

## Chapter 4 Alternative Routes Considered

### 4.1 Examination of Alternative Alignment Requirements

Statutory Instrument, SI No. 93 of 1999 requires that the EIS shall contain the following information:

*“an outline of the main alternatives studied by the road authority concerned and an indication of the main reasons for its choice, taking into account the environmental effects;”*

The development of the route was undertaken in three stages: A Constraints Study undertaken in 2000 / 2001, a Route Selection Study undertaken in 2001 / 2002 and development of the Preliminary Design through 2002 / 2003. The examination of alternative alignments in each stage of the development of the design is discussed below.

### 4.2 Development of Possible Route Options

#### 4.2.1 Constraints to Route Options

The objective of the route selection process was to select a single optimum route corridor between Kilcullen and Waterford, which would be developed to Preliminary Design Stage as part of the Statutory Procedures for making the CPO.

A preliminary study was carried out by collecting information on major engineering and environmental constraints within the full extent of the initial study area shown in Figure 4.1 in Volume 2. This information was methodically reviewed to identify areas where the probability of finding a feasible route would be unlikely (low routing potential). The issues that were considered included:

- the existing infrastructure, land use, topography and physical features;
- identification of sites or areas of environmental significance or sensitivity;
- planning, development and socio-economic character; and
- engineering constraints.

These areas of low routing potential, and adjacent areas, which became areas of low routing potential by association, were not considered further.

A Public Consultation (PC1) was undertaken at the end of March 2001. Comments from the public were invited by use of “cut out” comment sheets which were to be returned to Kildare County Council. The results of the study were recorded in the Constraints Study, which was published in May 2001.

The Constraints Study provided a comprehensive record of environmental and engineering constraints in the area. It assembled existing data such as traffic counts, accident records and geotechnical data that were then used in the Route Selection stage of the project.

#### 4.2.2 Methodology

As the various route options between Kilcullen and Waterford began to emerge, an assessment of the northern and southern sections of the scheme in the vicinity of Paulstown, indicated that all the different route options identified at the southern

end of the northern section could be connected to all the route options identified at the northern end of the southern section, such that the choice of route north of Paulstown and south of Paulstown could be made largely independently.

Following the identification and preparation of the alternative route options, a Public Consultation (PC2) was held between May and August 2001.

The objectives of the consultation were:

- Present the route corridor options to the public;
- Inform them of the process and programme for the project;
- Invite submissions on these options; and
- Gather local information, which may not be known to the design team.

Valuable information was collected during the Public Consultation, which assisted the route selection process.

Letters of consultation were also issued to a number of statutory and non-statutory bodies notifying them of the route options under consideration and inviting them to comment on the options.

The responses from the public, statutory and non-statutory bodies were considered together with the reports of the various specialists in order to compare the impacts of the alternative route corridors. The routes were then compared with each other with a view to eliminating the less favourable options. This comparison continued until one route was identified as the Preferred Route Corridor. The Preferred Route Corridor was then presented at Public Consultation No. 3 (PC3) in October 2001.

### **4.2.3 Route Standards**

The design standards for the scheme are the National Roads Authority's Design Manual for Roads and Bridges (the NRA DMRB). At the time of Route Selection the standard for the new road, in accordance with the National Development Plan (NDP), was to be either a Standard Grade Separated Dual 2 Lane (7.0 metres) Carriageway or a Standard Dual 2 Lane (7.0 metres) Motorway. Both categories have the same cross-section.

The road cross-section and alignment standards used are those identified in Section 3.2.

## **4.3 Alternative Route Options**

### **4.3.1 Initial Assessment of Options**

Whilst the first public consultation was underway a full range of studies was undertaken by environmental and engineering specialists to gather details along each of the route options. Wider studies, not specific to each option, were also undertaken to gather socio-economic data and planning constraints.

A number of initial routes were developed based on site visits and information recorded in the Constraints Study. Certain routes were discarded early in the development stage as described in the following paragraphs.

### **Athy to Monasterevin Route**

One possible route corridor (the “western corridor”) ran parallel to the railway north of Athy to join the proposed Heath to Mayfield M7 motorway scheme to the south of Monasterevin. However, it was found that a western corridor would not attract traffic from Carlow and this traffic would continue to use the existing N9.

### **N78 Corridor (Kilkenny – Castlecomer – Athy)**

A route corridor was investigated following the N78 corridor from north of Kilkenny City to Athy. This corridor, when compared with other possible route corridors which followed the River Barrow valley further east, was discarded prior to Public Consultation No. 2 for a number of reasons.

Firstly, the route corridor passes over the Castlecomer Plateau which has steep slopes at its edges. The steep ground proved difficult to develop an engineering design and would require extensive embankments and cuttings hence increasing the cost of construction and maintenance. The terrain would also require the road vertical alignment to have significant lengths with gradients greater than 3% in order to keep cutting and embankment heights within reasonable limits.

Secondly, 15 kilometres of the route would be at a relatively high elevation of over 150 metres, while 2 kilometres would be over 200 metres. The higher frequency of fog, frost and snow at these elevations could lead to a reduction in road safety and to maintenance problems compared to a route at a lower elevation. Winter maintenance costs would also be increased.

Thirdly, any route corridor following the N78 would not serve Carlow Town directly. A new link road, or upgrading of the N80 or R430 would be required. These links might not attract the Carlow to Dublin traffic from the existing N9.

In environmental terms the route corridor passes close to Castlecomer and adjacent sites of ecological value, and does not appear to have any over-riding benefits when compared to other route corridors.

In view of this result and the discarding of routes in the Athy to Monasterevin corridor, as described above, no further work was done on the western route as it failed to meet the objective of attracting traffic from the N9 corridor north of Carlow.

### **Upgrading the N9 to Dual Carriageway Standard**

Early in the project design phase the advantages and disadvantages of routing the proposed N9 / N10 high quality dual carriageway along the existing N9 were considered, and a number of major disadvantages were identified:

- (i) Over 57% of the route would need to be “off-line” to avoid settlements and to improve the horizontal alignment to comply with current standards for a high quality dual carriageway.
- (ii) Service roads would be needed over significant lengths of the on-line section to maintain access to properties and land. This would considerably increase the cross-section compared with an off-line solution.
- (iii) A significant number of properties close to the existing N9 would have to be demolished to accommodate the wider dual carriageway cross-section.
- (iv) Access for communities located in the vicinity of the N9 would be severely affected due to the restricting access to the new road. Local journeys and

journeys to and from the new road would be forced to use the existing low standard rural roads.

- (v) Severance would be significant for properties and land currently fronting the N9.
- (vi) Extensive traffic management measures would be required during construction which would increase construction costs and potentially increase the number of accidents.
- (vii) There would be significant delay and disruption to traffic on the existing N9 during construction.

For the above reasons the “on-line” option was discarded.

### **Incorporation of Moone – Timolin Bypass**

To enable the new Moone – Timolin Bypass to be used as part of the proposed N9 / N10 Scheme, the Bypass would have to be widened by approximately 7 metres to accommodate the dual carriageway cross-section. The option of incorporating the Moone – Timolin Bypass into the scheme was rejected for the reasons outlined above and for the following reasons:

- Construction difficulties and traffic delays associated with lowering the main carriageway and construction of retaining walls at Moone Bridge.
- Requirement for extensive access tracks and service roads to provide access to fields and properties currently serviced from the Bypass.
- The reintroduction of a significant volume of traffic onto the ‘old’ N9 through the villages of Moone, Timolin and Crookstown Upper. This would negate the objective of the original Bypass and have a negative environmental impact on the villages.

## **4.3.2 Route Corridors Under Consideration**

### **Introduction**

A wide range of options were investigated and the most promising were identified on the basis of site visits and the engineering and environmental constraints. For convenience at public consultation the northern study area was divided into four sections A to D each containing between approximately 11 and 15 kilometres of the route corridors (Note: these route selection stage sections cover different areas to the sections outlined in Section 1.1 of Chapter 1). The route corridors exhibited at Public Consultation No. 2 are shown in Figures. 4.2 to 4.5 (Volume 2) and described below.

### **Route Corridors in Section A**

#### Route Corridor A1

Route Corridor A1 commences at the southern end of the existing M9, south of Kilcullen, and runs initially to the east of the existing N9 before crossing the N9 near Halverstown Cross Roads. The corridor passes to the north of Calverstown and then runs parallel to, and about half a kilometre south of, the N78. East of Kilmead, the route corridor turns to the south-west and passes into Section B at Ardscull.

#### Route Corridor A2

Route Corridor A2 diverges from Route Corridor A1 west of Calverstown. The route corridor turns to the south and passes near Ballyadams before continuing as Route B4 west of Mullamast.

### Route Corridor A3

Route Corridor A3 commences at the southern end of the existing M9, south of Kilcullen, and is aligned east of Route Corridor A1 before crossing the existing N9 near Halverstown Cross Roads. The route corridor turns to the south and passes east of Calverstown before turning south-west, passing east of Narraghmore to join Route Corridor A1 near Ardscull.

### Route Corridor A4

Route Corridor A4 diverges from Route Corridor A3 near Cartersbog and crosses the existing N9 near Kilgowan. This route corridor continues to the south on the east side of Calverstown before passing west of Ballitore and into Section B.

### Route Corridor A5

Route Corridor A5 diverges from Route Corridor A3 near Cartersbog where it continues south to near Baronsland. The route corridor then turns to the south-west, skirting Brewel Hill and crossing the existing N9. It merges with Route Corridor A4 north-west of Ballitore.

## **Route Corridors in Section B**

### Route Corridor B1

Route Corridor B1 starts from east of Ardscull passes to the east of Athy and crosses the River Barrow approximately 2 kilometres south of town centre. The route corridor then turns south to follow the river valley continuing as Route Corridor C1.

### Route Corridor B2

Route Corridor B2 diverges from Route Corridor B1 east of Athy and continues on the east side of the River Barrow adjacent to the Dublin to Waterford railway. It joins Route Corridor C3 north of Maganey.

### Route Corridor B3

Route Corridor B3 also diverges from Route Corridor B1 east of Athy and is located further to the east than Route Corridor B2. The route continues in Section C as Route Corridor C5, where it passes approximately one and a half kilometres to the east of Maganey.

### Route Corridor B4

Route Corridor B4 starts west of Mullamast and heads south-westwards to cross the R418 Castledermot to Athy road north of Kilkea. Further to the south-west the route corridor crosses the River Barrow to the south of Levitstown.

### Route Corridor B5

Route Corridor B5 starts west of Ballitore. It runs parallel to, and to the west of, the existing N9 National Primary road. The route corridor is located approximately 2 kilometres to the west of Timolin and Moone, passing to the east of Mullamast, and continues into Section C north-west of Castledermot.

## **Route Corridors in Section C**

### Route Corridor C1

Route Corridor C1 emerges from Section B north of Ballynagarr and passes to the west of Carlow. It crosses the N80 Stradbally road at Coolhenry and the R430 Castlecomer road east of Killeshin. South-west of Carlow it follows the narrow

corridor between the high ground to the west and the River Barrow. It continues into Section D near Killeeshal.

#### Route Corridor C2

Route Corridor C2 emerges from Section B north-west of Ballyfoyle and runs nearly parallel to Route Corridor C1 approximately 1 kilometre to the east. The route converges with Route Corridor C1 south of Killeshin near Rossmore Bridge.

#### Route Corridor C3

Route Corridor C3 emerges from Section B south-east of Levitstown, passes close to Maganey before passing to the east of Carlow. The route corridor passes west of Palatine and crosses the N80 Wexford road at Kilmeany before crossing the railway from east to west near Ballybannon Bridge.

#### Route Corridor C4

Route Corridor C4 emerges from Section B two kilometres north-west of Castledermot, and heads south-west passing to the west of Carlow. The route corridor crosses the River Barrow north of Newgarden and continues in a south-westerly direction to merge with Route Corridor C2 near Garrough on the N80 Stradbally road.

#### Route Corridor C5

Route Corridor C5 emerges from Section B north-east of Maganey and passes to the east of Carlow. It follows the same corridor as Route Corridor C3 near Palatine before diverging eastwards to pass to the east of Tinryland.

#### Route Corridor C6

Route Corridor C6 emerges from Section B north-west of Castledermot at the same location as Route Corridor C4. It is the most easterly corridor passing to the east of Palatine, Bennekerry and Tinryland where it rejoins Route Corridor C5.

### **Route Corridors in Section D**

#### Route Corridor D1

Route Corridor D1 emerges from Section C near Killeeshal and continues southwards between the high ground to the west and the River Barrow, passing west of Milford and between Oldleighlin and Leighlinbridge.

#### Route Corridor D2

Route Corridor D2 emerges from Section C close to the railway line near Ballybannon Bridge and crosses the N9 National Primary Road and the River Barrow south of Milford. The route then runs nearly parallel to Route Corridor D1 approximately one kilometre to the east passing to the west of Leighlinbridge.

#### Route Corridor D3

Route Corridor D3 is a continuation of Route Corridor C6 and merges with Route Corridor D2. The route runs north of Clonmelsh and crosses the railway to join Route Corridor D2 north of Powerstown.

#### Route Corridor D4

Route Corridor D4 emerges from Section C east of Tinryland and is an easterly continuation of Route Corridor C5. The route passes to the east of Clonmelsh

before swinging westwards to cross the N9 National Primary road and the River Barrow north of Rathvinden and Leighlinbridge.

#### Route Corridor D5

Route Corridor D5 starts on Route Corridor D4 near Nurney. It crosses the River Barrow midway between Leighlinbridge and Muinebheag (Bagenalstown) and continues in a south-westerly direction to join Route Corridor D2.

### **4.3.3 Public Consultation No. 2**

Non-statutory public consultations were undertaken between May 2001 and August 2001 following the identification of alternative routes. The objectives of Public Consultation No. 2 were:

- Present the route corridor options to the public;
- Inform them of process and programme for the project;
- Invite submissions on these options; and
- Gather local information, which may not be known to the design team.

Because the scheme covered such a large geographical area the study area was split into seven sections, A – G. Sections A – D covered the section between Kilcullen and Paulstown, while Sections E – G covered the remainder of the route to Waterford. Each route corridor option covered a corridor width of 100 metres.

A total of 55,000 flyers giving details of the exhibition venues and dates were delivered to households in the study area. Advertisements were placed in the local papers and broadcast on local radio. The consultation exhibitions were held on display for a 2 week period in May 2001.

Each venue was attended by a number of staff from the Kildare County Council National Roads Design Office and from the Consultants. An Agricultural Consultant from Phillip Farrelly & Partners also attended these exhibitions.

Following the 2 weeks of exhibitions, sets of the exhibition material were on display at the County Hall, Kilkenny; Carlow County Council Offices; Kildare National Roads Design Office and Athy Community Library until the middle of July. These displays were available for inspection, but not attended by the project team. The scheme brochure with an accompanying questionnaire was made available at the exhibition and at the County Council venues.

A total of 1,623 people attended the northern consultation exhibitions held in Carlow Town, Athy, Castledermot and Bagenalstown. Attendees were asked to sign a register and were handed the information brochure, map inserts, questionnaire and freepost envelope on entry. Letters of consultation were issued to a number of statutory and non-statutory bodies notifying them of the route options under consideration and inviting them to comment on the options. Responses from ten of these bodies were obtained together with responses from a further seven official bodies.

### **4.3.4 Analysis of Preferences on Factors Affecting Route Choice**

A total of 1,308 responses were received from individuals together with 5 from local resident groups.

Respondee were asked to rank the importance of the following issues in the choice of the route corridor. The figures indicate the percentage that ranked the issue “important” or “very important” in the choice of route corridor. (See Table 4.6.1).

**Table 4.6.1 Public Consultation No. 2 Percentage Responses**

<b>Issue</b>	<b>% Ranked as Important or more</b>
Least effect on landscape	98%
Least impact on people living near the route corridor	98%
Least effect on archaeological sites and historic buildings	97%
Least demolition of property	96%
Least effect on agriculture	96%
Least effect on flora and fauna	95%
Reducing traffic noise	93.5%
Improving road safety	81%
Improving air quality	76%
Improving traffic conditions	70%
Improving the environment of towns and villages along the existing N9/N10	64%
Improving regional access	59%
Value for money	49%

Most responses were from people who would be affected by 1 of the options. In the Kilcullen to Paulstown section 25% of responses agreed in principle with the need for the N9 / N10 scheme with 57% unsure.

Environmental issues were clearly a major concern, as were the impacts of the scheme on people living near the route corridor or affected by demolition of property. Improving road safety or traffic conditions did not rank so highly and “value for money” was ranked as the least important issue in the choice of route corridor.

#### **4.3.5 Analysis of Points Raised by Respondents**

The consultation process was undertaken to ensure that the views expressed by respondents were listened to, the issues considered, both in terms of engineering content and environmental impact, and where appropriate, have influenced the design process.

All the responses to the Public Exhibition were analysed and the views given careful consideration. In addition, other concerns and views were received during the following months, these were also carefully considered.

The main issues raised by the respondents were:

- severance of farms, communities and local roads;
- the new road was not wanted in County Laois, which already has high quality dual carriageway proposals affecting the county; and
- upgrading the existing N9 was preferable to a new alignment.

The other main issues suggested to be taken into account were:

- The need to service Athy;
- A route east of Carlow would be preferable;
- Upgrade existing road network;
- Impact on people living near the route;
- Increase in noise and air pollution;
- Impact on farms;
- Proximity to major population centres;
- The impact on local roads;
- Proximity to schools; and
- Impact on the environment.

## 4.4 Assessment of Alternative Route Options

Each of the alternative routes within Route Selection Stage Sections A, B, C and D were assessed in respect of the environmental, engineering, traffic and economic issues. The route options were compared under the following headings:

- Impacts on People;
- Flora, Fauna and Fisheries;
- Archaeology and Cultural Heritage;
- Agricultural Land Use;
- Landscape and Visual;
- Engineering; and
- Geology and Hydrogeology.

Based on these assessments a “preferred option” was identified for each of the criteria in each section of the route. The preferred options were then evaluated using Impact Matrices to identify the “preferred route” in each section. In some cases, it was not possible to form a continuous route based on the preferences within each section (e.g. Route A1 does not connect with Route B5), and further work was undertaken to develop a continuous preferred route based on the preferred corridor within each section.

The environmental and engineering impacts of each of the route options shown at Public Consultation No. 2 were assessed in detail and reported on in the Route Selection Report, and the conclusions of the initial assessments are summarised in the paragraphs below.

### 4.4.1 Planning and Socio-Economic Impact

The principal socio-economic benefit of all the route options is the enhancement of the connection between the Kilcullen to Waterford corridor and major centres within Ireland including the major ports and airports. The creation of a high quality dual carriageway will improve the accessibility of all towns and industry served by the corridor. In overall socio-economic terms, the preferred corridor combined the following sequence of options:

- Route Corridor A1
- Route Corridor B2
- Route Corridor C3

- Route Corridor D2

This selection was based on the following reasons:

- services Athy well, reinforcing and supporting its role as a designated Secondary Development Centre in the Greater Dublin Area.
- services Carlow with a choice of interchanges and provides links to Castledermot and Tullow. This corridor and associated interchanges will facilitate the possible expansion of existing industries and businesses on the east side as well as attracting new industries to Carlow.

Subsequent work including an assessment of an Athy to R747 Link Road is discussed in Section 4.5 below.

#### **4.4.2 Impacts on People**

Each of the route corridor options was assessed in terms of their impact on people living or working near the corridors. These impacts were recorded under the following headings:

- Noise and Air Environment
- Severance
- Community Facilities
- Number of Properties within the Route Corridor
- Planning Permissions Granted within Route Corridor.

The number of properties within 300 metres of the route corridor centreline was relatively low in Sections A and B reflecting the rural nature of the study area. The routes closest to Athy affected more properties. In Section C the number of properties within 300 metres of the route corridors were higher especially on Route Corridors C3 and C5 close to the eastern side of Carlow Town. Again in Section D the number of properties within 300 metres was relatively low.

Communities close to each route option were identified, and it was found that community severance is not severe on any of the route options as, in general, the existing road network will be maintained by the provision of overbridges or underbridges.

The impacts of each route corridor have been compared, and the preferred options for each section, in terms of their impact on people, were:

- Route Corridor A5 (followed by Route Corridor A1)
- Route Corridor B4 (followed by Route Corridor B5)
- Route Corridor C6 (followed by Route Corridor C1)
- Route Corridor D1 (followed by Routes Corridors D2 and D3).

#### **4.4.3 Flora, Fauna and Fisheries**

All the route options pass through a broad band of mainly flat to gently undulating land with most of the land being used for agriculture and under intensive pasture with a high proportion of arable land, most notably around Athy and Carlow. Comparatively few ecological sites were impacted by the route options and most of these have a scattered distribution and are limited in size. Hedgerows were found throughout the study area and many contained mature broadleaved trees. The route corridors also crossed numerous watercourses. Apart from a small area that

falls within the River Liffey catchment in the northeast of the study area, most of the impacted watercourses are part of the River Barrow system. All the main watercourses are important for salmonoid fish.

At the time of the Route Selection process, there were no candidate Special Areas of Conservation (cSAC) or proposed Natural Heritage Areas (s) intersected by any of the route corridors. However, Route Corridor D2 crossed through the southern end of Cloghrick Wood, a pNHA. The results from the analysis were that the impacts do not vary significantly between the route options; and the following were the preferred options based on their impacts on ecological sites and watercourses:

- Route Corridor A5
- Route Corridor B2
- Route Corridor C3
- Route Corridor D3

#### **4.4.4 Archaeology, Architecture and Cultural Heritage**

The area is a particularly rich archaeological landscape, and therefore an area approximately 500 metres wide (250 metres each side of the route corridor centreline) was assessed on each route option. The assessment was based on a paper survey, identifying all recorded sites, followed by an aerial (helicopter) site inspection. The vast majority of the total of 123 sites identified consisted of earthworks and enclosures, although a large number of fulachta fiadh and ringforts were also identified. Further sites included a cist site, a moated site, several mottes and a number of castles and tower houses were also recorded. One site classed as a National Monument, Site N2, was close to Route A1. There are no sites with Preservation Orders or Registered Sites and the vast majority of sites are listed in the Record of Historic Monuments and Places (RMP). Seventy one sites of Architectural Importance and 19 sites of Industrial Archaeological Importance were also documented, together with historic towns and deserted settlements.

An assessment was made of each route corridor option taking into account the following 3 factors:

- the nature of the sites;
- the number of sites impacted; and
- the proximity of the sites to the route.

Having considered these factors the following route corridor options were preferred as having the least impact on the recorded archaeology in the area:

- Route Corridor A5
- Route Corridor B1
- Route Corridor C1
- Route Corridor D5

From an archaeological and cultural heritage point of view the preferred route should avoid direct impacts with the identified elements of the archaeological landscape wherever possible. Should this not be possible, a full programme of archaeological mitigation including aerial survey, topographical survey, geophysical survey and investigative excavation is recommended. This would be followed by full-scale excavation, should this be required.

#### 4.4.5 Agricultural Land Use

The northern section of the proposed N9 / N10 Kilcullen to Waterford Scheme will have a significant effect on farming in the area and in particular on the individual holdings that it intersects. The area in question contains some of the most productive land in the country and the majority of this land is being used intensively.

The area is predominately used for tillage operations but significant grassland based enterprises are also located in the area. All of the routes under consideration impacted on farming activity, with no individual route available which avoids affecting farm holdings.

Although the level of dairy farming in the area does not appear to be significant, the alignment of the preferred route was sought to minimise the impact on dairy farms and stud farms wherever possible.

Two intensive agricultural enterprises consisting of a pig fattening unit and a free range egg production unit were identified at Route Selection Stage.

None of the route options had a profound impact level, and in terms of agricultural impact the following routes were preferred:

- Route Corridor A1 or Route Corridor A2
- Route Corridor B5
- Route Corridor C3
- Route Corridor D5

The differences between all the route options were not large. The preferred routes had moderately significant impact level compared to the remaining route options which had major significant impact level.

#### 4.4.6 Landscape and Visual Assessment

Visual impact, landscape impact and landscape planning impacts for each option were assessed and rated in terms of the severity of impact. For each section of route the following had the least potential for adverse landscape and visual impact.

- Route Corridors A1 and A5
- Route Corridors B4 and B5
- Route Corridor C6
- Route Corridors D1 and D3

#### 4.4.7 Engineering Assessment

The engineering assessment was carried out under the following subject headings:

- Horizontal alignment;
- Vertical alignment;
- Junctions;
- Impact on Utility Services;
- River Crossings and Structures; and
- Earthworks and Geotechnical Requirements.

All routes complied with the NRA Designs Standards and there was little to choose between the routes on engineering grounds in Sections A and B. In Section C,

Route C6 was preferred in that a better earthwork balance could be achieved and it had the least number of road crossings.

In Section D the crossing of the River Barrow on Route D5 would have been difficult and expensive requiring either 1 continuous structure, or 2 structures crossing the canal navigation and River Barrow separated by approximately 150 metres. Similarly the River Barrow crossing on Route D4 would have been skewed and, a wider deck was likely to be required to accommodate the slip roads from the adjacent junction on the N9. Hence these routes were the least preferred on engineering grounds and Route D1 was preferred (the River Barrow crossing occurs upstream in Section B or Section C) followed by Route D2 as it was shorter and had a better earthwork balance than Route D3.

The conclusion from the engineering assessment of the options in each route section is that the following are preferred options:

- Route Corridor A2
- Route Corridor B5
- Route Corridor C6
- Route Corridor D1

#### **4.4.8 Geological and Hydrogeological Assessment**

The geology and hydrogeology along each of the route options was considered in some detail. As far as possible, all constraints were placed in one of the following categories:

- topographical features;
- geotechnical ground conditions;
- aquifer and source vulnerability;
- economic minerals; and
- geological landscape.

In Section A, Routes A1 and A2 were preferred as they avoided the potentially economic sand and gravel resources which occur towards the eastern side of the study area. Similarly, Route B5 fared marginally better than other routes in that it had a minimum length of route crossing potentially economic sand and gravel resources. In Section C, Route C6 was clearly preferred as it avoided impacting on aquifers which would have occurred with the other routes in Section C. Routes D2, D3 and D4 all had impacts on vulnerable gravel aquifers and Route D5 had more severe hydrogeological impacts. Route D1 thus, had the most favourable geotechnical ground conditions. Overall the preferred options from a geological and hydrogeological point of view were:

- Route Corridor A1
- Route Corridor B5
- Route Corridor C6
- Route Corridor D1

## 4.5 Development of the Preferred Route

### 4.5.1 Traffic Predictions and Economic Assessment

A road traffic model was built which covered the whole scheme from Kilcullen to Waterford. Existing data from origin-destination surveys, carried out at 6 locations during 1997 and 1998 and new data collected in March / April 2001 were used to provide a base year trip matrix.

Forecasting of traffic growth was carried out in accordance with the methods used in the National Road Needs Study for a design year of 2022. In addition, an estimate was made of the potential transfer of longer distance trips to the N9 / N10 corridor of the proposed scheme from other parallel corridors, as a result of construction of the scheme. A number of initial routes were tested. These routes included routes close to the N9, close to the N78, and bypasses to the east and west of Carlow.

Further tests were carried out during the route selection process, to evaluate the effects of a route following the N9 corridor (Route 9) and a route following the N78 corridor towards Athy (Route 10).

The conclusions reached were that an eastern bypass of Carlow had advantages in traffic terms. An eastern bypass could more readily distribute the traffic around Carlow with junctions on the N9 to the north and south of Carlow Town. Traffic from a western bypass would overload the N80 to the west of Carlow Town and would cause circulation difficulties within the Town.

The economic benefits of the route options were compared with the UK COBA (Cost Benefit Analysis) program using default parameters calculated for Irish conditions. The results were used to compare the relative economic performance of the various options.

### 4.5.2 Comparison of Routes

The objective of the route selection process was to select a single optimum route corridor between Kilcullen and Waterford. Inspection of the route options between Section D and E, immediately north of Paulstown, indicated that all the different route options in Section D and in Section E could be connected with each other such that the choice of route north and south of Paulstown could be made largely independently.

A formalised process was applied to the evaluation process. The steps are summarised below together with the results of each evaluation.

**Step 1** The engineering and environmental effects of each route corridor within each Section A to D were recorded on an Impact Matrix. Also lengths of route where the route corridor could be modified to overcome major impacts were identified. The route options were compared under the following headings:

- Impacts on People
- Flora, Fauna and Fisheries
- Archaeology and Cultural Heritage
- Agricultural Land Use
- Landscape and Visual

- Engineering
- Geology and Hydrogeology

**Step 2** Where alternative routes started and finished at common points within a single Section, the 2 route corridors were compared using a summary Selection Matrix and the less favourable route corridor discarded. Three comparisons were made at Step 2 as summarised below:

Route Corridor A1 with A3:

Route A3 was discarded in view of its greater impact on people.

Route Corridor A4 with A5:

Route A4 was discarded because of its ecological and landscape impacts near Calverstown and the impact on a major pig unit at Kilgowan.

Route Corridor D3 with D5:

Overall Route D3 was seen to have advantages compared with Route D5 particularly in relation to the crossing of the River Barrow. Hence Route D5 was discarded from further considerations.

**Step 3** Matrices for the main Traffic / Cost-Benefit / Socio-Economic Impacts were prepared for a number of representative overall Route Options (Routes 1, 2, 3, 4 and 7). Those route options, which were deemed to be less favourable, were discarded from further evaluation.

Consideration of the traffic issues indicated that routes to the east of Carlow were preferred. Good access to Carlow Town could be provided via junctions on the existing N9 to the north and south of the town. With routes to the west of Carlow, traffic volumes entering Carlow Town from the west increased significantly compared with the do-nothing situation. This traffic would have to cross the town to reach the industrial / commercial developments which are predominantly on the east side of the town.

The Present Value of Benefits was higher for the routes to the east of Carlow. As the capital costs of all routes were similar, these routes also showed higher Benefit to Cost Ratios.

In socio-economic terms the favoured route was via Athy and east of Carlow as it best served Athy and provided good access to Carlow Town. The issues summarised above, together with consideration of the engineering and environmental impact of Route C4 west of Carlow, led to the conclusion to discard route options to the west of Carlow Town. This decision reduced the number of possible route options significantly and, in the next step, the remaining route options were compared on a section-by-section basis.

**Step 4** Selection matrices were drawn up for the remaining route corridors in each section. These are:

Selection Matrix for Route Corridors A1, A2 and A5

Selection Matrix for Route Corridors B2, B3 and B5

Selection Matrix for Route Corridors C3, C5 and C6

Selection Matrix for Route Corridors D2, D3 and D4.

From Step 4, Route C6 at Carlow emerged clearly as the Preferred Route when compared with Routes C3 and C5. Route C6 directly affected significantly fewer properties and also had fewer people within the 300

metre corridor each side of the route centreline. This route had significant advantages in engineering terms in that it has the best earthwork balance, and in hydrogeological terms in that it does not cross any reported groundwater resources, whereas Routes C3 and C5 cross major gravel aquifers between Maganey and Knocharda and south of Newtownallen respectively.

With Route C6 selected, the choice north of Carlow was thus reduced to Route A1 plus B3 or Route A5 plus B5 and these routes were evaluated further as Route 9 and Route 10.

**Step 5** Selection matrices were prepared for the remaining overall Route Options (Routes 9 and 10) together with Traffic / Cost-Benefit / Socio-Economic Impacts. This enabled a Preferred Route from Kilcullen to south of Carlow to be identified.

The Routes 9 and 10 were identical south of Carlow and were tested to assess the advantages and disadvantages of a route following the N9 corridor (Route 9) or going via Athy (Route 10). Route 9 included, as part of the scheme, the cost of a single carriageway link from the N9 / N10 scheme to Athy with a connection eastwards to the R747 near Ballitore.

In environmental and engineering terms the analysis showed that the differences between the 2 routes were generally not significant.

The traffic and cost-benefit analysis showed that the volume of traffic attracted to Route 10 was marginally higher than to Route 9. However the discounted travel and accident benefits were significantly higher for Route 9 than for Route 10. This is due to the extra distance traffic has to travel between Carlow and Kilcullen using Route 10 via Athy. It results in a reduction of the Benefit to Cost Ratio from 2.01 to 1.66.

In socio-economic terms it was concluded that, with the Athy to R747 Link Road, Route 9 would bring major socio-economic benefits to Athy, and that Route 9 would provide most of the benefits that would accrue from implementation of Route 10.

Based on this analysis, Route 9 was selected as the draft Preferred Route because of its significantly better economic performance compared with Route 10.

**Step 6** Selection Matrices for the remaining combination of routes in Section D were prepared for those options that connected to Route Corridor E1, which was the Emerging Preferred Route Corridor in the southern section of the study area.

South of Carlow Route D3 affected less properties than Route D4 and was selected. As Route E1 was emerging as the Preferred Route south of Paulstown, a final comparison was undertaken. This compared a new connector between Route D3 / D2 and Route D4 with an alternative route using the E1 / E6 connector. The comparison showed that the route via Route D3 / D2 and Route D4 had less impact in terms of properties affected and was chosen in preference to the route using connector E1 / E6.

**Step 7** Where possible the Emerging Preferred Route corridor was adjusted to reduce the impacts further. Preliminary junction locations and layouts were developed and link roads were included.

#### **4.5.3 Adjustments to the Emerging Preferred Route Corridor**

The Emerging Preferred Route corridor was adjusted in 4 main locations prior to the Emerging Preferred Route being exhibited at Public Consultation No. 3. The amendments were made primarily to reduce the impacts on residential and other property following examination of available material from Public Consultation No. 2 and extensive site visits. The main 4 locations were:

- Crookstown Lower to Belan
- Belan to Prumplestown
- Bennekerry to Tinryland
- Clonmelsh to Powerstown

#### **4.5.4 Athy to R747 Link Road**

As described in Section 4.5.2 above [Step 5] a high quality link road was included in the scheme to improve, significantly, the standard of road connections between Athy and the National Primary Road Network. Four options for the alignment of the Link Road were investigated and an option was selected which avoided demolition of properties and reduced farm severance by adopting a 1.8 kilometre length which follows the existing Local Road.

#### **4.5.5 Further Adjustments to the Preferred Route Corridor**

Following comments received during Public Consultation No. 3, the Preferred Route Corridor was reviewed at the following locations:

- Baronsland to Calvertstown Little
- Crookstown Lower to Ballitore
- Clonmelsh
- Paulstown

Of the above, the draft Preferred Route Corridor was only modified at Paulstown. A minor change was also made to the alignment of the Athy Link Road at Burtown Cross, and the link between the existing N9 and the N78 near Kilcullen was adjusted to improve the junction location.

The amended route corridor was adopted in March 2002, following which the Route Selection Report was published.

During development of the Preliminary Design, the alignment of the N9 was moved outside the Selected Route Corridor at the following locations:

- Mullamast to Belan
- Ballyvass
- Russelstown

In addition, the west end of the Athy Link was amended.

#### **4.5.6 Alternative Junction Layouts Considered**

The Dumbbell layout is the preferred option for grade-separated junctions in the scheme for the following reasons. The Dumbbell junction layout provides high traffic flow potential at lower vehicle circulatory speeds, which provides improved safety. The Dumbbell layout is also generally efficient in land use and, in addition,

as there will generally only be one structure associated with a dumbbell junction layout, it tends to be cost effective.

Alternative layouts, with the junction constructed both under and over the mainline, were considered for each junction. The merits of the relative position of the mainline with respect to the junction roundabouts are considered in the discussion below.

### **Junction 1 at Kilcullen**

The existing grade separated junction between the M9 motorway and the N78 National Secondary Road at the southern limit of the M9 Motorway at Kilcullen has been retained in the N9 Kilcullen to Powerstown Scheme. An assessment of the predicted traffic flows indicated that the existing major minor junctions on the N78 have sufficient capacity for the Design Year traffic flows, which will be lower than the flows were the scheme not to proceed.

### **Junction 2 at Mullamast**

Junction 2 is located where the proposed Athy to R747 Link crosses the proposed N9 at Ch. 62,870. The proposed junction is sited on a hillside near Mullamast at an approximate elevation of 130 metres AOD.

The proposed junction will be constructed on the line of the Athy to R747 Link Road, and no traffic management will be required during construction of the junction and mainline at this location, as both routes are remote from existing roads. The L8027 Mullamast Road crosses the mainline some 550 metres north of the junction.

Two junction layouts were considered for this junction, 1 with the N9 passing beneath the junction and 1 with the N9 raised to cross over the junction. A junction layout with the N9 constructed in cutting, typically 7 – 8 metres deep, with the junction constructed close to existing ground level over the N9 was selected for the following reasons:

- Reduced noise impact on three nearby properties on the L8027 Mullamast Road
- Minimal earthworks will be needed to divert the L8027 Mullamast Road where it crosses the N9
- Minimises the lengths of the slip road construction on the approaches to the grade separated junction
- Maximises the length of overtaking section on the Athy to R747 Link road at each approach to the junction

Disadvantages of this layout are:

- Increased visual intrusion of the junction lighting, due to the junction being sited on high ground. However, this would also be an issue if the Mainline were to cross over the Link Road.
- A potential reduction in the appreciation of the junction layout from the approaches on the Athy to R747 Link Road and from the slip roads

The layout with the N9 passing beneath the junction was selected because the benefits of constructing the mainline in cutting are considered to outweigh any benefits gained from the reduced visual intrusion if the N9 were raised above ground level with the junction roundabouts sited below the N9.

### **Junction 3 at Prumplestown**

The existing N9 at mainline Ch. 50,500 runs from Carlow to Castledermot, and crosses the alignment of the proposed new road on a small embankment 0.75 metres high. The existing road is straight and has an estimated design speed of 100Kph, though the road width is restricted.

Barnhill rises 37 metres to the east of the junction and this together with the locations of nearby properties constrain the options for the mainline alignment.

A junction layout with the mainline passing over the junction was adopted at Junction 3. With this layout, the roundabouts are situated close to existing ground level, and as a result the connections between the at-grade junction roundabouts and the existing N9 are shorter. This layout will also minimise traffic management on the existing N9 during construction of the junction and approach roads, and reduce land take from properties along the existing N9.

Four alternative layout options were considered for the geometry of this junction, and the relative merits of the alternative layouts are considered below.

*Option 1* - The junction would be constructed on the line of the existing N9;

*Option 2* - The junction would be constructed offline and to the south of the existing N9;

*Option 3* - The junction would be constructed offline and to the north of the existing N9;

*Option 4* - The junction would be constructed partly online and partly offline to the south of the existing N9.

The online option was rejected despite it being most economic in terms of land use, as it would require extensive temporary diversions for management of traffic on the existing N9. In addition, the bridge under the new N9 would be heavily skewed.

Option 2 was considered to achieve an economic land use without the need for temporary diversions, while Option 3 was rejected due to the additional land take and its impact on the mature trees along the existing road.

In Option 4, the option developed into the current design, the South Roundabout is sited on the line of the existing N9, while the North Roundabout is sited to the south of the existing road, with the roundabout link road at zero skew to the mainline. This layout is efficient in terms of land use. During construction, traffic will need to be diverted to provide working space for the bridge construction. This can be substantially achieved within the lands acquired for the permanent scheme. The North Roundabout is sited off line, so that traffic flows are unlikely to be affected by its construction, while the South Roundabout is sited on the line of the existing road, and some traffic management will be required during its construction. This layout also has a straighter approach to the junction from the N9 on the southwest side.

### **Junction 4 at Rathcrogue**

The location of Junction 4 at Rathcrogue is constrained by properties fronting onto the existing N80, both to the northwest and southeast of the junction. The junction has been offset to the northeast of the existing N80 to permit construction of the bridge away from the live traffic. The roundabout junction has been designed at ground level, with the N9 passing over, to minimise disruption of the N80 traffic

during construction, and to maintain access to properties fronting onto the existing N80.

Considerable deliberation was made at Route Selection Stage as to whether to provide 2 north facing slip roads at this junction or all four slip roads, due to capacity constraints on the existing N80 within the approaches to Carlow Town. However, the capacity constraint on the N80 will be removed once the proposed Carlow Inner Relief Road and Southern Relief Road have been constructed, and consequently there are no traffic issues that justify omitting the south facing slip roads. The junction included in the scheme therefore permits all turning movements.

### **Junction 5 at Powerstown**

The N9 / N10 Kilcullen to Waterford Scheme has been divided into 2 sections for procurement and design purpose. The 2 sections are Kilcullen to Powerstown and Powerstown to Waterford, and these 2 sections join where the proposed new road crosses the existing N9 at Powerstown, south of Carlow Town.

Junction 5, at Powerstown, will form the southern termination of the Kilcullen to Powerstown Scheme, and the proposed N9 will be extended south from Junction 5 as a separate scheme. It follows that Junction 5 will need to be adaptable such that it will:

- *Form a termination of the N9 Kilcullen to Powerstown dual carriageway road with all movements connecting to the existing N9 – the Interim layout;*
- *Convert to a fully grade-separated junction to take slip roads from the new N9, both to the East and the West – the Final layout.*

The following constraints to the development of alternative layouts for Junction 5 were identified:

- The River Barrow is situated some 600 metres to the West of the existing N9, and the edge of the alluvial flood plain is only about 350 metres away.
- The Cloghrick Wood pNHA No. 806 lies in the River Barrow flood plain and extends south opposite the proposed Junction 5.
- The proposed route of the new road intersects the existing N9 immediately north of the landfill site at Powerstown.
- The existing N9 is routed approximately north–south and its vertical alignment is locally depressed where it crosses a tributary to the River Barrow.
- To the north of the stream there is a dwelling situated on the west side of the existing N9.

Although the River Barrow crossing is not part of the N9 Kilcullen to Powerstown Scheme, the river crossing lies immediately southwest of Junction 5, and the constraints to developing the scheme alignment across the river and to the south of Junction 5 in the future influence the design of the junction layout.

Geotechnical investigations have revealed that the River Barrow flood plain comprises a succession of weak alluvial materials, boulder clay and bed rock (at a depth of 10 metres). The nominal thickness of the alluvial materials (not exceeding 3 metres) suggests that an embankment construction should be feasible across the flood plain, and consequently the presence of the flood plain should not necessarily become a design constraint.

Alternative conceptual layouts for Junction 5, which allowed for both the initial dual carriageway road construction terminating at Powerstown and the subsequent extension to Waterford, were prepared for assessment. These layouts are discussed below and shown in Figure 4.6 in Volume 2.

#### Option 1 – Junction Located West of the Existing N9

In Option 1, the mainline alignment was located within about 80 metres of the Powerstown Landfill Site boundary in order to site the north dumbbell roundabout on the west side of the existing N9. The layout of the junction was constrained by the requirement to develop a re-alignment of the existing N9 for the approach from the North. The mainline would be constructed in cutting, while the junction link road bridge crossing over the mainline would be at a skew angle of 25 degrees. The southern roundabout was designed to be off line to the west of the existing N9 road, and raised on an embankment. Extensive stream diversions would be required as this roundabout was situated over the tributary stream to the River Barrow.

The realignment of the existing N9 at the northern approach to the junction would be extensive to achieve the sightline for a 100 kph design speed. A shorter realignment of the existing N9 would be required at the southern approach to the junction, though there would be a significant level difference between the southern roundabout and the existing N9 south of the junction. Access to the landfill site would be via a priority junction onto the realigned N9, south of the junction.

The proximity of the River Barrow crossing to Junction 5 meant that the west facing slip roads might extend onto the river crossing structure if a multi-span crossing were selected.

This option avoided any land take from the Cloghrick pNHA.

A similar layout, but with the mainline moved to the north, was assessed. However, this involved a higher skew angle for the bridge crossing over the mainline, possibly necessitating a central pier and / or the northern approach road taking more land due to the necessary horizontal alignment.

In either scenario, the dumbbell layout and bridge could be constructed together with the link road across the mainline as part of the current scheme. The tails for the west facing slip roads could also be constructed, in anticipation of the extension of the N9 south of Powerstown, in order to reduce traffic disruption during construction of the second stage works.

Two possible temporary layouts were identified for an interim scheme associated with Option 1:

- (i) The first option comprised a single at-grade roundabout of approximately 90 metre diameter located on and to the east of the existing N9. Some minor earthworks would be required to set the roundabout into the ground slope. The dumbbell layout for the final scheme would be constructed later, as part of the N9 road construction from Powerstown to the South. Traffic diversions would be required during the second stage works, and some of the lands acquired for this layout would be surplus to requirements in the long term.
- (ii) A second alternative interim scheme involved constructing the two dumbbell roundabouts for the final scheme together with a temporary offset link between the roundabouts. The temporary link would enable the connecting bridge to be constructed in the second phase as part of the N9 south of

Powerstown, and thus delay the capital expenditure for the bridge. Use of the south-bound diverge slip road connecting to this dumbbell layout, rather than the at-grade roundabout described above, could enhance safety as it would create a deliberate manoeuvre for drivers when leaving the dual carriageway, and as a result drivers would be more aware of the junction, thereby reducing speeds.

#### Option 2 – Junction located East of Existing N9 – Offset Dumbbell Layout

With this layout, the junction crossed the N9 mainline with a square crossing on the east side of the existing N9. This configuration included an additional western roundabout between the southern roundabout and the existing N9 south of the junction. The mainline was centred approximately 160 metres north of the Powerstown Landfill Site boundary, in a full depth cutting (i.e. 8 metres) at the dumbbell overbridge.

The North roundabout would be near to existing ground levels and the realignment of the N9 to the north would be significantly shorter than for Option 1. The south dumbbell roundabout would be raised on an embankment and the level differences with the existing N9, south of the junction, would be taken out on the link between the West and South Roundabouts.

The extension of the mainline alignment southwest of the junction would intrude into the southern end of the Cloghristick Wood pNHA with this option, reducing the length of the pNHA by approximately 60 – 70 metres.

In the Interim situation, the North and West roundabouts could be constructed on the line of the existing N9 and the southbound diverge slip could be extended through to the West roundabout. For the second phase the link bridge would be constructed offline.

#### Option 3 – Junction located East of Existing N9 – Dumbbell Layout

With Option 3, the north roundabout was located on the line of the existing N9, slightly further south than for Option 2. The junction link road bridge was located off-line from the existing N9, on a 25 degree skew, and a larger South Roundabout was located east of the existing N9 on an embankment. The mainline was centred approximately 160 metres north of the Powerstown Landfill Site boundary, in a full depth cutting (i.e. 8 metres) at the dumbbell link road overbridge.

With this option, neither of the slip road nosings southwest of the junction would be located within the Barrow flood plain. However, as with Option 2, the mainline intrudes into the southern end of the Cloghristick Wood pNHA, reducing the length of the pNHA by approximately 60 – 70 metres.

For the interim situation, the south roundabout could be constructed as part of the scheme, with the dual carriageway connected directly into it. The northern approach from the existing N9 would pass to the west of the link bridge site, though temporary earth retaining support would probably be needed to allow for construction of the proposed linking bridge. Alternatively, both roundabouts could be constructed together with the north facing slip road connections and a temporary roundabout link, as suggested for Option 1. Use of the south-bound diverge slip would enhance safety as drivers would make the deliberate manoeuvre to leave the dual carriageway and therefore they would be more aware of the junction, so reducing speeds.

A temporary diversion of the N9 would be required to facilitate construction of the N9 south approach where it crosses the existing road on embankment.

#### Option 4 – East of Existing N9 – Dumbbell Layout (Developed)

Option 3 was developed further to produce this layout. With this option, the dumbbell has been shifted further northeast to reduce the extent of the north approach on the existing N9. Movement of the south roundabout further away from the line of the existing N9 road enabled the level of the south approach to be lowered near to the existing road level and hence, avoided the need for a temporary diversion. There would also be less disruption to traffic on the existing N9, north of the junction because the junction would be constructed mostly off-line.

A right angled bridge crossing was included for this option, with cost savings relative to Option 3.

In the interim situation, the full construction of the dumbbell and the north facing slip roads is perceived to enhance safety.

As with Options 2 and 3, the mainline intrudes into the southern end of the Cloghrick Wood pNHA thus reducing the length of the pNHA.

#### Conclusions and Recommendations

Option 1 can be constructed off-line from the existing N9 and the various interim layouts could be developed to suit construction of the N9 Kilcullen to Powerstown scheme, as an interim or stand alone scheme. However, a long diversion of the existing N9 north of the junction would be required.

Option 2 adopted 3 roundabouts and was likely to be more costly and require greater landtake than Option 1. However, there would probably be less traffic disruption during construction of the N9 Kilcullen to Powerstown Scheme, as the west and north roundabouts would be constructed near to ground existing levels. The extensions of the slip roads onto the River Barrow floodplain for Option 1 also persist on this option.

Option 3 was more compact than Option 2, though temporary diversions would be required for the N9 re-alignment south of the junction.

Option 4, as developed, eliminated the need for significant temporary diversions and reduced construction costs relative to the other options discussed.

In Options 2, 3 and 4, the Mainline alignment southwest of Junction 5 intruded into the southern end of the Cloghrick Wood. Development of the road alignment during the Preliminary Design Stage has reduced the length of the wood impacted to 30 – 40 metres. To mitigate this impact, it is proposed to replace the lost trees by compensatory planting along the line of the N9.

For the N9 Kilcullen to Powerstown Scheme, it is recommended that the full dumbbell layout, including the overbridge for the link between the dumbbell roundabouts, is constructed. Provision would be made for constructing the west facing slip road tails to minimise traffic disruption when the scheme south of Powerstown is constructed.

## 4.6 Usk Little Overbridge

### 4.6.1 General

The proposed bridge to carry the existing N9 National Primary Road over the proposed N9 dual carriageway at Usk Little is heavily skewed (43.6 deg) and it is recommended that the structure is constructed with 3 spans as a continuous structure, supported on bearings at the abutments and piers. The bridge length will be approximately 135 metres in length. Because of the length of the spans on the N9 Overbridge at Usk Little, in situ concrete multicell box girder construction was considered the most suitable structural section for the bridge deck. Two alternative structural arrangements were considered: In-situ Post-Tensioned Concrete Multicell Box Girder (Option A) and Composite Steel Box Girders (Option B). (See Figure 4.7 and 4.8 in Volume 2) The cross section is given in Table 4.6.2.

**Table 4.6.2 Usk Little Overbridge Cross Sections**

Bridge Number	Class of Road	Carriageway Width (m)	Hard-Shoulders (m)	Footways (m)	Parapet Plinths (m)	Total Width of Deck (m)
A10	National	7.3	2.5	Varies (1.5m min)	2 x 0.5	19.2

### 4.6.2 Description / Evaluation

Abutment inspection galleries are required for both options. Lighting inside both types of box girder is recommended in order to facilitate inspection and maintenance.

The overbridge site lies under the line of the existing N9 Kilcullen to Carlow road, and construction of temporary works would have to consider the safe passage of traffic around the bridge site. The existing services running along the existing N9 would have to be diverted temporarily to permit construction of the new bridge. Despite this, both options would be relatively simple to construct.

Maintenance requirements for concrete bridges are considered to be less onerous than for steel bridges, and the use of reinforced concrete is widespread in Ireland.

The estimated construction costs and estimated whole life costs for the two forms of construction marginally favour the concrete box girder form of construction over steel composite.

### 4.6.3 Aesthetic Evaluation

#### Superstructure

Option A – The Bridge deck together with the parapet edge beam will give a simple and reasonably slender solution. The large cantilevers will help to create a more slender looking deck by casting shadow on the sides of the deck.

Option B – The parapet fascia and deck cantilever with the steel box girder deck will give an elegant structure.

## **Substructure**

The substructure supports for both Option A and B would be the same, with the reinforced concrete abutments positioned up the side slopes, to minimise their visual impact. Intermediate supports are formed from reinforced concrete.

### **4.6.4 Conclusion**

Option A, the In-situ Post-Tensioned Concrete Multicell Box Girder, is the recommended option.