Appendix 4-3

Construction Methodology

Timahoe North Solar Farm

Construction Methodology

ESB Wind Development Ltd and Bord na Móna Powergen Ltd.

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Sept 2018	03	K. McCloy	Amendments to project phasing
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1 Project Construction

1.1 Scope

Construction will principally involve the following:

- Tree felling will be completed as part of advance works to enable construction
- Construction of site entrances, upgrade of existing access track and construction of new access tracks throughout site
- Establishing temporary site facilities including site offices, car parking, construction laydown and storage areas
- Two temporary compounds/laydown areas
- Earthworks and drainage for the provision of solar panel access, inverter pads and the Substation
- Insert piles to support framework for solar panels
- Reinstatement of cable trenches and track edges
- Works to facilitate delivery of solar panels and frames to site
- Erection of frames and fitting of solar panels
- Installation of underground DC cabling from panels to main inverter
- Installation of underground AC cabling from each main inverter to the 110 kV Substation
- Deer fencing which will be erected around the perimeter of the site for safety and security
- Erect infra-red activated security cameras
- Access track leading to the electrical substation.

Further to the above, the following will be undertaken:

- Excavation of peat from 110 kV sub-station area and aggregate up fill to proposed levels
- Construction of 110 kV substation and surrounding infrastructure
- Connection to existing 110kV line within the site
- Hardstand area constructed within the sub-station area for battery storage.

1.2 Construction Environmental Management Plan

The contractor appointed to carry out construction works for this project will be required to prepare a site specific Construction Environmental Management Plan (CEMP) for work within the scope. The CEMP will identify the staff responsible as well as the steps and procedures that will be implemented to minimize the environmental impacts resulting from the site preparation, groundworks and plant erection and commissioning phases of the project.

Approval and ongoing auditing by the Developer of this Plan will be a feature of the contract.

The following outlines, as a minimum, the features required in the CEMP.

- Introduction including background details to contract and the parties involved
- Contractor's environmental policy and procedures
- Contractor's management structure which will identify the project management structure and clearly identify the roles and responsibilities with regard to managing and reporting on the construction phase environmental aspects
- An Environmental Risk Assessment and Risk Register together with the management controls proposed to eliminate and/or minimise the identified impacts
- A Geotechnical Risk Register (GRR) to monitor the risks and risk reduction strategies proposed as part of the detailed design for the floated access tracks and hardstandings

- Proposals on Environmental Training including site induction training, specialist environmental training and toolbox talks
- Procedures for Method Statements / Permits to Work, to incorporate any CEMP requirements relevant to the work
- Monitoring, auditing and reporting
- Contractor's procedures and scope for daily monitoring, weekly auditing and reporting on CEMP
- Procedures for handling external communications/ complaints, liaison including the development and maintenance of a clear audit trail
- Procedures for monitoring and recording environmental performance and disseminating the environmental information
- Procedures for addressing non-compliance and corrective actions
- Procedures for dealing with major incidents
- The operation of the Plan will be supervised on a daily basis by the resident supervisory staff augmented by regular audits by visiting staff.

1.3 Site Management

A full construction management team will be deployed on site in accordance with routine site construction procedures. This team will consist of a Resident Site Manager and Assistant Engineers as appropriate.

An Ecological Clerk of Works, who will be supported by an independent Project Ecologist, will be appointed for the duration of the works so as to ensure compliance of ecological mitigation measures.

A Geotechnical Supervisor, supported by a Geotechnical Engineer as appropriate, will be part of the site staff when required.

All construction works will be carried out under appropriate supervision. Works will be carried out by experienced contractors using appropriate and established safe methods of construction. All requirements arising from statutory obligations including the Safety, Health and Welfare at Work Act and associated regulations will be met in full.

2 Temporary site facilities

All temporary facilities will be fully removed upon project completion and the hardstanding left in place to revegetate naturally**.**

2.1 Contractor's Compounds

A suitably surfaced contractor's main compound 1 and laydown area will be provided for offices, equipment storage and construction staff welfare facilities for the duration of the site works, can be seen in drawing no. QS-000218-01-D453-007. Due to the scale of the project an additional holding storage area compound 2 will be constructed on the north east area of the site but will only be used for storage of construction material until it is fixed in place. Compound 2 will be removed after northern area of the site is complete and solar panels constructed over the area, this area can be seen in drawing no. QS.000218-01-D453-008.

Portable cabin structures will be used to provide temporary site offices, the layout for which is shown on the Module layout drawing. These will be managed and serviced on a weekly basis or more frequently if required, and will be removed from the site on completion of the construction phase.

Container storage units will be provided for holding tools and materials. The compound will be fenced with chain-link fencing on wooden posts and will have a lockable gate.

A potable water supply will be provided by a water tanker or by means of borehole.

Foul sewage from the temporary facilities will be routed to covered watertight tanks designed for receiving and storing sewage with no outlet. The tanks will be sized to suit the expected use and will be installed in a location remote from watercourses. Contents and residues will be regularly emptied by a competent operator for safe disposal to an approved treatment works. With high water tables the tanks will be calculated at design stage to omit the buoyancy risk.

The contractor may provide temporary storage and sanitary facilities at inverter hardstands and other construction areas during the construction period.

Portable generators will also be provided to facilitate commissioning of the site.

2.2 Vehicle Wheel Wash

A designated vehicle wheel wash area will be created adjacent to the main site entrance where all HGV's will be cleaned prior to leaving the site are deemed necessary.

The wheel wash will be a proprietary wheel wash approved by the Resident Site Engineer. Wash water will not be allowed to enter local watercourses and will enter a dedicated lagoon where any accumulated resultant sludge will be removed from site by a fully licenced contractor holding relevant waste collection and disposal permits.

2.3 Control of Oils & Fuel

Oils and fuels will be used in plant and equipment during the construction phase, and the following procedures will be implemented for on-site storage of fuels, lubricants and hydraulic fluids used on the construction site:

- Storage of fuels, lubricants and hydraulic fluids will occur mainly at the contractor's compound(s), which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorised access or vandalism. Any fuels, lubricants or hydraulic fluids not stored in bunded tanks will be stored within bunded containers
- The storage area within the compound will contain a small bund lined with an impermeable membrane in order to prevent any contamination of the surrounding soils and vegetation and of groundwater, the location of this area will be decided at construction stage
- Selection of the location for storage of fuels, lubricants and hydraulic fluids will be based on the following:
    - It will be remote from surface drains and watercourses
    - It will be readily visible for supervision and inspection
    - It will be readily accessible for filling and maintenance
    - It will be protected against accidental impact.
- The bund will have capacity of at least 110% of the largest tank accommodated or 25% of the total maximum capacities of all tanks, whichever is the greater, where more than one tank is installed. They will be constructed and managed in accordance with the EPA Guideline, Bunding and Spill Management (2007)
- Outside the contractor's compound(s) there will be short-term storage of fuels in bunded tanks for diesel generators used on site.

The following procedures will be implemented during construction operations:

- Fuels and oils will be carefully handled to avoid spillages
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and disposed of appropriately
- Any waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or recycling
- As a minimum, simple spill protection equipment that will be held locally will include specialist absorbent mats / pillows and granules for containment / clean-up of oil. Adequate quantities will be held in stock and be available for immediate use
- Appropriate spill control equipment, such as oil soakage pads, will be available on site to deal with any accidental spillage and emergency response procedures will be put in place
- Designated contractors' personnel will be trained and certified in oil spill control and clean up procedures and in the proper and safe disposal of any waste generated through such an event
- All maintenance and servicing of mobile plant will take place in designated control areas to be decided at design stage.

3 Construction Information

3.1 Construction Phase

The solar farm installation will have a construction period of approximately 20 months to complete, provided that conditions are favourable.

3.2 Pre-Construction Works

Prior to commencement of the construction phase of the proposal, a geotechnical site investigation will be undertaken in order to confirm the findings of preliminary studies.

3.2 Enabling Works

Prior to main construction works there will be a period of approx. 6 months of site preparation, clearance of forestry and vegetation which is required to be removed to enable main construction works to proceed. This may also include preparing the perimeter and erecting where necessary a temporary fence. Temporary welfare amenities for construction workers will be installed close to the substation area during this period. A Percentage of access tracks will be constructed at this stage to facilitate enabling works. Finally, some of the initial drainage works may be carried out.

3.3 Main Construction period

The final programme will be developed in consultation with the Project Supervisor Construction Stage, based on availability of plant, materials and projected delivery dates, and should be completed in approximately 20 months duration.

The Works shall include the following activities:

- Erection of fences & gates
- Preparation of onsite tracks and laydown areas.

- Restoration of existing drainage and installation of new site drainage works
- Construction of inverter pads
- Installation of piling for the panel supports
- Delivery of panels, frames, centralised electrical stations
- Installation of frames and panels
- Construction of 110 KV Substation
- Cable trenching and cable laying
- Erection of security cameras
- Installation of centralised electrical stations
- Commissioning of the panels and grid connection
- Site reinstatement and ecological enhancement
- Demobilisation from site.

Construction works will be undertaken in approximately the order listed above. However many of the tasks would be undertaken concurrently in order to minimise the duration of this phase.

3.3 Working Hours

Construction work will be scheduled to only occur between the hours of 07:00 to 19:00 on Monday to Friday and 07:00 to 13:00 on Saturday. Construction activities will be restricted to this times except where the nature of particular specialist works requires continuous working for a longer periods. Any such exceptions will be agreed in advance with the local authority.

4 Construction Phase Works

The construction phase works would comprise of all those elements described in Section 3.1. A description of these is given below.

4.1 Fencing, gates and security cameras

In order to secure the site during the construction phase, the fencing and gates will be installed first for the safety of the workers and public. The permanent site entrance shall be designed to ensure that appropriate sightlines are provided. It will consist of a double leaf security gate constructed of low visual impact fencing in a similar style to the security fence.

There will be several other gates to allow access to various parts of the site whilst preserving safety and security. These gates would be constructed of similar design to fencing to create low visual impact.

The fencing will be constructed using 2 m high deer fencing around the area of the solar panels, with wildlife flaps inserted to allow animals to pass in and out of the site, shown Figure 1. The substation will be fenced around using palisade fencing.

A number of discreet security cameras may be mounted at various points around the site. There will be no requirement to light the solar farm over night as the security cameras will be infra-red sensitive. The camera will not point toward the external area of the site towards any external landowners or dwellings. Shown in Figure.2.

Figure 1 **Deer fencing for perimeter fence**

Figure 2 **CCTV camera**

4.2 Onsite Tracks and Laydown Areas

The access track network required throughout the site to facilitate construction of the solar farm and substation will extend to approximately 3.5 km of main access tracks, approximately 12 km of spur tracks and an amenity trackway of approximately 2.0 km in length.

Construction will be to standards that meet the criteria for load carrying capacity of the ground over which the tracks will pass, for the axle loads of the vehicles and the total number of vehicles during the construction period.

Crossings of drains and minor watercourses will be by culverts. These will be suitably designed for base flows and peak flows, with a minimum size to avoid occurrence of blockages and build-up of discharges

and to avoid increased flow velocities with the potential to cause erosion. They will also be designed in accordance with the requirements of IFI's Requirements for the Protection of Fisheries Habitats during Construction and Development works at River Sites.

Investigations have indicated that an adequate strength of formation will generally be achieved using floating tracks on existing topography. The tracks will generally be formed by placing a layer of geotextile membrane on the existing surface and road make up with coarse granular fill followed by a 100 mm layer of fine gravel. An average overall thickness of about 400 mm - 750 mm is envisaged.

In areas where the peat does not make the required CBR ratings for floating track, excavate and replace method will be used, where the peat material is excavated and rock up fill is used to fill up to road formation level. Excavated peat material will be transported to peat repositories for permanent storage and areas were levels are permissible peat will be side casted and revegetated to side of access tracks.

Excavated material in the area of the substation permanent hardstanding will consist of peat material. The material will be placed in peat deposition areas around the site. Some of the excavated material will be reused at the edges of the track with the remainder being stored in deposition areas.

Trackside drainage will be provided within the excavated width and will discharge into silt ponds at regular intervals. The resulting discharge will be of an appropriate quality for release into the general drainage of the site.

A construction compound will be established in the South West area of the site beside the substation compound to facilitate temporary accommodation for construction phase, and also as contractor laydown area for material storage for HGV deliveries. The layout of the compound/laydown area is shown on the layout drawings. Although many deliveries will conform to a 'just in time' concept, where it is not possible to apply this approach, deliveries will be stored at this compound until they are ready to be installed on site. Smaller vehicles will then be used to transport divisible items to the appropriate locations within the site itself.

A second temporary holding area will be constructed on the north east side of the site which will be used to accommodate temporary welfare facilities. It will also be used as a secondary storage compound where necessary.

Construction traffic will access the site via an existing entrance off the Derrymahon Road. The main access track will be an upgrade of existing track and extend to the middle of the site, adjacent to the substation area. The design of the scheme requires additional track to be constructed. It will be a permanent track to facilitate access to the electrical substation and inverters and also to access different parts of site for panel maintenance. The extent of new track is shown on the module layout drawing and a cross-section showing its proposed composition is included in the track sections shown in drawing no QS-000218-01-D453-005.

Only small tracked vehicles and construction staff will be required to work between the rows of panels and as such no special provision of tracks will be required in these areas, unless for temporary track for construction processes and maintenance, type of temporary track to be used will be specified in detailed design stage.

4.3 Inverter pads

Inverter pads, which comprise level hardstandings of approximately 20 m x 25 m in size, are required adjacent to each central inverter base for the operation and assembly of the inverter components. The specification of these areas will be decided at detailed design stage and will be dictated by the local ground conditions and the load being imposed by lifting operations.

4.4 Installation of Centralised Electrical Inverter Units

The centralised electrical inverter stations may be prefabricated and delivered to site as single items or alternatively delivered separately and configured onsite. The peat in the area of the central inverter's will be excavated and up filled with rock and compacted to proposed level which will be dictated by flood risk assessment. Alternatively a piled foundation solution may be used to minimise the excavating of peat. A concrete or steel platform will then be formed for the components of the inverters to be assembled on. Shown Figure 3 below.

Figure 3 Rock fill with concrete plinth foundation and Piled alternative

Approximately twenty nine centralised electrical stations, each housing an inverter and a transformer, will be situated at strategic locations around the site. The developer wishes to retain the option to substitute the centralised inverters with a number of discrete string-inverter boxes, which would be mounted to the frames beneath the panels, this choice depending on the final electrical design configuration.

The electrical inverters will be delivered to site on Hiab lorries and set into place on the inverter pads by the means of small crane lift or the Hiab lorry.

4.5 Installation of piled foundations

Timahoe North site is situated in a disused peat bog which was historically used for peat harvesting to supply power stations. According to site investigation and historical records the site has peat depths of 0.3 m and up to 4.5 m.

The lightweight solar panel frames will be supported by mini piled foundations to a depth to achieve suitable bearing capacity below the peat layer for the forces calculated on the foundations. The number of piles driven on site will be predetermined by on site trials, but from the interim foundation design it has been calculated that there will be approximately 100,000 piles inserted to support the solar tables. See foundation methodology report for the different options which have been considered for the project.

Tracked dumpers and tracked trailers will be used to transfer materials around the site and where there is suitable bearing stratum double wheeled vehicles will also be used for transport of materials from the holding areas to the work areas. See figure 4.

Figure 4 Tracked dumper and trailer

Mini piling rigs will travel on top of the vegetated peat surface and will be used to drive the mini piles into the underlying soils, to a suitable embedment depth to support frames.

It is envisaged that piling will be executed in the areas of deeper peat using a wide track piling machine of approx. 14 tonnes. Detailed strategic planning will be required at piling stage to ensure minimal passes across the peat and ensure disruption to peat surface is kept to a minimum.

Temporary support in the form of bog mats/temporary matting will be used to support machines to execute piling and transfer of materials in areas where the soil is of poor stability.

The exact dimensions and spacing of piles will be determined at detailed design stage following calculations incorporating appropriate factors of safety will be considered. These will be based on detailed geotechnical investigations, which will include exploratory boreholes as necessary across the site with associated sampling and laboratory testing. The depth of individual piles will vary according to the depth to competent subgrade.

4.6 Installation of frame and panels

A final choice of solar panel manufacturer has yet to be made as a selection of a supplier would be premature at this stage of the project due to ongoing fluctuation in prices and availability of PV equipment. Therefore some of the specifications included in this chapter are indicative and may be subject to slight variation depending on the selection of a particular design of panel. The planning authority will be fully advised of any variation and in the unlikely event of any of a significant change further approval would be sought. The indicative design however is the most likely scenario at the time of application for planning consent and this proposal includes:

- Up to 400,000 solar panels will be installed, mounted on fixed frames at an angle of approximately 20-25 degrees with an anticipated height not greater than 3.0 m
- The PV panels will be bolted on top of the frames to hold them securely in place, connected to DC cable using the frame work to enclose the required cabling. The contractor may adopt a “Just in Time“ system of delivery to site with a number of HGV deliveries of frames and panels or an early delivery system with storage of components on site until required
- Equipment will be shipped to Ireland either to an intermediate location, such as a shipyard, where it will be stored until required, or directly to site. For “Just in Time” type delivery, equipment will arrive on site the week it is required and solar components will be delivered to the site on HGV transporter vehicles.

4.7 Cable Laying

Panels within rows will be connected by cabling running through conduit in the mounting frame. The PV arrays would then be connected together by DC cables buried in ca. 700 mm deep trenches, excavated by wide track bog master type excavators, but where possible, track type trenchers will be used to minimise peat excavation. Peat from excavations will be used to backfill trenches were possible, any excess peat will levelled in lower contour areas.

Beyond the centralised electrical stations, AC internal collector cable systems will be required and these will be placed in trenches approximately 800 mm deep and located as best as possible along the access track to minimise trenching through the solar panel areas. The cables along the track can be laid in ducting or direct buried in trenches in the original peat ground and over filled with sand and marker tapes to the cable designer's specification and the excavated peat backfilled to ground level. This will be done by a wide track excavator.

Where the ground conditions are permissible the internal collector cable system will be direct buried along designated routes from the inverter units back to the substation. In areas of deep peat and localised ground condition variations there may be a requirement to stabilise cables using a rafting or wrapping detail which will be developed by the installation contractor during the detailed design and installation.

Where appropriate, the vegetation and top 150 mm of soil will be stripped and laid beside the trench, and used to reinstate to original ground level immediately after the cables have been installed. Details of the trench construction are shown on the floated road design and typical cable drawing.

The crossing of streams and rivers will be carried out by open trench method or trenchless methods. The single stream within Timahoe North Bog is the Mulgeeth stream. The open trench method of crossing streams and rivers can be carried out by "damming and fluming" method or "damming and pumping" method. The method adopted at particular locations will be implemented only with the approval of IFI. The construction will take place outside the salmon spawning period from October to April unless otherwise agreed with IFI locally.

4.8 Commissioning of the Panels and Grid Connection

The testing and commissioning of the proposed photovoltaic plant would be undertaken by the solar contractor and an appointed electrical engineer based on standard industry procedures.

5 Site Drainage

During its commercial use for peat extraction for use in power plants a network of drains were formed to allow for harvesting of peat. This consisted of drainage channels running through the site at approximately 240 m centres, with the bog being out of use for many years most of these channels have now become blocked and to assist with the construction and operational stage of the project these drains will be cleaned and maintained.

The design principal on which drainage from the site will be managed is on the basis of flow separation, whereby separate "clean" and "construction / operational" drainage systems will be employed. The clean system will capture and manage runoff from areas of the site unaffected by the works and the construction/operational (C/O) system will accommodate runoff from the working areas of the site.

The key purpose of the drainage network will be to minimise the risk of the ingress of silt laden runoff from the construction and operational areas of the solar farm entering the surrounding habitats and local streams. Drainage from construction and operational areas will be directed to settlement ponds

before discharging to surface water flow. Interceptor drains will be put in place to divert surface water from areas where no construction activity is occurring away from the construction locations.

To maximise the effectiveness of the separation of clean and C/O flows, the clean drainage works will be installed immediately prior to the main earthworks activities related to the construction of site tracks, solar panel foundations, cable trenches, crane handstands and the substation.

The design of the track construction is such as to minimise the impact on the natural drainage patterns by allowing surface drainage to pass under the new track at closely placed intervals, corresponding with existing natural drainage lines where possible.

To intercept the clean surface water run-off before it reaches the construction and operational parts of the site, cut-off drains will be installed on the up-gradient side of the access tracks and inverter pads. These will generally follow the natural contour of the ground at relatively low gradients and convey drainage to nearby low points where it will be culverted beneath the site tracks or area of inverter pad. The size of the cut-off drainage channel and associated culverts will reflect the respective catchments and rates of run-off applicable to the site.

The Construction/ Operational surface water system will incorporate the following features as appropriate:

- Vegetation filter strips: Vegetation filter strips are areas adjacent to watercourses that are to remain in an undisturbed state throughout and after the development. The vegetation will act as an effective screen/ barrier between the stream and the development area, intercepting runoff and acting as an effective filter for sediment and pollutants from the development area.
- Swales: Swales are designed to slow and capture run-off by spreading it horizontally across the landscape, facilitating infiltration of the runoff into the soil. A swale will be created by digging a ditch and placing the excavated material on the downhill side of the ditch to create a berm.
- Settlement ponds: Settlement ponds are used to buffer larger volumes of run-off discharging from drainage systems during periods of high precipitation. The hydraulic loading to watercourses is reduced by retaining water in the settlement pond.
- Check dams: A check dam is a small barrier constructed of rock, gravel bags, sandbags, fibre rolls or reusable product. They will be placed across the constructed swale or drainage channel, thereby reducing the effective slope of the channel. This will result in a reduced water, allowing sediment to settle and thereby reducing erosion.

Addition information on the site drainage can be seen in the Site Drainage Report.

6 Timahoe North 110 kV Substation

6.1 Timahoe North Substation

Timely completion of Timahoe North Substation will be a critical issue in delivery of the full project. Construction works for this element will last approximately 14 months.

The Timahoe North Substation will include plinths to support electrical equipment including transformer, cable ducts, etc. The compound will be enclosed with security fencing on which warning, project description and interpretation signage will be attached.

The two control buildings will be single storey and will consist of a pitched roof supported on blockwork cavity walls on reinforced concrete strip footings. Hard finishes will be provided for the majority of floor areas throughout the building. These will provide durable surfaces that enhance the building environment and are easy to clean. External doors and escape doors will generally comprise metal flush doors and mild steel frames. The layout drawings are included in the planning pack.

The Grid Transformer(s) will be delivered on a multi-axle special purpose tractor and trailer transport that will distribute this load over eight or more axles, which results in acceptable loads.

There are no planned construction activities that could be considered abnormal or complex in the context of civil and building construction projects. The major elements will comprise the following:

- Site clearance involving stripping of approximately 25,000 m^3 of peat from construction areas to be stored in peat repositories and rock fill used to make up levels to finished ground level (FGL). The peat will be stored at maximum of 1 m high in areas shown on the layout drawing.
- Earthworks to achieve a flat working area for the compound
- Installation of surface water drainage pipework
- Installation of 18 m^3 foul water holding tank, which will be fitted with a high level warning sensor to the control room. A maintenance plan will be kept by the operations and maintenance team.
- Excavation of structural foundations to formation level for the control buildings and outdoor equipment, and pouring of ready-mixed concrete to bases and floors
- Installation of ducting for electrical cables, communication cables, lighting, etc.
- Construction of control buildings, refer to foundation report to see detailed proposed potential foundation details
- Installation of 110 kV transformers within impermeable bunds / oil interceptor and all other high voltage (HV) equipment
- Wiring and cabling of HV equipment and protection and control cabinets
- Commissioning of all newly installed equipment.

6.2 Battery Energy Storage System Infrastructure

Provision has been made as part of this submission for a battery storage system installation. This includes 10 No. battery modules contained within steel units with dimensions of approximately 13.7 m x 2.4 m x 2.8 m high. The enclosures will be similar in appearance to standard shipping containers and shall be placed on concrete foundations approximately 600 mm about the general site level.

The system proposed includes lithium-ion batteries, connected to inverters that convert direct current (DC) to alternating current (AC), which are in turn connected to step up/down MV/LV (medium voltage/low voltage) unit transformers feeding a common busbar located in the Independent Power Producer's (IPP) control building. Depending on the size and type of the transformers they may be bunded with drainage via an oil interceptor unit.

Detailed design of the Plant will be carried out following selection/ confirmation of the battery supplier.

The drawings included with this application show details of the bunding and drainage which will be installed, should they be required.

Fire protection for the Plant will be designed in accordance with relevant industry standards and the level of protection is subject to detailed design by the Plant's supplier.

The battery enclosures are expected to contain a fire suppression system.

7 Methodology for Reinstatement / Repository

The following general methodology will be employed in reinstating of repositories:

- Excavated materials that are surplus to backfill requirements and are deemed unsuitable for reuse in construction will be brought to the repository locations. This will include unsuitable materials generated during all construction stages.

- Excavators will level this material in suitable layers and compact it by tracking. Dead rolling may be carried out if the material is suitable. Volumes of materials generated during the access track, bases for inverters and hardstanding excavations will be stored in repositories. The peat material will be stored at approximately 1 m deep.
- Any mineral soils excavated during construction work will be stored separately in repositories within the site at a depth of approximately 1 m.
- The previously stripped and separately stored peaty topsoil layer, which contains the remnant seed bank required for restoration, will be placed as the final reinstatement layer. Its fibrous nature will help to promote a stable surface once the vegetation establishes itself.

The above method of reinstatement has been successfully applied at other renewable developments.

8 Tree felling

It is envisaged that tree felling will be completed as enabling works to allow for contractor to construct on a cleared site. To ensure a tree clearance method that reduces the potential for sediment and nutrient runoff, the construction methodology will follow the specifications set out in the Forest Service Forestry and Water Quality Guidelines (2000), and Forest Harvesting and Environmental Guidelines (2000).

The layout was modified to try incorporate some of the existing trees into the plan for wildlife, lower the visual aspect and wind breaks throughout the development. A band of approximately 25 m width of trees has been incorporated into the design along the south track to buffer the solar farm. A localised landscaping program will be carried out along the eastern boundary of the substation to screen the substation from the south track. This program will include the installation of a peat/soil berm to a height of between 1 and 2m. The berm will either be allowed to revegetate naturally or be subject to a suitable planting of native species.

Before any harvesting works commence on site all personnel, particularly machine operators, will be made aware of the following and will have copies of relevant documentation, including:

- The felling plan, surface water management, construction management, emergency plans and any contingency plans
- Environmental issues relating to the site
- The outer perimeter of all buffer and exclusion zones
- All health & safety issues relating to the site.

Across the Timahoe North site there are different maturity ranges of trees, with this taken into consideration the tree felling will come under three different categories:

- Mulching which will consist of track machine with a mulch head shredding the smaller trees with the mulch material being spread across the peat areas to assist the travelling across the sparsely vegetated peat areas
- Larger trees will be harvested and stock piled and used for other commercial use
- Over excavating will be completed in areas with light scrub to facilitate construction.

9 Public Roads

It is recognised that the public roads used in delivery of construction materials and solar components will require monitoring to facilitate the project. Any road improvements that are undertaken will ultimately be of long-term benefit to the local community.

It is proposed that a joint condition survey of public roads be carried out for agreement with Kildare

County Council prior to commencement of the project to identify any improvement works.

The surface of the public roads will be maintained for the duration of the works and following completion of the construction the above survey will form a basis for agreeing any remedial works that may be necessary.

10 Grid connection

10.1 110 kV Overhead Line Construction

The construction techniques carried out will be in line with international best practice and full comply with all health and safety requirements. In general the construction phase can be broken down into the following parts:

- Verify that all planning and environmental conditions have been satisfied
- Carryout pre-construction site investigations including access review and ground conditions
- Delineation of any on-site working area (e.g. erection of temporary fencing)
- Setting out of tower foundations and polesets
- Site preparation works including minor civil works such as removal of fences and erection of temporary fencing
- Installation of tower foundations
- Erection of towers and polesets
- Stringing of conductors and commissioning.

The proposed 110 kV line will be constructed of double wood polesets at intermediate locations and galvanised steel lattice towers at angle positions going towards the sub-station. This style of construction is the standard type of construction used for 110 kV single circuit lines in Ireland. Figures 5 and 6 below show the structure types to be used on this project. Double wood polesets are used for all straight line structures, angle towers are only used where the line changes direction.

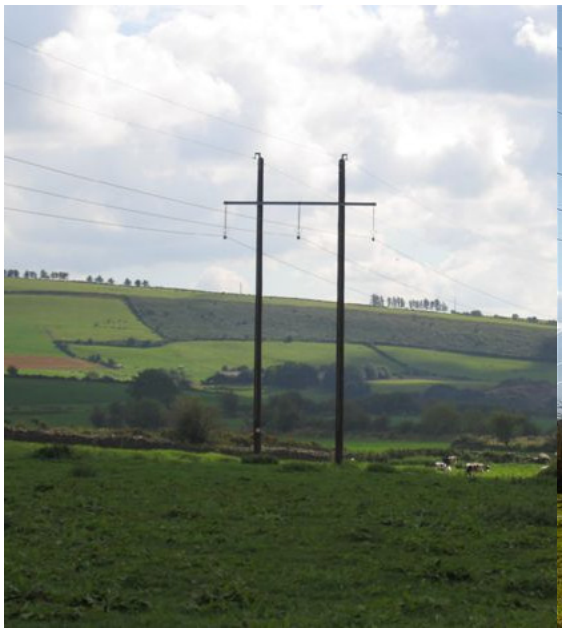

Figure 5: Typical Wood poleset

Figure 6 Typical steel angle structure

The terrain is generally undulating and access to the various structure sites will be fully agreed with the landowners and in wet areas temporary roads or bog-mats may be required in order to access sites without causing excessive damage.

Prior to commencement of work the contractor(s) will prepare a separate Construction and Environmental Plan for the overhead line which will include method statements and work programmes that show more detailed phasing of work. The appointed contractor(s) will develop a series of detailed plans for the erection of the tower and the stringing of the line. These Construction and Environmental Plans will detail access to structure sites, archaeological and ecological sensitive sites and will take account of third party requirements, mitigation measures outlined in the various sections of the Environmental Report and site investigations carried out prior to construction. It should be noted that this construction methodology is indicative and based on ESB/ EirGrid's long experience in similar transmission line projects. Any issues specific to this project, for example unique planning conditions, will be incorporated fully into the appointed contractors' scopes of work and careful supervision and management will be carried out to ensure full compliance.

The method statements produced by the contractor(s) will be agreed with the appropriate authorities. ESB will employ a team to monitor the construction phase of the project and ensure works are being carried out in accordance with the agreed method statement, safety procedures, pollution control etc.

10.2 Pole base excavation and pole erection

- The excavation for each pole will be carried out using a wheeled or tracked excavator
- Each of the two poles are lined up with the excavated holes and the machine operator then drives forward pushing the pole up until the pole is in an almost vertical position. The pole never passes through the point of balance in the vertical position
- The pole is supported at all times and the holes manually backfilled to a minimum depth of 1.0 m
- After excavation and erection of the poleset a further excavation 800 mm deep is necessary. This is a linear excavation perpendicular to the line necessary to install wooden sleepers. These sleepers add additional stability to the poleset and are attached to the poleset using a U-bolt.
- The two installed poles are connected near the top by a steel cross-arm from which three insulators are attached. The conductor is then attached to these insulators during the stringing process.
- As much of this overhead line is designed as an earth wire line an earth grid is required on all polesets. This earth grid is a section of earth conductor forming a loop underground around the installed poleset. It is connected to the shield wire on the pole top by another section of earth conductor running along the length of the pole.
- In poor ground conditions stay wires may be required at some poleset locations. These wires add stability to the pole and are supported by means of stay blocks. These stay blocks are made of concrete and are buried underground.

10.3 Installation of 110 kV steel tower foundations

All structure locations will be checked for underground services such as cables, water pipes etc. Consultation of existing services maps will help to confirm the location of these underground services. If field drains are encountered these will be diverted and all diversions marked on as built drawings.

The tower will be set out and pegged prior to foundation excavation. This may require excavation of some existing ditches or drains to allow clear pegging of each individual leg footing for excavation. All such removals are restored upon completion of foundation works. Excavations are set out specifically

for the type of tower and the type of foundation required for each specific site. It should be noted that pre-construction site investigations may show that ground conditions unsuitable to the standard foundations are present. In this case a modified, special foundation will be designed. A larger footing may be required in the case of weak soils, while piled foundations may be required in the case of deep peat. The exact details of each foundation will be decided at detailed design stage.

The tower stubs (lower part of tower leg) will be concreted into the ground. For each leg of the tower (4 in total) a foundation is excavated using a tracked excavator and the formation levels (depths) checked by the onsite foreman. Each of the four corners of the tower will be separately anchored below ground in a block of concrete as per Figure 7 below. Any water in the excavation is pumped out prior to any concrete being poured into the foundation. Concrete trucks shall be brought as close as possible to the excavation to pour directly into the excavation. In the event of this not being possible concrete shall be transported in dumpers, in the event that the ground is very poor and wheel dumpers will not transport the concrete over the terrain, track dumpers may be used.

In areas of poor ground or high water table it may be necessary to use sheet piles supported by hydraulic frame(s) to prevent collapse of the sides of the excavation and also to prevent the excavation becoming too large. During any dewatering activities a standard water filtration system will be utilised to control the amount of sediment in surface water runoff.

After this, the remaining part of the foundation, the concrete shear block or neck is formed using shuttering.

During each pour the concrete shall be vibrated thoroughly using a vibrating poker. In the event that sheet piles have been used these are removed (pulled) at this stage. Care is taken not to damage the base members of the tower. The shear block formers are removed at this stage.

The tower foundations are backfilled one leg at a time with the excavated material. The backfill is placed and compacted in layers. All dimensions are checked following the backfilling process. If the excavated material is deemed unsuitable for backfilling imported fill material may be used also compacted in layers. When the base construction crew leaves site they shall ensure all surplus materials are removed from the site including all unused excavated fill.

Once the tower base is completed and fully set (usually after seven days) it is ready to receive the tower body which is normally constructed in an area near the foundation site ready to be lifted and bolted into place.

Figure 7: Photograph of steel tower base in open excavations

11 Construction waste

All wastes will be managed in accordance with applicable legislation and recognised best practice within the construction industry. Burning or burying of waste or packaging materials will not be allowed on site at any time.

The main items of waste that will arise during the construction phase and their sources are set out in Figure 8 below.

Waste	Source
Canteen and office waste	Staff welfare facilities and site offices
Hardcore, stone, gravel, waste, and concrete	Temporary surfaces to facilitate construction
Concrete blocks and miscellaneous building materials	Left over from construction of the control building and temporary office accommodation
Timber	Temporary supports, shuttering and product deliveries
Steel	Steel that is unused in reinforced concrete structures
Lubricating Oils, Diesel	Unused quantities at end of construction period

Figure 8 Construction Waste and their Sources

Waste materials will be dealt with as follows:

- Non-hazardous Office & Canteen Waste: A licensed waste disposal contractor will transport this waste to a licensed landfill
- Construction Waste: This waste will be stockpiled on site and will be transported to a licensed landfill for final disposal
- Steel: All waste steel reinforcing bars will be stockpiled. Unused material may be gathered for reuse elsewhere and scrap items will be collected for recycling by a scrap metal merchant
- Timber: Timber waste will be minimised through reuse of shuttering, etc. throughout the project. At completion it is expected that the majority of timber will be gathered for reuse elsewhere at a different site
- Fuel, Oils and Hydraulic Fluids: Waste will be stored on site in labelled containers and will be collected by a licensed oil recycling contractor as necessary.
- Electrical Waste: All electrical waste will be stored on site in labelled containers and will be collected by a licensed recycling contractor as necessary.

Appropriate waste management records will be maintained.

12 Reinstatement

The process of backfilling the excavated soil and restoring surface vegetation along access track margins, over the margins of hardstanding areas, etc., will commence as soon as the related tasks in the construction process are complete.

Some overburden material will be stored temporarily adjacent to the works areas for reinstatement when the main construction activities are completed.

Soil will be backfilled outside the drainage channels along track-sides and vegetated sods replaced over the surface, bedded-in, regraded, etc., to re-constitute a stable and settled ground surface on which the natural vegetation can recover and will be resistant to erosion.

13 Mitigation of impacts

Incorporation of measures to mitigate environmental impacts is inherent in the planning and design of solar farms such as Timahoe North. This extends to all phases of the solar farm project from site

selection and the concept phase, including consideration of alternatives, through development pre-planning and design phases to construction, operation and decommissioning.

The hierarchy in mitigating environmental impacts in Timahoe North Solar Farm project has been avoidance, reduction and remedy. In the early design stages there was an ecological study completed on the site which consecutively led to most sensitive areas of the site being avoided as advised by Bórd na Móna and McCarthy Keville O'Sullivan Ltd. ecologists. The objective of the development has been to maximise the sustainable Solar energy capture of what is a very suitable site for solar energy development without causing significant adverse environmental impacts. The design of Timahoe North Solar Farm meets the primary objective of avoidance of impacts on environmental resources.

A consideration in all projects is to minimise the scope of project activity necessary to achieve the project objectives in a manner that is environmentally responsible. At Timahoe North impacts on all aspects of the environment are being minimised by selection of the proposed scheme over the multiplicity of possible alternatives.

In particular, the results of significant geotechnical investigations will be utilised to develop a layout that can be safely constructed and minimises impacts on the most valuable habitats at the site.

Key mitigating actions during design, construction and operation of the solar farm include the following:

- A full construction management team will be deployed on site in accordance with routine site construction procedures. This team will consist of a Resident Site Manager and Assistant Engineers as appropriate.
- All construction works will be carried out under appropriate supervision. Works will be carried out by experienced contractors using appropriate and established safe methods of construction. All requirements arising from statutory obligations, including the Safety, Health and Welfare at Work Act and associated regulations, will be met in full.
- ESB and Board na Móna has had a long history of responsible operation of power plants throughout Ireland and are mindful of its obligations in regard to environmental protection.

14 Traffic

Anticipated traffic movement for the project is shown for deliveries and construction traffic in Figure 9 below.

During the initial months of the construction project the average daily workforce is expected to be in the region of 30 people, which will increase to an average of 200 people per day during panel erection and electrical works. A peak workforce of 213 people is expected. Given the larger staff numbers anticipated, contractors working on the project will be expected to provide transportation for their teams. A vehicle occupancy rate of average of 3 is assumed.

Material/Equipment	Vehicle Type	Number of Deliveries	Vehicle Movements
Site offices and welfare	Large articulated truck	35	70
Stone deliveries	4 axle truck	9,400	18,800
Drainage Items	Large articulated truck	40	80
Plant deliveries	Large articulated truck	30	60
Security Fencing	Large articulated truck	40	80
Piles	Large articulated truck	200	400
Framing	Large articulated truck	420	840
Panels	Large articulated truck	502	1,004
Inverters	Large articulated truck	29	58
Cabling	Large articulated truck	100	200
Concrete	4 axle truck	100	200
110 kV Electrical Substation	Large articulated truck	400	800
110 kV Transformer	Abnormal load delivery	1	1
Demobilisation	Large articulated truck	35	70
Light construction traffic & Site staff	Van/car	14,100	28,200

Figure 9 Construction Traffic (Based on a construction period of 400 working days)

*Bulk of Stone deliveries are expected to be ongoing from month 1 to 8 of the construction period.