

## Appendix 3-7

# Turbine Delivery Route Assessment

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Killaloe  
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Turbine Delivery Route Assessment

on behalf of  
Coilte

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## 1 Introduction

The purpose of this report is to assess the feasibility of delivering wind turbine components to the proposed development at Carrownagowan, Slieve Bernagh, County Clare. The components will be delivered by sea to Galway Harbour or to the Port of Foynes in County Limerick. From either of these ports, delivery to the site will be via Junction 13 on the M18 motorway which is located to the northeast of Ennis. From Junction 13 the route follows the R352 regional road, the R465 regional road and the local road to the site entrance at Caherhurly.

This analysis was carried out using Bing aerial photography which is ortho-rectified to ITM coordinates. A detailed topographical survey will be required for further verification prior to delivery. Autodesk AutoTrack vehicle swept path analysis software was used to determine the wheel track and oversail extent for each critical location along both routes.

The proposed wind farm will consist of 19 turbines. The turbine type is currently unknown. It is assumed that the maximum tip height will be 169 metres with a maximum rotor diameter of 136 metres.

## 2 Delivery vehicle types

The longest components are the turbine blades which are usually the most onerous for delivery. The analysis of the route has been carried out for the delivery of a 68 metre-long turbine blade. However, for large turbines such as those envisaged for Carrownagowan the tower sections or the nacelle can be excessively wide or high. The bottom tower section is likely to have a bottom flange diameter of up to 4.50 metres. Allowing for ground and overhead clearance a load height of 5.00 metres has been assumed for the tower sections.

The type of trailer considered for blade transportation is commonly available from turbine transport companies. There are several manufacturers including:

- Nootboom Teletrailers  
[http://www.nootboomgroup.com/nootboom/en/our\\_products/trailer\\_programme/](http://www.nootboomgroup.com/nootboom/en/our_products/trailer_programme/)
- Broshuis Platform Trailers  
[http://www.broshuis.com/index.php?option=com\\_content&view=article&id=19&Itemid=5&lang=en](http://www.broshuis.com/index.php?option=com_content&view=article&id=19&Itemid=5&lang=en)

There are generally two methods of transporting towers:

- The clamp method using self tracking bogies such as manufactured by Goldhofer <http://www.goldhofer.de/gh-en/trailers/self-tracking-rear-bogies-sn.php> and shown in Figure 1.
- The stepped Semi Low-loader manufactured by Nootboom and Broshuis among others, and shown in Figure 2.



Figure 1 - Bogie type tower transporter



Figure 2 - Semi Low-Loader

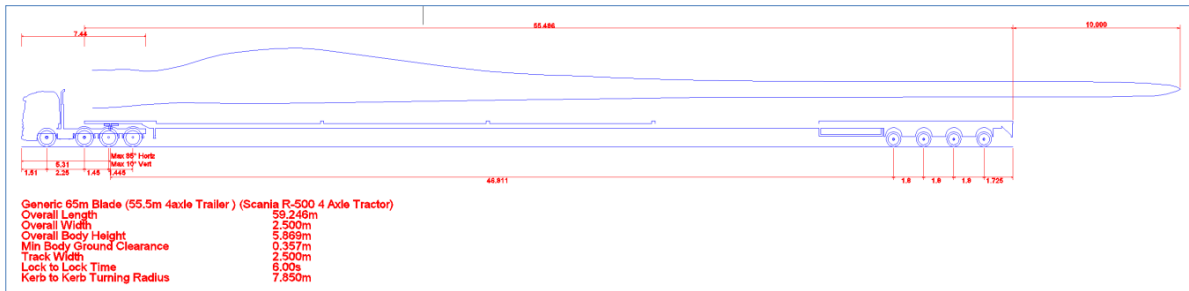


Figure 3 - Blade delivery truck with 68-metre long blade

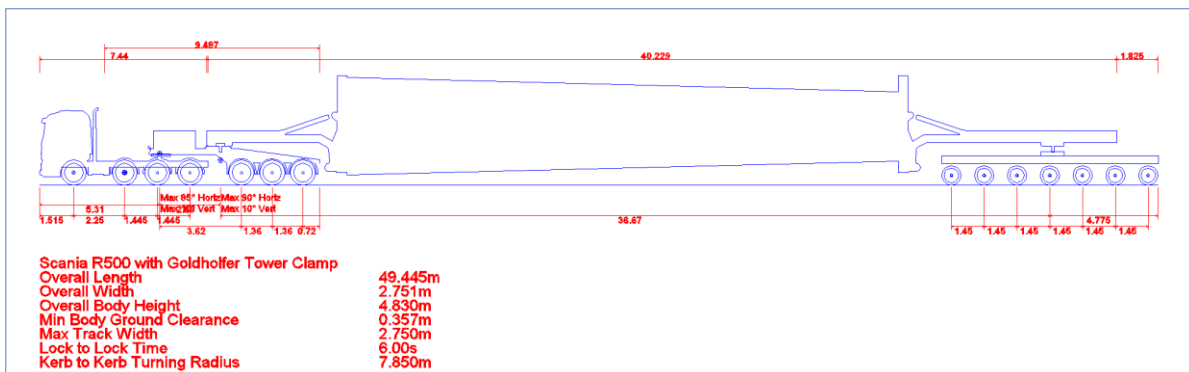


Figure 4 - Clamp tower delivery truck with 24-metre long tower section

An important consideration for the route assessment is the standard delivery clear area for manufacturers of this class of turbine which is 6m wide. When road alignments are straight the blade delivery truck is not the most onerous in terms of width and height. For the 3MW+ class of turbine the base tower sections and nacelle can be in excess of 4m wide and high.

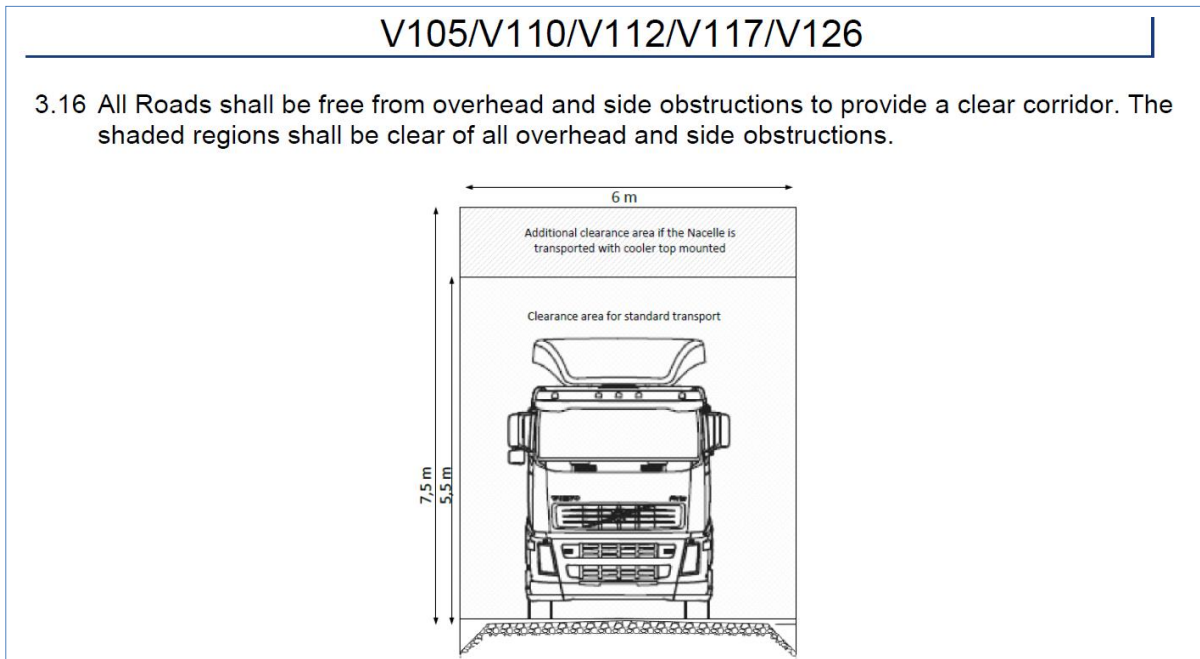


Figure 5 - Clearance envelope typical of proposed turbine class



### 3 Route from Galway Harbour to M18 Junction 13

The route from Galway Harbour to Junction 13 on the M18 motorway is shown in Figure 6.

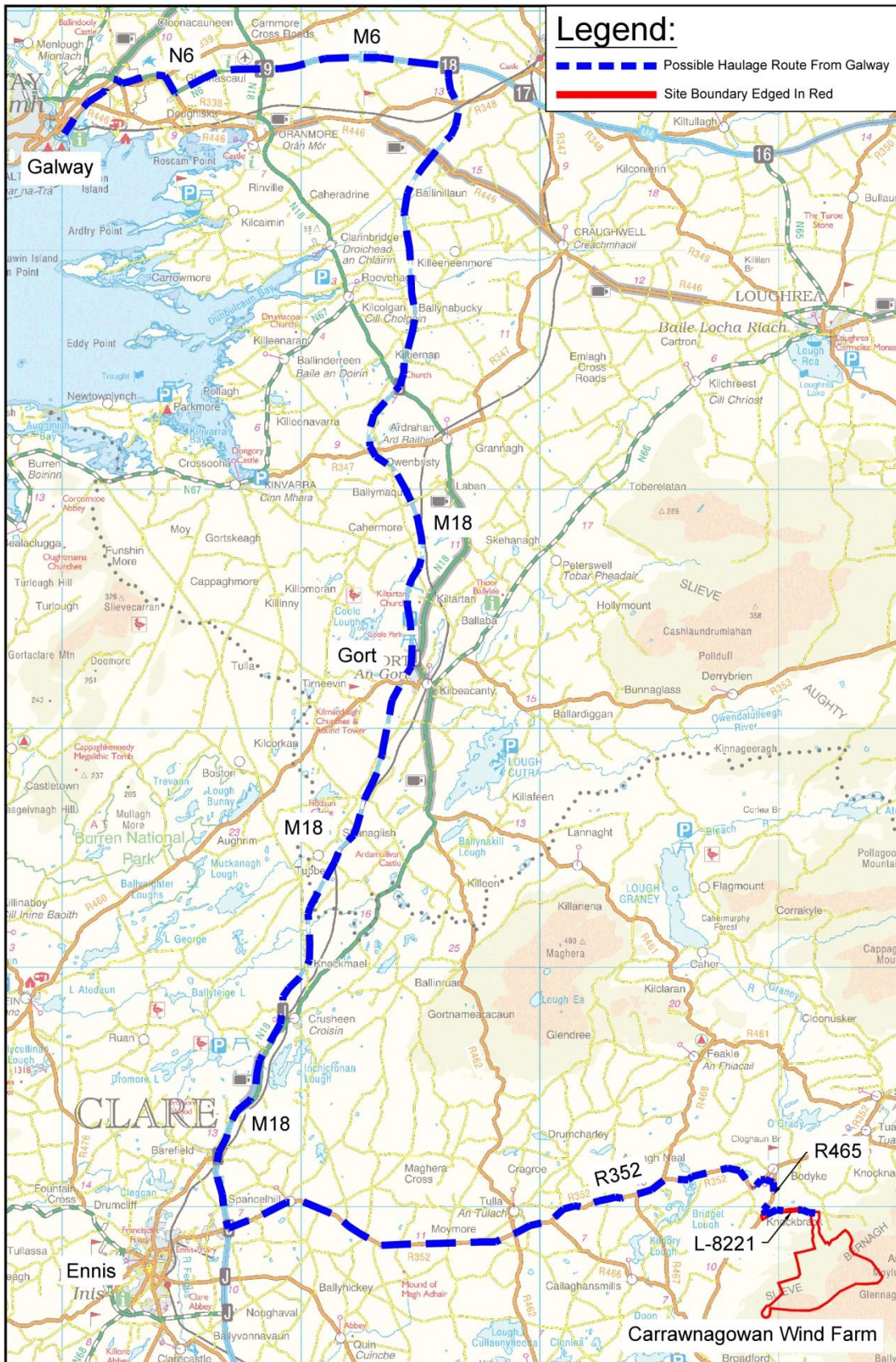


Figure 6 - Route from Galway Harbour to Junction 13



### 3.1 Galway Harbour to M6

The route through Galway City is from the Harbour, along Lough Atalia Road, Wellbrook Road (R339), Tuam Road (R336), Bothar na dTreabh (N6) to the western terminus of the M6 motorway. The route through the City is shown in Figure 7. The turning movements in the following figures are for a 68-metres long turbine blade.



Figure 7 - Route through Galway City

The railway bridge at Lough Ataile (Figure 8) has a clear height of 5.46 metres at the quarter points which will accommodate the large bottom tower sections and the nacelles for the turbine types being considered for the wind farm. This is higher than the standard clearance for the motorway bridges.



Figure 8 - Railway bridge on Lough Ataile Road





Figure 9 - Left turn from the R339 towards Tuam Road



Figure 10 - Left turn from the R339 towards Tuam Road - swept path

The turning movement from the R339 towards the Tuam Road is feasible but requires temporary removal of the following:

- Two lighting columns on the south quadrant
- Pedestrian traffic light on the south quadrant

The photograph in Figure 10 shows a grass verge on the right hand (east) side within the wheel track but the road has since been widened to create an additional lane on this side.





Figure 11 - Right turn onto Tuam Road

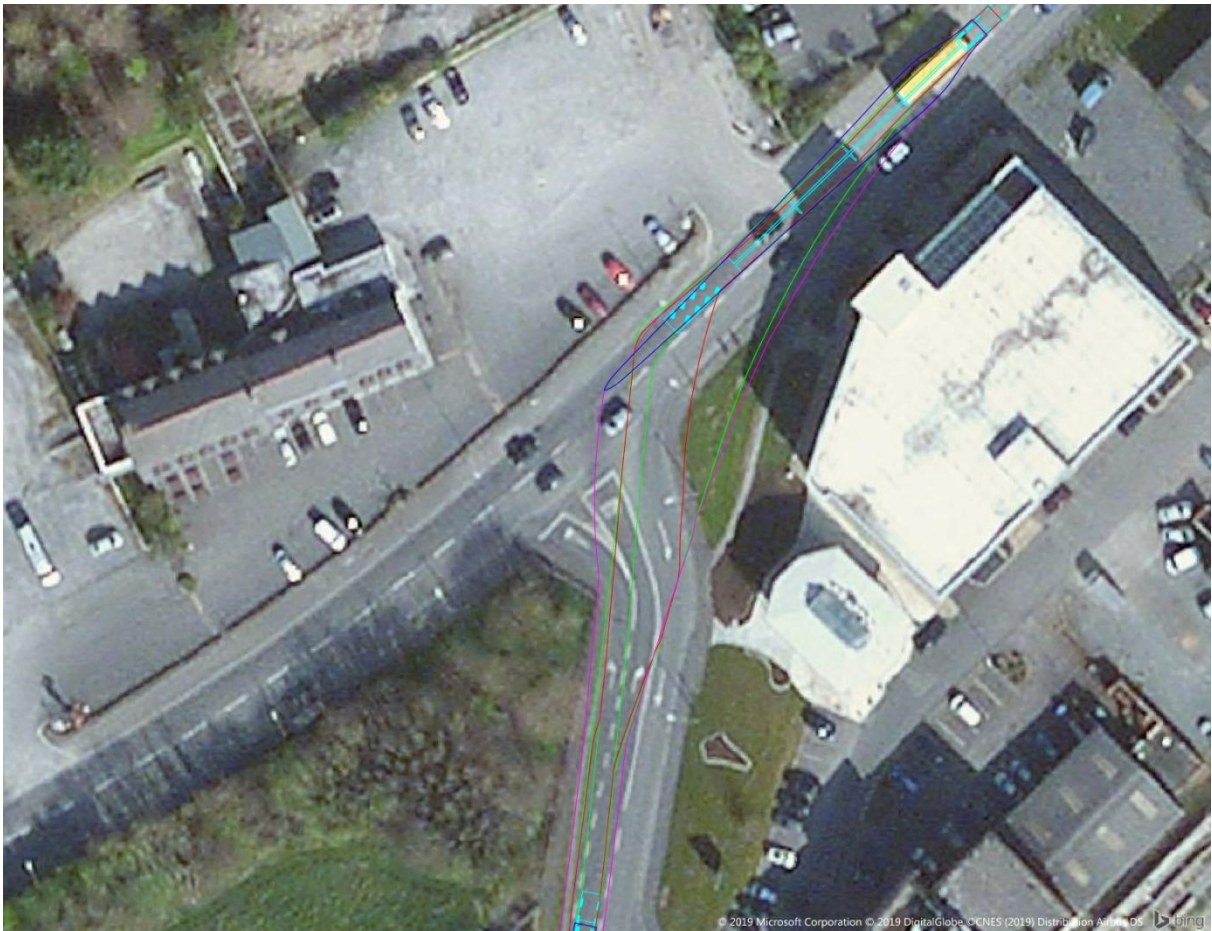


Figure 12 - Analysis of right turn onto Tuam Road - swept path

The right turn onto the Tuam Road (R336) overhangs into the grassed area on the east side. This will require temporary removal of the following:

- Two lighting poles in the grassed area



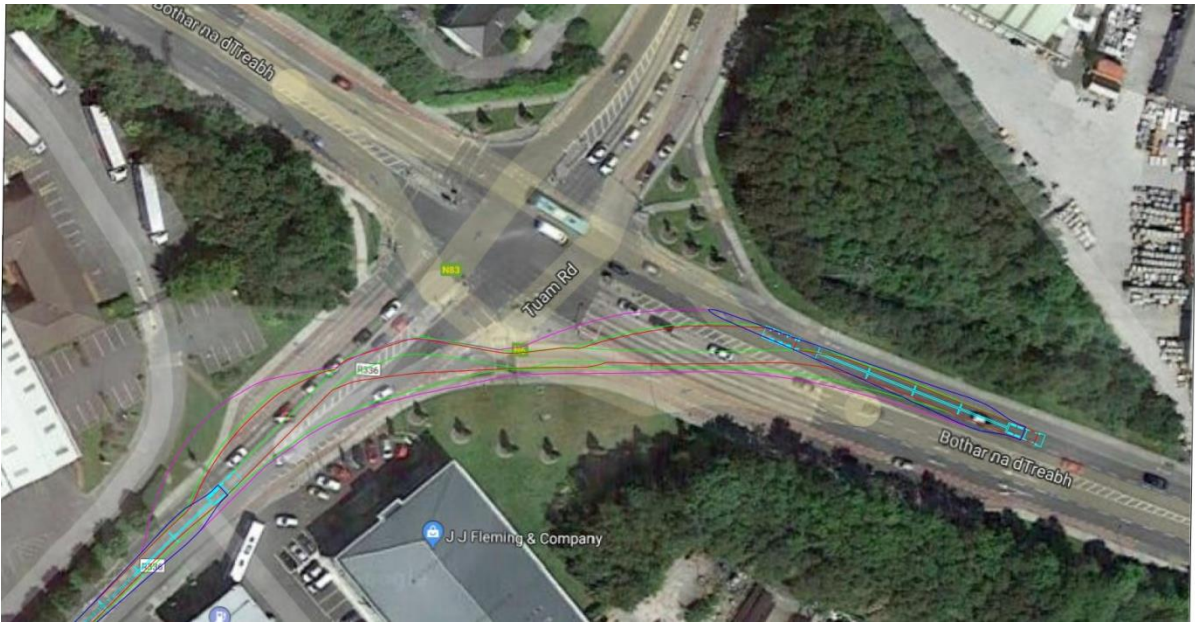


Figure 13 - Right turn from Tuam Road (R336) to Bothar na dTreabh (N6) - swept path

The manoeuvre onto Bothar na dTreabh (N6) will be done as a contra-flow through the south side of the junction, avoiding the pedestrian barriers on the central medians of both roads.

The route from here to the M6 western terminus is along the N6 and is unrestricted. The exit from the N6 to the M6 eastbound is also unrestricted. The swept path is shown in Figure 14 below,



Figure 14 - Exit from Bothar na dTreabh (N6) to M6 eastbound - swept path



### 3.2 M6 / M18 interchange (M6 exit 18)

The M18 south is accessed via Junction 18 on the M6 motorway. The entry and exit routes and the swept paths through the interchange for a 68-metres long turbine blade are shown in Figure 16 to Figure 19 below.

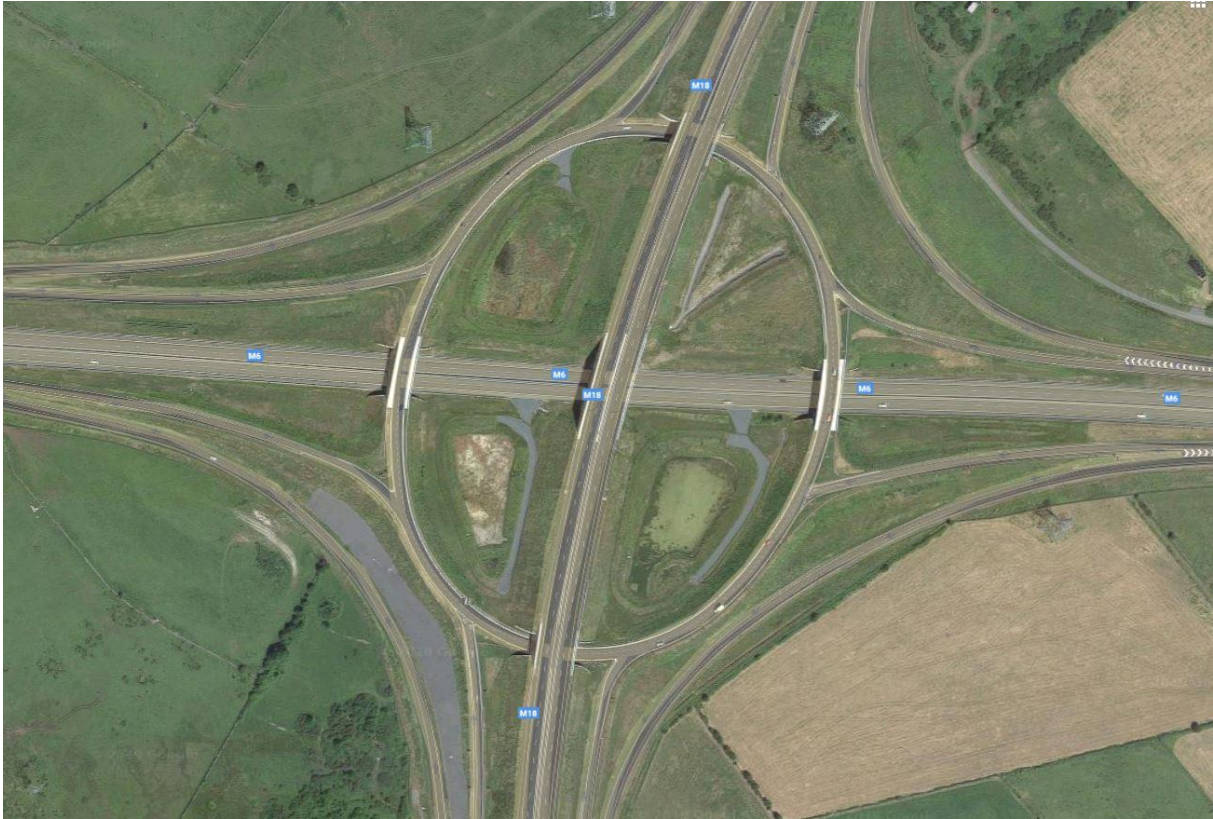


Figure 15 - M6 / M18 interchange



Figure 16 - Yield line at entry to M6 / M18 interchange



Figure 17 - Swept path for entry to M6 / M18 interchange - swept path

The wheel track for entry to the interchange is within the paved area but the overhang of the trailer and blade require temporary removal of the following:

- Yield signs on both sides of the approach
- One lighting column on the left side of the approach near the yield line





Figure 18 - Exit to M18 from M6 / M18 interchange



Figure 19 - Exit to M18 from M6 / M18 interchange - swept path

The overhang of the trailer and blade at the exit require temporary removal of the following:

- Two lighting columns on the left side of the exit lane



### 3.3 M18 Junction 13 south bound

The junction 13 south bound exit is a compact grade-separated motorway junction leading to a roundabout on the R352 regional road to the east. The route to the wind farm is via the first exit from this roundabout. The swept path for the motorway exit and the manoeuvre through the roundabout are shown in Figure 20.



Figure 20 - Junction 13 south bound - swept path



Figure 21 - Junction 13 south bound exit



Figure 22 - Junction 13 south bound roundabout

This route requires widening of the carriageway on the inside (LHS) of the first bend on the exit to accommodate the wheel track on the bend. Other than this the wheel track is within the carriageway.

The following signs and lighting poles will have to be temporarily removed during delivery:

- Two lighting poles at the motorway exit
- A two-way / no entry sign at the motorway exit
- A 100 km/h sign
- Two lighting poles at the 90-degree bend
- A chevron sign at the 90-degree bend
- Two lighting poles at the roundabout before the first exit
- A directional sign at the splitter island on the first exit (towards Tulla)



## 4 Route from Foynes to M18 junction 13

The route from Foynes Port to the M18 Junction 13 is via the N69 east to Limerick City, through the roundabout at the N18 interchange, and north along the N18 via the Limerick Tunnel to Junction 13. The route is shown in Figure 23.

The Limerick Tunnel has a height clearance of 4.65 metres and will accommodate the turbine blades and the upper tower sections. However, it may not be high enough for the bottom tower sections or the nacelles for the turbine types envisaged for this project. In this instance, the route will continue along the N69 to Shannon Bridge on the R527, and the R445 to join the N18 to the north of the Limerick Tunnel.

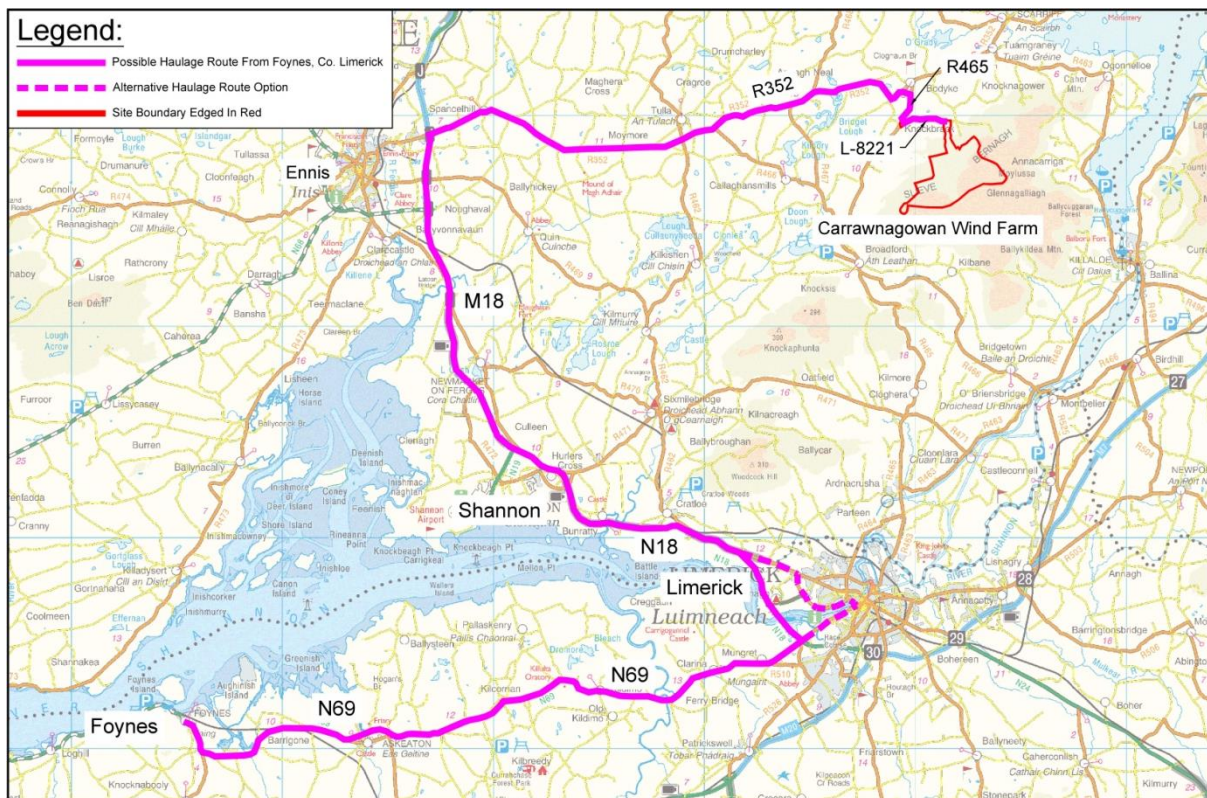


Figure 23 – Route from Foynes via M18 Junction 13



## 4.1 Foynes Junction



Figure 24 - Junction of Foynes Port road with N69



Figure 25 - Junction of Foynes Port road with the N69 - swept path



The manoeuvre through the junction of the Foynes Port road and the N69 will require temporary removal of the following:

- One lighting pole on the southeast corner of the junction
- Two direction arrows on the junction islands
- One Stop sign on the junction splitter island
- One direction sign on the splitter island

Some vegetation will also have to be cleared on the north side of the Port road on the approach to the junction.

## 4.2 Ferry Bridge on the River Maigue

The bridge on the N69 over the River Maigue has sufficient width for all likely loads. The shape of the vertical profile will have to be confirmed when details of the delivery vehicles and load are known to confirm if any temporary build up is required at either side of the crest of the bridge. This bridge and route from Foynes has previously been used for turbine delivery.



Figure 26 - Ferry Bridge on the River Maigue facing east



Figure 27 - Ferry Bridge on the River Maigue - swept path



### 4.3 N69 Roundabout at Clarina

The central island of the Clarina roundabout has been planted with trees and this restricts the possible routes through it. However, any trees to be removed will be uprooted and retained for replanting. Alternatively, new similar tree species can be replanted.



Figure 28 - Clarina roundabout facing east

The vehicle path through the central island, as shown in Figure 29, would require removal of up to 50% of the trees.

This route would require temporary removal of the following:

- Direction sign and yield sign on the approach splitter island
- Direction sign and yield sign on the exit splitter island
- Chevron sign and direction sign on the central island



**Figure 29 - Clarina roundabout swept path through central island**

An alternative path that uses part of the central island but does not affect the trees is shown in Figure 30. However, this requires intrusion, both for the wheel track and oversail, into property on the northwest corner of the roundabout. This would also require temporary removal of the following:

- Two light poles on the northwest quadrant
- A yield sign on the left on the approach to the yield line



**Figure 30 - Clarina roundabout alternative path through third party land**



#### 4.4 N69 roundabout at N18 Junction 2

The route through the roundabout on the Dock Road at N18 Junction 2 to the ramp onto the N18 incurs a minor intrusion of the wheel track onto the central island. The width of the exit road from the roundabout is slightly restrictive and may require temporary widening on the left side for the wheel track.



Figure 31 - N69 Dock Road roundabout to N18 on ramp

Temporary removal of the following items would be required for the manoeuvre:

- Yield sign, direction arrow and lighting pole on the approach splitter island
- Yield sign on the left of the approach lane
- Chevron sign on the central island



## 4.5 N18 Limerick Tunnel and Toll Plaza

The route through the Limerick Tunnel is suitable for turbine blade delivery but, as discussed previously, may not be high enough for the bottom tower sections of the turbines or for the nacelles. An alternative route for the delivery of these components is outlined below in section 4.7 and shown in Figure 37. The route at the toll plaza is through the left lane and is adequate for all loads in terms of width and height.



Figure 32 - N18 Limerick Tunnel entrance north bound



Figure 33 - N18 toll plaza north bound



## 4.6 M18 Junction 13 north bound

The junction 13 north bound exit is a compact grade-separated motorway junction leading to a roundabout on the R352 regional road on the west side of the motorway. The route to the wind farm is via the overbridge to the roundabout on the east of the motorway and via the second exit from this roundabout.



Figure 34 - Junction 13 north bound - swept path

This route requires carriageway widening on the inside of the bend (LHS) at the exit from the motorway. Elsewhere the manoeuvre can be completed with the wheel track within the existing road carriageway.

The blade oversail requires the temporary removal of signs and lighting poles as follows:

- One lighting poles at the exit from the motorway
- A two-way / no entry sign at the exit from the motorway
- A 100m end of motorway sign
- Two directional signs on the approach to the west roundabout
- The flexible delineator posts on separating the lanes
- The directional arrow and the yield sign on the splitter island of the west roundabout



Figure 35 - Junction 13 north bound exit



Figure 36 - Junction 13 north bound, approach to west roundabout



## 4.7 Wide loads alternative route at Limerick

The Limerick Tunnel has a height clearance of 4.65 metres and this is likely to be too low to accommodate the bottom tower sections or nacelles of large turbines. If these components are to be delivered to site from Foynes Port, an alternative route will be required to bypass this section of the N18. The proposed alternative is from the N69 at the N18 Junction 2 roundabouts, along the Dock Road, across the Shannon Bridge to the R527 Condell Road, and the R445 to N18 junction 4, two kilometres north of the Toll Plaza. This route includes the Greenpark and Shannonbridge roundabouts on the Dock Road, and roundabouts at Clonmacken, Coonagh, Clondrinagh, Meelick and the Cratloemoyle Roundabout on the approach to the N18 junction 4 on ramp. The only over bridge on this route is at N18 Junction 4 and this has normal height clearance. The alternative route is shown in Figure 37.

The alternative route has been used in the past for the delivery of wide and high loads from Foynes to the N18 without the need to remove any signs or street furniture at the junctions. However, as standard practice, the route will have to be confirmed when the actual dimensions of the oversize loads and vehicles are known.



Figure 37 – Alternative route at Limerick

## 5 M18 Junction 13 to Carrownagowan Wind Farm

From Junction 13 the route follows the R352 regional road east to Bodyke, the R465 regional road south to the junction with the local road at Drummod and the local road east to the site entrance at Caherhury. The route from Junction 13 to the site, which is shown in Figure 38 is 28 kilometres long. There are three locations where significant road widening or bypasses are required. These are numbered on Figure 38 as 2 (at Coolready), 3 (at Bodyke) and 4 (at the R465 junction with the local road). Widening of the local road (5) and changes to the existing site entrance (6) are also required. These are described in Sections 0 to 5.5 below.

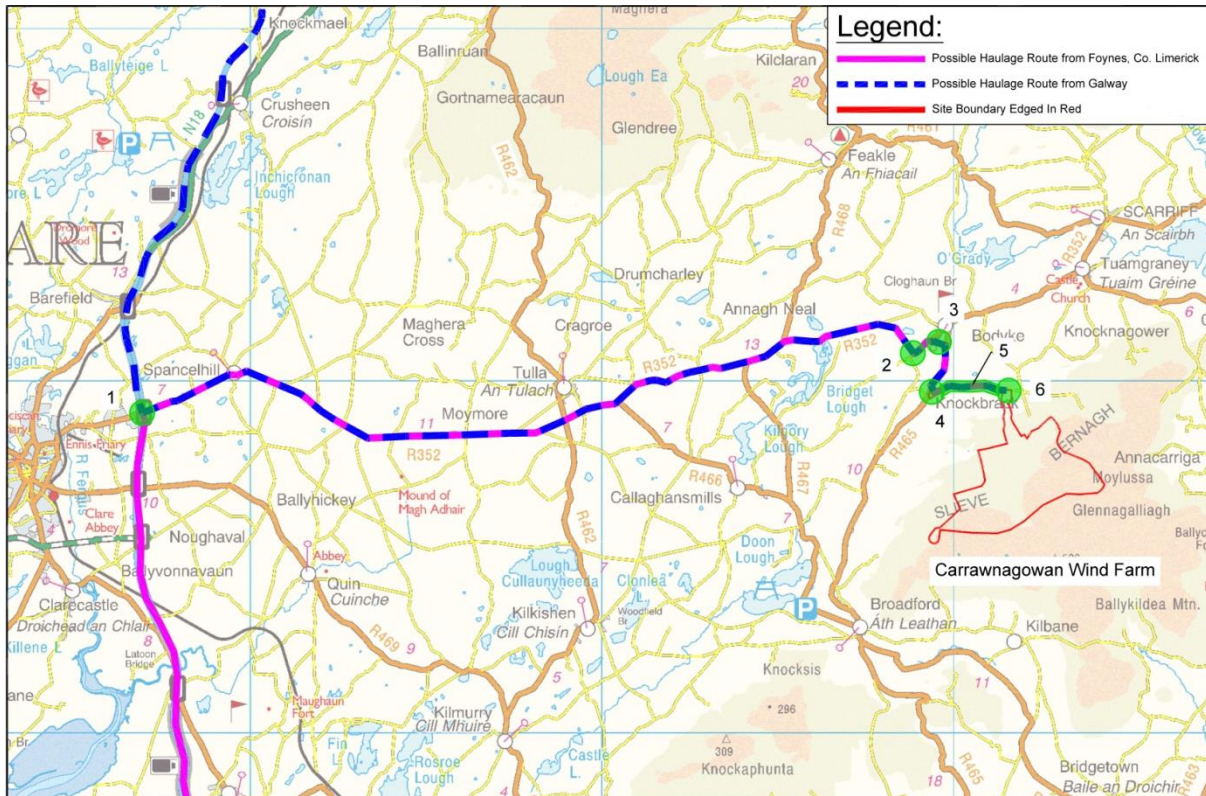


Figure 38 – Route from Junction 13 to the wind farm entrance



## 5.1 R352 - 90-degree bend at Coolready

There is a 90-degree bend on the R352 regional road at Coolready (bend 2 on Figure 38). The delivery of the turbine blades will require road widening into third party land on the north side of the junction. The modified bend will accommodate all other load types.



Figure 39 - 90-degree bend on the R352 at Coolready - swept path



## 5.2 Bodyke

A new section of road is required through third party land to the south of Bodyke village to access the R465 from the R352 (bend 3 in Figure 38). This route is shown in Figure 41.



Figure 40 - Bodyke Village



Figure 41 - R352 / R465 link - swept path



### 5.3 R465 / local road junction

The existing junction of the R465 and the local road (bend 4 in Figure 38) is bound on two sides by private houses and it is not possible to negotiate it without substantial intrusion into several adjacent properties. It is proposed to bypass the existing junction and create a new route further to the east as shown in Figure 43.



Figure 42 - R465 / local road junction



Figure 43 - Bypass route from R465 to the local road - swept path



## 5.4 Local road (L-8821) to the wind farm

From the R465 cross roads the route is relatively straight but is currently narrower than the clearance required by turbine manufacturers (numbered 5 in Figure 38). The road width is less than the minimum required which is generally 4.50m to 5.00m for this class of turbine. Irrespective of the findings of the swept path analysis, third party land will be required along the majority of the route to allow the minimum requirements to be met.



Figure 44 - Narrow local road (< 3m) with trees on both sides

The first significant pinch point occurs approximately 370m from the junction where a right hand sweep bend will require third party land.

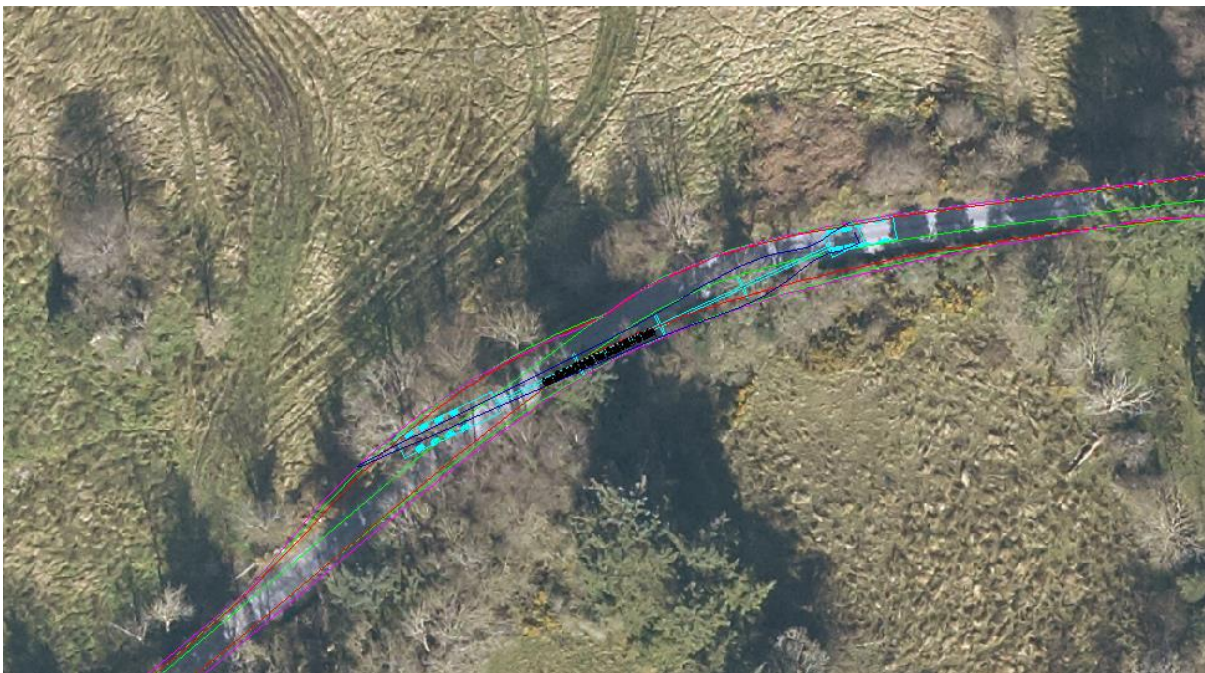


Figure 45 - Pinch point at Chainage 370m - swept path



There is a pinch point at a left hand curve at chainage 490 metres where third party land will be required on one side of the road to accommodate turbine blade delivery.



Figure 46 - Pinch point at Chainage 490m - swept path

There is a right hand curve at chainage 825 metres where third party land will be required.



Figure 47 - Pinch point at Chainage 825m - swept path



There is a right hand curve at chainage 1,700 metres where third party land will be required.

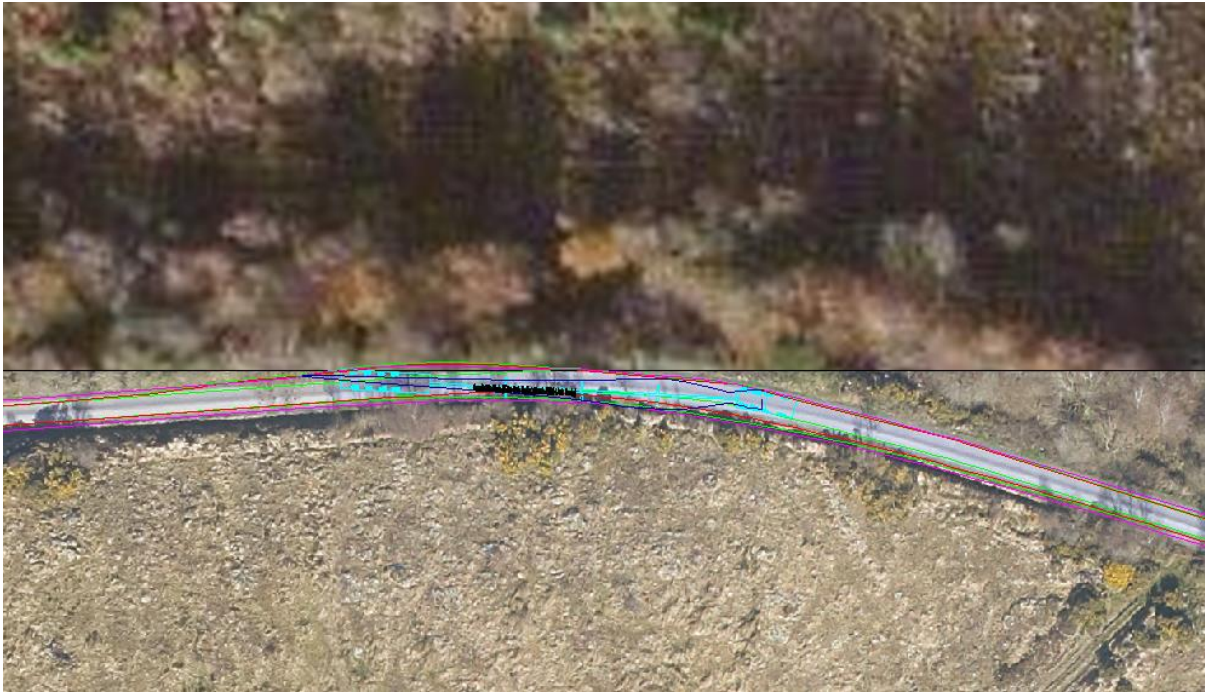


Figure 48 - Pinch point at Chainage 1,700m - swept path



## 5.5 Site entrance

The existing entrance to the wind farm site, which is at chainage 2,340 metres, is not suitable for the size of trucks required for turbine delivery. It is proposed to realign the entrance within Coillte land to the east as shown in Figure 50. Some widening will also be required, as well as provision for blade oversail, on the north side of the public road. This arrangement will accommodate all traffic movements associated with the construction and operation of the wind farm.



Figure 49 - Existing site entrance at Caherhilly



Figure 50 - Proposed modifications to existing entrance - swept path

## 6 Conclusions

The route from Galway Harbour to the M18 Junction 13 near Ennis is suitable for delivery of all turbine components for the type of turbine envisaged for the Carrownagowan Wind Farm based on the assumptions made in regard to component size.

The route from Foynes to the M18 Junction 13 is suitable for delivery. However, the bottom tower sections and the nacelles may be too high to go through the Limerick Tunnel. If this is the case, a route for these latter components via the Shannon Bridge in Limerick City is a feasible alternative for these load types.

The R352 regional road route requires widening of an existing 90-degree bend at Coolready to the south of Bodyke.

A link road through third party land will be required to the south of Bodyke to link both regional roads.

The turn from the R465 regional road to the L-8821 local road requires a link road through third party land to the northeast of the house at the junction between the two roads.

The entire length of the L-8821 local road from the R465 at Drummod, through Ballydonaghan, to Caherhurley has too narrow a road surface to meet minimum delivery requirements of a 4.50 metre wide roadway as it currently exists and widening is proposed along this route to the site entrance.