the drainage criteria for the Timahoe North Solar Farm. The criteria has been designed to mimic as much as possible the current hydrological system in the area. Although there is proposed hardstanding areas to be constructed at the site, they are relatively small in terms of the overall development. Wetland areas around the Mulgeeth watercourse have the capacity to cater for the extra hardstanding areas.

The main element to the drainage design is to construct a large connector drain along the access track which will replace the old railway line. This drain will connect all field ditches to the discharging Mulgeeth watercourse. This creates a free flowing drainage system within the site. To maintain pre-development flows in the post development environment a flow restrictor is proposed on the downstream end of the Mulgeeth watercourse. This restrictor plus the storage area within the wetland area around the Mulgeeth will ensure the drainage strategy will not have a negative impact on downstream flooding. It should also be noted that where required, field drains which once may have discharged from the bog at different locations will be blocked so that all flows pass through the 900 mm diameter flow control pipe located in the Mulgeeth.

It is proposed that in extreme flooding, in excess of the 100 year flood, some of the solar panels will become inaccessible. The panels have been designed so that they are 500 mm above the 1000 year flood level. However they will not be accessible for maintenance during a flood.

The surface water drainage system was devised to accommodate drainage from the solar farm and associated structures in conjunction with existing surface water drainage. A key purpose of the drainage network is to minimise the risk of the ingress of silt laden runoff from the operational areas of the solar farm from entering the local streams.

Surface water drainage from the site has been sub-divided into two separate drainage networks - “clean” and “sediment laden” systems. The “clean” system will capture and manage runoff from areas of the site unaffected by the works. The construction or “sediment laden” system will accommodate runoff from the working areas of the site.

The drainage design incorporated numerous SUDS measures as outlined in Section 5 to ensure the quality of surface water runoff entering receiving watercourses is similar to pre-development runoff.

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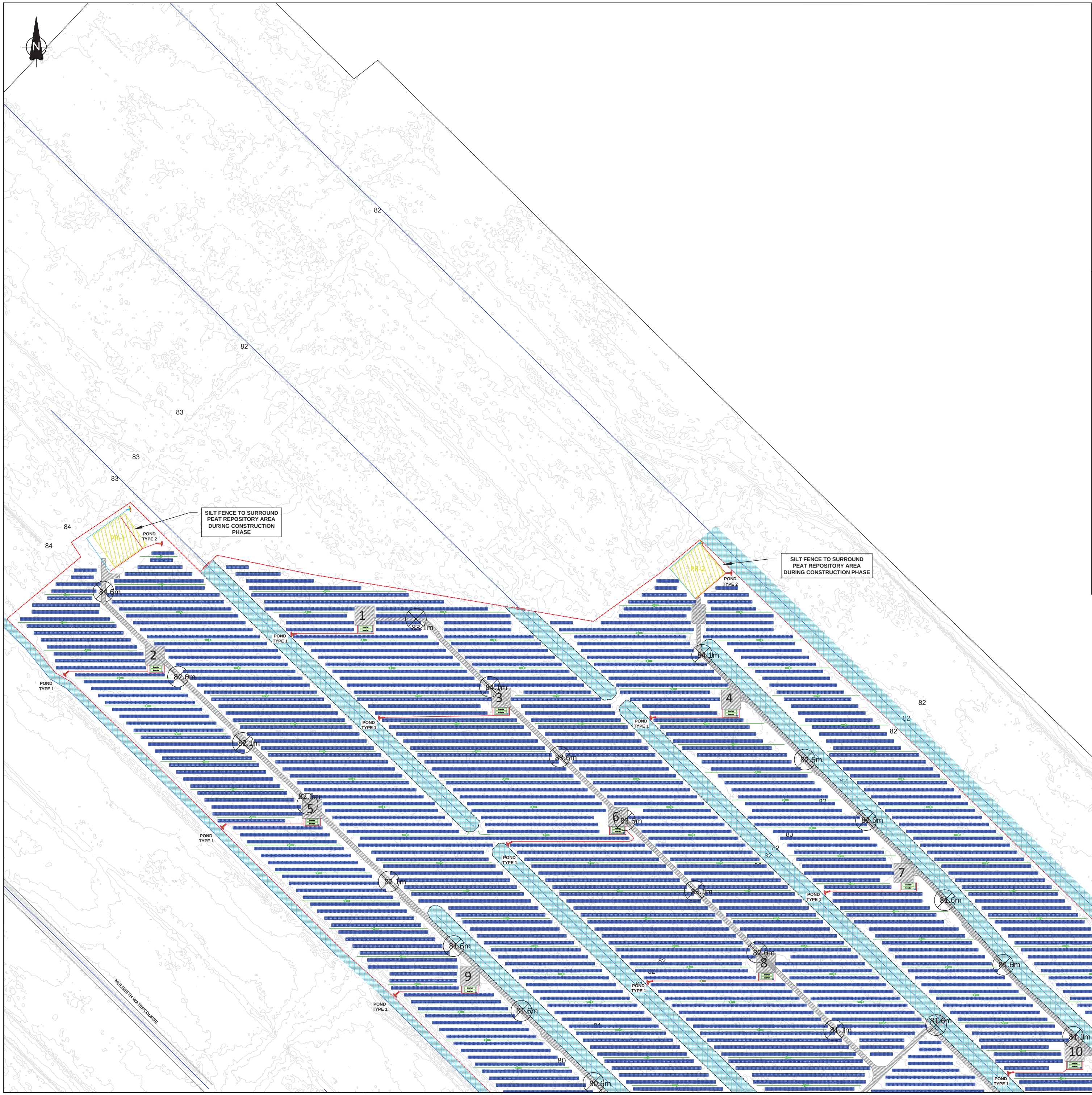
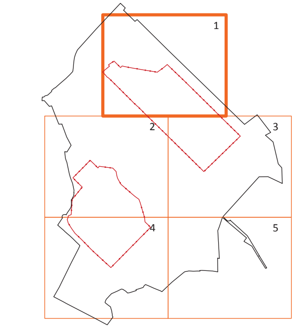
Appendix A: Drawings





KEY PLAN

Legend

- PV TABLE
- EXISTING ACCESS ROAD TO BE UPGRADED
- NEW ACCESS ROAD
- BRIDGE OVER DRAIN WITH ACCESS ROAD
- INVERTER STATION AND CONCRETE PAD
- INVERTER HARDSTANDING AREA
- DEER FENCE
- BRIDGING STRUCTURE OVER DRAIN FOR THE DEER FENCE CROSSING
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- SHEEP FENCE (AROUND DRAINS)
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- CONNECTOR DRAIN
- FLOW RESTRICTOR
- OVERFLOW DRAIN
- OVERFLOW DRAIN FLOW PATH
- BUND DEWATERING SYSTEM AND OIL SEPERATOR (SEE NOTE 9)

PROPOSED DRAINAGE

Drainage Design Notes

1. ALL DRAINAGE SUBJECT TO MICRO-SITING AND OPTIMISATION ON SITE.
2. LOCATIONS OF COLLECTOR DRAINS, CHECK DAMS, CULVERTS, SWALES, SETTLEMENT PONDS AND BUFFERED OUTFALLS/LEVEL SPREADERS ARE SHOWN AS INDICATIVE AND MAY BE CHANGED TO SUIT THE REQUIREMENTS OF THE LOCAL TOPOGRAPHY.
3. DOWN GRADIENT SLOPE BELOW BUFFERED OUTFALL/LEVEL SPREADER ONTO WHICH WATER WILL DISSIPATE TO HAVE A GRADE <6%.
4. SUPERVISING HYDROLOGIST OR ENVIRONMENTAL CLERK OF WORKS / ENVIRONMENTAL SCIENTIST TO OVERSEE INSTALLATION OF DRAINAGE FEATURES.
5. ALL DRAINAGE FEATURES SUBJECT TO INSPECTION & MAINTENANCE PLAN.
6. EROSION PROTECTION TO PREVENT SCOUR TO BE PROVIDED IN DRAINAGE CHANNELS WITH A CHANGE IN DIRECTION <130°, WHERE THE FALL EXCEEDS 1:40 AND AT ALL ROAD CROSSING CULVERT LOCATIONS, OR WHERE OTHERWISE DIRECTED BY THE SITE ENGINEER.
7. CONSTRUCTION PROCESSES THAT POSE RISK OF ACTIVATION OF SEDIMENT LADEN RUN-OFF TO BE HALTED DURING PERIODS OF EXTREME RAINFALL. NO EXCAVATION TO BE CARRIED OUT IN ADVANCE OF FORECASTED HEAVY RAINFALL.
8. MINIMISE STOCKPILING OF MATERIAL AND LOCATE ESSENTIAL STOCKPILES OUTSIDE BUFFER ZONES AND AS FAR AWAY AS POSSIBLE FROM WATERCOURSES.
9. "ENTEXOL SCS001" OR SIMILAR APPROVED OIL SENSITIVE BUND DEWATERING SYSTEM (1 L/S WITH LOW SHEAR VORTEX PUMP WITH OIL SENSITIVE DETECTION. "ENTEXOL SCS002" OR SIMILAR APPROVED INTEGRATED CLASS 1 FULL RETENTION OIL SEPARATOR WITH INDEPENDENT CERTIFICATION OF COMPLIANCE TO BS EN 858

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
0	13/06/18	ISSUED FOR PLANNING	TOR	RMG	DC	AD

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PROJECT
TIMAHOE NORTH SOLAR PROJECT

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DRAINAGE LAYOUT
SHEET 1 OF 5

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ESB INTERNATIONAL
One Dublin Airport Central,
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Web: www.esbinternational.ie
ESB International is a trading name of
ESBI Engineering & Facility Management Ltd
Registered Office: as above Registered in Ireland No. 155348

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T O'Rourke	R McGowan	D. Cody	A. Downey	13/06/2018
CLIENT REF		NO. OF SHTS	SIZE	SCALE
		1	A1	1:2500

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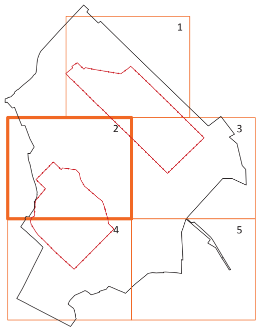

KEY PLAN

<u>Drainage Design Notes</u>

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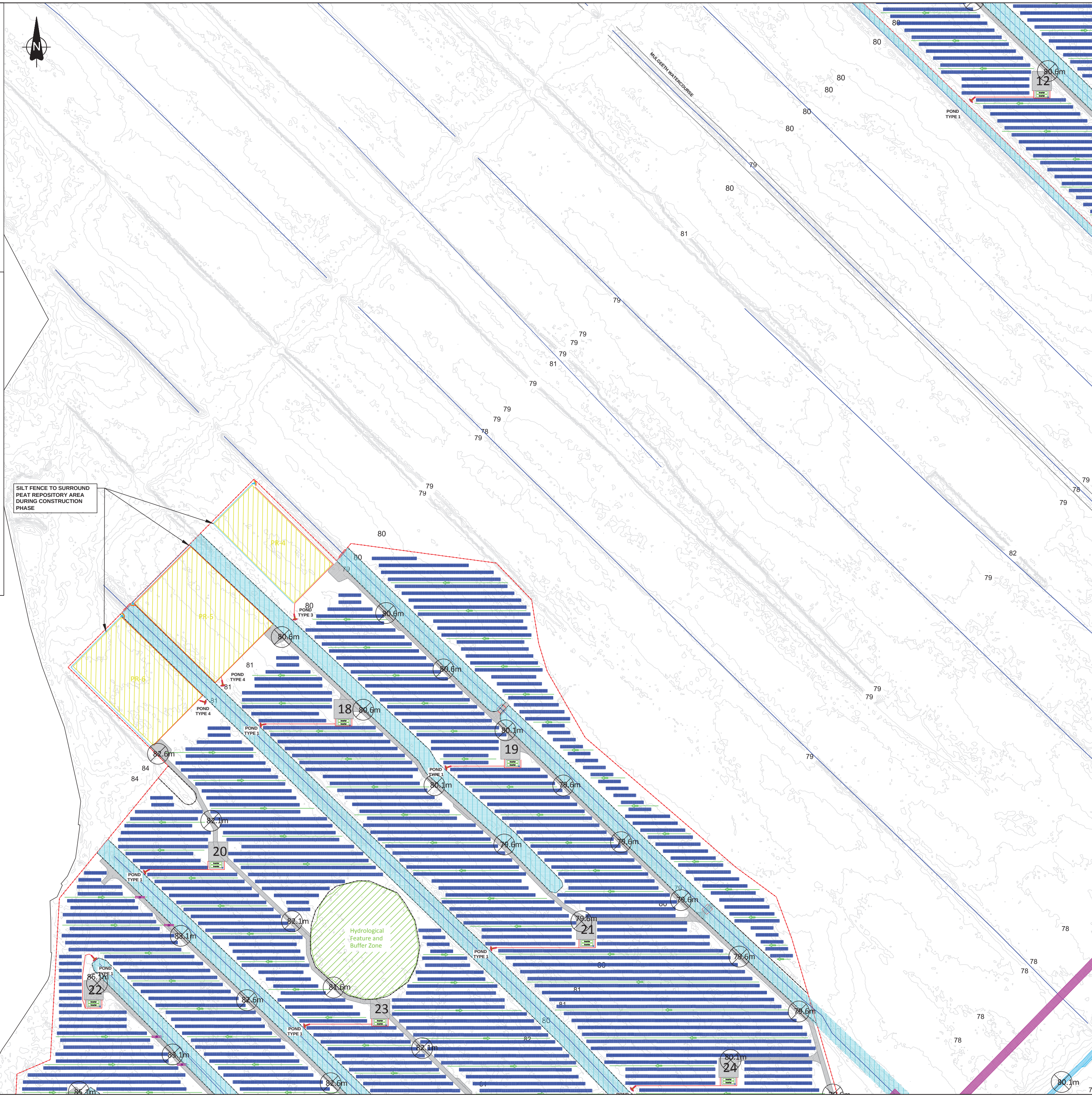

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		1	A1	1:2500

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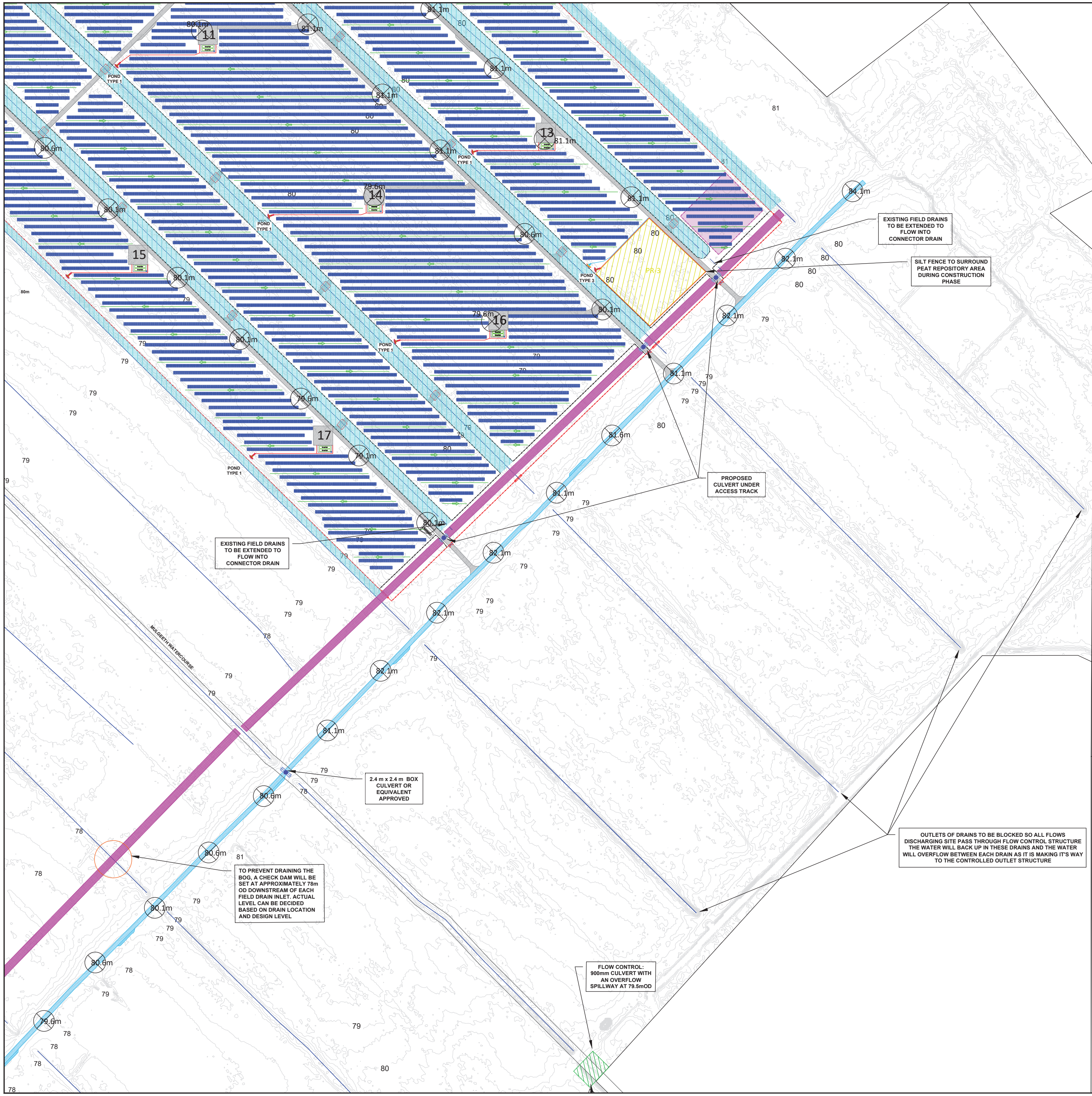

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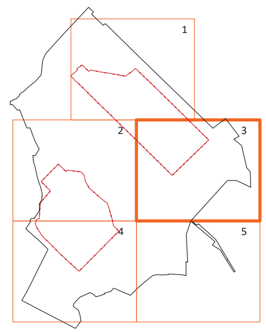

KEY PLAN

DRAINAGE DESIGN NOTES

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PROJECT
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T O'Rourke	R McGowan	D. Cody	A. Downey	13/06/2018
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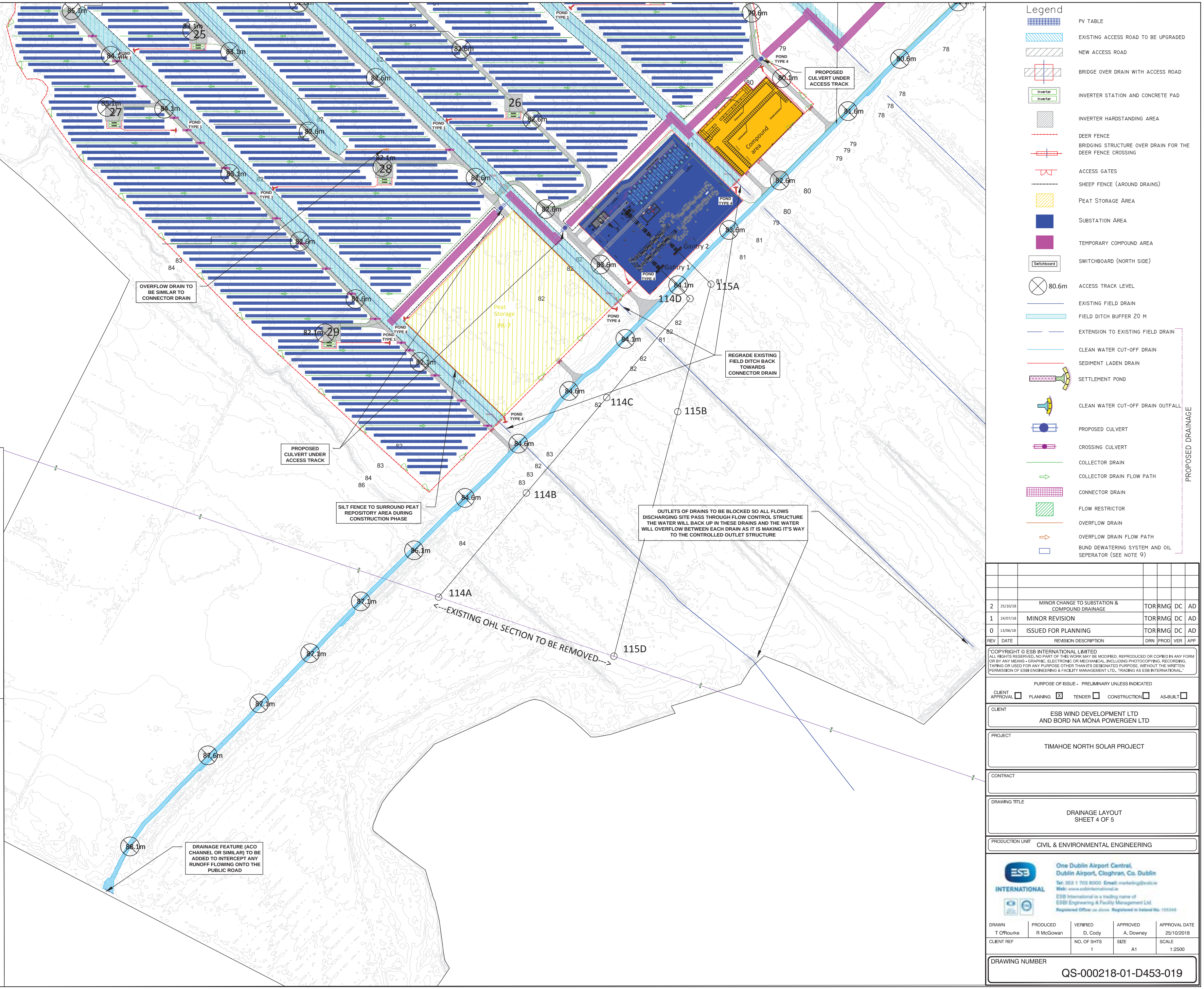
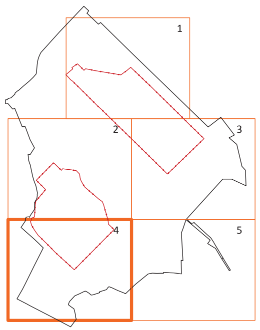
DRAWING NUMBER
QS-000218-01-D453-018





KEY PLAN

Drainage Design Notes

1. ALL DRAINAGE SUBJECT TO MICRO-SITING AND OPTIMISATION ON SITE.
2. LOCATIONS OF COLLECTOR DRAINS, CHECK DAMS, CULVERTS, SWALES, SETTLEMENT PONDS AND BUFFERED OUTFALLS/LEVEL SPREADERS ARE SHOWN AS INDICATIVE AND MAY BE CHANGED TO SUIT THE REQUIREMENTS OF THE LOCAL TOPOGRAPHY.
3. DOWN GRADIENT SLOPE BELOW BUFFERED OUTFALL/LEVEL SPREADER ONTO WHICH WATER WILL DISSIPATE TO HAVE A GRADE <6%.
4. SUPERVISING HYDROLOGIST OR ENVIRONMENTAL CLERK OF WORKS / ENVIRONMENTAL SCIENTIST TO OVERSEE INSTALLATION OF DRAINAGE FEATURES.
5. ALL DRAINAGE FEATURES SUBJECT TO INSPECTION & MAINTENANCE PLAN.
6. EROSION PROTECTION TO PREVENT SCOUR TO BE PROVIDED IN DRAINAGE CHANNELS WITH A CHANGE IN DIRECTION <130°, WHERE THE FALL EXCEEDS 1:40 AND AT ALL ROAD CROSSING CULVERT LOCATIONS, OR WHERE OTHERWISE DIRECTED BY THE SITE ENGINEER.
7. CONSTRUCTION PROCESSES THAT POSE RISK OF ACTIVATION OF SEDIMENT LADEN RUN-OFF TO BE HALTED DURING PERIODS OF EXTREME RAINFALL. NO EXCAVATION TO BE CARRIED OUT IN ADVANCE OF FORECASTED HEAVY RAINFALL.
8. MINIMISE STOCKPILING OF MATERIAL AND LOCATE ESSENTIAL STOCKPILES OUTSIDE BUFFER ZONES AND AS FAR AWAY AS POSSIBLE FROM WATERCOURSES.
9. "ENTEXOL SCS001" OR SIMILAR APPROVED OIL SENSITIVE BUND DEWATERING SYSTEM (1 L/S WITH LOW SHEAR VORTEX PUMP WITH OIL SENSITIVE DETECTION. "ENTEXOL SCS002" OR SIMILAR APPROVED INTEGRATED CLASS 1 FULL RETENTION OIL SEPARATOR WITH INDEPENDENT CERTIFICATION OF COMPLIANCE TO BS EN 858

REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
2	25/10/18	MINOR CHANGE TO SUBSTATION & COMPOUND DRAINAGE	TOR	RMG	DC	AD
1	24/07/18	MINOR REVISION	TOR	RMG	DC	AD
0	13/06/18	ISSUED FOR PLANNING	TOR	RMG	DC	AD

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT
ESB WIND DEVELOPMENT LTD
AND BORD NA MÓNA POWERGEN LTD

PROJECT
TIMAHOE NORTH SOLAR PROJECT

CONTRACT

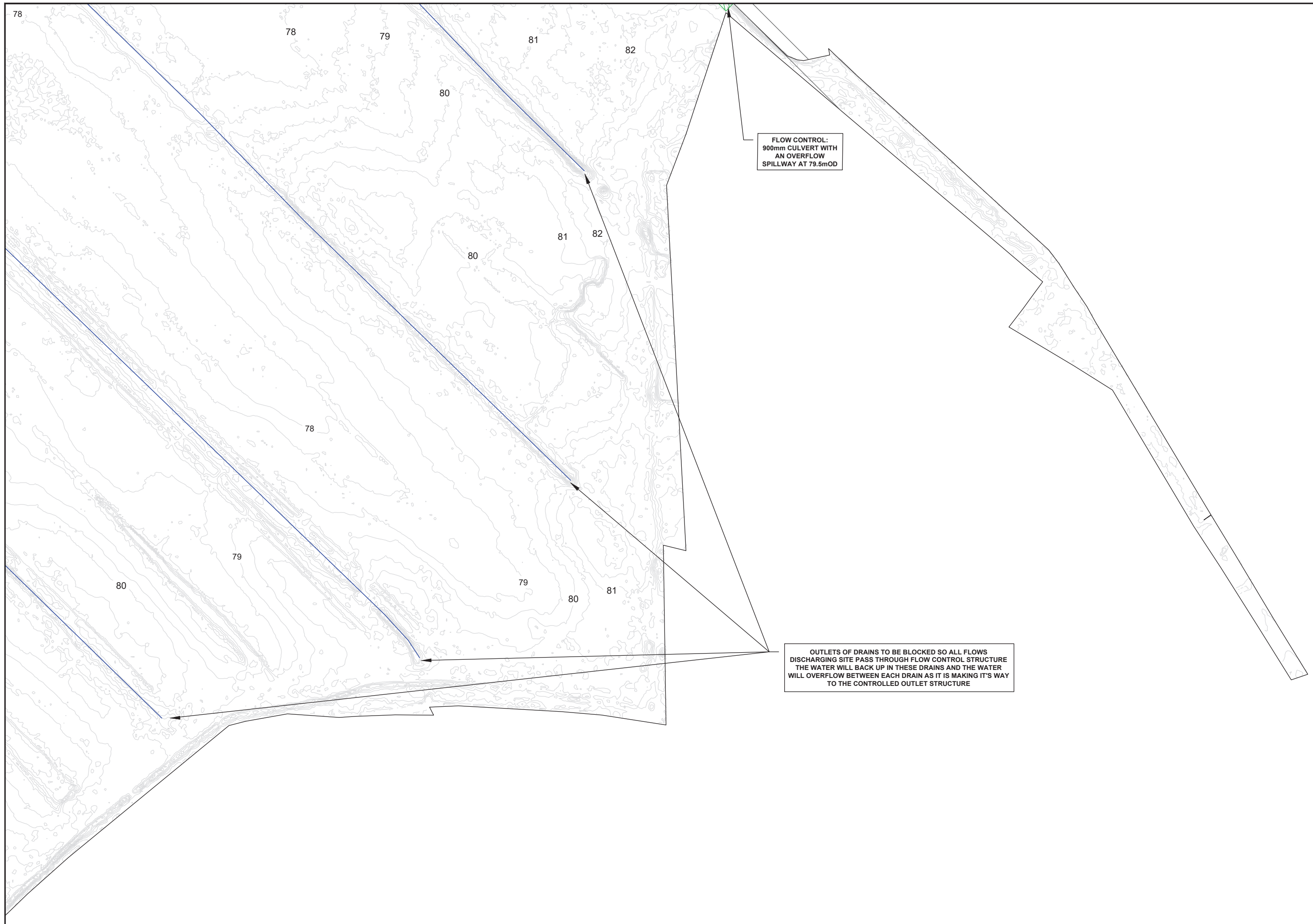
DRAWING TITLE
DRAINAGE LAYOUT
SHEET 4 OF 5

PRODUCTION UNIT CIVIL & ENVIRONMENTAL ENGINEERING

ESB INTERNATIONAL
One Dublin Airport Central,
Dublin Airport, Cloghran, Co. Dublin

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
T O'Rourke	R McGowan	D. Cody	A. Downey	25/10/2018
CLIENT REF		NO. OF SHTS	SIZE	SCALE
		1	A1	1:2500

DRAWING NUMBER
QS-000218-01-D453-019

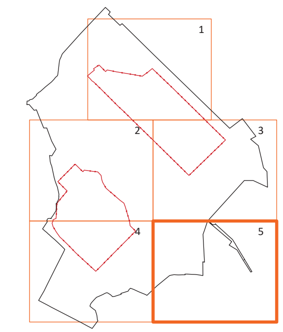


Legend

- PV TABLE
- EXISTING ACCESS ROAD TO BE UPGRADED
- NEW ACCESS ROAD
- BRIDGE OVER DRAIN WITH ACCESS ROAD
- INVERTER STATION AND CONCRETE PAD
- INVERTER HARDSTANDING AREA
- DEER FENCE
- BRIDGING STRUCTURE OVER DRAIN FOR THE DEER FENCE CROSSING
- ACCESS GATES
- SHEEP FENCE (AROUND DRAINS)
- PEAT STORAGE AREA
- SUBSTATION AREA
- TEMPORARY COMPOUND AREA
- SWITCHBOARD (NORTH SIDE)
- 80.6m ACCESS TRACK LEVEL
- EXISTING FIELD DRAIN
- FIELD DITCH BUFFER 20 M

PROPOSED DRAINAGE

- EXTENSION TO EXISTING FIELD DRAIN
- CLEAN WATER CUT-OFF DRAIN
- SEDIMENT LADEN DRAIN
- SETTLEMENT POND
- CLEAN WATER CUT-OFF DRAIN OUTFALL
- PROPOSED CULVERT
- CROSSING CULVERT
- COLLECTOR DRAIN
- COLLECTOR DRAIN FLOW PATH
- CONNECTOR DRAIN
- FLOW RESTRICTOR
- OVERFLOW DRAIN
- OVERFLOW DRAIN FLOW PATH
- BUND DEWATERING SYSTEM AND OIL SEPERATOR (SEE NOTE 9)



KEY PLAN

Drainage Design Notes

1. ALL DRAINAGE SUBJECT TO MICRO-SITING AND OPTIMISATION ON SITE.
2. LOCATIONS OF COLLECTOR DRAINS, CHECK DAMS, CULVERTS, SWALES, SETTLEMENT PONDS AND BUFFERED OUTFALLS/LEVEL SPREADERS ARE SHOWN AS INDICATIVE AND MAY BE CHANGED TO SUIT THE REQUIREMENTS OF THE LOCAL TOPOGRAPHY.
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REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
0	13/06/18	ISSUED FOR PLANNING	TOR	RMG	DC	AD

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT
ESB WIND DEVELOPMENT LTD
AND BORD NA MÓNA POWERGEN LTD

PROJECT
TIMAHOE NORTH SOLAR PROJECT

CONTRACT

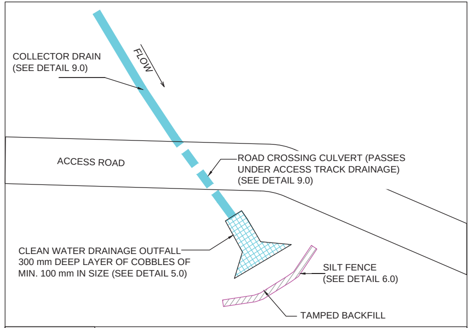
DRAWING TITLE
DRAINAGE LAYOUT
SHEET 5 OF 5

PRODUCTION UNIT CIVIL & ENVIRONMENTAL ENGINEERING

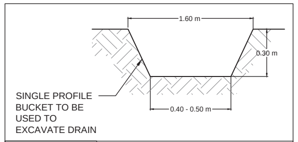
J:\CAD Directory\00 - AutoCAD Standard Objects\Logos\Airport_2017_Logo\ESBI Title Blocks A0 A1 L P.jpg

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
T O'Rourke	R McGowan	D. Cody	A. Downey	13/06/2018
CLIENT REF		NO. OF SHTS	SIZE	SCALE
		1	A1	1:2500

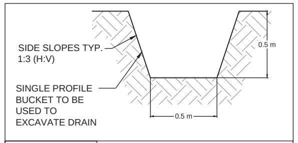
DRAWING NUMBER
QS-000218-01-D453-020



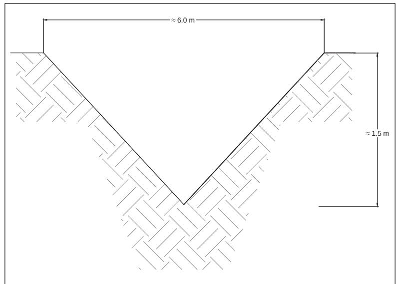
DETAIL 1.0 | **COLLECTOR DRAIN, ROAD CROSSING AND OUTFALL DETAILS**



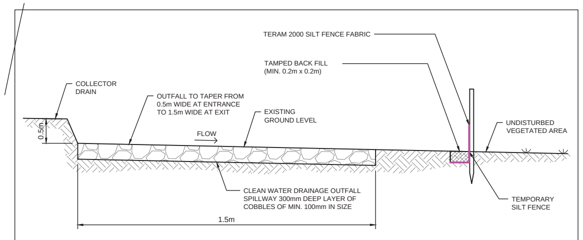
DETAIL 2.0 | **COLLECTOR DRAIN**



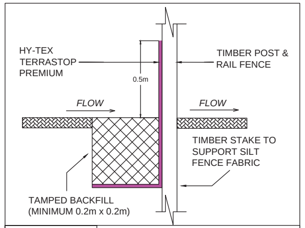
DETAIL 3.0 | **SEDIMENT LADEN/CLEAN WATER CUT-OFF DRAIN**



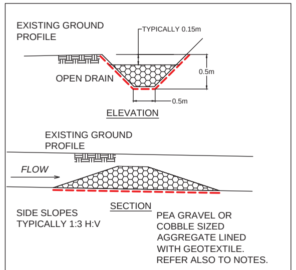
DETAIL 4.0 | **CONNECTOR DRAIN**



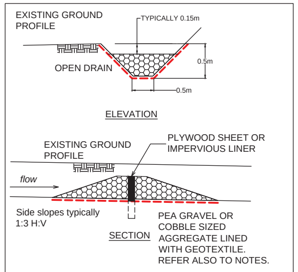
DETAIL 5.0 | **CLEAN WATER CUT-OFF DRAIN OUTFALL DETAIL**



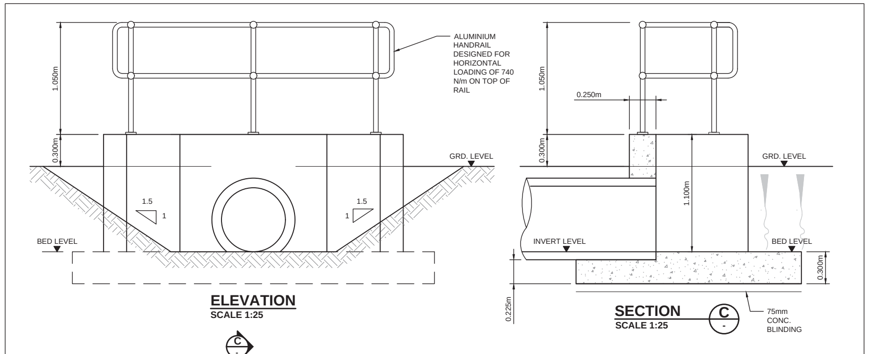
DETAIL 6.0 | **SILT FENCE**

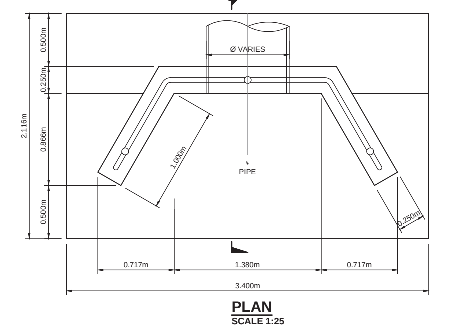


DETAIL 7.0 | **V-NOTCH DRAIN CHECK DAM**

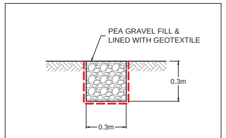


DETAIL 8.0 | **V-NOTCH DRAIN CHECK DAM WITH IMPERVIOUS LINER**

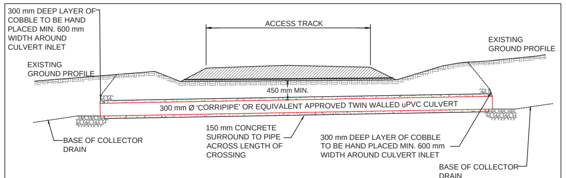




DETAIL 10.0 | **HEADWALL DETAIL**



DETAIL 11.0 | **SILT TRAP**



DETAIL 9.0 | **COLLECTOR DRAIN ACCESS TRACK CROSSING DETAIL**

GENERAL DRAINAGE NOTES:

1. ALL DRAINAGE SUBJECT TO MICRO-SITING AND OPTIMISATION ON SITE.
2. LOCATIONS OF COLLECTOR DRAINS, CHECK DAMS, CULVERTS, SWALES, SETTLEMENT PONDS AND BUFFERED OUTFALLS/LEVEL SPREADERS ARE SHOWN AS INDICATIVE AND MAY BE CHANGED TO SUIT THE REQUIREMENTS OF THE LOCAL TOPOGRAPHY.
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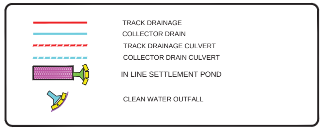
LEGEND:



REV	DATE	REVISION DESCRIPTION	DRN	PROD	VER	APP
0	13/06/2018	ISSUED FOR PLANNING	RK	RMG	DC	AD

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT
ESB WIND DEVELOPMENT LTD
AND BORD NA MÓNA POWERGEN LTD

PROJECT
TIMAHOE NORTH SOLAR PROJECT

CONTRACT

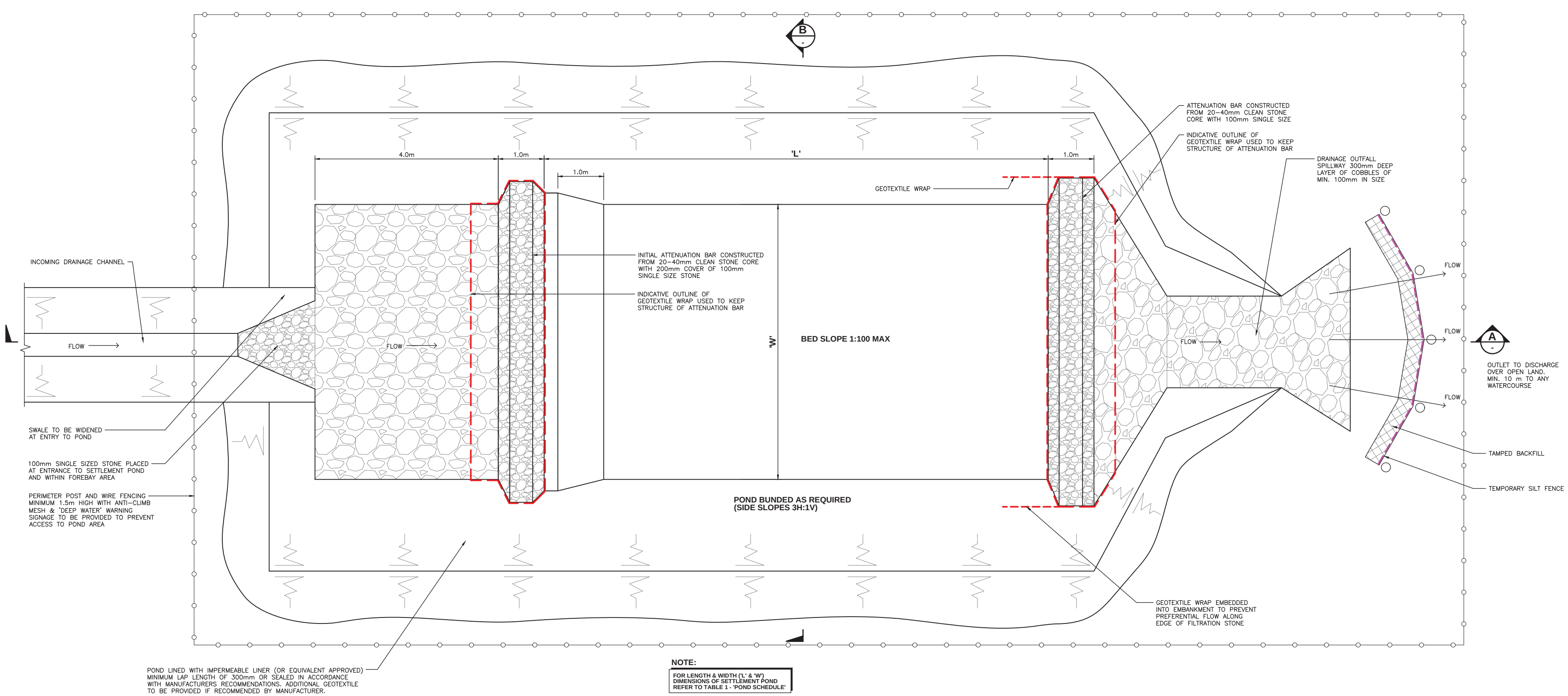
DRAWING TITLE
DRAINAGE DETAILS

PRODUCTION UNIT CIVIL & ENVIRONMENTAL ENGINEERING

ESB INTERNATIONAL
One Dublin Airport Central,
Dublin Airport, Cloghran, Co. Dublin
Tel: 353 1 703 8000 Email: marketing@esbi.ie
Web: www.esbinternational.ie
ESB International is a trading name of
ESBI Engineering & Facility Management Ltd
Registered Office: as above Registered in Ireland No. 155249

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
R KELLY	R McGowan	D. Cody	A. Downey	13/06/2018
CLIENT REF		NO. OF SHTS	SIZE	SCALE
		1	A1	N.T.S

DRAWING NUMBER
QS-000218-01-D453-021

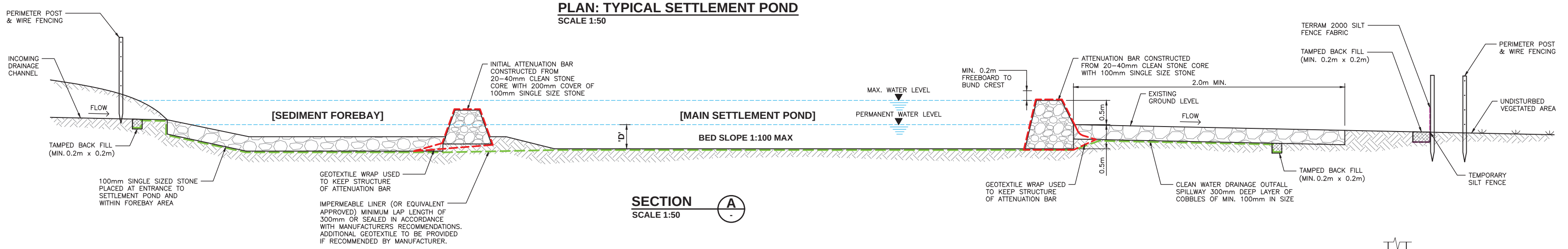


NOTE:

FOR LENGTH & WIDTH ('L' & 'W') DIMENSIONS OF SETTLEMENT POND REFER TO TABLE 1 - 'POND SCHEDULE'

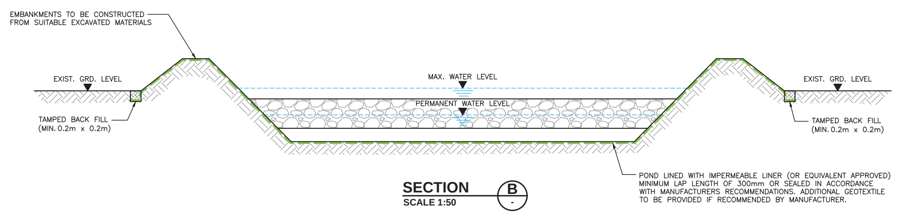
PLAN: TYPICAL SETTLEMENT POND

SCALE 1:50



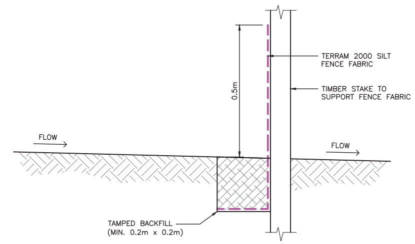
SECTION A

SCALE 1:50



SECTION B

SCALE 1:50



TYPICAL SILT FENCE DETAIL

SCALE 1:10

TABLE 1:

POND SCHEDULE				
ITEM	POND TYPE	WIDTH (m)	LENGTH (m)	DEPTH (m)
	1	2	10	0.5
	2	3.5	17.5	0.5
	3	7.0	35	0.5
	4	9.0	45	0.5

NOTES:

1. NO DEWATERING OF EXCAVATIONS SHALL PROCEED BEFORE A POND HAS BEEN CONSTRUCTED.
2. ALL PUMPED WATER TO DISCHARGE VIA A SILT BAG, PRIOR TO DISCHARGE TO PONDS.
3. MAX. ALLOWABLE GRADIENT OF 1:100 ACROSS POND.
4. 'DEEP WATER' SIGNAGE & LIFE BUOY TO BE PROVIDED.

GENERAL DRAINAGE NOTES:

1. ALL DRAINAGE SUBJECT TO MICRO-SITING AND OPTIMISATION ON SITE.
2. LOCATIONS OF INTERCEPTOR DRAINS, CHECK DAMS, CULVERTS, SWALES, SETTLEMENT PONDS AND BUFFERED OUTFALLS/LEVEL SPREADERS ARE SHOWN AS INDICATIVE AND MAY BE CHANGED TO SUIT THE REQUIREMENTS OF THE LOCAL TOPOGRAPHY.
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0	13/06/18	ISSUED FOR PLANNING	RK	RMG	DC	AD

PURPOSE OF ISSUE - PRELIMINARY UNLESS INDICATED

CLIENT APPROVAL ☐ PLANNING ☒ TENDER ☐ CONSTRUCTION ☐ AS-BUILT ☐

CLIENT: ESB WIND DEVELOPMENT LTD AND BORD NA MÓNA POWERGEN LTD

PROJECT: TIMAHOE NORTH SOLAR PROJECT

CONTRACT:

DRAWING TITLE: SETTLEMENT POND DETAILS

PRODUCTION UNIT: CIVIL & ENVIRONMENTAL ENGINEERING

ESB INTERNATIONAL
One Dublin Airport Central, Dublin Airport, Cloghran, Co. Dublin
Tel: 353 1 703 8000 Email: marketing@esbi.ie
Web: www.esbinternational.ie
ESB International is a trading name of ESB Engineering & Facility Management Ltd
Registered Office: as above Registered in Ireland No. 155349

DRAWN	PRODUCED	VERIFIED	APPROVED	APPROVAL DATE
R KELLY	R McGowan	D. Cody	A. Downey	13/06/2018
CLIENT REF		NO. OF SHTS	SIZE	SCALE
		1	A1	N.T.S

DRAWING NUMBER: QS-000218-01-D453-022

Appendix B: Foul Water Calculations

			PROJECT Timahoe North Solar Farm		
			CALCULATION TITLE Foul Water Volumes Generated		
Calc Sheet No. 1 of 1	Document No.	Calculation by R.McGowan	Date 15/01/2018	Verified by D. Cody	Date 12/06/2018

Ref	Calculations	Output

Foul Water Volumes Generated

Personnel Generated Foul Waste

Use	Loading (Litres)	Frequency per day	Foul Waste Generated (litres)
WC Flush	6	4	24
WHB	1	4	4
Sink	0.6	4	2.4
Total Foul Loading for 1 PE			30.4

Annual Water Demand (No. operatives for 4 * 3 days per wk)

No. Operatives	12	52	weeks

Total Foul Loading Per Annum (litres)	**18,970**

Automatic Flush Generated Foul Waste

Use	Loading (Litres)	Frequency per	Foul Waste
Auto WC	6	2	12

Annual Automatic Flush demand from WC	1,248

Total Foul Loading Per Annum (litres)	**20,218**

Note: No allowance made for human consumption which would generally constitute a 10% reduction on the PE related foul loading.

Foul Holding Tank Capacity	18,000	litres

Tank Emptied once every 6 months
Note: Tank will have a high level alarm fitted

Capacity of Tank with routine emptying (litres)		**36,000**

Capacity >> Foul Water Generated

Tank Sufficiently Sized

Appendix C: Potable Water Calculations

			PROJECT Timahoe North Solar Farm		
			CALCULATION TITLE Potable Water Volumes Generated		
Calc Sheet No. 1 of 1	Document No.	Calculation by R.McGowan	Date 15/01/2018	Verified by D. Cody	Date 12/06/2018

Ref	Calculations	Output

Potable Water Demand in Proposed Development

Personnel Demand for Potable Water

Use	Loading	Frequency	Foul Waste
WC Flush	6	4	24
WHB	1	4	4
Sink	0.6	4	2.4
Total Foul Loading for 1 PE			30.4

Annual Water Demand (4 operatives for 3 days per wk) 18,970

Automatic Flush Generated Foul Waste

Use	Loading	Frequency	Foul Waste
Auto WC Flush	6	2	12

Annual Automatic Flush demand from WC 1,248

Total Potable Water emand Per Annum (litres)	**20,218**