Chapter 19 Mitigation Measures

19.1 General

Mitigation measures are the measures proposed in order to avoid, reduce or where possible remedy the significant adverse environmental effects of the proposed development. Mitigation measures have been incorporated into the design of the proposed development and will be applied during both the construction and operation phase where they have been assessed as necessary.

The following chapter provides a summary of the mitigation measures for the proposed scheme as contained within the preceding chapters of the EIS. This is a summarised version stating only the mitigation measure to be provided and does not discuss the requirement for the measure to be applied or the residual impacts. This chapter also deals only with mitigation measures to be applied to the proposed road project and does not address the avoidance or reduction mitigation which has been applied through the design development.

19.1.1 Construction Management Plan

Prior to any demolition, excavation or construction a Construction Management Plan (CMP) will be produced by the successful contractor. A Construction Management Plan deals with the Contractor’s overall management and administration of a construction project. A CMP is prepared by the Contractor during the pre-construction phase, to ensure that the project is completed on-time and within budget and to ensure that all construction activities are undertaken in a satisfactory and safe manner, to a delivery program meeting the Clients requirements. The CMP will include a detailed programme of works and budget.

The production of the CMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

19.1.2 Environmental Operating Plan

During the construction phase of the scheme the works will comply with all relevant legislation and guidelines that aim to reduce and minimise environmental impacts. Construction related impacts are generally of short-term duration and localised in nature, these impacts will be reduced as far as possible by complying with the mitigation measures outlined in the EIS for the Scheme, construction industry guidelines, NRA Environmental Construction Guidelines, Environmental Operating Plan and Waste Management Plan.

NRA Environmental Construction Guidelines

The NRA Environmental Construction Guidelines provide guidance with regard to environmental best practice methods to be employed in construction on National Road Schemes for the following:

- Guidelines for the Treatment of Badgers prior to the Construction of a National Road Schemes;
- Guidelines for the Treatment of Bats during the Construction of National Road Schemes;
- Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes;
Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes;

Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes;

Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes;

Guidelines on the Management of Noxious Weeds on National Roads;

Guidelines for the Treatment of Noise and Vibration in National Road Schemes;

Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes;

Management of Waste from National Road Construction Projects;

Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

This is a non-exhaustive list and relevant guidance current at the time of construction will be followed.

**Environmental Operating Plan (EOP)**

The Contractor will be required to complete an Environmental Operating Plan (EOP) in accordance with the NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIS and measures stipulated in the planning conditions. Details within the plan will include;

- All Environmental commitments and mitigation measures included as part of the planning approval process and any requirements of statutory bodies such as the National Parks and Wildlife Services as well as a method documenting compliance with the measures;

- A list all applicable environmental legislation requirements and a method of documenting compliance with these requirements;

- Outline methods by which construction work will be managed to avoid, reduce or remedy potential adverse impacts on the environment.

To oversee the implementation of the EOP the Contractor will be required to appoint a responsible manager to ensure that the mitigation measures included in the EIS and the EOP are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

**Waste Management Plan (WMP)**

Included within the EOP will be the Waste Management Plan prepared in accordance with the Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, July 2006). The WMP will clearly set out the Contractor’s proposals regarding the treatment, storage and recovery or disposal of waste. As a minimum the plan itself will contain (but not be limited to) the following measures;

- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste and collection times;
• Details of where and how materials are to be disposed of - landfill or other appropriately licensed waste management facility;
• Details of storage areas for waste materials and containers;
• Details of how unsuitable excess materials will be disposed of where necessary;
• Details of how and where hazardous wastes such as oils, diesel and other hydrocarbon or other chemical waste are to be stored and disposed of in a suitable manner;
• A construction and demolition waste plan.

The mitigation measures contained within this EIS and summarised in Chapter 19 which will form the basis for the Schedule of Commitments submitted to An Bord Pleanála at the conclusion of the Oral Hearing will be strictly adhered to within the WMP.

**Construction Management Plan**

Prior to any demolition, excavation or construction a Construction Management Plan (CMP) will be produced by the successful contractor. A Construction Management Plan deals with the Contractor’s overall management and administration of a construction project. A CMP is prepared by the Contractor during the pre-construction phase, to ensure that the project is completed on-time and within budget. The CMP will include a detailed programme of works and budget. The CMP is also developed to ensure that all construction activities are undertaken in a satisfactory and safe manner, to a delivery program meeting the Clients requirements. The Contractor will be required to include details under the following headings;

• Details of working hours and days;
• Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services;
• Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
• Details of construction plant storage, temporary offices and on-site chemical toilet areas;
• Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
• Truck wheel wash details (including measures to reduce and treat runoff);
• Dust management to prevent nuisance (demolition & construction);
• Site run-off management;
• Noise and vibration management to prevent nuisance (demolition & construction);
• Landscape management;
• Management of demolition of all structures and assessment of risks for same;
- Lighting details (construction & operation);
- Signage;
- Stockpiles;
- Project procedures & method statements for:
  - Demolition & removal of buildings, services, pipelines (including risk assessment and disposal)
  - Diversion of services
  - Excavation and blasting (through peat, soils & bedrock)
  - Piling
  - Construction of pipelines
  - Temporary hoarding & lighting
  - Borrow Pits & location of crushing plant
  - Storage and Treatment of peat and soft soils
  - Exporting of surplus geological material (peat, soils, rock etc)
  - Protection of watercourses from contamination and silting during construction.

The production of the CMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

The mitigation measures contained throughout this EIS and summarised in Chapter 19 which will form the basis for the Schedule of Commitments submitted to An Bord Pleanála at the conclusion of the Oral Hearing will be strictly adhered to in framing the minimum requirements with the CMP.

19.1.3 Construction Compounds

There will be a number of construction compound sites along and / or in the vicinity of the scheme. The location, size and suitability of the sites selected will be at the discretion of the contractor, while planning permission will be required from the planning authority for sites proposed outside of the development boundary.

The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will not be permitted within 50m of a watercourse and within 100m of the River Moy SAC or the Castlebar River. All fuel storage areas will be bunded to 110% of storage capacity to prevent spills and provide sufficient additional capacity in the event of rainfall occurring simultaneously. The compounds will also have appropriate levels of security to limit potential vandalism, theft and unauthorised access within the compounds.

Following completion of construction these areas will be cleared and re-instated, temporary buildings and containers, parking areas and waste material such as rubble, aggregates and unused construction materials will not be permitted to remain exposed on these sites and will need to be removed and disposed of appropriately.
19.1.4 Construction Material

Earthworks
In areas of deep peat, alluvial material and other soft areas it is proposed that the construction method will entail ground improvements including piling to avoid the removal of large amounts of material.

The early programmed construction of piled embankments at Black Lough, Ch.18,420 - 18,530 and 18,750-18,910, the low embankment crossing at Lough Lannagh, Ch 19,600 – 19,860 and the railway bridges at Ch. 30,800 and Ch. 36,100 and their associated approach embankments will be critical in allowing the distribution of materials along the mainline.

Sourcing of Materials and Waste
Only those quarries that conform to all necessary statutory consents will be used in the construction phase.

Some of the excavated material will be unsuitable for embankment construction. Some of this will be used for topsoil on the proposed earthwork slopes, on landscaping areas and in the creation of noise bunds. The excess will be disposed of off-site subject to compliance with the relevant legislation and approvals.

Working Hours
The normal working hours to be employed by the contractor will be as follows:

- Monday to Friday 07:00 to 19:00hrs
- Saturday 08:00 to 16:30hrs
- Sunday & Bank Holidays 08:00 to 16:30hrs

Works on Sundays and Bank Holidays will only be permitted with the approval of the Client. Similarly, emergency works outside of the normal working hours will only be permitted with the written approval of the client.

19.2 Mitigation Measures for Socio Economics

The following mitigation measures are proposed:

- Encourage cycle and tourist use of existing N5 in preference to the Proposed Scheme through signage and appropriate facilities.
- Provide netting where the Proposed Scheme follows the boundary of Westport GAA Club.
- Provide a footpath along the N59 (Newport South Road) to connect to existing footpaths.
- Reconnect the Western Way at the severed Attireesh Road.
- Provide NRA approved signage at proposed Knockranny South and Castlebar West Junctions for businesses including accommodation located on the existing N5 between Westport and Castlebar.
- Provide a footpath at and in the vicinity of the proposed junction with the N60.
- Provide netting along the proposed scheme adjacent to Castlebar Golf Club.
- Provide signage for the National Museum of Ireland - Country Life.
- Provide directional signage to Abbeybreaffy Nursing Home at Turlough Junction and in Turlough village.
- Permit severed section of L-5779 Gortnafolla Road to be used for parishioner parking at Church of Ireland.
- Facilitate continued pedestrian access to Church of Ireland from Turlough during construction and operation.
- Provide services and amenity signage in line with NRA guidelines at Castlebar East Junction and Turlough Junction.
- On opening, monitor eastbound cyclist use of Knockranny South and Castlebar East Junctions to determine whether additional cycle lanes or cycle facilities will be needed. Mitigation Measures for Ecology.

### 19.3 Terrestrial Ecology

#### Measures for Receptors of Conservation Value

Where appropriate, the 9 identified plots will be fenced off during construction and management measures implemented to increase their biodiversity value as outlined below. An indication of recommended enhancement measures is given below and is summarised in Table 19.1.

#### Table 19.1 Habitat Mitigation Areas: Summary Information

<table>
<thead>
<tr>
<th>No.</th>
<th>Location / Name</th>
<th>Chainage</th>
<th>Main currently present</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Knockbrack</td>
<td>12+700 – 12+850</td>
<td>Improved grassland GA1</td>
<td>Allow to revert naturally to wet grassland</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wet grassland GS4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Kilbree Lower</td>
<td>14+150 – 14+400</td>
<td>Cutover bog PB4</td>
<td>Leave in present state</td>
</tr>
<tr>
<td>3</td>
<td>Lough Lannagh</td>
<td>19+700 – 19+800</td>
<td>Birch woodland Marsh GM1</td>
<td>Leave in present state</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wet grassland GS4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Shanvally</td>
<td>36+400 – 36+750</td>
<td>Wet grassland GS4 Scrub WS1</td>
<td>Plant native woodland in part of this area</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Leave wet areas in present state</td>
</tr>
</tbody>
</table>

In addition, specific mitigation measures are identified for each receptor to reduce the impacts during construction.

**Receptor No. 1 Knockbrack Bog (Chainage 12+400 – 13+800)**

**Mitigation Area 1**

A plot of grassland (improved and wet grassland) (chainage 12+700-12+850) between the road and cutover bog will be allowed to regenerate to wet grassland or scrub. Plant road margins between 12+400 and 13+800 with tree species characteristic of local cutover bog, especially downy birch (*Betula pubescens*) and eared willow (*Salix aurita*).
Receptor No. 2 Kilbree Lower Bog (Chainage 14+200 – 14+600)

Mitigation Area 2
A strip of cutover bog to the south of the road will be fenced and retained. Plant road margins between 14+150 and 14+550 with tree species characteristic of local cutover bog, especially downy birch (*Betula pubescens*) and eared willow (*Salix aurita*).

Receptor No. 3 Drumneen Bog (Chainage 15+100 – 15+600)
Protect with fencing the stand of oak-ash-holly woodland (WN1) which extends into the take line area on south side of road. Where appropriate, plant road margins with tree species characteristic of local cutover bog and scrub, especially downy birch (*Betula pubescens*), eared willow (*Salix aurita*) and hazel (*Corylus avellana*).

Receptor No. 4 Black Lough (Chainage 18+800 – 18+900)
Sensitive design and various mitigation measures as detailed in the hydrological assessment in Chapter 10 will ensure that the existing water levels in the wetland will be maintained when works are complete. Measures will also minimise any lowering of water quality during construction works from potential pollutants. Where feasible at the crossing point, marginal planting will be confined to strips of downy birch (*Betula pubescens*) and grey willow (*Salix cinerea* subsp. *oleifolia*). At the commencement of works, marking of the take lines with fencing will be done with particular care. No excavated material or any materials associated with road construction will be stored in the lake basin to the north or south of the road embankment.

Receptor No. 5 Lough Lannagh (Chainage 19+250 – 20+000)

Mitigation Area 3
This area is a peninsula with birch woodland and marginal wet grassland and marsh vegetation. Some recent disturbance has occurred to the eastern side of the wood. Fence area to prevent cattle access and retain in current condition. Mitigation measures as detailed in Chapters 7.2 will ensure that the water quality of Lough Lannagh is maintained during construction works, and that the existing water levels in the wetland habitats to the south of the road (and especially the reed swamp between chainage 19+850-19+950) are maintained when works are complete.

Receptor No. 6 Derrylea Bog (Chainage 30+200 – 30+800)
Where appropriate, plant road margins with tree species characteristic of local cutover bog, especially downy birch (*Betula pubescens*) and eared willow (*Salix aurita*).

Receptor No. 7 Aghadrinagh Wetland (Chainage 32+600 – 33+100)
Ensure there are no incursions into area of rich fen to the north of route corridor.

Receptor No. 8 Shanvally Wetland and Wood (Chainage 36+100 – 36+750)

Mitigation Area 4
A plot of land containing wet grassland and scrub (mostly gorse) is being retained for habitat mitigation. This adjoins the area of native woodland on the ridge. Plant some native deciduous woodland to mitigate for the loss of part of the nearby wood. Species to include hazel, ash, and hawthorn, though final composition will depend on wetness of ground conditions.
At the commencement of works, marking of the take lines with fencing will be done with particular care to ensure no disturbance to the area of fen and minimal disturbance to the woodland. No excavated material or any materials associated with road construction will be stored elsewhere within this ecological receptor.

Receptor No. 9 Castlebar River corridor (Chainage 43+600 – 44+600)
Detailed mitigation measures to protect water quality during both the construction and operation phases are given in the aquatic ecology section of this EIS.

Further Mitigation Area
An existing area of woodland between Ch.13+800 – 13+900 will be acquired as part of the scheme. This is useful woodland habitat on old cutover bog. Remedial work may be necessary at the margins after the road works are complete.

Hedgerows, Trees and Landscaping
Removal of hedgerows and especially trees will be kept to a minimum. Tall trees which are being retained at the edge of the take lines will be fenced to prevent accidental damage.

Landscaping along the road verges and embankments will comprise planting of trees and shrubs as well as grass verges. In areas of cuttings, bare rock and shallow soils will be left to re-vegetate naturally consistent with engineering stability.

Where trees are being planted, these will link in with existing hedgerows (which will have been truncated by road construction) so as to maintain corridors for animals. Where space exists, the planting of trees and shrubs in copses (as opposed to lines) will be carried out. To maximise the value for wildlife, trees and shrubs will be mainly native species that occur in western Ireland. These would include ash, hawthorn, blackthorn, hazel, alder (only Alnus glutinosa), birch (Betula pubescens), willow (mainly Salix cinerea and S. aurita), native holly (Ilex aquifolium), and oak (Quercus petraea).

Some sections of verges and embankments will be planted with native meadow grass seed mixtures. A particularly good diversity of plant species would be expected to become established where the soil has a calcareous element. As already noted, if the substrate is rocky or very stony, it is preferable to leave such areas unplanted and allow grassland vegetation to develop naturally. Management of grassy embankments and margins will involve periodic cutting to prevent formation of dense scrub.

Badgers and otters
All recommended mitigation measures are based on the NRA Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes (2006a), NRA Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (2006b) and NRA Guidelines for Crossing of Watercourses During the Construction of National Road Schemes (2005) and refer to the existing specimen design for the proposed road.

An approach of multiuse mitigation will be employed which involves the effective use of all structures: culverts, agricultural and pedestrian underpasses and bridges, for wildlife passage and protection. All agreed mitigation measures will be put in place and completed before the road is open to traffic.
A total of 3 badger setts were identified within, or within 50m of, the CPO boundary of the proposed road development and each of these setts will require site specific mitigation measures. A further 5 setts are located within 50 to 150m of the CPO boundary and will only be subject to mitigation measures if pile driving or blasting is proposed within 150m of the sett location. The mitigation measures for each sett are separated into two stages; mitigation measures during fence-line construction or vegetation clearance, and mitigation measures prior to or during construction. This takes account of the potential for the vegetation clearance/fence-line construction to be carried out well in advance of the commencement of the construction works. If the vegetation clearance/fence-line construction is carried out in conjunction with the construction phase then the mitigation measures prior to or during construction column details all the required mitigation measures.

**Pre-construction badger survey**

In addition to those already found, badgers may also create new setts in advance of road construction. In accordance with the NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a), where 36 months or more has elapsed between obtaining statutory approval for a road scheme and initiation of the construction phase, an appropriate level of resurvey will be carried out as the baseline date may be altered during this time.

An assessment of the activity status of all setts close to the alignment will be carried out pre-construction.

**Monitoring during site clearance**

Where dense vegetation prevents adequate determination of the presence or absence of setts, these areas will require monitoring during vegetation clearance to ensure that any setts present will be found and treated appropriately.

**Protection of setts close to the CPO**

No construction machinery will be used within 30m of badger setts (extended to 50m for active setts during the breeding season, December – June inclusive). During the pre-construction survey setts located adjacent/close to the CPO boundary (within 50m) will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage, if deemed necessary. Such marker fencing will be sufficiently durable and robust to cover the period of construction. Neither blasting nor pile-driving will be undertaken within 150m of active setts during the breeding season.

Landscaping activities after the road construction phase can also affect badger setts, and care will be taken to ensure that setts safeguarded on or near the site are not interfered with at this stage and that access to foraging areas is not restricted.

**Evacuation of setts adjacent to the CPO**

Where required, evacuation and destruction of active badger setts will be carried out under the supervision of an appropriately qualified ecologist under licence from the National Parks and Wildlife Service (NPWS). Evacuation and destruction will be undertaken during the period 1st July to 30th November. All active setts will be protected from interference or disturbance by an exclusion zone of 30m (50m during the breeding season - December to June inclusive) within which no machinery or vegetation removal will take place. Sett tunnels can extend for over 20m from sett entrances and use of any vehicles, digging, or heavy machinery can cause collapse
of tunnels and cause mortality of badgers. Light work, such as hand digging or scrub clearance will not take place within 10m of sett entrances.

The setts will be clearly marked and the area from which vehicles are prohibited will be clearly marked by timber post and rail fencing (and appropriate signage) which will allow badgers to move in and out freely. To ensure that accidental damage to setts does not occur, it is important that there is a transfer of information between construction personnel at all levels. The mitigation measures and procedures required in relation to badgers will be included in the Environmental Operating Plan for the proposed N5 Westport to Turlough Road Scheme.

Exclusion of badgers from disused or currently inactive setts is not seasonally restricted and can be conducted at any time.

**Badger/mammal underpasses**

Badgers typically follow the same pathways between setts, feedings areas and latrines. Such pathways are identified on the basis of the presence of tracks and feeding scrapes. In most cases, these pathways occur along features such as watercourses, hedgerows, treelines, and woodland and scrub margins. To avoid unnecessary badger road casualties, mammal underpasses will be constructed adjacent to regular crossing points on the proposed road. The locations recommended for badger/mammal underpasses are listed below in Table 19.2 and presented on Figures 7.1 – 7.17. Underpasses will be constructed in accordance with the NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a). Additional advice on the construction and location of mammal underpasses is available in the Highways Agency document Design Manual for Roads and Bridges (Highways Agency, 2001a and b).

The following general guidelines will be adhered to:

- The exit and entrance to tunnels will be flush with badger-proof fencing and the invert set at ground level. A concrete surround will provide a solid connection to the uprights of the fence and inhibit any efforts by badgers to dig under the pipe. Drainage will be adequate to prevent water-logging at the entrances during wet weather.
- Specific design of underpasses will be tailored to individual locations and will be carried out at the detailed design stage.

Placement of mammal underpasses through sections of cut creates engineering difficulties. Where engineering difficulties arise, it is recommended that underpasses be moved to the nearest more suitable location, but not more than c. 250m away. Final design and placement will be advised at detailed design stage by a qualified ecologist.

Where suitable, badger underpasses can be combined with proposed culverts greater than 1m in diameter by the incorporation of raised mammal ledges. These culverts/underpasses will also serve otter movement where located along watercourses. Similarly, existing, proposed accommodation roads and railway tunnels under the proposed road development will also serve to facilitate badger passage.

Where it is not possible to install mammal underpass facilities in areas where the road will be in cut, any over-bridges along the proposed road development will allow passage of mammals between areas cut by the road.
<table>
<thead>
<tr>
<th>Mammal Underpass (MU) Number</th>
<th>Chainage</th>
<th>Species</th>
<th>Underpass Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>2+470</td>
<td>Badger</td>
<td>600mm pipe</td>
</tr>
<tr>
<td>1b</td>
<td>3+210</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>1c</td>
<td>3+000</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>2</td>
<td>10+200</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>3</td>
<td>10+430</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>4</td>
<td>10+990</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>5</td>
<td>11+220</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>6</td>
<td>11+780</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>7</td>
<td>12+700</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>8</td>
<td>12+870</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass installed adjacent to culvert</td>
</tr>
<tr>
<td>9</td>
<td>13+920</td>
<td>Badger and otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert on west bank of watercourse</td>
</tr>
<tr>
<td>10</td>
<td>14+160</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>11</td>
<td>15+380</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>12</td>
<td>16+120</td>
<td>Badger and otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert on east bank of watercourse</td>
</tr>
<tr>
<td>13</td>
<td>16+380</td>
<td>Badger</td>
<td>Farm underpass</td>
</tr>
<tr>
<td>14</td>
<td>16+980</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>15</td>
<td>17+520</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>16</td>
<td>17+870</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>17</td>
<td>18+890</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
<tr>
<td>18</td>
<td>19+600</td>
<td>Otter</td>
<td>Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert</td>
</tr>
</tbody>
</table>
### Mammal Underpass (MU) Number | Chainage | Species | Underpass Construction
--- | --- | --- | ---
19 | 19+900 | Otter | Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert
20 | 30+820 | Badger | Railway accommodation underneath the road carriageway will provide mammal passage facilities
21 | 31+050 | Badger | Accommodation road underneath the road carriageway will provide mammal passage facilities
22 | 31+750 | Badger and otter | Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert on west bank of watercourse
23 | 32+590 | Badger and otter | Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert on west bank of watercourse
24 | 33+990 | Badger | 600mm pipe
25 | 35+410 | Badger | 600mm pipe
26 | 35+660 | Badger | 600mm pipe
27 | 36+100 | Badger | Railway accommodation underneath the road carriageway will provide mammal passage facilities
28 | 36+400 | Otter | Mammal ledge incorporated in culvert, or separate dry mammal underpass (600mm pipe) installed adjacent to culvert
29 | 38+630 | Badger | 600mm pipe
30 | 43+805 | Otter | Castlebar River/ clear span bridge to maintain natural bank passage on both banks

### Badger / Mammal Fencing
Mammal resistant fencing will be required to guide badgers and other mammals to passage facilities and to prevent animals crossing the new roadway. The specification for mammal resistant fencing is given in the NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a). The locations of the mammal resistant fencing required is shown on Figure 7.1 to 7.17 in Volume 3. Fencing will be recessed and tied into culvert and mammal underpass locations to guide badgers and other mammals safely under the road and prevent them accessing the road carriageway. Dedicated mammal crossings will be more readily used if the approach is softened through the use of appropriate planting. Mammal resistant fencing will be incorporated at the earliest possible stage during road-construction, preferably during erection of the permanent fenceline with gaps left at locations recommended for underpasses. Gaps shall be subsequently closed after underpasses have been constructed.

Gates entering onto farm access roads will require concrete sills and mesh to exclude badgers from accessing the proposed road. The location of gates on farm access roads requiring this modification will be determined at detail design stage.

Where there is an overlap of stock-proof fencing and mammal resistant fencing at culvert/underpass locations, stock-proof fencing must be adjusted to allow for unimpeded access to the underpass. This involves modification of the lower section of the stock-proof fence. The fence will be adjusted so that the bottom rail and wire mesh are removed and chain-link is not fixed to the ground at the location of the
underpass. This allows for the animals to see a break in the fence line and thus clear access to the underpass nearby. Detail of this can be seen in Figure 1 of NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a).

Post-construction monitoring and mitigation

The success of the mitigation measures for badgers will be monitored for a period after construction, and measures taken to enhance use of underpasses where required. Quarterly monitoring will be carried out to determine the success of the measures employed. Monitoring will be continued for a minimum of one year after construction ceases, in accordance with the NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2005).

In order to ensure that the long term effectiveness of badger resistant fencing and underpasses, these will require periodic maintenance in accordance with the NRA Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (2006a).

Other recommendations

The location of any depots, spoil heaps or other additional site usage during clearance and construction will avoid any disturbance to the location of the setts given in Appendix 7.1.2 and also avoid areas identified for the installation of mammal underpasses.

Protection of Otter

Otters are likely to use most of the watercourses in the study area and will traverse along smaller as well as larger streams and rivers and also along drainage channels, where they access foraging areas. Otters do not limit their movements to watercourses and enter hinterlands to search for prey species, such as frogs in particular.

A detailed pre-construction survey will check for any otter holts within or close to the alignment (at least 200m upstream and downstream of the crossing point) at all river crossings if there is any delay between this current survey and construction commencing (e.g. period of 9-12 months). Any holts found to be present will be subject to monitoring and mitigation as set out in the NRA Guidelines for the Treatment of Otter prior to the Construction of National Road Schemes (2006b).

If found to be inactive, exclusion of holts may be carried out during any season. No wheeled or tracked vehicles (of any kind) will be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance will also not take place within 15m of such holts, except under licence. The prohibited working area associated with otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the otters have left the holt, as determined by a specialist. Breeding may take place at any season, so activity at a holt must be adjudged on a case by case basis. Exclusion and destruction will be undertaken, in accordance with the NRA Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (2006b). This process involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the otters have left the holt prior to removal.
Culvert design
Facilities for otter passage will be provided at all watercourses where evidence of otter use was recorded during the field surveys. Where a watercourse was deemed suitable, or likely, to support otter, facilities for otter passage will be provided (including watercourses where recorded otter signs were absent during the field surveys). Each of the culverts and bridges requiring passage for otter will incorporate provision for mammal passage. The retention of natural bank paths along the Castlebar River, as well as the provision of raised ledges within culverts (or separate dry mammal underpasses) will provide appropriate passages for otters to pass beneath the proposed road (refer to Table 7.1.19).

Mammal resistant fencing
Locations where mammal resistant fencing is recommended along the proposed road development are shown on Figure 7.1-7.17 in Volume 3 and this will prevent otters gaining access to the proposed road. The fencing will be put in place in accordance with the NRA Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (2006b).

Protection of riparian corridor
Natural riparian vegetation cover will be retained where practical, or other landscaping measures undertaken, to ensure that all watercourses may continue to function as contiguous natural habitat for this species.

Post-construction monitoring and mitigation
The success of the mitigation measures for otter will be monitored for a period after construction, and measures taken to enhance use of underpasses where required. Quarterly monitoring will be carried out to determine the success of the measures employed. Monitoring will be continued for a minimum of one year after construction ceases.

Bats
Standard mitigation measures, as would apply to any large-scale development, will be adopted in the construction of the carriageway. These include limiting season of disturbance to trees and vegetation so as to reduce impacts on breeding species and to provide for habitat replacement as necessary. Specific measures will also be required to protect bats within the survey area. Pro-active enhancement measures are also recommended to improve bat habitats along the route.

The following mitigation measures are in line with the NRA Guidelines on provisions for the conservation of bats during the planning and construction of roads (2006). Reference is made to the NRA Guidelines (Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes and the Guidelines for the Treatment of Bats during the Construction of National Road Schemes).

Buildings
There was no evidence of bat use of any of the impacted buildings surveyed along the proposed road route - therefore no mitigation measures are recommended for any of the impacted buildings.

Bridges
Any re-pointing or pressure grouting of existing bridges will only proceed after an inspection of the structure (by a bat expert) for bats.
Any new bridge will incorporate access points and roosting areas for bats. This can be easily done at no extra cost and without affecting the integrity of the structure. Studies have shown that bats use a variety of crevice sizes in bridges from 13mm to 70mm in width to 350mm to 1000mm in depth for summer roosts and deeper for winter hibernation sites. Ready-made artificial roost units are available for inclusion in such situations. Bat 'Tubes' of the 750/6 design are suggested. Bat tubes have an added advantage as they are maintenance free (the entrance/exit slit is at the bottom allowing bat droppings to fall freely from the tube). These may also be inserted as part of the bridge fabric during construction in areas not requiring maintenance. Such insertion would also prevent vandalism. Alternatively, areas of some bridges could be faced with natural stone leaving crevices of the dimensions described above unfilled with mortar.

The minimum height of new bridges spanning Lough Lannagh and major rivers will be 4 m above the water surface (measured during winter/spring flood levels) to allow unrestricted bat flight beneath. New bridges will also span the entire width of these water courses and incorporate at least 2 m of bank and bank vegetation. The height of the bridge will be 2 m above the bankside vegetation. Where bankside vegetation is not present, such shall be provided using native vegetation.

A native hedgerow will be planted leading from any new bridge and connecting to hedgerows dissected by the proposed route. Newly planted hedgerows adjacent to the bridge will be at a height and density to ensure that commuting bats will not cross the road but continue to commute safely under the bridge.

**Potential bat roosts in trees**

Several species of bats roost in trees. Where possible, treelines and mature trees that are located immediately adjacent to the line of the proposed route shall be avoided and retained intact. Mature trees to be retained adjacent to the corridor and any construction areas will be protected from root damage by an exclusion zone (see recommendation in habitat section). Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing.

Any mature trees within the woodland at Clogher that require felling will be surveyed by a bat specialist, prior to removal, for their potential to harbour bats and further mitigation measures, including application for a derogation licence, erection of bat boxes etc., will be carried out will bats or signs of bat use be found.

Mature trees, which are to be removed, shall ideally be felled in the period late August to late October or early November, in order to avoid the disturbance of any roosting bats as per NRA guidelines. Felling at this season will also avoid the bird nesting period. Tree felling will be completed by mid-November at the latest because bats roosting in trees are very vulnerable to disturbance during their hibernation period (November – April). Ivy covered trees, once felled, will be left intact in situ for 24 hours to allow any bats beneath the foliage to escape prior to their disposal.

**Lighting restrictions**

In general, artificial light creates a barrier to commuting bats so lighting will be minimised along the proposed route especially at areas of interest for bat species. Lighting will especially be avoided beneath new bridges over water as this would impact on bat foraging and commuting activities, especially that of Daubenton’s bats which presently use the various water courses. Lighting may also prevent use of installed bat tubes. Where lighting is required, directional lighting (i.e. lighting which only shines on roads and not nearby countryside) shall be used to prevent overspill.
This will be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only.

**Compensation for loss of commuting routes**

Linear features such as hedgerows and treelines serve as commuting corridors for bats (and other wildlife). The following measures are recommended to compensate for inevitable loss of these features that are used by bats as commuting routes.

Severed linear features such as hedgerows and treelines will be reconnected using semi-mature trees under-planted with hedgerow species. The exact locations of such planting will be identified at detailed landscaping stage. Native species will be used as they support more insect life than non-native varieties.

Watercourses present along the route corridor will be enhanced by the planting of native shrubs along one or both banks. The planting of shrubs in such areas provide shelter in which insect numbers can accumulate and also provide a corridor along which bats can commute. These measures would also enhance these areas for wildlife in general. Native species will be used to provide a vegetation belt of greater than three metres to act as shelter for foraging bats.

At the proposed major river crossing points, existing vegetation will be retained as close as possible to the crossing point in order to maintain a corridor and encourage bats to cross beneath the bridges and utilise feeding habitat on both sides.

**Habitat retention, replacement and landscaping**

Habitat replacement and landscaping could compensate for or add to the wildlife value of the area. Pro-active habitat restoration measures are considered below.

In general, best practice design shall aim to retain the quality of the landscape where possible and ensure its protection within the landscaping programme. Existing hedgerows and treelines, semi-natural scrub, semi-natural woodland or semi-natural grasslands will be retained where possible and incorporated into the landscaping programme.

The overall design of the project will also include habitat replacement or enhancement of existing scrub and woodland habitat. For example, planting of native trees along the route shall also be carried out in order to provide visual screening of the development. Native species will be chosen in all landscaping schemes. Planting schemes shall attempt to link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.

Additional planting could also include night-scented species to encourage night-flying insects onto the site to act as prey items for bats. A list of suggested plants is given in Appendix 7.1.3.

**Additional measures: further survey and monitoring**

Will any further structures be impacted by changes to the current proposed route alignment then these shall be assessed for their potential to harbour bats prior to works and the findings reported. If bat use is confirmed, appropriate mitigation measures shall be taken to ensure no animals are harmed.

The success of the mitigation measures for bats shall be monitored for a period of three years after construction and appropriate measures taken to enhance these if and where required.
Amphibians
Whilst frogs (and possibly) smooth newts are present in the area, the scheme will not affect any identified specific breeding pool. Therefore, mitigation is not considered necessary for amphibians.

Birds
To comply with the Wildlife Acts (1976 & 2000) tree and hedgerow clearance will not take place between 1st March and 31st August during the bird nesting and breeding season. If clearance is required within the restricted period, this must be agreed with the National Parks & Wildlife Service (subject to the issue of a derogation licence).

19.4 Mitigation Measures for Aquatic Ecology

19.4.1 Designated Areas and Protected Species
Measures to avoid, reduce or remedy impacts on the River Moy SAC during construction and operation of the proposed scheme include the proposed design of the crossing structure at the widening of the existing bridge on the N5 at chainage 43+805, along with the widening of the existing N5 between Ch 40+400 to Ch 40+900 and at Ch 44+300 to Ch 44+400. The existing structure on the N5 is clear-span with abutments set back from the river edge to avoid any alteration to river banks and instream habitat. A typical construction sequence for the widening of this structure has been developed which provides for the avoidance of any instream works by the retention of a minimal 1.3m set back from the river and the avoidance of siltation or untreated site-run-off. The drawings (presented in Appendix 7.2.5) identify the works restriction areas at the Castlebar River and provide the absolute minimum required for construction purposes.

The construction work zones along the Castlebar River shall be defined at the outset of construction using rigid timber or equivalent robust fencing. Within the site boundary fence, earth bunds shall be constructed to contain surface water run-off and channel it to a silt trap before discharge. This shall entail a mechanism for containment of runoff in the event of accidental spillage to enable clean-up and appropriate disposal through licensed facilities. Measures of pollution control for road run-off to the Castlebar River during the operation phase of the scheme include provision of vegetated treatment systems which will function as attenuation, treatment systems and containment to accommodate accidental spillage.

The measures described below under Aquatic and Fisheries will serve to ensure that any potential impacts on the River Moy SAC from siltation or pollution during both the construction and operation phases are avoided or remedied.

To avoid, reduce or remedy potential impacts on otter, in all watercourses where otter has been identified to occur (or may be likely to occur) (see Appendix 7.2.1) bridge and culvert design will accommodate otter movement in accordance with the Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (NRA, 2007). In addition, otter passage will be facilitated at ch. 12+870; 17+520; 19+900 and 36+400 where potential for otter movement has been identified during the general mammal survey for the scheme (see Table 7.1.19). Otter passage across the road will be facilitated by dedicated culverts or ledges within culverts in conjunction with otter-proof fencing along the road network to prevent animals from accessing the carriageway. In accordance with the NRA Guidance, a further inspection of the development area will be undertaken immediately prior to
site clearance to ensure that no new holts have been created in the intervening period.

To avoid impacting on spawning amphibians and tadpoles in the artificial ponds at Carrowmore, the ponds will be drained outside of the period February to July.

**Aquatic Habitats and Fisheries**

The mitigation measures detailed below will be incorporated in their entirety into the construction contract documentation.

(i) A suitably qualified project ecologist will be employed by the contractor to ensure successful implementation of the mitigation measures.

(ii) All design, construction and operation will be carried out in accordance with *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes* (NRA, 2006) and *Control of water pollution from construction sites; Guidance for Consultants and Contractors* (SP156) (CIRIA, 2002) in addition to the specified requirements within the EIS.

(iii) Design and construction method statements will be submitted to Inland Fisheries Ireland for approval prior to commencement of construction.

(iv) Sediment traps or settlement ponds will be provided for on all watercourses during construction. Total suspended solid levels in all waters discharging to the River Moy system shall be in compliance with the Quality of Salmonid Water Regulations (SI 293:1988).

(v) Where site investigation (including archaeological works) is required in the vicinity of or adjacent to the watercourses within the River Moy system, these works will be carried out with due sensitivity and appropriate measures employed to minimise siltation. Site investigations alongside the Castlebar River shall be subject to seasonal constraints where spawning habitat is present or within 300m downstream (as required by the Inland Fisheries Ireland).

(vi) Site compounds and soil storage areas will be located at a minimum distance of 100m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.

(vii) Culvert design will avoid impacting on flow regimes and river bed profiles upstream and downstream of the structure and allow for unimpeded movement of fish by ensuring a minimum depth of water within the structure. Flow regimes for all crossings identified as supporting salmonids shall allow for the unimpeded passage of fish upstream and downstream by having the invert buried 500m below bed level.

(viii) Clear span structures and box culverts will be used on watercourses as specified in Appendix 7.2.1. Where box culverts are proposed, these shall match the existing width of the watercourse by use of a stepped profile as appropriate.

(ix) Where bank strengthening or scour protection is required, this will utilise sensitively placed rock armour with appropriate landscaping to tie the feature into the existing river bank profile. Gabion baskets and Reno mattresses shall not be used.

(x) Instream works on all watercourses supporting salmonids (see Appendix 7.2.1) shall be undertaken during the period 1st June to 30th October as required by Inland Fisheries Ireland to avoid accidental damage or siltation of spawning beds. This will include preparatory work such as piling or rock blasting in the
vicinity of watercourses. Bank works will not interfere with migrating fish from March to June and spawning fish migration from October to February.

Where watercourses require re-alignment to provide a right-angle crossing to the road or to minimise culvert length, detailed designs for realignments will be submitted for approval to Inland Fisheries Ireland (IFI). The designs will take into consideration the sinuosity and riffle ratio of the existing river and provide details of the substrate composition for the reconstructed channel. Realignments will reflect the natural river systems in both plan and profile, and be compatible with the upstream and downstream sections of the existing channel. Landscaping along realigned sections of watercourse will aim to recreate riparian habitats using exclusively appropriate native species.

(xi) The crossing of the stream at Claggarnagh will be designed to ensure unimpeded upstream and downstream movement of fish by incorporation of a fish pass. The design and construction of the pass will be approved by IFI.

(xii) New stretches of watercourse on realignments will be completed and have vegetation established prior to connecting to the original watercourse. Abandoned stretches will be electro-fished by suitably qualified personnel (under licence from IFI or NPWS as appropriate) to salvage fish where identified as occurring or having the potential to occur (see Table 7.2.1).

(xiii) Streams classified as being of Low local Importance (see Appendix 7.2.1) will be afforded protection from high silt loads to prevent pulses of silt-laden water entering more valuable stretches of watercourses lower on the system.

(xiv) Watercourse crossing and approach road design will incorporate best environmental practice and design in the control of road run-off and accidental spillage.

(xv) Run-off from the road during operation will be channelled through a stilling process to allow suspended solids to settle out (this may be in open ditches, ponds, hydrodynamic separators, etc.) or through some form of spill-containment facility and vegetated treatment system prior to discharge to a watercourse.

(xvi) Specific measures for the Castlebar River outfalls include provision of vegetated treatment systems which will function as attenuation, treatment systems and containment to accommodate accidental spillage (see Chapter 3.2.5, Plate 3.34). Discharge from the system will be via a penstock or similar to enable retention of accidental spillages, into a shallow drainage channel excavated towards the river. The channel will not connect directly to the river bank to avoid any instream works or requirements for headwalls, scour protection etc within the river.

(xvii) An emergency-operating plan will be established to deal with incidents or accidents during construction that may give rise to pollution within any watercourse. This will include means of containment in the event of accidental spillage of hydrocarbons or other pollutants (including oil booms, soakage pads, etc).

(xviii) Landscaping and design will focus on the establishment of naturally occurring habitat types using native species to re-establish the linear corridor of vegetation along watercourses in accordance with A Guide to Landscape Treatments for National Road Schemes in Ireland (NRA, 2006).

(xix) Angling access will be maintained along the Castlebar River and in the vicinity of Lough Lannagh Ch 19+600.

(xx) Throughout all stages of the construction phase of the project the contractor will ensure that good housekeeping is maintained at all times and that all site...
personnel are made aware of the importance of the freshwater environments and the requirement to avoid pollution of all types.

(xxii) The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).

(xxii) The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment.

(xxiii) All machinery operating in-stream will be steam-cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be undertaken on dry land.

(xxiv) The risk of accidental transfer of non-native invasive species will require adherence to current best practice protocol for avoiding the spread or transfer of all invasive plants and animals in accordance with the NRA National Roads Authority Guidelines on the Management of Noxious Weeds and Non-native plant species on National Road Schemes (2010) along with any modified or updated approaches to invasive alien species control (www.invasivespeciesireland.com).

(xxv) These measures will be enforced during construction to ensure accidental spread does not occur on machinery or materials from/to the site. The developers will also adopt any modified or updated approaches to invasive alien species control.

19.4.2 Specific Mitigation measures for the Operational Phase in the Vicinity of the Castlebar River

Specific measures to effectively mitigate against the risk of pollution to the Castlebar River and River Moy SAC during the operation phase, (e.g. from surface water runoff) include the following measures:

(i) Surface water run-off from the N5 and the L5779 Turlough Road Link in the vicinity of the Castlebar River will be provided by vegetated treatment systems which will function as attenuation ponds, treatment systems, and containment to accommodate accidental spillage. This will be in accordance with the design set out in Chapters 3.2.5 of the EIS.

(ii) Maintenance of the drainage and pollution control systems will be undertaken during the life time of the proposed road.

19.5 Mitigation Measures for Soils & Geology

19.5.1 Construction Mitigation Measures

Effects of Construction Dewatering

Where slopes become unstable due to high groundwater table and inflow during construction, pumping locations shall be constructed in order to drain the water table below the level of the granular material and/or cut level for the duration of the construction and the slope stability shall be monitored. Long term gravity drainage measures will be employed to retain the groundwater levels below the road level.

Slopes in Glacial Till

Seepage from slopes in glacial till shall be mitigated by the use of an appropriate drainage system such as herringbone drains on the slope surface with suitable angles employed to maintain slope stability.
Slopes in Rock
Side slopes in rock have been conservatively assumed to be 1:2 prior to detailed design assessments. However rock slope often prove capable of standing at 2:1, in which case the contractor may choose to widen the base of the rock cuttings to win additional fill material. If local sections of the rock slopes are not stable at this steeper slope angle the slopes can be stabilised using rock anchors, netting and shotcrete.

Rock Excavation Methods
Rock excavation methods shall be assessed after the rock quality and orientation and nature of bedding planes and joints have been determined. The rock slopes will be engineered so they will not affect the development boundary as this has been determined based on standard 1:2 side slopes.

Removal of Materials from the Scheme
Importation of materials from outside the site will be minimised by ensuring that materials arising within the site are used to the greatest extent possible. Where necessary naturally occurring materials will be processed to reduce moisture content and/or improve grading in order to maximise suitability for use.

Inevitably materials will be encountered which cannot practically be processed into usable fill material. These materials are generally suitable for landscaping attenuation/treatment ponds and habitat restoration areas and therefore will be used within the site boundary. Any surplus materials remaining which cannot be incorporated into the works will be disposed to a licensed landfill off-site or preferably for agricultural purposes in adjoining lands subject to the appropriate planning approvals.

If encountered, contaminated soils will be excavated and disposed off site in accordance with the Waste Management Acts, 1998 – 2006, and associated regulations and guidance provided in the NRA’s Guidelines for the Management of Waste from National Road Construction Projects (National Roads Authority 2008).

Peat and Alluvium Recovery
Where soft ground is encountered, the most economical method, where the deposits are relatively thin, would be to excavate the soft material and replace it with suitable fill. However, where there are deeper soft soil deposits, such as close to rivers and or floodplains, more extensive measures may be required, such as pre consolidation or soil strengthening, e.g. using lime. Based on the investigations undertaken there are significant areas with soft ground along the scheme.

In areas of shallow Peat/Alluvium the only economical solution would be to remove this material. In areas where deep deposits occur, consideration can be given to the following ground improvement solutions:

- Partial Excavate and replace (Removal of Peat);
- Basal Reinforced Earthworks;
- Pile Supported load Transfer Platforms;
- Vibro Stone columns.

The above list is non exhaustive and any one or a combination of measures can reduce the amount of peat to be excavated and disposed along the route. Some of
these measures are not suitable on peat as peat exhibits large primary and more significantly large secondary consolidation characteristics.

The proposed piled embankments at Deerpark East, Calggarnagh East & Annagh and Derrylea & Derrcoosh will reduce the total amount of peat, alluvium and soft material to be excavated which is anticipated to have a high moisture content and very low strength. It is therefore proposed to spread this material over various land parcels within the lands acquired for the scheme to allow the peat to dry out and consolidate, thereby recovering its strength and cohesive properties. When the peat has recovered, it will be landscaped in a manner similar to the surrounding landscape.

19.5.2 Operational Mitigation Measures

Mitigation of geological impacts during operational phase will be in relation to slope stability issues identified during construction. The mitigation will include the appropriate design of gabions, soil nailing and structural retention systems. The areas will be monitored to ensure the measures in place suitably mitigate the risk of slope failure.

19.6 Mitigation Measures for Hydrogeology

Overview of mitigation measures

Mitigation measures follow the principles of avoidance, reduction and remedy. Where avoidance has not been possible, then consideration has been given to trying to locally modify the proposed road alignment option to reduce / minimise the extent of the impact and / or the exposure to human contact e.g. via groundwater supply usage.

General mitigation measures

Operational Mitigation

The impact of road construction on aquifers and groundwater resources can be minimised by applying sound design principles and by following good work practices as outlined by the NRA in its ‘Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes’. For groundwater, the following mitigation measures are considered:

- Where possible, re-align the road down-gradient or an appropriate distance up-gradient of the source protection area for high yielding water supply springs and wells and natural hydrogeological features;
- Where possible, minimise the depth of road cutting within a source protection area or zone of contribution to minimise the impact on groundwater flows to downgradient springs, wells, wetlands and other hydrogeological features;
- Where possible, minimise the depth of road cutting in order to ensure that its zone of contribution does not extend upgradient to a hydrogeological feature or wetland;
- Where it is not possible to avoid running the road through the vulnerable part of the source protection area for a high yielding water supply well, spring or other hydrogeological feature, provide sealed drains and avoid outfall discharges to groundwater via soakaways, infiltration fields and directly via swallow-holes and fissures bedrock;
- Provide sealed drains along sections of road overlying the vulnerable parts of locally important or regionally important aquifers;
• Provide site-specific measures to protect relatively small natural hydrogeological features such as springs, seeps or wetlands;

• Assess the potential impact of re-grading small streams on nearby wells or springs;

• Replace wells or provide alternative water supplies where low yielding wells have to be replaced;

• Ensure that all surface water run-off discharged to groundwater via soakaways is passed through systems for settlement or filtration of suspended solids with the parallel effect of removing contaminants (certain heavy metals and hydrocarbons) associated with the suspended solids;

• Groundwater monitoring may be appropriate in certain instances, instead of automatically providing specific mitigation measures. In these circumstances however, thresholds should be set that will trigger the introduction of pre-defined mitigation measures;

• Specifying regular monitoring of groundwater during the construction period and for a defined period thereafter, following opening of the road scheme;

• All wells abandoned as part of the road scheme should be sealed and abandoned in accordance with Well Drilling Guidelines produced by the Institute of Geologists of Ireland. Ground investigation boreholes should be backfilled using bentonite or cement bentonite grout in accordance with the Specification and Related Documentation for Ground Investigation published by the Institution of Engineers of Ireland; and

• Abandon obsolete ground investigation boreholes / water supply wells and springs in accordance with the appropriate well drilling guidelines.

In formulating hydrogeological mitigation measures, regard should be made to the requirements of the Water Framework Directive and Groundwater Directive. In developing mitigation measures, there should be co-ordinated and ongoing consultation with the River Basin Management Projects, the National Parks and Wildlife Service, Local Authorities, Group Water Schemes and Environmental Protection Agency as required.

As low yielding wells of low to moderate importance (i.e. domestic wells) are very common in the rural community, it is most likely that the proposed road alignment will have an impact on some of these along its 26km length, resulting in occasional abandonment of the supply. It is assumed that:

• All groundwater supplies currently used that are within the footprint of the proposed road alignment will need to be replaced;

• All groundwater supplies currently used that are within 100m of the footprint boundary will need to be assessed specifically for potential impacts on water level and quality, and

• All groundwater supplies currently used that are up to 150m from the scheme boundary or 50m beyond the zone of influence of cuttings will have to be monitored (for water level and quality) prior to, during and for a time (typically 12 months) after construction.

Constructional Mitigation
During the construction phase any compound areas / service yards should be located away from key hydrogeologically sensitive areas and features. As the majority of the proposed route will be underlain by a Regionally Important Aquifer this will not be possible, and best environmental practices and good housekeeping procedures will
need to be in place. Any areas of extreme vulnerability should be avoided for locating construction compounds. To minimise the risk of pollution to the groundwater, any fuel storage, refuelling and maintenance of construction vehicles will be confined to an impermeable hardstanding area with absorbent materials stored nearby to quickly manage any spillages.

Any hydrocarbon leakages or spillages during construction should be dealt with immediately, absorbing the bulk of the contaminant immediately with absorbent material and storing it and the contaminated soil in a stockpile underlain and covered by plastic to prevent leachate generation, until such times as it can be removed off-site by an appropriately licenced waste management company.

Generation of dust particles during earthworks and site traffic should be minimised through the use of water spray vehicles during dry weather, ensuring the runoff does not directly enter any sensitive receptor.

Mobile concrete plants should not be located in areas of extreme groundwater vulnerability / exposed bedrock, and those that are required along the alignment should be properly operated to ensure that any nearby hydrogeological features are not impacted.

Where significant groundwater flows are encountered in deep bedrock cut sections, it will be necessary to ensure their continued flow by either piping it or construction of gravel filled pathways.

The contractor should be made aware of any areas of potential karst features located at shallow depths, and site traffic in these areas kept to a minimum to reduce the potential compression and collapse of subsurface flow features.

Areas requiring fill material for the vertical alignment should try and source natural material from local quarries and borrow pits. If imported fill is required it is important to ensure that appropriate chemical tests are carried out to ensure its suitability and demonstrate that there are no contaminants present in it.

Where water supply wells and springs are located underneath the alignment of the footprint, these should be appropriated backfilled and sealed to prevent contaminants entering the aquifer.

Site specific mitigation required

Extreme vulnerability areas

In areas of regionally important bedrock aquifer that have been assessed as having an extreme groundwater vulnerability i.e. less than 3m depth of subsoil, the option of incorporating sealed drains will minimise the potential impact. The use of wetland treatment systems should be considered for outfall locations within sensitive areas.

Based on available site investigation data along the route the following sections are considered to encounter bedrock at a shallow depth and are thus classified vulnerable with regards to the risk of aquifer pollution: Chainage 12+400 to 13+400; 30+000 to 34+000; and 35+000 to 39+400. It is possible that other areas of cut sections may encounter bedrock at shallow depths, and appropriate drainage design measures should be implemented at these locations.
**Hydrogeological features**

All wetland and ecologically sensitive features (Shanvally Wetland and Black Lough) that are traversed by the road alignment will incorporate sealed drains. This would prevent potentially contaminated surface runoff from infiltrating the underlying aquifer through the floor of the drainage channel, or from waters overtopping the channel during high rainfall events. Alternatively an attenuation pond / wetland system will be used. The use of over the edge embankment drainage and toe drains shall not be permitted in these sensitive areas as they have the potential to either drain or introduce additional surface and groundwater flows to these features.

In the Regionally important Karstified Aquifer of extreme vulnerability from Ch 19+900 to Ch 40+000 the proposed road drainage will incorporate sections of sealed drainage and sealed storm attenuation/water quality ponds where required. The use of french drains to convey road runoff is not to be permitted in these areas as they provide a potential pathway for road runoff contaminants to enter the bedrock aquifer.

At deep cut sections such as the Doogory / Carheens area (36+820 to 38+240) and (38+800 to 39+380) a separate filter drain / cut-off channel will be provided to collect and drain intercepted groundwater and interflow safely to nearly watercourses (Shanvally Stream and Castlebar River) separate from road drainage.

The swallow hole / fissured permeable area and associated karstified bedrock located at Balloor needs to be protected from contamination by surface water runoff. The area has a history of flooding with a seasonal lake forming after heavy rainfall, until it infiltrates into the bedrock aquifer. An ecological assessment for the area has reported that the vegetation is predominantly wet grassland and marsh and is not characteristic of turlough habitats. Stormwater drainage from the proposed road will be collected and conveyed away from the area. Suitable drainage channels will be provided underneath the alignment in this location to allow the continued connection of flood waters at either side of the road.

The wetland feature located in Shanvally will be protected, in particular during the construction phase when it will be most at risk from site traffic, deposition of dust particles on vegetation and spillages of hydrocarbons. There is also a risk that shallow conduits within the bedrock that supply the wetland may be compacted up gradient, restricting the recharge. A detailed assessment of this system indicates that such impacts are likely to be slight with a surface route feeding the wetland area identified.

**Ground collapse**

The area of collapsed ground located in Knockranny will be investigated further to ensure that similar features are not present underneath the proposed alignment. Particular attention can be made during earthworks for the construction phase to note any incidences of ground subsidence. The other areas of potential subsurface karstification identified should also be considered and in particular monitored during construction.

**Groundwater supply sources**

Only 1 private groundwater sources has been identified that will potentially be lost by road construction. The borehole belonging to P2080 in Liscomwell is likely to be destroyed during the works. The borehole belonging to P2080 is also connected to the Lough Mask RWSS. This borehole should be backfilled and capped following best practices. If required it may be necessary to re-drill another borehole nearby for the cottage should the mains supply to Lough Mask RWSS not suffice.
A routine groundwater monitoring programme will be established to collect water levels of all supply wells located along or close to the alignment so that any impacts during the construction phase can be identified. Sensitive locations down-gradient of the alignment that may be at risk from contaminated surface runoff entering the supply will be sampled for water quality parameters as specified under the Drinking Water Regulations. In the event of contamination being recorded, the source of same will be identified and rectified. In such cases until the presence of contamination is removed and proven no longer to be a risk an alternate water supply will be provided. Where the source of the contamination cannot be identified or mitigation of same either not possible or not financial viable an alternate water supply will be provided either by a replacement well or provide alternative water supplies (i.e. connection to a regional or group water supply scheme) where low yielding wells have to be replaced.

19.7 Mitigation Measures for Hydrology

Overview of Mitigation Measures

Mitigation measures follow the principles of avoidance, reduction and remedy. The most effective measure of avoidance is ideally dealt with during the Constraints Study and / or Route Corridor Selection stage, by either moving the proposed alignments either laterally or vertically, to ensure that it does not traverse or come in close proximity to any sensitive hydrological attributes.

Where avoidance has not been possible, then consideration is given to trying to locally modify the proposed road alignment option to reduce / minimise the extent of the impact and / or the exposure to human contact e.g. via groundwater supply usage. If any modifications are proposed to reduce hydrological impacts it is necessary to also consider any associated impacts to the hydrogeological and ecological regimes.

Constructional Mitigation

As is normal practice with large road infrastructure projects an Environmental Operating Plan will need to be prepared for the scheme and the following will be implemented as part of the EOP:

- Prepare an Emergency Response Plan detailing the procedures to be undertaken in the event of serious spillage of chemical, fuel or other hazardous wastes, non-compliance incident with any permit of license or other such risks that could lead to a pollution incident, including flood risks.
- Water quality management plan to ensure compliance with environmental quality standards Specified in the relevant legislation (i.e. surface water regulations and Salmonid Regulations 1988). This plan will included details and method statements for the control, treatment and disposal of potentially contaminated surface water.
- Obtain all necessary permits and licenses for in stream construction work and OPW Section 50 consent for all culverts and bridges including new and widening of existing structures.
- Inform Inland Fisheries Ireland

Construction operation will be required to take cognisance of the following guidance documents for construction work on, over or near water.
• Eastern Regional Fisheries Board for use by all Regional Fisheries Board – Requirements for the protection of fisheries habitat during Construction and development works at river Sites
• Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers
• CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and contractors;
• CIRIA C648 Control of Water Pollution from Constructional Sites
• Guidelines for the Crossing of Watercourses during the Construction of National Road schemes (NRA, 2006)

Based on the above guidance documents concerning control of constructional impacts on the water environment, the following outline the principal mitigation measures that will be prescribed for the construction phase to protect all the catchments, watercourses and ecologically protected areas:

• All constructional compound areas will be required to be located on dry land and set back from river and stream channels and out of potential floodplain areas.
• Surface water flowing onto the construction area will be minimised through the provision of berms and diversion channels.
• Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and surrounding stockpiles with cut-off ditches to contain runoff.
• Where constructional works are carried out along side stream and river channels and particularly the Moyour Basin (Clogher Lough and tributaries) and the Moy Basin (Castlebar River and tributaries) protection of such rivers from silt load will be carried out through use of Grassed buffer area, timber fencing with Silt curtains or earthen berms so as to prevent direct runoff constructional site runoff waters to the Watercourses.
• Use of settlement ponds, silt traps and bunds and minimising construction within watercourses. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
• All watercourses that occur in areas of land that will be used for site compound/storage facilities will be fenced off at a minimum distance of 5 m. In addition, measures will be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. Compounds shall not be constructed in lands designated as Flood Zone A or B in accordance with the OPW Flood Risk Management Guidelines (November 2009). Compounds will not be permitted in or within a 100metres of a SAC.
• Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with recognised standards as lay out by the EPA. All chemical and fuel filling locations will be contained within bunded areas.
• Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner to prevent pollution of rivers and local.
• The quality of surface water discharge from the site will meet water quality targets specified to protect riparian ecosystems and protected species.
Appropriate Environmental Quality Standards, namely the Surface Water Regulations 2009 will be utilised to determine specific water quality targets.

- Riparian vegetation will be fenced off to provide a buffer zone for its protection and will be specified in consultation and agreement with the Inland Fisheries Ireland and NPWS.
- Any surface water abstracted from a river for use during construction shall be through a pump fitted with a filter to prevent intake of fish.
- The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which as stated earlier has a deleterious effect on water chemistry and aquatic habitats and species. Alternate construction methods are encouraged for example, use of pre-cast or permanent formwork will reduce the amount of in-situ concreting required. Where on-site batching is proposed this activity will be carried out well away from watercourses. Washout from such mixing plant will be carried out only in a designated contained impermeable area.

For further details on mitigation measures required to protect ecology please refer to Section 7.1 of this EIS.

**Operational Mitigation**

**Water Quality Impact Mitigation**

All road pavement runoff water will be collected in a conventional road drainage system and discharged to receiving surface waters at specified outfall sites (20 No. outfalls sites over the 26.4km scheme length). Spillage containment in excess of 50m$^3$ and pre-treatment in terms of silt traps will be provided upstream of all outfalls. These treatment and spillage containment facilities are proposed to be provided within the storm attenuation ponds for all outfalls except for Lough Lannagh outfalls where attenuation ponds are not proposed (i.e. storm attenuation not required). In respect to the two storm outfalls to the Lough Lannagh system, 50m$^3$ spillage storage and conventional silt trap is proposed.

The proposed drainage system incorporates a range of appropriate pollution control features to limit the water quality impact to receiving waters. These include the use of filter drains, closed drainage systems and the use of a vegetated wetland system upstream of all road drainage outfalls which will be sized to cater for at least 10% of the peak 5-year storm flow with further detention storage provided within the attenuation pond system for settlement of suspended pollutants. The vegetated system will allow for the take up of nutrients in the drainage water. These treatment systems will be provided upstream of all proposed outfalls.

To facilitate emergency response to serious spillages all pond and storage systems will be fitted with a manual penstock so as to close off the outfall and contain the spillage water within the pond/storage system for pumping out and appropriate treatment and disposal.

**Storm Runoff Mitigation**

All outfalls and respective discharges are designed to prevent impact to river morphology and surface water flow hydraulics

In order to minimise local flooding and associated channel morphological impacts all outfall storm discharges to watercourses with the exception of Lough Lannagh and the Castlebar River outfalls are to undergo storm attenuation reducing outflow to the
natural Greenfield runoff rate and attenuating the 100 year storm event within the Pond Storage area.

The engineering design also proposes to provide storm attenuation for the Castlebar River outfalls which is not necessary given the relative scale of the River and the timing of the flood and storm peaks. This attenuation storage will provide protection in respect to accidental spillage and water quality impacts from the storm Runoff.

This attenuation storage ponds for each of the outfall sites will not be located in Floodplain Areas in order to avoid any storage loss to the receiving river / stream.

**Culverts and Bridges**

All culverts and bridges are to be designed to prevent permanent impact to the river morphology. This will be achieved by ensuring the river width is not exceeded or contracted by the proposed culvert and that reasonable transitions to and from the culvert is provided where approach and exit channels are skewed to the culvert alignment. The culvert will be embedded into the channel to a depth of 500mm for box sections and a minimum of 150mm / 300mm for pipe culverts (depending on size).

All culverts and bridges are also designed to allow for both aquatic (Trout Brook Lampery, etc.) and mammalian (otter) species migration and to maintain the existing river bed as far as possible, in accordance with Guidelines for the crossing of Watercourses during the Construction of National Road Schemes, NRA 2008.

**River Diversions**

The proposed stream and drain diversions have been assessed in Table 10.19. Localised mitigation measures have been identified in respect to preventing bank erosion at sites of bends which were found often to coincide with the proposed road culvert. This protection may be in the form of large boulders or rip-rap along the outer bank. All diversion channels will include fishery friendly requirements where they are identified as having fishery potential. The flood capacity will be enhanced while preserving the low flow channel characteristics.

**Loss of Flood Storage**

Flood storage loss as a result of encroachment of the Road Scheme at Black Lough, Lough Lannagh and Balloor was identified. For all of these cases except for the Balloor flood area the loss of flood storage was found to have a negligible impact on flooding and flood risk and thus not considered warranting compensation storage. In respect to Balloor flood area full compensation storage is required so as to maintain the existing flood levels.

**Specific Mitigation Measures**

**Balloor Flood Area**

**Operational**

Provide full flood storage compensation in respect to the flood area and flood storage volume lost by the road embankment in the Balloor flood area by providing designated compensation storage lands (lowering of these lands) immediately adjacent to the Balloor Flood Zone.

Divert all road drainage runoff (c6.5 ha) northwest to Knockrawer flood area via a gravity storm outflow pipe.
Ensure road embankment within Balloor Flood Area is constructed using clean rock fill of suitable porosity to ensure connectivity between separated flood areas to the northwest and southeast and to maintain vertical percolation through the bedrock under the road footprint. To enhance connectivity provide a number of pipe culverts through the road embankment.

All drainage pipes including the outflow storm pipe to Knockrawer will be sealed.

Provide for a flood relief overflow culvert to Knockrawer in the event that the natural groundwater outlet for the Balloor area deteriorates at some stage in the future.

No embankment toe drains will be excavated within the Balloor Area so as to avoid any potential importation of drainage waters that would otherwise have percolated to the deeper groundwater table.

**Constructional**

Cordon off the work area through the Balloor Flood Area minimising the land-take used for construction activities. In particular, cordon off and protect the swallow-hole area near CH 35+450.

Provide double silt fences along the cordoned work area to contain silt and sediment runoff. Earthworks activities along this section will be carried out only during low flow summer periods to avoid flood periods making the collection treatment and disposal of construction runoff waters more manageable.

Stockpiling, temporary or otherwise, of excess material or topsoil in the Balloor Area will be avoided in order to minimise construction footprint and sources of sediment runoff.

No compound area temporary or otherwise to be located within or adjacent to the Balloor Flood area.

**Black Lough Ecological Receptor**

**Operational**

The main mitigation measure proposed to reduce the direct impact of the road embankment footprint on the Black Lough Basin is piling through the peat to support the road embankment. The use of geotextile liner and a rock formation layer above the piles is proposed. Above the rock formation layer normal fill activities can take place. This rock layer is likely to form at about 1m below existing ground level. This approach avoids the major excavation works and a doubling on the constructional footprint.

This approach will reduce the direct impact of forming an embankment from approximately 1ha (i.e. 40% of the winter flood area) through normal excavation of peat and rock fill to c. 0.5ha (i.e. 20% of the winter flood area). Normal construction measures would involve excavating out the peat layer which has been reported in the site investigation to be of the order of 6m deep at Black Lough resulting in a much greater fill footprint area across the lake basin.

This approach will allow piling and filling to progress almost simultaneously across the lake basin and minimises the constructional footprint and potential disturbance of peat and the resultant peat laden runoff.
In order to mitigate potential dewatering of the Lough by the rock capping layer that is supported on top of the piles at and slightly below existing ground level the impermeable geotextile along the base will be extended up along the face of the embankment both upstream and downstream faces.

No embankment toe drains will be excavated within the Lough Basin itself and any approaching toe drains will discharge to nearby local drainage channels.

The twin 300mm diameter land drain observed on the western bank of the Lough will be continued under the road embankment using an equivalent pipe culvert size so as to maintain its outfall with the existing drainage channel.

The proposed 3.6m wide by 2.1m high box culvert at Black Lough is sufficiently sized not to impact on the flood regime in the Lough. The upstream invert of this culvert will retain existing levels. It is recommended that this is achieved by embedding the culvert 500mm and replacing /fill using granular material and placing Stop logs or a concrete weir at the upstream face so as to retain the appropriate invert level. Monitoring of Lake levels both pre and post construction is important for calibration and fine tuning of the weir so as to ensure that lake levels are maintained.

Constructional

The proposed embankment construction will involve retaining the peat in place by concrete piling and the subsequent placement of a geotextile liner and Rock Fill on top of piles. The concrete piles are likely to be at reasonably close spacing of the order of 1.5 to 2m apart over the 0.5ha foot print area of the lake basin. This piling option reduces peat handling and the subsequent loss and suspension of peat fines and sediments in the Lake water. It is recommended that embankment construction across the lough in terms of piling and placing of the embankment will be timed for the summer period when the Lough has retreated southwards to its permanent lake body. (Note: Based on the Islandeady Lough EPA gauge Ref No. 34072 data from the period October 1976 to May 1996, the minimum lake levels in Islandeady Lough occur during the months May to September, likely corresponding to the decreased long term rainfall (required to raise the lake level) and the increase evapotranspiration).

A double silt fence will be placed around the works area at Black Lough including the embankment path across Black Lough. The silt fence will reduce the potential direct runoff from the works area to the Lough. The double silt fence will be continued upstream and downstream of the works area along the bank of the Lough Basin and along its outlet drainage channels (two outlet channels) for a distance of 50 to 100m.

Surface water flowing onto the construction area surrounding the Black Lough Site will be minimised through the provision of berms and diversion channels so as to reduce the volume of constructional runoff. No diversion channels will be connected directly to the Lough.

All constructional runoff water will be directed through a silt pond and subsequently dispersed by overland sheet flow across a grassed vegetated buffer area before entering Black Lough of its connecting land drains.

Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap / Sediment pond.
Management of excess material stockpiles to prevent siltation of Black Lough and its associated drains through runoff during rainstorms will be undertaken. This will involve allowing the establishment of vegetation on the exposed soil and surrounding stockpiles with cut-off ditches to contain runoff.

Riparian vegetation will be fenced off to provide a buffer zone for its protection and will be specified in consultation and agreement with the IFI and NPWS.

Any surface water abstracted from a river for use during construction shall be through a pump fitted with a filter to prevent intake of fish.

The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. Where on-site batching is proposed this activity will be carried out well away from watercourses and their associated flood plains. Washout from such mixing plant will be carried out only in a designated contained impermeable area.

Shanvally Wetland ecological Receptor

The wetland feature located in Shanvally will be protected, in particular during the construction phase when it will be most at risk from site traffic, soiled water runoff and spillages of hydrocarbons. There is also a risk that shallow conduits within the bedrock that supply the wetland may be compacted up-gradient, restricting or stopping the necessary groundwater recharge.

During the construction phase it will be necessary to ensure that the retained wetland area is avoided by all groundwork’s and is protected against construction runoff. A small berm feature and silt curtain along the boundary with the retained wetland area will be constructed so as to intercept and divert any surface water runoff from the working area into the small stream to the north, via suitable measures to remove suspended solids and potential contaminants (i.e. large settlement pond area). The protection of the Balloor Swallow from construction works is necessary to prevent any potential impact will the Shanvally Wetland be connected.

The design of this stretch of road will include suitable drainage systems to prevent any operational phase surface runoff entering the wetland area via overland flow or vertically into the underlying aquifer from whence it may discharge to the wetland. No direct surface outfall to the wetland shall be permitted. Discharge shall be to the existing drainage channel downstream of the wetland. Given that the underlying vulnerability of the bedrock aquifer in this section of roadway a sealed pipe drainage system will be provided and road drainage will pass through a wetland treatment system prior to outfall.

The road embankment adjacent to the wetland will be constructed on a granular layer so as to maintain existing pathways for overland and interflow from the west and southwest to continue discharging to the wetland. It may be necessary to strip back overburden layer to shallow bedrock so as to ensure that the drainage layer functions appropriately. This granular layer will be wrapped in a geotextile to avoid infiltrating fines reducing its porosity over time. Importantly this granular layer shall be isolated from any existing or constructed surface drains so that it does not have the potential to drain the wetland as opposed to supply it.

The use of toe drains along this section of high road embankment (36+060 to 36+360) will be avoided and will be replaced by a stone filter field that promotes the
local infiltration of the surface runoff from the road embankment and avoids capture and discharge either to the wetland or the nearby stream channel.

19.8 Mitigation Measures for Landscape & Visual Impacts

19.8.1 Mitigation Measures: Construction Stage

During the construction stage, an Environmental Operating Plan (EOP) will be drawn up by the main contractor using the NRA’s ‘Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan’. Adherence to this plan will be a contract requirement and this will ensure good working practices are followed so as to minimise and manage any significant, negative environmental impacts arising from construction. As well as other items, the EOP will include the mitigation set out within this chapter and incorporate them as part of their implementation.

General mitigation will ensure that the works will have continuous monitoring under the Environmental Operating Plan so as to ensure adequate protection of areas outside of the construction works. Specific measures shall ensure that:

- site machinery shall operate within the proposed road development construction area.
- storage areas shall be located so as to avoid impacting further on existing residential and other property, woodlands, trees, hedgerows, drainage patterns, etc.
- solid site hoarding shall be provided where construction works adjoin residential property to the extent and heights as indicated on Figures 11.1 to 11.17 in Volume 3.
- where construction compounds are located within 200m of residential properties, solid hoarding or similar, of minimum 2.0m in height shall be provided for visual and general screening.
- construction compounds shall be fully-decommissioned and reinstated to their pre-construction condition at the end of the construction contract.
- Side slopes and other landscape areas along the proposed road development shall be prepared for soiling, and either seeded and/or planted at the earliest possible opportunity as set out in this Section of the EIS and Figures 11.1 to 11.17. As such, scope exists for undertaking significant areas of seeding and planting prior to the end of the construction works. However, due to construction programming and seasonal restrictions, it is also likely that significant planting works will not be undertaken until the end of the major construction phase.

19.8.2 Mitigation Measures: Operational Stage

General Mitigation Measures

Landscape mitigation proposals shall take full account of the approaches and principles as set out in A Guide to Landscape Treatments for National Road Schemes in Ireland, in particular to Chapter 4: Components of the Roadside Landscape; Chapter 5: Soil Geographic Factors; and Chapter 6: Landscape Treatments. Unless otherwise qualified in Section 11.5 of this EIS, seeding and planting proposals, including species and planting type and species shall be in accordance with Chapter 6 of these Landscape Guidelines.
General measures will be applied over the entire proposed road development, depending on the nature of the particular road section. Where feasible such measures shall include for the re-connection of field boundaries with hedgerows established along the boundary of the proposed road development (see Landscape Guidelines, Section 6.2.1: Hedgerows & Tree-lined Hedgerows). Trees within such hedgerows shall be randomly spaced in a visually naturalistic manner.

This approach will be locally modified to incorporate other landscape treatments, which may negate the requirement for the hedgerow, e.g. blocks of native woodland planting (see Landscape Guidelines, Section 6.2: Tree and Shrub Treatments) or naturalising grassland meadows (see Landscape Guidelines, Section 6.1: Grassland Treatments) where it is considered appropriate to have open sections of carriageway. Open sections shall allow for views to the wider landscape where they do not impinge on requirements for screening residential or other amenity.

Proposals will ensure that planting is distributed along the entire proposed road development and the associated local road re-alignments and will vary from typical rural, randomly tree-lined hedgerow reinstatement to wide plantings of landscape and screen planting to the establishment of larger areas of new woodland for integration of the development into the wider landscape. Shrub planting will be used at the edges of the tree planting. This will increase the density and diversity of the plantings and improve the biodiversity structure (see Landscape Guidelines, Section 6.2: Tree and Shrub Treatments).

Treatments will take into consideration the assessment and recommendations of the Ecology section of this EIS (Chapter 7) and will ensure that in general, species which are locally indigenous and native are utilised in the proposed plantings. However, detailed proposals in terms of their nature and approach will consider the locally impacted environment and in terms of species may include non-native plants, e.g. beech at old demesnes or a more ornamental approach where garden plantings are disturbed.

Where areas are in cut or fill, a grass or meadow sward will generally be established over the entire slope except in areas of cutting through stable rock (see Landscape Guidelines, Section 4.2: Cuttings and Embankments). Stable rock slopes will be retained as an exposed face for natural colonisation and as a local landscape feature. In general it is not proposed to plant either cut or fill slopes in their entirety, but to encourage a more naturalistic and locally sympathetic grouping of plantings within a naturalising grass sward.

Along the length of the proposed road development, landscape areas within junctions and small areas of severed fields, plots or other property acquired for the construction of the proposed road development will be varyingly treated including being planted in a semi-natural copse like fashion with native woodland species (see Landscape Guidelines, Section 4.6: Additional Plots and Other Areas). Such woodland blocks dispersed along the proposed road development will assist in the improvement of the longer-term visual character of the proposed road development and local surrounds. Particular attention shall be given to an appropriate extent and scale of planting in and surrounding junctions (see Landscape Guidelines, Section 4.3: Junctions, Interchanges and Roundabouts) and embankments (see Landscape Guidelines, Section 4.2.2: Embankments).

Certain areas along the length of the proposed road development have been set aside for drainage requirements/ pollution control/attenuation. Where such works are of a linear nature, disturbed sections of hedgerow will be reinstated / planted to
match the existing. Where attenuation ponds are proposed these will be fenced and will be treated with appropriate hedgerow screen planting along the development boundary to minimise their impact.

In general the proposed planting will generally be established using bare-root transplants, whips and feathered trees which adapt readily to disturbed ground conditions. A proportion, totalling not less than 5% of ‘Half-standard’ (6-8cm girth & 200cm-250cm tall) and a further 5% ‘Standard’ (8-10cm girth & 250cm-300cm tall) trees shall be used to supplement these plantings especially in the vicinity of residential areas. All planting mixes will take cognisance of, and include native and local species as identified in Chapter 7 of this EIS. These requirements have been adapted and further detailed as appropriate to particular areas as set out in Tables 19.3 and 19.4.

Tree species utilised will be selected from a list of primarily native, naturalised and indigenous species (except where the proposed road development is contiguous with existing plantations containing other species such as conifers or beech etc), which will include alder, common ash, common birches, common oaks, mountain ash, Scots pine and willow species. Planting sizes will be from 75cm to 400cm in height and tree species will be planted at average 2.0m centres within the wider planting mix.

Shrub planting species utilised will be selected from a list of primarily native and indigenous species, which will include, blackthorn, elder, hawthorn, hazel, holly, guelder rose, spindle, willows and other plants found naturalised in the affected localities. Planting sizes will vary from 30 to 75cm in height and shrub species will be planted at between 1.0 and 1.5m centres depending of landscape type, see Tables 19.3 and 19.4.

Hedge planting will be primarily of blackthorn and hawthorn interspersed with other species such as elder, hazel, holly and those found locally. Hawthorn within hedgerows shall be planted at between 75 to 90cm in height and at 500mm centres in each of 2 double staggered rows. The hedgerow will be interspersed with standard-sized randomly spaced tree species such as alder, common ash and oaks, as appropriate to particular locality.

Areas to be seeded to naturalising meadow will be thinly topsoiled (5cm layer) and seeded with a locally appropriate seed mix. Mainline and side road verges will be cultivated, topsoiled minimum 20cm deep and stone buried to remove stones down to 25mm diameter prior to seeding to a low-maintenance grass sward.

The proposed road development lighting design shall meet the requirements of BS5489-1: 2003, Code of Practice for Design of Road Lighting. Lighting of Roads and Public Amenity Areas and shall comply with the requirements of the NRA DMRB TD 34-91. The detailed lighting design shall be completed in a manner, which will minimise glare and light pollution that in combination with extensive landscaping as proposed at junctions will ensure that light-spill effect is minimised. It is noted that the proposed road development includes for a minimum of roadside illumination, effectively restricted to major roundabouts and junctions and along the immediate approaches to and from such features.

In specific locations barriers and earth bunds will be provided to reduce the impact of noise. Such barriers will also have the effect of providing immediate visual screening of traffic from properties. Such features shall, wherever possible, be integrated within the proposed landscaping measures. Chapter 12 of this EIS outlines the assessment
of noise and the requirements for such mitigation. The noise mitigation measures are proposed as either barriers or bunding or as a combination of such features.

Specific Mitigation Measures
Specific mitigation measures are set out on Figures 11.1 to 11.17 in Volume 3. The measures include construction-related aspects such as avoidance/minimising impact on property boundaries and landscape features as well as provision of solid screen hoarding during the construction phase for those properties particularly impacted by the works.

Other landscape-related measures are described in detail in Tables 19.3 and 19.4.

Table 19.3: Specific Landscape and Visual Mitigation Measures (see Figures 11.1 to 11.17 in Volume 3 and Table 19.4). (Note: Proposed Road Development has been abbreviated to PRD in the following Table)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Chainage and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM-A1</td>
<td>Deerpark East 0-2+050: N59 tie-in, roundabout and local access 1+900 to 2+150 both sides of PRD</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Elsewhere provide for reinstatement and/or provision of new Boundary Hedgerow Type 1 along full boundary of tie-ins, access links/roads and around roundabout. Provide Landscape Treatment 1 on embankments and between existing and new alignments of N59. Provide new entrance landscape with signage, to match existing, at Westport Industrial Park.</td>
</tr>
<tr>
<td>LM-A2</td>
<td>Deerpark East 0-2+000: Roundabout and N59 tie-in south</td>
<td>Provide for Landscape Treatment Type 1 in areas around roundabout and along N59 tie-in south.</td>
</tr>
<tr>
<td>LM-A3</td>
<td>Ch 2+000 to 2+350. Both sides of mainline of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along sections of PRD as indicated on Figures 11.1 to 11.17. Provide for Landscape Treatment Type 1 to cut and fill slopes of PRD, including around attenuation pond.</td>
</tr>
<tr>
<td>LM-A4</td>
<td>Ch 2+350 to 3+000 North side of mainline of PRD.</td>
<td>Provide for Boundary Hedgerow Type 2 and Landscape Treatment Type 2 to upper sections of cut slopes of PRD.</td>
</tr>
<tr>
<td>LM-A4</td>
<td>Ch 2+350 to 3+000 South side of mainline of PRD.</td>
<td>Provide for Landscape Treatment Type 2 to full extent of slopes of PRD. Provide for sections of Boundary Hedgerow Type 1 as indicated on Figures 11.1 to 11.17. Landscape works between Ch. 2+550 and 2+750 to be developed in discussion with Property Owners H0245 &amp; H0246.</td>
</tr>
<tr>
<td>LM-A5</td>
<td>Ch 3+000 to 3+600 both sides of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along full length of PRD. Provide for Landscape Treatment Type 1 to sections of cut and fill slopes of PRD (as per Figures 11.1 to 11.17), including around attention pond and at existing retained edge of woodland.</td>
</tr>
<tr>
<td>LM-A6</td>
<td>Ch 3+600 to 4+100 both sides of PRD.</td>
<td>Provide for Landscape Treatment Type 2 to full extent of slopes of PRD.</td>
</tr>
<tr>
<td>LM-A7</td>
<td>Ch 4+100 to 10+000 both sides of PRD including roundabout.</td>
<td>Provide for Landscape Treatment Type 1 to upper half (50%) of all cut slopes and to full extent of fill slopes.</td>
</tr>
<tr>
<td>LM-A8</td>
<td>Both sides of link from roundabout on proposed N5 to proposed roundabout on existing N5.</td>
<td>Provide for minimum 5m wide Screen Planting Type 1 to upper half (50%) of all cut slopes and full extent of fill slopes. Extend planting to adjoining additional areas of land.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>LM-A9</td>
<td>Proposed roundabout on existing N5.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for re-use of existing stone walls in new roadside boundaries where possible. Elsewhere provide for reinstatement and/or provision of new Boundary Hedgerow Type 1 along full boundary of tie-ins and around roundabout. Include for Screen Planting Type 1 between proposed roundabout and re-aligned local access road.</td>
</tr>
</tbody>
</table>

**PROPOSED ROAD DEVELOPMENT (PRD): SECTION B**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Chainage and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM-B1</td>
<td>Ch 10+000 to 10+250 north side of PRD</td>
<td>Provide for Landscape Treatment to Peat Fill Areas as set out in Table 11.8. Provide for Landscape Treatment Type 1 to upper half (50%) of all cut slopes and to full extent of fill slopes.</td>
</tr>
<tr>
<td>LM-B2</td>
<td>Ch 10+000 to 10+250 south side of PRD</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD. Provide for Landscape Treatment Type 1 to upper half (50%) of all cut slopes and to full extent of fill slopes.</td>
</tr>
<tr>
<td>LM-B3 &amp; LM-B4</td>
<td>Ch 10+250 to 11+250 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 2 along full extent of PRD and all local roads and accesses. Provide for Landscape Treatment Type 2 to full extent of all cut and fill slopes and bunds. Landscape Treatment Type 2 to extend to areas between alignments and any additional lands.</td>
</tr>
<tr>
<td>LM-B5</td>
<td>Ch 11+250 to 11+900 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 2 along full extent of PRD and all local roads and accesses. Provide for Landscape Treatment Type 2 to upper (50%) of all cut slopes. Provide for Landscape Treatment Type 2 to full extent of all fill slopes and bunds. Landscape Treatment Type 2 to extend to full extent of areas between alignments and any additional lands.</td>
</tr>
<tr>
<td>LM-B6</td>
<td>Ch 11+900 to 12+050 both sides of PRD.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD.</td>
</tr>
<tr>
<td>LM-B7</td>
<td>Ch 12+050 to 12+900 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and all local roads and accesses. Provide for Landscape Treatment Type 2 to upper (50%) of all cut slopes. Provide for Landscape Treatment Type 2 to full extent of all fill slopes and bunds. Landscape Treatment Type 2 to extend to full extent of areas between alignments and any additional lands. Incorporate requirements of specific Habitat Mitigation Area 1 – see Figure 7.20.</td>
</tr>
<tr>
<td>LM-B8</td>
<td>Ch 12+900 to 13+900 both sides of PRD, including local roads and accesses and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all fill slopes and bunds. Provide for Boundary Hedgerow Type 2 in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-B9</td>
<td>Ch 13+900 to 14+500 both sides of PRD, including local roads and accesses and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all fill slopes and bunds. Provide for extended 12 – 15m wide area of Landscape Treatment Type 2 to south side between Ch 13+900 and 14+200. Provide for Boundary Hedgerow Type 2 in replacement of any disturbed vegetation along drainage works. Incorporate requirements of specific Habitat Mitigation Area 2 – see Figure 7.21.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>LM-B10</td>
<td>Ch 14+500 to 15+300 both sides of PRD, including local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all cut and fill slopes and bunds. Provide Landscape Treatment Type 2 to full extent of areas between alignments and to any additional lands.</td>
</tr>
<tr>
<td>LM-B11</td>
<td>Ch 15+300 to 16+200 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all cut and fill slopes and bunds. Provide Landscape Treatment Type 2 to full extent of areas between alignments and to any additional lands.</td>
</tr>
<tr>
<td>LM-B12</td>
<td>Ch 16+200 to 16+950 both sides of PRD, including local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper quarter (25%) of all cut slopes and to full extent of fill slopes and bunds.</td>
</tr>
<tr>
<td>LM-B13</td>
<td>Ch 16+900 to 17+350 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all cut and fill slopes and bunds. Provide Landscape Treatment Type 2 to full extent of areas between alignments and to any additional lands. Provide for Landscape Treatment to Peat Fill Areas as set out in Table 11.8.</td>
</tr>
<tr>
<td>LM-B14</td>
<td>Ch 17+350 to 17+800 both sides of PRD, including local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of large cut slope south of mainline Ch 17+630 – 17+800 and to full extent of area between mainline and realigned local road north of mainline Ch 17+550 – 17+630.</td>
</tr>
<tr>
<td>LM-B15</td>
<td>Ch 17+800 to 19+400 both sides of PRD, including local roads and accesses. Excludes LM-16 Black Lough, Ch 18+750 – 19+000 see below.</td>
<td>Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads, accesses and stream. Provide for Landscape Treatment Type 2 to full extent of all cut and fill slopes. Provide Landscape Treatment Type 2 to full extent of all areas between alignments, to any bunds and to any additional lands.</td>
</tr>
<tr>
<td>LM-B16</td>
<td>Black Lough: Ch 18+750 – 19+000 both sides of PRD.</td>
<td>Minimise impact on lakeside habitats. In general provide for Landscape Treatment Type 2 to full extent of fill slopes, providing for locally appropriate, diverse habitats along mainline. Treatments to be sympathetic to adjoining existing habitats and to have full regard to the requirements of Chapter 7 of this EIS.</td>
</tr>
<tr>
<td>LM-B17</td>
<td>Ch 19+400 to 20+050 both sides of PRD, including local roads and accesses. Excludes LM-18 Lough Lannagh Local Road, Ch 19+575, see below.</td>
<td>Minimise impact on lakeside habitats. In general provide for Landscape Treatment Type 2 to full extent of cut and fill slopes, providing for locally appropriate, diverse habitats. Treatments to be sympathetic to adjoining existing habitats and to have full regard to the requirements of Chapter 7 of this EIS. Provide for Boundary Hedgerow Type 1 leading to and from lakeshore and along local roads and accesses. Provide for Landscape Treatment Type 2 to full extent of all areas between alignments, to any bunds and to any additional lands. Incorporate requirements of specific Habitat Mitigation Area 3 – see Figure 7.25.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>LM-B18</td>
<td>Ch 19+575 both sides of Lough Lannagh Local Road,</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property boundaries and planting in agreement with property owners. Minimise impact on lakeside habitats. In general provide for Landscape Treatment Type 2 to full extent of cut and fill slopes. Treatments to be sympathetic to adjoining existing habitats and to have full regard to the requirements of Chapter 7 of this EIS. Provide for Boundary Hedgerow Type 1 leading to and from lakeshore. Provide for Provide Landscape Treatment Type 2 to full extent of all areas between alignments, to any bunds and to any additional lands.</td>
</tr>
<tr>
<td>LM-B19</td>
<td>Ch 20+050 – 20+310, both sides of PRD, including proposed roundabout on existing N5.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to full extent of all cut and fill slopes. Provide Landscape Treatment Type 2 to full extent of any additional lands.</td>
</tr>
</tbody>
</table>

**PROPOSED ROAD DEVELOPMENT (PRD): SECTION C**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Chainage and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM-C1</td>
<td>Ch 30+000 to 30+500 both sides of PRD, including proposed roundabout on existing N5.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 2 along full extent of PRD and along local roads and accesses and to full extent of any additional lands. Provide for Landscape Treatment to any Peat Fill Areas as set out in Table 11.8. Provide for Landscape Treatment Type 2 to upper half (50%) of all cut slopes and bunds and to full extent of fill slopes.</td>
</tr>
<tr>
<td>LM-C2</td>
<td>Ch 30+500 to 31+400 both sides of PRD, including accesses and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment to any Peat Fill Areas as set out in Table 11.8. Provide for Landscape Treatment Type 2 to full extent of all bunds, all fill slopes and any additional west of railway. Provide for Landscape Treatment Type 2 to upper half (50%) of all slopes east of railway. Provide for Boundary Hedgerow Type 2 in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-C3</td>
<td>Ch 31+400 to 31+950 both sides of PRD, including accesses and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all bunds and all fill slopes. Provide for Boundary Hedgerow Type 2 in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-C4</td>
<td>Ch 31+950 to 32+400 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to upper half (50%) of all bunds and all cut and fill slopes.</td>
</tr>
<tr>
<td>LM-C5</td>
<td>Ch 32+400 to 33+300 both sides of PRD, including accesses and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and accesses. Provide for Boundary Hedgerow Type 1 in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-C6</td>
<td>Ch 32+300 to 34+250 both sides of PRD, including junction, local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD, junctions ramps and along local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and all cut and fill slopes. Provide for Landscape Treatment Type 3 in areas within junctions and in any additional landscape areas.</td>
</tr>
<tr>
<td>LM-C7</td>
<td>Ch 34+250 to 34+600 both sides of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>LM-C8</td>
<td>Ch 34+600 to 35+100 both sides of PRD, including local roads and accesses and along drainage channels.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and all cut and fill slopes. Provide for Landscape Treatment Type 3 to additional areas of land east and west of Milebush Local Road and north of PRD. Provide for Boundary Hedgerow Type 1 in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-C9</td>
<td>Ch 35+100 to 35+700 both sides of PRD and along drainage channels.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and in replacement of any disturbed vegetation along drainage works.</td>
</tr>
<tr>
<td>LM-C10</td>
<td>Ch 35+700 to 36+100 south / east side of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD. Provide for Landscape Treatment Type 1 to full extent of all fill slopes.</td>
</tr>
<tr>
<td>LM-C11</td>
<td>Ch 35+700 to 36+100 north / west side of PRD.</td>
<td>Avoid impact on boundary hedgerow. Provide minimum 4.0m high hoarding to protect hedgerow and properties. During scheme construction, provide second minimum 2.0m high hoarding at top of side slope as soon as constructed to screen construction traffic. Provide for Boundary Hedgerow Type 1 where existing boundary hedgerow is not retained. Provide for Landscape Treatment Type 1 to full extent of all fill slopes and any adjoining additional area.</td>
</tr>
<tr>
<td>LM-C12</td>
<td>Ch 36+100 to 36+650 both sides of PRD, including accesses.</td>
<td>Minimises impact on tree-lines and associated habitats. Provide for Boundary Hedgerow Type 1 along full extent of PRD and accesses. Provide for Landscape Treatment Type 1 to full extent of all fill slopes. Details of landscape proposals to be informed by requirements of Chapter 7 of this EIS. Incorporate requirements of specific Habitat Mitigation Area 4 – see Figure 7.29.</td>
</tr>
<tr>
<td>LM-C13</td>
<td>Ch 36+650 to 36+900 both sides of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD. Incorporate requirements of specific Habitat Mitigation Area 4 – see Figure 7.29.</td>
</tr>
<tr>
<td>LM-C14</td>
<td>Ch 36+900 to 37+300 both sides of PRD, including junction, local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for re-use of existing stone walls in new property boundaries. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and all cut and fill slopes.</td>
</tr>
<tr>
<td>LM-C15</td>
<td>Ch 37+300 to 37+600 both sides of PRD.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and all cut and slopes.</td>
</tr>
<tr>
<td>LM-C16</td>
<td>Ch 37+600 to 37+800 both sides of PRD, including local roads and accesses.</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide for Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and all cut and fill slopes and to additional lands.</td>
</tr>
<tr>
<td>LM-C17</td>
<td>Ch 37+800 to 38-700 both sides of PRD including local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD, local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and fill slopes.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>LM-C18</td>
<td>Ch 38+700 to 39+386 both sides of PRD including local roads and accesses.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD, local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds, cut slopes and to full extent of additional lands.</td>
</tr>
<tr>
<td><strong>PROPOSED ROAD DEVELOPMENT (PRD): SECTION D</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM-D1</td>
<td>Ch 40+000 to 41+050; Ch 41+600 to 41+800; Ch 42+200 to 43+100 and Ch 43+400 to 43+600 on north side of PRD, and Ch 40+000 to 40+650; Ch 40+700 to 40+900; Ch 41+100 to 41+320; Ch 41+500 to 40+900; Ch 42+200 to 43+050 on south side of PRD, and including any local roads / accesses.</td>
<td>Minimise impact on existing roadside plantings and boundaries. Where impacted, provide for reinstatement and/or provision of new Boundary Hedgerow Type 1 along full extent of PRD and along local roads and accesses. Provide for Landscape Treatment Type 2 to the upper half (50%) of all fill slopes over 2.0m in height; to the upper quarter (25%) of all cut slopes over 3.0m in height, and to the full extent of all bunds.</td>
</tr>
<tr>
<td>LM-D2</td>
<td>Ch 40+000 to 41+400 on north side of PRD, including around proposed roundabout on existing N5.</td>
<td>Minimise impact on riverside habitats and where impacted provide Landscape Treatment Type 2 to full extent of impacted area. Proposals to be informed by requirements of Chapter 7 of this EIS.</td>
</tr>
<tr>
<td>LM-D3</td>
<td>Ch 40+650 to 40+700 on south side of PRD, including along Windsor Local Road. (TPO 1993/3)</td>
<td>Fence off and minimise impact on 3 retained beech trees. Monitor retained trees during construction and re-assess condition at end of works. Provide for planting of 8 new semi-mature (18-20cm girth) rootballed beech trees at junction of PRD and Windsor Local Road. Fence-off new trees to protect from rabbits and livestock.</td>
</tr>
<tr>
<td>LM-D4</td>
<td>Ch 40+800 to 40+950 on south side of PRD. (TPO 1993/4)</td>
<td>Fence-off and avoid impact on retained trees in existing stand of beech trees. Monitor retained trees during construction and re-assess condition at end of works. Plant retained edge with 10no heavy-standard (12-14cm girth) rootballed beech trees. Fence-off new trees to protect from rabbits and livestock.</td>
</tr>
<tr>
<td>LM-D5</td>
<td>Ch 41+050 to 41+400 on north side of PRD. (TPOs 1993/5 &amp; 1993/6)</td>
<td>Fence off and where possible avoid impact on edge of existing plantation. Monitor retained trees during construction and re-assess condition at end of works. Plant at 1.5m centres along full length of edge of plantation and up to 3m in width with beech transplants 75-90cm in height. Fence-off new trees to protect from rabbits and livestock.</td>
</tr>
<tr>
<td>LM-D6</td>
<td>Ch 41+350 to 41+620 on north side of PRD and Ch 40+950 to 41+100 and Ch 41+320 to 41+510 on south side of PRD.</td>
<td>Provide for Landscape Treatment Type 1 (modified to replace all tree species with 20% beech at 90-120cm in height) to full extent of upper half (50%) of slopes and to additional areas.</td>
</tr>
<tr>
<td>LM-D7</td>
<td>Ch 41+780 to 42+000 on north side of PRD including local road and access.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and access. Provide for Landscape Treatment Type 2 to full extent of fill slopes.</td>
</tr>
<tr>
<td>LM-D8</td>
<td>Ch 42+000 to 42+200 both sides of PRD, including local road and accesses.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD, local roads and accesses. Provide for Landscape Treatment Type 1 to upper half (50%) of all bunds and fill slopes and full extent of additional land at Abbeybreaffy Nursing Home and opposite properties H2374 and H2375.</td>
</tr>
<tr>
<td>LM-D9</td>
<td>Ch 43+100 to 43+400 north side of PRD including local access.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and local accesses. Provide for Landscape Treatment Type 1 to full extent cut and fill slopes and all bunds. Provide additional tree planting of 25no. Heavy-Standards (12-14cm girth) Beech and Oak along boundary with Turlough Park.</td>
</tr>
<tr>
<td>LM-D10</td>
<td>Ch 43+020 to 43+600 south side of PRD including local access.</td>
<td>Provide for Boundary Hedgerow Type 1 along full extent of PRD and local accesses. Provide for Landscape Treatment Type 2 to the upper half (50%) of all fill slopes over 2.0m in height; to the upper quarter (25%) of all cut slopes over 3.0m in height, and to the full extent of all bunds.</td>
</tr>
</tbody>
</table>
Table 19.4: Specific Landscape and Visual Mitigation Elements and Treatments. (Note: Proposed Road Development has been abbreviated to PRD in the following Table)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Chainage and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM-D11</td>
<td>Both sides of local road realignment</td>
<td>Provide for Boundary Hedgerow Type 1 along both sides of local road realignment. Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners.</td>
</tr>
<tr>
<td>LM-D12</td>
<td>Both sides of local road realignment</td>
<td>Protect and retain existing boundaries where possible. Provide for Boundary Hedgerow Type 1 along both sides of local road realignment.</td>
</tr>
<tr>
<td>LM-D13</td>
<td>Northern access and embankments to overbridge</td>
<td>Minimise impact on riverside habitats and where impacted provide Landscape Treatment Type 2 to full extent of impacted area. Extend treatment to full extent of fill slopes and to additional lands. Proposals to be informed by requirements of Chapter 7 of this EIS.</td>
</tr>
<tr>
<td>LM-D14</td>
<td>Southern access and embankments to overbridge at Turlough Church</td>
<td>Minimise impact on riverside habitats and where impacted provide for Landscape Treatment Type 2 to full extent of fill slopes. Proposals to avoid screening view of Turlough Church from N5.</td>
</tr>
<tr>
<td>LM-D15</td>
<td>Both sides of local road realignment</td>
<td>Where impacted, provide for reinstatement and/or provision of new garden property accesses and boundaries and planting in agreement with property owners. Provide additional lands to Turlough Church as overflow carparking. Provide for appropriate boundaries and seeding of verges in agreement with Church.</td>
</tr>
<tr>
<td>LM-D16</td>
<td>Ch 43+800 to 44+650 on north side of PRD and Ch 43+800 to 44+400 on south side of PRD.</td>
<td>Minimise impact on existing roadside plantings and boundaries. Where impacted, provide for reinstatement and/or provision of new Boundary Hedgerow Type 2 along full extent of PRD.</td>
</tr>
<tr>
<td>LM-D17</td>
<td>Ch 44+400 to 44+650 on north side of PRD</td>
<td>Provide for Landscape Treatment Type 2 to additional lands between N5 and cul-de-sac on local road.</td>
</tr>
</tbody>
</table>

**Verges**

Mainline and Local Roads

- Generally: Minimum 3.0m wide verge (which includes 0.5m hard strip) shall be provided along both sides of mainline, around junctions and to full width of local road re-alignments and tie-ins. Verges shall be finished to even gradients, with minimum 100mm topsoil and stone buried or raked to be free of rubble and stones over 25mm diameter. Verges to be seeded to low-maintenance seed mix.

**Cut slopes and Embankments**

Mainline and Local Roads

- Generally: Cut slopes and embankments shall be finished to even gradients, topsoiled unless otherwise stated in this table, Table 11.7 above or elsewhere in EIS. Slopes shall be free of rubble and stones over 50mm diameter. All such rubble/stone shall be removed or buried. Unless otherwise stated in the EIS slopes shall be seeded to a non-agricultural meadowgrass.

**Ponds, swales, 'V-drains' etc.**

Generally: All slopes shall be evenly graded and free of rubble and stones over 50mm diameter. Slopes shall be seeded to non-agricultural meadowgrass allowing for natural development over time. Steep slopes on pond edges and 'V-drains' shall be hydro-seeded. Non-palisade type fencing shall be used around pond areas. Areas around ponds shall be a diverse landscape of meadowgrass / species-rich meadowgrass and plantings of low-canopy woodland and shrub planting. Hedgerow (without tree species) shall be established along all non-roadside boundaries.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Chainage and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peat fill areas</td>
<td>All ‘LM-PA’ Areas (see Figures 11.1 to 11.17 in Volume 3)</td>
<td>Unless otherwise stated in the EIS, peat areas shall be allowed to naturally regenerate to heath grassland. Between 25 and 50% of area shall be planted to a mosaic mix of alder, birch, Scots pine and willow species. Subsoil may be mixed into final surface to improve surface rigidity.</td>
</tr>
<tr>
<td>Noise barriers / bunds</td>
<td>Generally</td>
<td>Low-canopy woodland, hedgerow and/or shrub planting of native species shall be established as either a narrow planting of 3.0m minimum width or double-staggered hedgerow along the full external face of barriers. Low-canopy and/or shrub planting of native species shall be established on the full external face of bunds. The planting shall include ash, birch, blackthorn, elder, hawthorn, and/or willow species as appropriate. Plants shall be 90 to 120cm in height at planting.</td>
</tr>
<tr>
<td>Plants and Planting Areas</td>
<td>Generally</td>
<td>All tree species over 150cm in height together with all Pine shall be appropriately staked and tied. All failed, dead or defective plants shall be replaced before the end of each and every year of defect aftercare. Full planting area to free of stones over 50mm in diameter.</td>
</tr>
<tr>
<td>Grass</td>
<td>Generally</td>
<td>Grass areas shall provide full sward cover within 12 months of seeding. Any failed, bare or defective areas shall be re-seeded between March – May and/or August – September in each and every year of defect aftercare.</td>
</tr>
<tr>
<td>Unauthorised Access, Parking and/or Encampment</td>
<td>Generally</td>
<td>Landscape proposals shall avoid creating areas considered as being suitable for unauthorised parking and shall use landscape proposals to deter and prevent such use.</td>
</tr>
<tr>
<td>Headlight Impacts</td>
<td>Generally</td>
<td>Landscape proposals shall use specific landscape treatments to avoid and/or reduce the potential impact of headlights on residential and other sensitive property. The measure shall apply equally to the mainline, junctions, roundabouts, tie-ins and local and link roads.</td>
</tr>
<tr>
<td>Fill Areas and/or Surplus Areas</td>
<td>Generally</td>
<td>Any post-construction surplus lands shall be treated to a diverse range of planting and non-planting proposals to include a minimum 50% Landscape Treatment Type 1 and/or Type 2 and/or Type 3, as locally appropriate. The remaining area shall be treated as locally appropriate meadowgrass / species-rich meadowgrass.</td>
</tr>
<tr>
<td>Screen Planting Type 1</td>
<td>Planting at 1.0m centres for visual screening shall be of a minimum of 5m in width. The planting shall extend for a minimum of 100m to either side of any adjoining residential property or amenity.</td>
<td>Planting will include a minimum of 5% of ‘standard-sized’ trees (8-10cm girth); 5% of half-standard trees (6-8cm girth); 15% of ‘whips’ (minimum 150cm in height), together with a further 10% of evergreen Scots pine of minimum 60cm in height at planting. Standard and Half-standard tree species shall be ash. Standard, Half-standard and Pine to be planted at average 2.5, centres throughout. The planting shall include a dense under-storey (at average 1 plant/metre) of woodland transplants and shrubs. Transplants, which shall include 20% Hawthorn, shall be between 90 to 120cm in height) Shrub species shall be 30 to 50cm in height and include a minimum of 10% holly.</td>
</tr>
<tr>
<td>Screen Planting Type 2</td>
<td>Planting at 1.0m centres for visual screening shall be of a minimum of 5m in width. The planting shall extend for a minimum of 100m to either side of any adjoining residential property or amenity.</td>
<td>Planting shall include a minimum of 5% of ‘standard-sized’ trees (8-10cm girth); 5% of half-standard trees (6-8cm girth); 15% of ‘whips’ (minimum 150cm in height), Standard and Half-standard tree species shall be ash. Standard and Half-standard trees shall be planted at average 2.5, centres throughout. The planting shall include a dense under-storey (at average 1 plant/metre) of woodland transplants and shrubs. Transplants, which shall include 30% hawthorn, shall be between 90 to 120cm in height) Shrub species shall be 30 to 50cm in height and include a minimum of 20% holly.</td>
</tr>
<tr>
<td>Reference</td>
<td>Chainage and Location</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Boundary Hedgerow Type 1</td>
<td>General double staggered hedgerow with tree planting</td>
<td>Primarily blackthorn (20%) and hawthorn (40%) hedgerow interspersed with other species such as elder, hazel, holly and those found locally. Hawthorn plants shall be of between 75 to 90cm in height and planted at 50cm centres in each of two double staggered rows, 25cm apart. Other plants shall be interspersed and of between 30 to 50cm in height. The hedgerow shall be interspersed with ‘standard-sized’ (8-10cm girth) randomly planted ash and/or oak trees planted at random naturalistic spacings but averaging 1 tree per 25 linear metre.</td>
</tr>
<tr>
<td>Boundary Hedgerow Type 2</td>
<td>Double staggered hedgerow with little or no tree species</td>
<td>Primarily blackthorn (25%) and hawthorn (60%) hedgerow interspersed with other species such as elder, hazel, holly and those found locally. Hawthorn plants shall be of between 75 to 90cm in height and planted at 50cm centres in each of two double staggered rows, 25cm apart. Other plants shall be interspersed and of between 30 to 50cm in height. The hedgerow shall be interspersed with ‘standard-sized’ (8-10cm girth) randomly planted ash and/or oak trees planted at random naturalistic spacings but averaging 1 tree per 25 linear metre. Limited tree species, such as birch and mountain ash may be included as ‘whips’ at 150cm metres in height.</td>
</tr>
<tr>
<td>Landscape Treatment Type 1</td>
<td>General low-canopy woodland planted at average 1.5m centres</td>
<td>Area to be planted to native or indigenous woodland. Planting shall include a proportion, totalling not less than 5% of ‘Half-standard’ trees (6-8cm girth &amp; 200cm-250cm tall) and a further 5% ‘Standard’ trees (8-10cm girth &amp; 250cm-300cm tall) to be used to supplement a general planting of 10% tall whips (150cm minimum) 10% whips (120 - 150cm) 25% transplants (90-120cm), and shrub plantings. Species to include alder, ash, birch, blackthorn, hawthorn, hazel, holly, mountain ash, oak, Scots pine and willows as locally appropriate. Half-standard and Standard-sized trees to be alder, ash, mountain ash and/or oak.</td>
</tr>
<tr>
<td>Landscape Treatment Type 2</td>
<td>Semi-natural low-canopy woodland with limited tree species planted at average 1.5m centres</td>
<td>Area to be planted to native or indigenous semi-natural woodland with limited or tree species. Planting shall include a proportion, totalling not less than 15% whips (120 - 150cm) 30% transplants (90-120cm) and shrub plantings. Species to include alder, birch, blackthorn, hawthorn, hazel, holly, mountain ash and willows as locally appropriate. If locally appropriate tree species may be omitted entirely.</td>
</tr>
<tr>
<td>Landscape Treatment Type 3</td>
<td>High-canopy Woodland planted at average 1.5m centres</td>
<td>Area to be established as native semi-natural high-canopy woodland containing higher percentage ash, oak and/or Scots pine. Planting shall include a proportion, totalling not less than 5% of ‘Half-standard’ trees (6-8cm girth &amp; 200cm-250cm tall) and a further 5% ‘Standard’ trees (8-10cm girth &amp; 250cm-300cm tall) to be used to supplement a general planting of 10% tall whips (150cm minimum) 10% whips (120 - 150cm) 25% transplants (90-120cm), and shrub plantings. Species to include alder, ash, birch, blackthorn, hawthorn, hazel, holly, mountain ash, oak, Scots pine and willows as locally appropriate. Half-standard and Standard-sized trees to be ash, and/or oak and Scots Pine to be minimum 10% of planting.</td>
</tr>
<tr>
<td>Construction Screening</td>
<td>Specifically as indicated on Figures 11.1 to 11.17 in Volume 3</td>
<td>Provide for solid screening hoarding of the heights stated for the duration of the construction stage for those properties most particularly impacted by the works (See also LM-C11).</td>
</tr>
</tbody>
</table>
19.9 Mitigation Measures for Noise & Vibration

19.9.1 Operational Phase Noise Mitigation

Table 19.5 Mitigation Measures with a Standard Road Surface

<table>
<thead>
<tr>
<th>Receiver Location Reference</th>
<th>Carriageway</th>
<th>Chainage Start (m)</th>
<th>Chainage End (m)</th>
<th>Bund/Barrier</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0140</td>
<td>N5 North</td>
<td>1+985</td>
<td>2+045</td>
<td>Barrier</td>
<td>1</td>
</tr>
<tr>
<td>H0152</td>
<td>N5 North</td>
<td>2+060</td>
<td>2+135</td>
<td>Barrier</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Attireesh Road Local Road</td>
<td>0+000</td>
<td>0+020</td>
<td>Barrier</td>
<td>1.5</td>
</tr>
<tr>
<td>H0600</td>
<td>N5 South</td>
<td>10+265</td>
<td>10+515</td>
<td>Barrier</td>
<td>2.5*</td>
</tr>
<tr>
<td>H0622</td>
<td>N5 North</td>
<td>10+265</td>
<td>10+515</td>
<td>Barrier</td>
<td>2.0*</td>
</tr>
<tr>
<td>H0630</td>
<td>N5 South</td>
<td>10+770</td>
<td>10+940</td>
<td>Bund</td>
<td>1.0</td>
</tr>
<tr>
<td>H0670</td>
<td>N5 North</td>
<td>10+940</td>
<td>10+980</td>
<td>Bund</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10+980</td>
<td>11+100</td>
<td>Bund (1.5m) &amp; Barri</td>
<td>3.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11+100</td>
<td>11+240</td>
<td>Bund</td>
<td>3.0</td>
</tr>
<tr>
<td>H0760</td>
<td>N5 South</td>
<td>12+430</td>
<td>12+660</td>
<td>Bund</td>
<td>1.75</td>
</tr>
<tr>
<td>H1260</td>
<td>N5 North</td>
<td>19+420</td>
<td>19+530</td>
<td>Bund (2.5m) &amp; Barri</td>
<td>3.5</td>
</tr>
<tr>
<td>H1230</td>
<td>N5 East</td>
<td>20+145</td>
<td>20+310</td>
<td>Bund</td>
<td>2</td>
</tr>
<tr>
<td>H1750</td>
<td>N5 North</td>
<td>34+920</td>
<td>35+070</td>
<td>Bund</td>
<td>2.25</td>
</tr>
<tr>
<td>H1790</td>
<td>N5 West</td>
<td>35+870</td>
<td>35+990</td>
<td>Barrier</td>
<td>1.0</td>
</tr>
<tr>
<td>H1930a &amp; b</td>
<td>N5 West</td>
<td>37+035</td>
<td>37+090</td>
<td>Barrier</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Mitigation Measures

Noise

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS 5228: Part 1 and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
• Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.

• During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 12.10 using methods outlined in BS 5228 “Noise and Vibration Control on Construction and open sites”.

Air Overpressure
Air overpressure from a blast is difficult to control, however, because of its variability much can be done to reduce the effect. A reduction in the amount of primer cord used, together with the adequate burial of any that is above the ground, can give dramatic reduction to air overpressure intensities especially in the audible frequency range. Most complaints are likely to be received from an area downwind of the blast site, and therefore, if air blast complaints are a continual problem, it would be advisable to postpone blasting during unfavourable weather conditions if at all possible. As air blast intensity is a function of total charge weight, then a reduction in the total amount of explosives used can also reduce the air overpressure value.

Further guidance will be obtained from the recommendations contained within BS 5228: Part 1 and the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988 in relation to blasting operations.

The methods used to minimise complaints could consist of some or all of the following:

• Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs).

• A publicity campaign undertaken before any work and blasting starts (e.g. 24 hour written notification).

• The firing of blasts at similar times to reduce the ‘startle’ effect.

• Ongoing circulars informing people of the progress of the works.

• The implementation of an onsite documented complaints procedure.

• The use of independent monitoring by external bodies for verification of results.

• Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

Working Hours
Normal working times will be 07:00 to 19:00hrs Monday to Saturday. Works other than the pumping out of excavations, security and emergency works will not be undertaken outside these working hours without the written permission of the Contracting Authority. This permission, if granted, can be withdrawn at any time will the working regulations be breached.

Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of the Contracting Authority. Night is defined as 19:00 to 07:00hrs. Some works associated with rail bridges and the bridges on the existing N5 on line section may need to be undertaken outside of normal working hours.
When overtime and shift work is permitted, the hauling of spoil and delivery of materials outside normal working hours is prohibited and the noise limits outlined in Table 12.10 will apply.

**Emergency Work**

The emergency work referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads.

**19.10 Mitigation Measures for Air Quality & Climate**

**19.10.1 Construction Phase**

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of any dust produced will be deposited close to the potential source and any impacts from dust deposition will typically be within two hundred metres of the construction activities.

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared and will be included in the EOP for implementation during the construction phase of the project. These measures are as follows:

- Site roads will be regularly cleaned and maintained as appropriate. Hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads will be restricted to essential site traffic only. Any road that has the potential to give rise to fugitive dust will be regularly watered during dry and/or windy conditions.

- Vehicles using site roads will have their speeds restricted where there is a potential for dust nuisance at nearby properties.

- Where practicable, vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads. This will ensure that mud and other wastes are not tracked onto public roads. Public roads outside the site will be regularly inspected for cleanliness, and cleaned as necessary. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.

- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

- The dust minimisation procedures put in place will be monitored and assessed by the contractor. In the event of dust nuisance occurring outside the site boundary, the effectiveness of existing measures will be reviewed and further mitigation will be implemented to rectify the problem.

Provided the dust minimisation measures outlined above are adhered to, the air quality impacts during the construction phase will be not be significant.
19.11 Mitigation Measures for Archaeology & Cultural Heritage

Mitigation measures, both at pre-construction and construction phases, shall be undertaken as directed by the Minister of the DoEHLG in compliance with national policy guidelines and statutory provisions for the protection of the archaeological and cultural heritage, including:

- Framework & Principles for the Protection of the Archaeological Heritage (1999). Department of Arts, Heritage, Gaeltacht & the Islands;
- Policy & Guidelines on Archaeological Excavation (1999). Department of Arts, Heritage, Gaeltacht & the Islands;
- Code of Practice (2000) between the National Roads Authority and Department of Arts, Heritage, Gaeltacht and the Islands.

19.11.1 Mitigation Measures – Prior to Construction

It is recommended that this work be carried out in advance of construction to allow for the implementation of a calculated and controlled mitigation programme.

Geophysical Survey

To aid in interpreting the archaeological landscape a geophysical survey will be carried out along selected sections of the route (where suitable) in advance of a possible programme of test trenching. Archaeologically-directed geophysical surveys are recommended at two potential archaeological sites (A3 & A5) and on parts of the road take which pass close to RMP sites (A17 & A18) including on any previously undisturbed areas adjacent to three excavated sites (AP2 & AP3). It is also recommended at six sites of pre-Famine villages/buildings, which lie directly on the line of the road (C9, C12, C13, C19, C20 & C22).

Archaeological Underwater Inspection and Survey

Underwater inspection will be carried out on significant water bodies that will be directly impacted by the Proposed Road Design. This will consist of either a wading or underwater survey depending on the depth of water; visual inspection; and, possibly a metal-detector survey of the underwater environment. Surveys of all ten watercourse crossings will be carried out.

Photographic Recording

Photographic recording will be undertaken for all 50 townland boundaries impacted, and where coinciding, to be carried out in conjunction with water crossing surveys mentioned above. This will consist of a photographic record and a description of the composition of the townland boundary.

Site-Specific Test Trenching

Site specific archaeological investigative test trenching will be undertaken for all sites which are directly impacted or have their environs impacted by the road. Site-specific archaeological test trenching aids in determining the nature, extent and significance of the archaeology present. The results of the test trenching investigations will enable the appropriate mitigation strategy to be developed with the approval of the DAHG.
Overall Archaeological Testing

In order to locate sites of archaeological significance where no surface remains exist, testing by centre-line trenching or other suitable testing layout is recommended for the entire length of the route. Where archaeological sites are found in the course of this work, mitigation strategies will be adopted to deal with such findings in advance of construction, thereby helping to minimise delays during the construction phase. Such mitigation strategies will involve preservation by record of the archaeological deposits (archaeological excavation) or preservation in situ.

Preservation in situ

Strategies for the preservation *in situ* of archaeological remains will be considered on a case-by-case basis, in consultation with the Statutory Authority. Preservation *in situ* will be undertaken through avoidance of the confirmed feature in the development process, if possible, or preservation of the confirmed feature through detailed design, for example blanketed under road embankment.

Preservation by record (Archaeological Excavation)

Preservation by record in the form of archaeological excavation and recording, to resolution, will be carried out for sites where initial investigation has yielded evidence of archaeologically significant material or structures, and where preservation *in situ* is not feasible.

19.11.2 Mitigation Measures – During Construction

Mitigation measures at construction phase will be undertaken in compliance with national policy guidance and statutory provisions for the protection of the archaeological and cultural heritage.

Archaeological Monitoring

Archaeological monitoring of topsoil stripping and ground works associated with the scheme, will be undertaken only where required by the Statutory Authority after the trenching phase. There will be a provision for preservation *in situ* or by record of any archaeologically significant material uncovered in the course of this work.

Discovery of Archaeological Material

In the event of archaeological features or material being uncovered during the construction phase, the machine work will cease in the immediate area to allow the archaeologist to inspect any such material. Initial assessment will determine the nature, extent and significance of the archaeology present. As a result of the assessment, decisions on the most appropriate mitigation strategy will be taken with the approval of the National Monuments Service. The discovery of any archaeological object will be reported to the Director of the National Museum of Ireland or An Garda Síochána within 96 hours of discovery (Section 23 of the National Monuments Acts 1930 [as amended]).

Fencing

Fencing is recommended for two sites (A6 & A17) and of any archaeological sites discovered. This will be carried out as appropriate during their excavation.

Preservation in situ

Strategies for the preservation *in situ* of archaeological remains as described above will be considered on a case-by-case basis, in consultation with the Statutory Authority.
Construction Works
The positioning of temporary site offices, access roads, haul roads, spoil heaps and borrow pits will take into account the location of identified sites and areas of archaeological potential.

19.12 Mitigation Measures for Architectural Heritage

Site BH-02
The affected length of the railway line will be recorded, along with any associated features, prior to the construction of the road.

Site BH-04
This will be moved to safety prior to any construction, following recording of the precise location and photographing it in place. It will then be relocated at the margin of the road as close to its original position as is possible having regard to the need to protect it from damage.

Site BH-06
Prior to the commencement of construction the bridge will be recorded by measured drawings, photographs and written.

Site BH-12
This feature will be recorded by photographs and written description prior to removal.

Following mitigation by recording there would be no residual impact as the level of interest is considered to be “record only”.

Site BH-13
This feature will be recorded by photographs and written description prior to removal.

Following mitigation there would be no residual impact as the level of interest is considered to be “record only” and the wall was rebuilt in the 1960s using salvaged stone.

Site BH-15
Care will be taken to minimise the effect of the scheme on this planting and replacement trees of similar species will be planted to supplement those remaining following construction.

Site BH-16
Some planting will take place to minimise the potential effects of the scheme on the setting of the house at Turlough Park. No original features of the demesne would be affected by the proposals.

Site BH-17
Some supplementary planting around the perimeter of the churchyard would ensure that the effect on this building would be minimised.
19.13 Mitigation Measures for Material Assets - Agriculture

19.13.1 Agriculture

Mitigation measures detailed in this section relate to engineering accommodation works alone. Further measures to compensate farmers due to land acquisition, drainage works and loss of facilities can be agreed at a later stage.

There are forty land parcels (17.5% of 229 land parcels) on which new access will have to be provided. There are 104 land parcels on which the existing access point will be affected or a new access point off an existing road may be required.

On the severed areas where no access is available, new access provisions will be required. The extent and complexity of such access provisions vary with each farm depending on the nature of the impact and the type of enterprise being carried out. In most cases simple gateways will suffice, while in other cases new accommodation roads and / or structures will have to be constructed to provide access across the scheme to severed lands. The structures included within the preliminary design and assessed in this EIS are described in Table 19.6. Timber post and rail fencing with stock proofing as appropriate will be provided along the main line, regional, local and accommodation roads. The Local Authority will maintain the fence along the National road. It will be the responsibility of the landowners to maintain the fence along regional, local and accommodation roads.

Table 19.6 Structures on the Proposed Scheme

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Chainage (m)</th>
<th>Description of structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10+700m</td>
<td>Shared underpass suitable for shared livestock, pedestrian and cyclist use (5.0m X 3.0m)</td>
</tr>
<tr>
<td>2</td>
<td>16+400m</td>
<td>Shared underpass suitable for livestock use (3.0m X 3.0m)</td>
</tr>
<tr>
<td>3</td>
<td>17+950m</td>
<td>Private underpass suitable for livestock use (3.0m X 3.0m)</td>
</tr>
<tr>
<td>4</td>
<td>31+050m</td>
<td>Shared underpass suitable for agricultural vehicle and livestock use (4.5m X 4.5m)</td>
</tr>
<tr>
<td>5</td>
<td>31+600m</td>
<td>Shared underpass suitable for agricultural vehicle and livestock use (4.5m X 4.5m)</td>
</tr>
<tr>
<td>6</td>
<td>36+150m</td>
<td>Shared underpass suitable for agricultural vehicle and livestock use (4.5m X 4.5m)</td>
</tr>
<tr>
<td>7</td>
<td>38+600m</td>
<td>Shared underpass suitable for agricultural vehicle livestock and pedestrian use (4.5m X 4.5m)</td>
</tr>
</tbody>
</table>

Construction Noise

Good communication between the contractor and the landowners during the construction phase will prevent undue disturbance due to noise.

Dust

Measures to control the reduction of dust will be put in place by the contractor. Good communication between the contractor and the farmers in the proximity of construction activities will facilitate on-going farm enterprises.
Restricted Access to Severed Land Parcels during construction

As in the case of mitigating noise and dust pollution, good communication between individual farmers and the construction authorities will minimise difficulties caused by the restriction of access to severed land parcels.

Temporary or permanent fencing will be erected as required to delineate the site boundary and to minimise disturbance to adjacent lands. Farmers may need to move animals across the construction site while they await more permanent measures to be put in place and this will be facilitated by providing gates where needed until such time as the access arrangements are in place for these farmers when these gateways will be replaced by permanent stock-proof fencing. Any agricultural boundaries removed or created by the land acquisition will be fenced by timber post and rail stock proof fencing complying with standard. Fencing along the N5 mainline will be maintained by the Council.

Disturbance of field drainage works

In cases where impeded drainage during construction will cause obvious difficulty to a particular landowner, temporary measures will be taken to allow waters to drain to less critical areas and so minimise the impact.

Disturbance of services

Ducting will be provided to take water supply and electric fencing across the proposed road. The location of these will be agreed in advance of road construction on an individual farm basis and put in place during the construction phase. Again some temporary measures may be needed, such as water tanks and battery power electric fencing to ensure that disruption to farming is minimized.

19.14 Mitigation Measures for Material Assets - Non-Agriculture

Castlebar Golf Club

Mayo County Council have assessed a number of potential solutions and have concluded that the most suitable mitigation for the impacts will be financial compensation to fund the acquisition of adjoining land by Castlebar Golf Club and reconfiguration of the golf course. Mayo County Council have funded Castlebar Golf Club to enable them to engage a golf course designer and are facilitating discussions with a number of landowners with a view to the Club purchasing additional lands adjacent to the course. This solution will allow the Club and designer to reconfigure the course utilising these additional lands.

The financial compensation to the Golf Club will permit the acquisition of lands to provide a functioning 18 hole golf course, which will be at a minimum of equal standard to the existing course and is likely to allow for an improved course layout and design.

National Museum of Ireland - Country Life (Mayo County Council)

The effected access direct from the existing N5 is only used on an occasional basis. The access is proposed to be retained, but diverted to connect to the local road network by a shared parallel access road from the L-5779. This is consistent with all field/house accesses along Section D of the scheme. The lands (0.063 hectares) which are proposed to be acquired on a temporary basis form part of the existing museum car park. When the widening works along the N5 are complete, is proposed to reinstate this section of the museum car park. A new
boundary treatment along the museums southern boundary will be provided as part of the accommodation works.

**Church of Ireland**

In order to complete the construction of the junction at Turlough, acquisition of the existing road to the west of the Church of Ireland located in the townland of Drumdaff is required. In order to avoid the need for parking on the new interchange link roads, a short section of the existing road, which will be turned into a cul-de-sac, will be retained as a parking area adjacent to the church linking onto the newly realigned road.

19.14.1 **Commercial, Residential and Other Property**

Where an access to property classified as ‘other’ is affected the access would be reinstated. Any compensation claims will be the subject of a separate process. Where the entrance or boundary of a residential property is acquired same will be replaced or compensation paid on a like for like basis.