Appraisal Framework Report

Greater Dublin Area
Draft Transport Strategy 2011-2030
2030 vision

Údarás Náisiúnta Iompair
National Transport Authority

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Framework for Greater Dublin Area 2030 Transport Strategy Appraisal (Version 6)

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EXECUTIVE SUMMARY

This report outlines the role of appraisal in developing a major transport strategy; and how the indicators used were derived from, and aligned with the Strategy-specific Objectives and Sub-Objectives which were subject to extensive public consultation.

This consultation established the validity of the objectives and sub-objectives and this framework has been changed since the initial draft to make more direct use of these indicators in all three stages of the process, alongside multi-criteria analysis (MCA).

This Appraisal Framework is used at three points in the process – initially, in Stage 1 – where a high-level assessment is provided to identify feasible measures to be used in alternative packages and give an idea of their benefits – then to appraise the resulting alternative packages' performance once assembled in Stage 2. Using these Stage 3 package appraisal results, the draft Final Strategy will be assembled and appraised, with Cost-Benefit Analysis (CBA) tests included alongside a full two-stage appraisal.

The Indicators used to assess performance against Strategy Objectives mainly draw on data from the GDA transport model (primarily journey times, usually disaggregated by the mode of transport used for the journey in question) to inform relative scores. In cases where no data is available, criteria to use in qualitative assessments are given. The method of calculation and reporting for each indicator is shown in Table 4.

Alongside this Strategy-specific assessment, detailed Multi-Criteria Appraisal will also take place, assessing comparisons between options under the following headings[1]:

- Safety
- Economy
- Accessibility
- Social Inclusion
- Integration
- Environment

This will involve completion of an Appraisal Summary Table (AST – Table 5 below). Once more, indicators for each of the AST criteria are outlined, drawing on both data from the Transport Model, other analysis (e.g. GIS) and, where no alternative sources of data are available, using qualitative assessment of benefits against pre-set criteria.

In both cases, assessment of the Environmental objectives and Criteria will be cross-referenced with the Strategic Environmental Assessment (SEA) process, either using values from the SEA to inform an indicator score (e.g. Air Quality Index); reporting an SEA-derived value (e.g. for Carbon emissions); or using SEA qualitative assessment.

Lastly, to supplement MCA analysis under the 'Economy' heading, the draft Final and Final strategies will involve a Cost-Benefit Analysis, feeding in the TEE value from the AST (estimation of transport user and producer benefits) alongside monetary values for the key 'externalities' (Carbon – using market prices for greenhouse gases; and Accidents – costs resulting from injury or death) to assess social cost and benefit.

While there will remain some uncertainty over the investment costs of many aspects of the draft Strategy, alongside the detailed results from objectives an MCA appraisal, this CBA will help to illuminate the overall value of the proposed set of measures, as well as providing some certainty as to the aggregate value of the investment required.

However, like all the types of assessment proposed here, it should not be taken on its own, nor should results for any area be deemed to have more weight than others: the appraisal framework here is designed to provide an all-round picture of performance.

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[1] These headings correspond with those recommended in the Department of Transport *Guidelines on a Common Appraisal Framework for Transport Projects and Programmes,* June 2009

1 INTRODUCTION – APPRAISAL IN THE STRATEGY PROCESS

This report was undertaken to guide the NTA strategy team in the appraisal of the Greater Dublin Area Transport Strategy 2010-2030 ('2030 Vision'). When developing a major strategy requiring significant investment, it is important to have an objective appraisal framework, in order to evaluate the merits of different proposals. Strategy appraisal is carried out to provide input to decision-making and resource allocation.

When considering implementation, including a robust appraisal process at the strategy stage will assist in project delivery. Strategies may form the basis of a preliminary appraisal for specific projects and, in this context, it is important to take cognisance of Department of Finance *Guidelines on Capital Appraisal* and the revised 2009 Department of Transport *Common Appraisal Framework for Transport Projects and Programmes*. Hence, a Multi-Criteria Analysis (MCA) stage is proposed, based around the principles and criteria used in this Common Appraisal Framework.

In the strategy development process outlined by NTA, the appraisal process was also to include assessment of feasibility and 'policy fit', against strategy specific objectives derived from, and verified by, the public consultation process. Appraisal is intended to take place at two stages within the three stage process, organised broadly as follows:

- **Stage 1**, which reviews and refines a 'long list' of potential measures and undertakes a high level assessment of each one's feasibility (Stage 1a), its contribution towards the strategy objectives (1b); and its performance, using a largely qualitative version of the MCA framework (1c) – also including SEA;
- **Stage 2**, which assembles measures into strategy alternative packages; and
- **Stage 3**, which will assess each alternative package's contribution towards strategy objectives, and against a quantified version of the MCA framework.

Subsequent to this, it has been agreed that a draft final strategy would be assembled – comprised of the best performing measures (of infrastructure, complementary policy and best practice) from each of the three alternative packages – for further appraisal.

The full process is outlined in detail in Chapter 4. The principle applied at each stage is that appraisal will be proportionate to the known level of detail of the measures and be sufficiently robust to inform decisions on the next stages of strategy development.

2 STRATEGY-SPECIFIC OBJECTIVES

An early stage of the NTA Strategy involved stakeholder consultation to determine a draft vision and high-level objectives for the GDA. From these objectives a set of 26 sub-objectives, with specific relevance to transport and land-use, was derived. These objectives and sub-objectives were re-confirmed through public consultation, in order that they could be used within the Appraisal Methodology. A public consultation was necessary to establish the validity of objectives and sub-objectives and to ensure that the outcome of appraisal could be reconciled with "what the public said they wanted".

These objectives and sub-objectives play a role in each part of a three stage process:

- Stage 1 assesses the 'strategic fit' of a measure against high-level objectives;
- In Stage 2, combinations of objectives define the three package option 'themes'; and
- In Stage 3, further 'policy fit' assessments of package options are undertaken.

Hence, it can be seen that these strategy-specific objectives and sub-objectives make up the 'golden thread' that links the stages of the process coherently together, and relates appraisal to the original vision and wider social, economic etc. outcomes.

This is in line with strategy development best practice and complements the more 'objective' MCA work, which focuses on the transport performance of measures and packages, and the Strategic Environmental Assessment which covers various issues.

Table 1: Strategy-specific objectives and sub-objectives agreed following consultation

Final High-Level Objective	No.	Final Sub-Objectives
Objective 1 - Build and Strengthen Communities	1.1	Improve accessibility to work, education, retail, leisure and other activities
	1.2	Improve access for disadvantaged groups
	1.3	Improve access between communities within the region
	1.4	Improve access to other regions and the rest of the island of Ireland
Objective 2 - Improve Economic Competitiveness	2.1	Improve journey time reliability for business travel
	2.2	Reduce overall journey times for business travel
	2.3	Ensure value for money of transport expenditure
	2.4	Support agglomeration and competition
	2.5	Improve access to ports and airports
	2.6	Provide for efficient goods distribution, servicing and access to resources
Objective 3 - Improve the Built Environment	3.1	Improve and maintain the environment for people movement (e.g. better quality design of streets and spaces)
	3.2	Improve the quality of design and maintenance of public spaces and transport fleets, infrastructure
	3.3	Minimise physical intrusion of all forms of transport
Objective 4 - Respect and Sustain the Natural Environment	4.1	Minimise the impact of transport on air quality
	4.2	Minimise the impact of transport on water quality
	4.3	Reduce the rate of growth of greenhouse gases associated with transport
	4.4	Improve efficiency in the use of non-renewable natural resources (e.g. land, materials, fuels)
	4.5	Minimise the impact of noise and vibration
	4.6	Minimise adverse impact of transport on biodiversity and natural amenities
Objective 5 - Reduce Personal Stress	5.1	Improve journey time reliability for personal travel
	5.2	Reduce overall journey times for personal travel
	5.3	Improve travel information
	5.4	Improve ease of use of public transport system (ticketing, fares)
	5.5	Promote healthier forms of travel and use of public space
	5.6	Improve travel safety and the sense of personal security
	5.7	Improve travel comfort

In Stage 1, professional judgment was used to assess the likely impacts of individual types of transport and land-use measures against these objectives. However, for the more detailed Stage 3 appraisal, it was necessary to develop – as far as possible – a set of quantitative appraisal indicators to either score or inform judgment on impacts. These indicators and their methods of calculation are explained in detail in Chapter 4.

3 THE APPRAISAL PROCESS

Technical appraisal is necessary at two different stages of the strategy development process. In Stage 1, it is required to assist in identifying which of the proposed strategy measures will deliver which high-level strategy-specific objectives – whilst also performing well under a more 'traditional' transport Multi Criteria Analysis.

This analysis is needed to ensure that the specific interventions identified within these categories of measures can be correctly allocated to the strategy alternative package that best reflects the relevant objectives. This is undertaken in Stage 2 of the process.

In Stage 3, the three resulting packages are put through a further assessment round – first against the strategy objectives, though this time using a range of quantitative and qualitative indicators at the detailed sub-objective level; and also through initial MCA – using quantified data wherever possible, albeit without the full Benefit-Cost analysis.

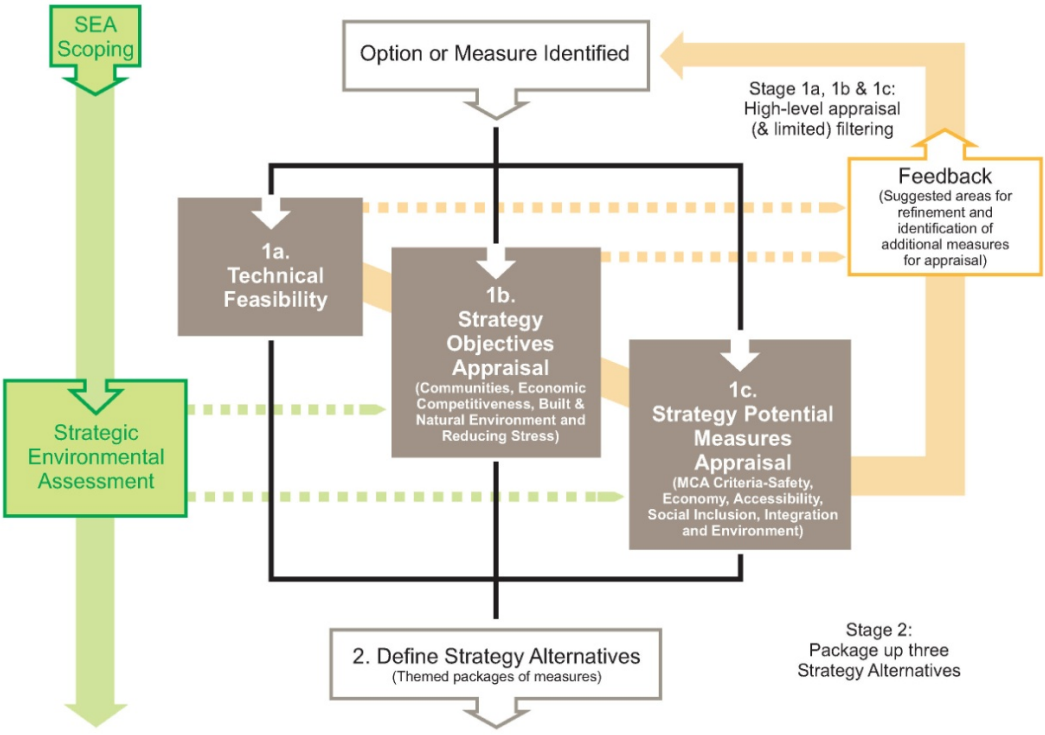
Lastly, the best-performing interventions from all three packages – including infrastructure and service enhancements together with relevant supporting policy and best practice-type interventions – will be combined into a draft final strategy, which will be subject to a further two-step appraisal, using the same set of indicators and this time including a quantified MCA with a full benefit-cost analysis.

Each of these stages of appraisal includes analysis undertaken as part of the Strategic Environmental Assessment (SEA) process, which is integrated with appraisal results.

3.1 Stage 1 Appraisal of generic transport and land use measures

The 'Stage 1' appraisal process aims to provide a picture of what scope and scale of impact a certain type of transport intervention might be able to achieve, to inform the process of combining these into the three 'strategy packages'. From this perspective, the information on how far each might contribute to high level policy objectives (along with a commentary on their relationship to specific sub-objectives) will be valuable to set alongside the MCA appraisal estimations of their 'quality' as transport measures.

Figure 3.1 – Stage 1 Appraisal Process



The first step establishes the feasibility of implementing proposed measures, picking up the potential political/institutional, technological and legal barriers to 'deliverability':

- **Political/Institutional feasibility**: are there any significant governance issues or institutional arrangements which constitute barriers to delivery of a measure?
- **Technological feasibility**: is significant technological development required to deliver the measure and how likely is it to occur within the life of the strategy?
- **Legal feasibility:** is new legislation required to permit delivery of a measure?

This step is not necessarily designed to eliminate measures, but to identify required pre-requisites to implementation and assess the risks to a strategy containing them.

The Strategy Objectives Appraisal stage generates a score against each of the five high-level objectives, using professional judgement of the likely typical performance of that measure type. This is informed by applying a number of questions about each measure's performance related to the sub-objectives under that category, as follows:

Table 2: Stage 1b assessment summary scoring notes outline

Strategy objective	Summary scoring notes (directly linked to strategy sub-objectives)
Build and strengthen communities	Does it improve access to employment and/or services? Does it improve access for disadvantaged groups (including mobility-impaired)? Does it improve links with other communities and the rest of the island of Ireland?
Improve economic competitiveness	Does it tackle congestion and/or improve journey time reliability (but only for business travel and goods)? Does it improve access to gateways, national and international markets (only for business travel and goods)? Does it support efficient distribution, servicing and/or access to raw materials? Does it support business competition and co-location? Does it provide value for money?
Improve the built environment	Does it help improve or maintain the physical environment for pedestrians, cyclists and users of public transport? Does it improve design quality and upkeep of public transport stations and vehicles? Does it help to minimise the physical intrusion or impact of motor vehicles (all types)?
Respect and sustain the natural environment	Does the measure help to reduce or minimise transport CO_2 emissions? Does it minimise direct impact on the natural environment (air, water, noise, nature and biodiversity)? Does it assist efficient resource use?
Reduce stress	Does it make personal travel faster, more reliable and/or more efficient? Does it make it easier to use healthier forms of travel (walking and cycling)? Does it improve the overall journey experience for public transport users? Does it improve safety/cut accidents? Does it improve transport users' sense of personal security, and/or comfort?

The resulting scores are calibrated against a seven-point scale, from -3 to +3, to take account of negative as well as positive impacts a measure may have in these areas.

Outline Multi-Criteria Analysis (MCA) is then undertaken, using criteria derived from 'Project Appraisal Balance Sheets' (PABS) used in Government's Common Appraisal Framework. Some sub-criteria have been adjusted to better align within the strategy – e.g. environmental criteria were added to match those agreed through SEA scoping – while others were added in line with international best practice, such as the 'security' sub-criterion within "Safety", and the 'severance' sub-criterion under "Accessibility".

All sub-criteria were scored directly for the likely performance of feasible measures, with the scores again expressed on a seven point scale to illustrate both positive and negative effects. A criterion for value for money was considered on the same basis.

3.2 Stage 2 Define package 'themes' by objectives and allocate measures

This stage uses the Stage 1 scoring of potential measures against specific high-level objectives to develop three themed strategy packages, defined broadly as follows:

- **Economic** package: built around those measures that achieved high positive scores against the "improve economic competitiveness" and/or the "reduce personal stress" strategy objectives.
- **Environmental** package: built around those measures that achieved high positive score against the "improve the built environment" and/or "respect and sustain the natural environment" objectives.
- **Social / community** package: built around those measures that achieved a high positive score against the "build and strengthen communities" and/or the "reduce personal stress" objectives.

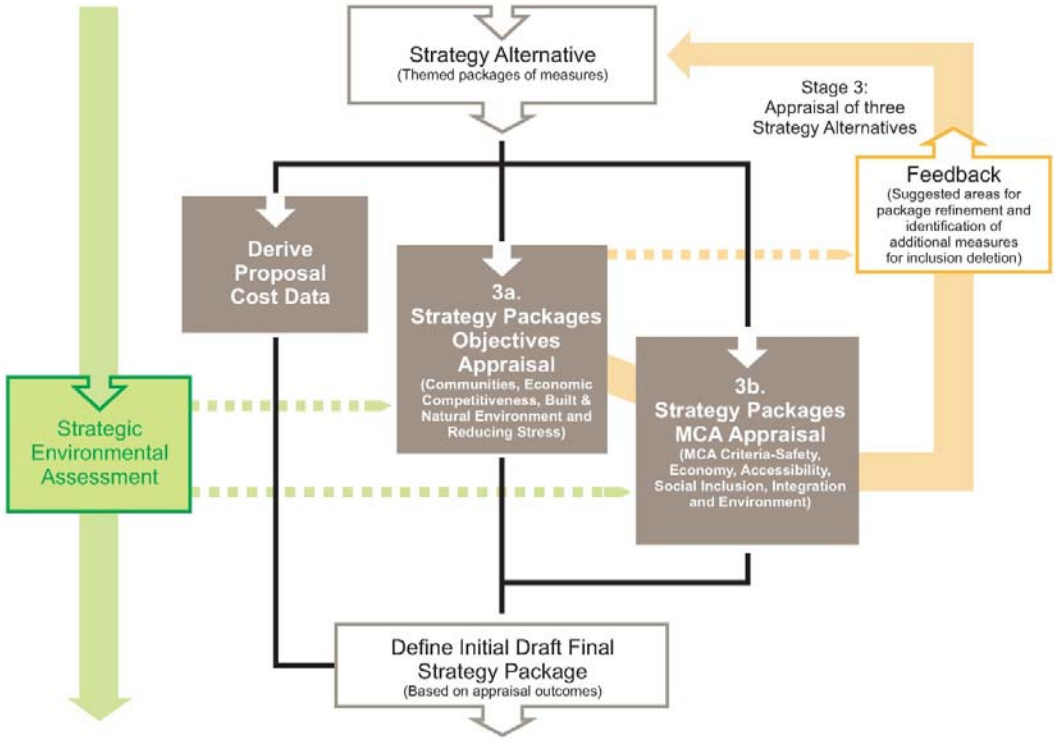
As the "reducing personal stress" objective covers all personal journeys, including commuting, its sub-objectives influence both economic and social packages. If this objective were not included in the economic package then a bias towards business journeys would result, with no economic value given to commuting. Similarly, were personal travel not to be included in the social package, then it would not reflect the wider social benefits of many feasible enhancements. However, a high score against the 'stress' objective alone – with no corresponding positive score against 'economy' and 'communities' - does not guarantee inclusion in the economic or social packages.

Although each of the three packages emphasises certain high-level objectives, each also needs to be cognisant of the other high-level objectives. Proposed interventions which would seriously undermine any of the other high-level objectives are not to be included in any package.

3.3 Stage 3 Appraisal of Strategy Alternative Packages

The initial process to be used for Stage 3 mirrors the three-step approach in Stage 1 – but without the technical feasibility elements – and is illustrated in the diagram below.

Figure 3.2 – Stage 3 Package Appraisal Process



The thematic packages will each be appraised through the two-step framework at this stage. However, it is not necessary to carry out a full MCA process including a Benefit cost analysis on each of the three strategy options. Instead, relative levels of benefits will be generated, by using the indicators and quantitative assessment methods in the framework, and compared with likely scales of cost (for large scale infrastructure and linked operational and policy measures). This will used as a proxy for initial analyses.

Since benefits from infrastructure and service improvements within a CBA are heavily influenced by journey time savings, compared to the 'Do Minimum' situation, the likely levels of benefits can be easily identified from GDA model outputs, across all modes. Similarly, relative levels of cost between the packages can be estimated from generic 'per kilometre' rates for different types of infrastructure and operations. Although such estimates would not be robust enough in scheme appraisal, they allow comparisons – and also provide evidence of how different elements of a package contribute to costs.

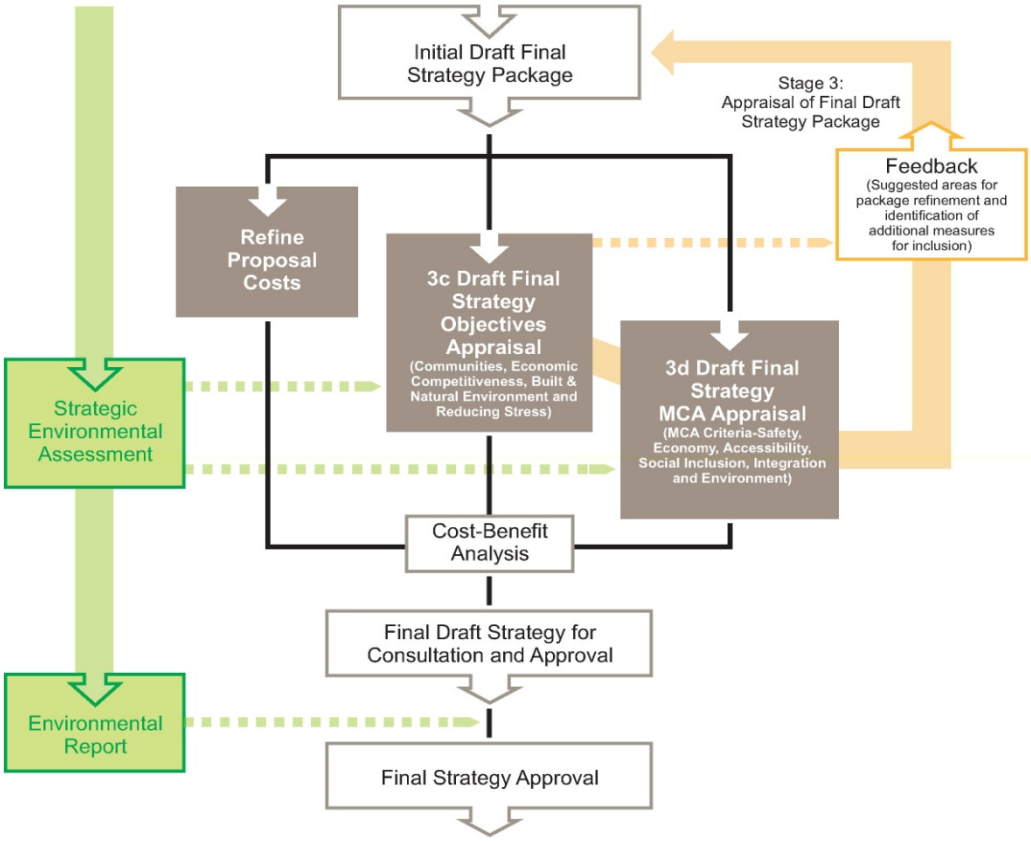
Formal qualitative and quantitative assessment against each of the Strategy-Specific Sub-Objectives will still be undertaken for each alternative, as well as the assessment against SEA criteria. This will all be used to inform the contents of the Draft Strategy.

3.4 Stage 3 Assembly and appraisal of draft Final Strategy Package

A draft final strategy package will be assembled from the best-performing elements in the three alternative packages. Data outputs from the model will be used to assess the indicators outlined below, which will be compared across packages, but may also be used to assess how an element within a package is performing relative to another.

This will be investigated using a variety of cross-cutting data checks – for example, by time savings and demand along key radial corridors by mode; trips to key centres and travel volumes by area band – and compared against the measures' known attributes.

Figure 3.3 – Stage 3 Draft Final Strategy Assembly and Appraisal



Several iterations of options within the draft final package may be assessed prior to commencing its formal appraisal; while elements may change again following initial results. The optimisation of the final package will also take account of issues raised through the parallel SEA process. However, appraisal of the full Final Strategy will be in line with this framework's requirements, against the criteria outlined in Chapter 4.

4 INDICATORS FOR STRATEGY OBJECTIVES APPRAISAL

To appraise the 'policy' merits of strategy options, it will be necessary to develop a set of indicators which correspond to the strategy sub-objectives. Eurostat defines an indicator as: "a parameter, or a value derived from a set of parameters, that points to, provides information about and/or describes the state of a phenomenon. It has significance beyond that directly associated with the parameter value." Hence, they should be related to wider outcomes than just the performance of a transport system.

The European Commission's RACER framework provides a useful set of criteria against which indicators should be chosen and assessed - see the Table below[2].

Table 3: RACER indicator assessment criteria

Criteria	*Definition*
Relevant	Policy support, Identification of targets and gaps
	Identification of trends
	Forecasting and modelling
Acceptance	Stakeholder acceptance
Credible	Unambiguous
	Transparency of method
Easy	Data availability
	Technical feasibility
Robust	Defensible theory
	Sensitivity
	Data quality

Where possible indicators have been chosen which match the criteria outlined above. The relative weight of these criteria should not be deemed to vary across the different sub-objectives, nor with different methods of data collection or analysis – a qualitative assessment based on best practice research, or overseas comparisons, should be as useful in analysis as one derived from data or outputs from the GDA transport model.

In particular, certain key elements of the alternative packages – and thus potentially of the final strategy – are not capable of being robustly modelled. Policy measures which relate to land use controls or travel behaviour change fall into this category. However evidence exists that such measures may be very effective and cost-efficient – hence it would be unhelpful to exclude them or give them a lower priority because they do not directly affect the quantitative modelled output. These indicators take account of this.

It should be noted that several indicators require a final 'score' which results from the combination of assessments which can be quantified and some which cannot. Where available all data will be included in reporting; however some non-quantified elements may have significant influence in the final 'score' – this will be explained in a narrative.

Several of the Strategy Appraisal indicators share data with criteria assessed for the MCA analysis, while both share some assessments with the SEA over environmental issues. However, the way in which these are used will differ – in a Strategy Appraisal assessment, performance against the required wider outcomes will be the key factor.

[2] European Commission (2005) Impact Assessment Guidelines. SEC(2005) 791.

The full set of Objective and Sub-Objective indicators, and how they are reported, is described in the Table below.

Table 4: Strategy Objectives Appraisal Indicator set

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
Objective 1 – Build and strengthen communities			
1.1	Improve accessibility to work, education, retail, leisure and other activities	Report changes in catchment of major towns in the GDA by car and public transport modes by catchment time band. Score aggregate impacts across all transport modes using seven-point scale.	Using transport model calculate population within 30 and 60 minute travel time bands of key towns in the GDA. Perform separate calculations for car and PT/walking (using walk as a mode or part of journey mode where quicker). The following RPG-designated large towns represent the locations most likely to be providing the work, education, retail and leisure facilities required for this sub-objective: Dublin City; Blanchardstown; Swords; Tallaght; Clonburris; Liffey Valley; Dun Laoghaire; Dundrum; Navan; Naas; Newbridge; Bray; Wicklow.
1.2	Improve access for disadvantaged people (including physical access for mobility impaired)	Report improvements in average journey times (by car and public transport) from origin zones with evidence of deprivation to nearest large town and Dublin City Centre. Report figures by mode (PT/walking and car) and by the population that benefits. Qualitatively assess physical improvement measure benefits for people with mobility impairments. Score aggregate impacts across all transport modes using seven-point scale.	Using the transport model calculate the journey times from areas of high deprivation (including CLAR and RAPID areas) to the nearest town plus Dublin City Centre. Perform calculation separately for car and PT/walking (using walk as a mode or part of journey mode where quicker), using the town definitions from sub objective 1.1. As there are a high number of deprived origins, report changes to average journey times (weighted by trip volumes) for each destination. Walk & cycle: qualitative assessment of access improvements for disadvantaged populations by walking and cycling. Also qualitative assessment of all physical access measures for people with impaired mobility within packages.
1.3	Improve links between communities within the region	Quantitative improvement in access (journey times) by car and public transport to main GDA towns. Report time savings by mode and also weighted by percentage mode split. Score on a seven-point scale.	Schemes (or groups of schemes) within packages likely to impact upon access to the defined main towns (as stated in 1.1 above) will be assessed quantitatively based on the journey time evidence for each key town extracted from the model Assessment to be carried out for each town by car and public transport, with results weighted by the numbers using each of these modes for those trips to each town.

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
1.4	Improve links to the rest of the island of Ireland	Improvement in journey times on select links in GDA to 'Rest of Ireland' by car and PT. Data then used to inform a qualitative assessment scored on seven-point scale.	Using the transport model calculate the car, bus and rail journey times from Dublin City Centre to the GDA boundary on key road and rail corridors within GDA leading towards: • Belfast (car/bus via M1 and Dublin-Belfast rail to Dundalk) • Cork (car/bus via (M7/M8 and Kildare rail line to Portlaoise) • Galway (car/bus via (M4/ M6 and Kildare rail line to Athlone) • Limerick (car/bus via (M7 and Kildare rail line to Portlaoise) • Waterford (car/bus via M7/M9 and (N9/Waterford rail line to Carlow) Assess the relative benefit between modes weighted according to the mode split (rail/bus/road) for that corridor in that package. This will inform a qualitative assessment of the impact on access to key locations throughout Ireland by mode.
Objective 2 – Improve economic competitiveness			
2.1	Improve journey time reliability for business travel and movements of goods	Quantitative assessment of change in links 'over capacity' (demand in excess of 85% capacity). Report numbers of trips affected by mode. Aggregate score against seven-point scale.	Using the transport model calculate network kilometres, vehicle kilometres and passenger kilometres where demand exceeds 85% of capacity. Report results separately by highway (network and vehicle kilometres), Dublin Bus, other buses, Luas and rail (all passenger kilometres).
2.2	Reduce overall journey times for business travel and movement of goods	Improvement in average journey time for car, HGV and public transport for journeys between identified business clusters. Report time savings by mode and also weighted by percentage mode split.	Define 'business clusters' as transport model zones where employment levels exceed 10,000 jobs or employment density exceeds 8,000 employees per km^2. Using the transport model calculate the average journey times by car, HGV and PT modes between these business clusters, weighted by mode split for each cluster.
2.3	Ensure value for money of transport expenditure	Estimated aggregate value for money of all schemes and measures in Strategy Alternative packages. Full BCRs based on TEE analysis (and indicative BCRs for schemes not directly appraised by modelling) for Final Strategy. Report relative level of the aggregated net benefit (low to high on seven-point scale).	Qualitative assessment for Strategy Alternatives, based on professional judgement. For the draft Final and Final Strategy packages, aggregate benefit cost ratios will be produced based on the value of time savings etc. (generated by model outputs) and estimated scheme capital and operating costs, by using the full TEE analysis method (as undertaken for the MCA appraisal – see Section 5.2.1 below for details). As far as feasible, estimated benefit cost ratios will also be produced for measures not directly modelled . The evaluation of benefits other than by the transport model will draw on previous research and appraisal of similar schemes.

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
2.4	Support business agglomeration and competition	Qualitative assessments of overall changes in journey times to identified business clusters by car and Public Transport. Report time savings by mode (car and PT) and weight by mode split for these trips.	Define identified business clusters as per sub-objective 2.2. Calculate average journey times to the business clusters from all origins, by car, HGV and public transport, weighted by mode split for each cluster.
2.5	Improve access to GDA ports and Dublin airport	Improvement in average journey time for all trips to Dublin Port, Dublin Airport and Belfast by car, HGV and PT. Report average times and splits by mode. Aggregate score on seven-point scale.	Using the transport model calculate the average journey times to Dublin Port, Dublin Airport and Belfast for car, HGV and PT from all origins, weighted by the mode split for all trips to that destination.
2.6	Provide for efficient goods distribution, servicing and access to materials	Qualitative assessment of the impact on goods distribution of schemes within the packages. Score on seven-point scale.	Schemes (or groups of schemes) within packages that are likely to impact upon the distribution of goods will be assessed. This will apply research and monitoring of similar measures when adopted elsewhere to assess the scale of potential benefits.
Objective 3 – Improve the built environment			
3.1	Improve and maintain the environment for people movement (e.g. better quality design of streets and open spaces)	Qualitative assessments of impacts on the built environment. Score on a seven-point scale.	Consider the impact of all proposed schemes, cross-referenced with town centres to identify areas where built environment affected most. Consider the quality and design of streets and open spaces, along with the layout and appearance of the built environment.
3.2	Improve the quality of design and maintenance of transport infrastructure and vehicles	Qualitative assessments to be provided for the in-vehicle and other quality impacts described right. Separate results would be assessed for vehicles and infrastructure. Score on a seven-point scale.	Key attributes relating to high quality transport infrastructure and vehicle design will be assessed. These include quantitative increases in things passengers value, e.g.: • Ease of Interchange (integration between modes) • Condition of vehicles and infrastructure (cleanliness, appearance, lighting etc,) • New facilities (ticket offices, ticket machines, toilets, retail outlets etc.) • Condition (of vehicles, overall cleanliness, appearance, lighting, heating etc,) • Ride quality (noise, ride comfort, seats etc.) Scores will be weighted by proportion of GDA population benefiting from the improvement, based on the proportion of bus, rail and Luas passenger kilometres.

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
3.3	Minimise physical intrusion of motor traffic	Quantitative assessment of the volume of trips through major areas of public realm(defined as key links in main towns). Qualitative assessment of overall changes in the level of intrusion of vehicles/HGVs. Score on a seven- point scale.	Each major town in the GDA (as defined in sub-objective 1.1) will have road links through the central populated areas defined – this will draw on the GIS analysis for SEA Objectives #9 and 18 (to assess populations exposed to noise and air quality) – see Appendix A for further details. The volume and mix (car/bus/HGV) of trips on these links relative to the population affected will be compared and the relative level of impact aggregated qualitatively.
Objective 4 – Respect and sustain the natural environment			
4.1	Minimise the impact of transport on air quality	Results expressed as change in air quality index. Score on a seven- point scale.	Draw on analysis from SEA Objective 18 – Change in GDA population exposed to pollution concentration bands. Estimated from GDA model traffic data, weighted towards the metropolitan area as a proxy for population density, for each Strategy Alternative, and by using DMRB methodology for Final Strategy (see Appendix A).
4.2	Minimise the impact of transport on water quality	Qualitative scores on seven- point scale.	Draw results from analysis of SEA Objectives 12-15 and aggregate results (see Appendix A).
4.3	Reduce greenhouse gases associated with transport	Change in CO_2 emissions. Score on a seven- point scale.	Draw results from analysis of SEA Objective 20. Include emissions from PT modes if possible (see Appendix A).
4.4	Improve efficiency in use of natural resources, especially non-renewable ones (e.g. land, materials, fuel)	Qualitative scores on seven- point scale.	Draw results from analysis of SEA Objective scores 21, 22, 25 and 26 (see Appendix A).
4.5	Minimise the impact of noise and vibration	Change in population affected by noise. Score on a seven- point scale.	Draw on analysis from SEA Objective 9 – Change in numbers of GDA population exposed to noise changes >3dBA. Estimated from GDA model traffic flow data (weighted towards the metropolitan area as a proxy for population density) for each Strategy Alternative, and by using full DMRB methodology for the Final Strategy (see Appendix A).

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
4.6	Minimise the adverse impact of transport on biodiversity and natural amenities	Qualitative scores on seven- point scale.	Draw results from analysis of SEA Objectives 1, 2 and 3 (biodiversity) and 4 and 5 (landscape) – see Appendix A.
Objective 5 – Reduce personal stress			
5.1	Improve journey time reliability for personal travel	Quantitative assessment of highway links 'over capacity' (with traffic flows in excess of 85% capacity). Quantitative assessment of public transport passenger kilometres on services over 85% capacity. Report numbers of trips affected by mode. Aggregate score against seven point scale.	Methodology as described in 2.1. Using the transport model to calculate network kilometres, vehicle kilometres and passenger kilometres where demand exceeds 85% of capacity. Report results separately by road (network and vehicle kilometres), Dublin Bus, other buses, Luas and rail (all passenger kilometres).
5.2	Reduce overall journey time for personal travel	Overall journey time changes report separately by car and PT modes.	Using the transport model calculate the average journey times by car, PT and 'soft' modes for all AM peak trips, weighting the results according to the mode split for the whole GDA for that package.
5.3	Improve travel information	Qualitative scores for the impact against each of elements listed, separately by vehicles and interchanges/stops as appropriate. Score on a seven- point scale.	A number of key attributes relating to provision of travel information which it is known from research that passengers value will be assessed, including: • Announcements (audibility, usefulness etc.) • Visual (signage etc.) • Real-time information (at interchanges, stops, on-board etc.) • Electronic media (internet, SMS etc.) • Timetables Scores for each element will be weighted by the proportion of the population benefiting from the improvement, based on the relative numbers of passenger kilometres carried by Dublin/other bus, Luas and rail for the package in question.

Objective and sub-objectives		Package Appraisal Indicator and reporting method	Indicator Assessment Methodology
5.4	Improve ease of public transport system	Qualitative scores for access and ticketing impacts for both interchanges/stops and vehicles. Score on a seven- point scale.	Key attributes relating to ease of use of public transport will be assessed including: • Access (clear, signposted, step-free, automatic doors etc.) • Ticketing (purchase, integrated ticketing, fare structures etc.) Scores for each element will be weighted by the proportion of the population benefiting from the improvement, based on the relative numbers of passenger kilometres carried by Dublin/other bus, Luas and rail for the package in question.
5.5	Promote healthier forms of travel and use of public space	Qualitatively assess changes in: • Number of walk/cycle trips; • Total length of walk/cycle trips; and • Health impacts of walk/cycle trips. Aggregate effects scored against a seven point scale.	Mode Choice modelling process will be used to quantitatively assess the impact that each package has upon levels of walking and cycling (or active travel modes). Trips will be 'skimmed' from the Transport Model to provide an indication of total increase in travel kilometres by walk and cycle, as well as total numbers of trips.
5.6	Improve travel safety	Numbers and monetised impacts of types of accident forecast against highway trips. Aggregate effects scored against a seven point scale.	Applying road traffic accident rates by road classification it is possible to forecast accident levels, in terms of fatal, severe and minor. Monetised benefits will then be determined through application of values for each type of accident. The analysis will use the COBA method and NRA provided accident rates (see Appendix B). A qualitative assessment will be made of the overall impact on travel safety, covering all modes. This will consider the likely effect of schemes in the packages particularly on vulnerable road users.
5.7	Improve travel comfort and the sense of personal security	Qualitative assessment of surveillance and design impacts for both PT and walk/cycle modes. Also assessment of crowding and assistance impacts for PT modes. Aggregate effects scored against a seven point scale.	Comfort: Using the transport model calculate passenger kilometres where demand exceeds 85% of capacity. Report results for Dublin Bus, other buses, Luas and rail. Security: Key attributes will be assessed including: • Assistance (Staffing, help points, etc.) • Surveillance (CCTV, etc.) • Design Scores for each element will be weighted by the proportion of the population benefiting from the improvement , based on the relative numbers of passenger kilometres carried by Dublin/other bus, Luas and rail for the package in question.

5 MULTI-CRITERIA ANALYSIS

As mentioned above, the appraisal framework for strategy options will include multi-criteria analysis of the Strategy Alternatives and draft Final Strategy. This will involve completion of a 'Strategy Appraisal Summary Table', as set out in Table 5 below, for each option. Note that a Cost-Benefit Analysis will be done for the final strategy only.

Most of the criteria within the table require relative scoring on a seven point scale. This will seek to distinguish between levels of impacts that are broadly as follows:

- Highly positive +3
- Moderately positive +2
- Slightly positive +1
- Neutral 0
- Slightly negative -1
- Moderately negative -2
- Highly negative -3

When evaluating strategy alternatives, it will be necessary to include more detailed indicator data too, as set out in the qualitative and quantitative columns of Table 5.

The remainder of this chapter sets out how indicator data is derived and calculated, or qualitatively assessed, to complete AST entries for each criterion and sub-criterion.

Table 5: Final Strategy Appraisal Summary Table

Criteria		***Qualitative Method and Statement***	***Quantitative Method and Statement***	***Value Reported or Scaling Statement***
SAFETY	Accidents	Impact on accidents by road user, including impacts on particular groups of road users	Data on value of forecast numbers of fatalities and personal injuries on the highway (value is used in full CBA calculation) [as per sub-objective 5.6]	Monetised impacts of forecast highway accident levels
	Security	Impact on personal safety and security while travelling (as per that part of Sub-objective 5.7)	None	Score on seven-point scale
ECONOMY	Transport Economic Efficiency (*NB. this is only undertaken for the draft Final Strategy – see sub-objective 2.3 above for assessment of Alternatives)*.	Summary of impacts on user benefits (e.g. journey times), and operator costs	Summary of Net Present Value of benefits, against the discounted sum of all capital and net operating costs (Value is used in full CBA calculation). The assessment of user and non-user benefits across all modes is based on: • Journey time • User charges • Vehicle operating costs Net transport operator benefits will be forecast through assessments of each schemes (or groups of schemes). This will include taking account of: • Investment costs • Maintenance costs • Operating costs • Revenues • Grant subsidy/payments	Ratio of Net Present Value of Benefits over Costs

Criteria		*Qualitative Method and Statement*	*Quantitative Method and Statement*	*Value Reported or Scaling Statement*
	Reliability and Quality	Summary of transport reliability and quality impacts not captured in the Transport Economic Efficiency calculation: - Quality of transport infrastructure and vehicles (as for sub-objective 3.2) - Information provision as (for sub-objective 5.3) - Ease of use of public transport (as for sub objective 5.4) - Comfort and security (as for sub objective 5.7)	Passenger kilometres on crowded services and vehicle km on links above capacity [as per sub-objectives 2.1 & 5.1]	Score on seven-point scale
	Wider Economic Impacts	Summary of economic benefits not captured in transport efficiency calculation	Changes in journey times (by mode) to defined business clusters. (as per sub-objective 2.4) Changes in journey times (by mode) between defined business clusters (as per sub-objective 2.2)	Score on seven-point scale
ACCESS-IBILITY	Option values	Transport service changes which result in additional (or reduced) travel options for non-users as well as users. Nature of change in mode/service and whether the option is gained or lost	Size of the population affected by the gain or loss of additional travel options (e.g. proximity to new bus service corridors, new rail or Luas points of access; and additional car or cycle access options along new local roads)	Score on seven-point scale
	Severance	Impact of any proposed strategy on those using non-motorised modes, especially pedestrians and cyclists	Supporting quantitative data on size and proximity of populations to new or enlarged infrastructure likely to create severance issues (measured by GIS)	Score on seven-point scale
	Accessibility	Summary of access to key destinations(towns) by public transport/walk and cycle	Supporting quantitative data on populations within journey time bands for key GDA towns (as per sub-objective 1.1 but by PT/walk/cycle only)	Score on seven-point scale
SOCIAL INCLUS-ION	Deprived geographic areas	Summary of access to destinations by public transport and walk/cycle from CLAR, RAPID and other areas classified as suffering from deprivation	Supporting quantitative average journey time data from these areas by PT/walk and car to nearest key GDA destination and to Dublin City Centre [as per sub-objective 1.2]	Score on seven-point scale
	Vulnerable groups	Impact of proposals on people in vulnerable groups (irrespective of geography) including women, children, older people and those with disabilities	None	Score on seven-point scale

Criteria		*Qualitative Method and Statement*	*Quantitative Method and Statement*	*Value Reported or Scaling Statement*
INTE-GRATION	Transport interchange	Impact on scope for and ease of interchange between modes including walk and wait times plus other barriers such as fare structure	Number and location of new interchange nodes and facilities	Score on seven-point scale
	Geographic Integration	Identify elements likely to lead to enhanced/reduced international travel opportunities	Journey times to the key international destinations/gateways of Dublin Airport, Dublin Port and Belfast (data as per sub-objective 2.5)	Score on seven-point scale
	Land-Use Policy	Assessment of compatibility with land use options (National Spatial Strategy and RPGs)	Supporting GIS data on proximity of new development to key local services, plus access to the major towns across Ireland (as per sub-objective 1.4)	Score on seven-point scale
	Other Government Policies	Assessment of impact on other Government policies e.g. health	None	Score on seven-point scale
ENVIRON-MENT	Air Quality	Summary of air quality effects	Population numbers affected by change in PM_{10} and NO_X levels (as per sub-objective 4.1/SEA objectives 18 and 19)	Score on seven-point scale
	Noise	Summary of noise effects	Estimated change in number of people affected by transport-related noise – greater or fewer (as per sub-objective 4.5/SEA objective 9)	Score on seven-point scale
	Landscape	Key landscape characteristics affected; Effects on key views and Impact on landscape character as per SEA objectives 4 and 5	None	Score on seven-point scale
	Biodiversity	Potential compliance/ conflict with biodiversity objectives; Indirect impacts on protected species, designated sites as per SEA objectives 1,2 and 3	None	Score on seven-point scale
	Cultural heritage	Overall effect on Cultural, archaeological and architectural resources as per SEA objective 27	None	Score on seven-point scale
	Water	Overall potential significant effects on water attributes as per SEA objectives 12 to 17	None	Score on seven-point scale
	Climate Change (CO_2)	Overall effect on Climate Change	NPV of value of emissions avoided (as calculated for sub-objective 4.3; or as calculated in TUBA for final strategy).	Score on seven-point scale
	Soil and geology	Overall impact on land take, property, soils and geology as per SEA objectives 21, 22 and 23	None	Score on seven-point scale
	Material assets	Overall impact on material assets as per SEA objectives 24, 25 and 26	None	Score on seven-point scale

5.1 SAFETY

5.1.1 Accidents

Safety has a potentially very high impact on large numbers of people living, moving around and working in the region. Transport-related projects often have a significant impact in improving safety, and transport policy has a specific focus on the reduction of accidents. Project design in new roads and public transport services emphasises accident reduction. Along with estimates of the NPV arising from accident reductions (which contribute to a full social Cost-Benefit Analysis), the AST itself includes the net present value of 'safety', to capture these wider impacts of proposed strategy options.

When appraising against the 'safety' criterion, it will be necessary to provide robust estimates of levels of accident reduction, and preferably impacts on particular groups of road users – pedestrians and cyclists being especially vulnerable. Quantification of the accident reductions in terms of fatalities and personal injuries should be provided.

5.1.2 Security

Fear of crime, assault and injury (other than from accidents), and offensive or anti-social behaviour affects many people's trip-making, both in terms of overall mobility and of choice of transport mode, time of day etc. Whilst these behavioural decisions are not capable of being modelled, research and experience suggest that a range of measures can be introduced across transport networks which enhance their users' feelings of security. Moreover, in many situations, greater use of the mode or facility itself can increase security through natural surveillance and 'safety in numbers' etc.

It is proposed to make a qualitative estimate of these benefits in each strategy option.

5.2 ECONOMY

Transport investment contributes to economic growth through the improvement in the efficiency and effectiveness of the transport systems. These effects have traditionally been captured in two ways – directly, through calculation of 'Net Present Benefits' to transport users and operators (through a 'Transport Economic Efficiency' calculation); and more widely through using '*social Cost-Benefit Analysis'* (CBA), which measures the overall welfare gains or losses to society resulting from investments in transport.

It is proposed that the 'economy' criterion within the Multi-Criteria Analysis of strategy alternatives will use a transport cost-benefit ratio, derived from a simplified Transport Economic Efficiency calculation taken direct from model outputs – as specified below.

However, for the Final Strategy this will be based on a full TEE calculation using the TUBA (Transport User Benefits Assessment) software. In all cases, this Economic value will be backed up Reliability, Quality and Wider Economic Benefits estimates.

For the Final Strategy, further work will be done to calculate a full benefit to cost ratio (BCR), using the social Cost-Benefit Analysis explained further in Section 5.7 below.

5.2.1 Transport Economic Efficiency (simplified)

This usually requires calculation of Net Present Value (NPV) of Benefits, in the form:

Discounted Present Value of Benefits – Discounted Present Value of Costs

This will include estimates of both user and producer costs and benefits – as defined below – but will take no account of the wider social impacts captured elsewhere in the AST. However, since the estimates used at option appraisal level will necessarily be based on very broad assumptions, it is better not to present Net Present Values as a currency value. Instead, an estimated ratio of Benefits to Costs will be reported here:

$$\frac{\textit{Discounted Relative Present Value of Benefits}}{\textit{Discounted Relative Present Value of Costs}}$$

5.2.1.1 User benefits

In terms of changes to *user benefits,* these are likely to be based on the following set of outputs from the model (and will represent only travel undertaken in the AM peak):

- Journey Time savings (in-vehicle time, walk and wait time etc. for all modes)
- User Charges (fares/tolls/parking costs etc.)
- Vehicle operating costs (derived from kilometres operated, using standard values)

The largest component of transport benefits usually involve reduced journey times; hence for the purpose of evaluating Strategy Alternative Packages, only this will be taken into account, and assessed against the capital investment or programme costs.

Transport user benefits arising from investment in a particular mode will potentially accrue to existing users of a mode, those diverted from other modes, and those who change routes. Others who change their trip origins and destinations and make trips generated by the investment would also benefit, but these will not be captured in the GDA model, which operates with fixed demand and origin-destination trip matrices.

Numbers and lengths of trips by mode may be derived from the model; values for the other elements of these calculations, including current standard values of users' time and vehicle operating costs, are given in Appendix B. Since the journey purposes of the trips captured in the SATURN model are not known, there will be a need to factor results by the proportion of trip kilometres that are for work, commuting etc. purposes (these values are provided in TUBA – see Appendix B - and can be applied robustly in the appraisal of the draft Final Strategy. TUBA will not be used in option appraisal).

5.2.1.2 Strategy costs

Turning to the producer/cost side of the equation, for transport service and network owners/operators, the main impacts which will offset benefits include the following:

- Investment costs (in new infrastructure, rolling stock/vehicle kilometres etc.)
- Grant/subsidy payment (assumed increase or decrease against do-minimum)
- Operating and maintenance costs (using known values for each mode)
- Revenues (assumed level of increase or decrease against do-minimum)

Increases in transport operator revenues represent the benefits to transport providers that may be set against increased transport operating costs. In practice, some (but not all) of the additional farebox revenues accruing will merely represent transfers of costs from transport user to transport provider – the totals will differ due to inter-mode transfer. However, as Transport User benefits are defined to include consideration of all user charges, the impact on Transport Operator's revenues must also be included.

It should be noted that Investment costs are likely to be whole-life values; whereas operating costs and revenue streams derived from the model will be a weekday AM peak only. Maintenance and Operating costs should be available at a proportionate level (derived from kilometres operated), but using the whole Investment costs would skew the resulting calculation and potentially make the user benefits look inadequate.

It is therefore proposed that only the additional revenues and operating costs found to occur within the relevant modelled period be set against the level of user benefits that accrue within the time period modelled, with the Investment cost reported separately.

As noted above, for Strategy Alternative Package appraisal, only the Investment cost (either capital expenditure or the cost of delivering programmes of measures etc.) will be taken into account, and set against the values of user journey time savings alone.

5.2.1.3 Transport Economic Efficiency calculation (Final Strategy)

At the strategy alternatives stage, it will be sufficient to estimate user benefits direct from AM peak model outputs as above, and net off the proportionate relevant costs. This will provide a ratio for purposes of comparison between the strategy alternatives.

However, when considering the final strategy, the appraisal should include a detailed estimate of costs, reliability and externalities. This will involve inputting model results (for journey times, user charges and revenue) and cost estimates into a TUBA model, and using the full whole-life Investment Costs of all interventions due to be delivered.

The programme will calculate annualised values for User and Producer benefits and costs, which can be compared against the discounted whole life costs of the strategy. This will allow TEE reporting of accurate Net Present Values for Costs and Benefits, which will in turn feed into the calculation of a full social Cost-Benefit Ratio (see 5.7).

5.2.2 Reliability and quality

In addition to the estimation of journey times, it is clear that reduced variability in journey times is also highly valued by users. For road users, this relates closely to the extent of congestion on the network. Although levels of variability cannot be modelled, the number of users on road links at risk of congestion can be assessed.

This assumes that roads become prone to congestion when traffic rises above 85% of notional capacity. Numbers of users on these links for any strategy option can be measured. For public transport users, discomfort rather than delay is the most likely outcome of excess demand; hence numbers of passengers on overcrowded services will be measured. Bus services without priority are of course subject to both effects.

5.2.3 Wider Economic Benefits (WEBs)

In addition to the 'traditional' transport user economic benefits, resulting from time-savings, and the social benefits of reduced emissions and accidents, improvement of transport services can lead to wider benefits. These benefits may not be captured in the TEE and CBA processes, but should nonetheless be included in appraisal. Types of Wider Economic Benefits which should to be taken into account are set out below.

Agglomeration benefits: This refers to the extent to which transport provision may facilitate positive external benefits accruing to firms clustering in a particularly dense location. There are three types of externalities associated with this concentration of activity – input market sharing, output market sharing and knowledge spillovers. All are associated primarily with high-density employment clusters and related sectors.

Move to more productive jobs (M2MPJ): The gain to the worker from making a trip to work, 'the net wage', is recognised in appraisal by commuters' willingness to pay for time savings and this welfare gain is offset by costs such as travelling to the job. This is captured in conventional appraisal benefits. There is however a difference between the productivity of a worker and the net wage the worker receives – the 'tax wedge' – so that the wage does not reflect the full social benefit of labour supplied. Where this wage rises – due to access to more productive, higher-paid, jobs becoming available – there is 'external' benefit, arising from the increased tax take resulting from the move.

Employment impacts: Where there is a divergence between wages and the marginal resource cost of labour, and transport investments give rise to employment creation. In a full employment economy as Ireland's has been until recently, the case for this impact is not substantial. However, there may be regional development impacts to which employment creation benefits are relevant, in the hinterland rather than Dublin City, though this may overlap with the accessibility gains to CLAR and RAPID areas.

All of the above will be captured through assessing improvements in access to the areas with densest clusters of employment, both for business and commuter trips, in line with the approach adopted for the closely-related Sub-Objectives. However, other

aspects of WEBs –listed below – cannot be estimated, due to a lack of economic data, and any estimate of their value will need to be qualitative and supported by narrative.

Market restructuring: Where markets are imperfectly competitive[3], there may be benefits additional to those measured in conventional appraisal. These benefits reflect the value placed on the increased output in imperfectly competitive markets – where evidence exists – that is in excess of the marginal cost of producing the output.

Land use impacts: The market for land may exhibit features of market failure, which may be mitigated by transport investment. Urban regeneration policies rest on the premise of market failure, and transport investments may be a catalyst for urban change. Both of the above require detail on land and markets that is not available.

Inward investment impacts: Where the transport investment is a significant factor in motivating foreign industrialists to invest in Ireland, this is potentially an additional benefit. However, it is more likely to arise in the context of large sites and major transport investments. It is also more likely to be a factor in promoting better regional balance, and is therefore best considered under the 'Integration' criterion below.

Many of the benefits outlined above are not readily quantifiable. This does not justify their exclusion, however, and it is proposed to include a qualitative heading for wider economic benefits, which will be informed by data for trips to and between the main business clusters. Scoring against this criterion will augment the outcome of the TEE in determining overall performance under the 'economy' heading. Any benefits seen to arise under this heading will need to be supported by further economic arguments.

5.3 ACCESSIBILITY

The importance of accessibility emerges particularly strongly when evaluating the outcome of stakeholder consultations. Many of the sub-objectives, from 'increasing options for community interaction', through 'access to the rest of the island of Ireland, to 'improving economic competitiveness' involve some measurement of accessibility.

However, measurement of accessibility is not straightforward – it is differentiated by which transport mode people have access to, with cars automatically providing higher access levels – but the following indicators are strongly linked into the overall concept:

- Option value
- Severance
- Accessibility

5.3.1 Option Value

Option values are associated with potential use of a new transport facility or service by people newly capable of accessing it, in addition to those forecast to start using it in the modelling stage, whose trips would already appear in the appraisal as benefits.

Option values are related to individual's attitudes to new opportunities - in practice a range of option values is likely to be found within the population; and there is a risk of double counting, particularly in trying to separate individuals' willingness to pay for an 'option' of using a service compared to willingness to pay for actual use of a service.

As noted in the Strategy Appraisal Summary Table (Table 5), in presenting findings pertaining to 'option value', it is important to identify which group of transport services are the source of any additional option value and the nature of the change in service.

[3] In perfectly competitive markets, it is assumed, price is equal to marginal cost (P=MC)

5.3.2 Severance

If a large or increasingly busy road, or a new railway line cuts through an area it can have the effect of driving a wedge between communities. This can limit local people's ability or desire to move around in that area, which in turn can reduce accessibility to key services (such as health, education and employment opportunities and quality food shopping) and damage local social networks and overall community 'cohesion'.

Appraisal of severance will focus on the impact on any community of new or busier infrastructure, with assumed disbenefits being higher for those using non-motorised modes – pedestrians and cyclists – but to be measured for the community as a whole.

The likelihood of severance may be classified according to the following four levels:

- None - Little or no hindrance to pedestrian movement from any new services.
- Slight - All people wishing to make pedestrian movements will still be able to, but there will probably be some hindrance to movement (e.g. on-street Luas).
- Moderate - Some people, particularly children and old people, are likely to be dissuaded from making journeys on foot. For others, pedestrian journeys will be longer or less attractive – from additional traffic, bridges over railways etc.
- Severe - People are likely to be deterred from making pedestrian journeys to an extent sufficient to induce a reorganisation of their activities. In some cases, this could lead to a change in the location of centres of activity or to a permanent loss of access to certain facilities for a particular community. Those who do make journeys on foot will experience considerable hindrance.

5.3.3 Accessibility

In appraising overall levels of accessibility offered by the transport system, it is important to consider issues such as:

- Pedestrian and cycle access to transport service
- Service frequency which influences the time people would expect to wait for a service;
- The level of crowding which influences whether people can expect to board the next service which arrives
- The fares people can expect to pay
- The number of times people can expect to have to change from one service to another
- The travel speeds while riding in the public transport vehicle
- The general quality of the public transport service, including factors such as the availability of information, ease of access to the vehicles themselves, and standards of comfort

Many of the above are included in the generalised costs used in the modelling of all options. The intention here is to show related information in a different way so that the improvement to accessibility from the measures can be more directly assessed. This will build on the analysis of access from each local community to the nearest main town, and to Dublin City Centre. Hence, the more people able to access these key locations within journey time bands up to an hour, the better accessibility should be.

5.4 SOCIAL INCLUSION

Social inclusion embraces the notion that priority should be given to benefits that accrue to those suffering from social deprivation, geographic isolation and mobility and sensory deprivation. This should take account of the lower levels of car access usually enjoyed by those affected by deprivation, and hence prioritise other modes.

As noted in the Strategy appraisal summary table, above, assessing social inclusion should distinguish between deprived areas and vulnerable groups as follows:

5.4.1 Deprived geographic areas

- Impact on deprived areas; increased service levels to residents in these areas

Analysis to determine locations and numbers of the population classified as 'in deprived communities' will be undertaken using map-based GIS analysis to identify the areas designated by the CLAR and RAPID programmes. Access improvements by non-car modes can then be identified to both the nearest centre and to Dublin City.

5.4.2 Vulnerable groups

- Impacts on low-income groups (children, older people) and non-car owners, people with disability; Increased access to jobs and facilities for such groups.

Due to the lack of specific geographical data on such populations, it will be sufficient to undertake qualitative analysis of measures likely to improve things for such users.

5.5 INTEGRATION

Integration across transport modes can lead to a more cohesive environment for the delivery of services for those living and working in the GDA. Integration can take a number of forms e.g. integration of transport services, integration of transport policies with wider government policies. These different types of integration are set out below.

5.5.1 Transport Interchange

This addresses the notion of seamless transport options. Integration of transport infrastructure and services through the development of missing transport links, better opportunities for interchange, and through ticketing all promote 'seamless' journeys.

It could be argued that elements of this assessment may constitute double counting, because many of these benefits of interchange may be captured in the journey time savings to users arising from better integration of modes and the resultant lower transfer penalties. However, this element is separated out to ensure that the benefits that arise from improved interchange itself and fully captured in such circumstances.

Consideration of transport integration effects is likely to centre on both the improved services made possible and the infrastructure provided. Transport service integration measures may lead to the following direct journey time and journey quality benefits:

- Reduced in-vehicle journey times (for both passenger and freight)
- Reduced walking and waiting times associated with interchange
- Greater reliability and frequency in interchange
- Simpler fare systems and reduced fare costs and ticket purchasing time associated with through ticketing (including fares integration)

These effects will largely be captured within the core Transport Economic analysis.

Transport infrastructure integration may include the following benefits and indicators:

- Improved capacity of interchange infrastructure and reduced overcrowding;
- Improved quality of interchange infrastructure such as physical layout, services provided, amenities and environment.
- Improved integration with non-mechanised modes, such as walk and cycle;
- Improved traveller information.

These are unlikely to be captured in the core cost-benefit analysis. Hence it will be important to capture the number of improved interchange locations and measures.

5.5.2 Geographic Integration

This addresses the ability of people to reach key national and international gateways – such as Ports and Airports. It can be directly assessed through analysing journeys times for all trips to those key destinations, for all origin points throughout the GDA.

5.5.3 Land Use Integration

It is critical to the success of any potential strategy that land use and transport and integrated. Strategy options will be appraised against an agreed land use scenario derived from emerging Regional Planning Guidelines, and compliant with National Spatial Strategy. This will be tested for each transport option against two indicators:

- The proximity of new development to key services in their immediate locality (schools, shops, primary healthcare etc. within walking and cycling distance)
- Ability to reach major towns across Ireland along main corridors from the GDA

The former assessment will only be undertaken for a draft final strategy option, where other land use options are relevant, since the results should be the same for all three alternative scenarios where only a single land-use scenario is expected to be applied.

Journey times to the edge of the GDA along the main corridors leading to main towns across the island of Ireland will also be undertaken, with both scores assessed jointly.

5.5.4 Other Government Policy Integration

There is a need for transport projects to be compatible with Government policy more generally. There is a requirement therefore to consider the wide range of Government policies to determine whether in principle the strategy could impact to any significant degree on one or more of them e.g. health impacts. Any significant effects should be highlighted and scored qualitatively, potentially against numbers of policies affected.

5.6 ENVIRONMENT

As with the sub-objectives assessments for environmental factors, this section will be informed by the SEA process, being undertaken in parallel with the development of strategy options. The SEA will provide environmental inputs for appraisal of strategy alternative options and ultimately the appraisal of the draft final and final strategy.

The main environmental impacts covered by the appraisal process are as follows:

- Air Quality
- Noise
- Landscape
- Biodiversity
- Cultural heritage
- Water resources
- Climate Change
- Soils and geology
- Material assets

Values will be informed by analysis for the SEA process, outlined in Appendix A. In line with the SEA, indicators will be reported against a seven-point scale. However, the quantified impacts of strategy alternatives in the areas of air quality, noise and carbon emissions will be directly reported in the AST, with the value given for CO_2 emissions carried forward to be monetised, and used in the CBA process below.

5.7 SOCIAL COST-BENEFIT ANALYSIS OF FINAL STRATEGY

As stated in 5.2, for the draft Final and Final strategy only, in addition to the Economic criteria within the AST – calculated as per 5.1 above – all of the elements of appraisal which are capable of being translated into robust monetary values, will be combined to calculate a Benefit-Cost Ratio (BCR) using a simple Cost-Benefit Analysis (CBA)[4].

The World Bank details the basic terms in any CBA as follows[5]:

Overall Economic Impact	=	Change in transport user benefits (Consumer Surplus)	+	Change in system operating costs and revenues (Producer Surplus and Government impacts)	+	Change in costs of externalities (Environmental costs, accidents etc.)	-	Investment costs (including mitigation measures)

The BCR may be defined as follows:

- Net Present Value of Benefits (to users and producers) divided by the discounted sum of all future External Costs to society (NPV/C).[6]

The NPV should be computed over a 30 year period, applying a discount rate of 4%.[7]

5.7.1.1 Net Present Value of Benefits

User and Producer Net Present Values of Benefits will be calculated as per the TEE definitions in 5.2 above, but using TUBA to take the modelled outputs and generate discounted annual values of benefits, accounting for all costs and benefits 'internal' to transport – such as user charges, operational costs, maintenance, net revenues etc.

Note that here, the total whole-life strategy Investment Cost is deducted separately at the end of the CBA calculation, where it offsets all user, producer and social benefits.

5.7.1.2 Externalities

The monetised costs and benefits to be used in the CBA calculation should include key 'externalities' which follow directly from transport system performance, namely:

- Carbon emissions
- Accident casualties

Where such monetary values are present, these costs are counted in the cost benefit analysis. Wider environmental impacts (including climate change) are covered by the Sustainable Environmental Analysis (SEA) process and these impacts will be scored separately within the multi-criteria analysis (MCA), under the 'Environment' heading.

However, it is possible to accurately predict (from model outputs) and to calculate the value of, Carbon emissions from transport in any given strategy alternative option. All kilometres travelled by each mode are multiplied by known values to represent fuel consumption, petrol/diesel mix and potentially even power generation for electric rail.

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[4] Where CBA is recommended, values applied are 2002 prices prescribed by Goodbody Economic Consultants in *Parameter Values for Use in Cost-Benefit Analysis of Transport Projects*, 2004

[5] *Transport Notes,* World Bank, Transport Economics, Policy and Poverty Thematic Group, 2005

[6] Goodbody Economic Consultants *Cost Benefit Parameters and Application Rules for Transport Project Appraisal*

[7] Department of Finance *Revision of Test Discount Rate for cost benefit analysis and cost effectiveness analysis*, 2007 http://www.finance.gov.ie/documents/publications/other/CApraisspotcheckguidance.pdf

The measurement of accident costs distinguishes between costs that relate to the casualties of accidents and costs that relate to the accident itself. As with the Carbon element, parameters are applied for CBA purposes, covering the following aspects:

Casualty related costs (i.e. multiplied up by numbers and severity of casualties):

- Lost output
- Human costs (suffering and pain)
- Medical costs

Accident related costs (i.e. multiplied up by numbers of accidents):

- Damage to property
- Insurance administration
- Gardai costs

Numbers of accidents and numbers of casualties are the key quantitative indicators for the assessment of proposals. Combining these numbers with fixed values for the prevention of casualties and accidents provides a monetary estimate of the accident benefits of proposals. Values used in these calculations are provided in Appendix B.

5.7.1.3 Investment costs

These need to be representative of all the likely costs of delivering all of the transport measures whose performance is being assessed. This will include the likely costs of:

- Construction (based on typical per-kilometre rates by mode/type of scheme)
- Land acquisition (set at market values, with typical land-take by scheme type)
- Mitigation measures (e.g. crossings and bridges to overcome severance etc.)
- One-off costs for rolling stock acquisition, policy and programme delivery etc.

Costs for all interventions will be estimated. An opportunity cost approach should be adopted to measuring infrastructure and vehicle/rolling stock acquisition costs. This has particular reference to the costing of land inputs, which should be costed at their value in alternative uses or market prices, irrespective of the ownership of the land.

The overall calculation will then provide a rough estimate of the balance between the costs and likely benefits of the strategy to society, given standard assumptions about the social value of carbon emissions, accidents and the value of transport users' time.

Due to the relative lack of precise detail for many of the measures under appraisal, it is important not to give this BCR calculation more credence than it merits in overall assessment of strategy performance. All the values in the AST should be looked at in the round, and a balanced picture of the likely performance of the strategy arrived at.

Appendix A:

Assessment methodology for the Strategic Environmental Assessment (SEA)

Introduction

This note has been prepared for the NTA to assist them in preparing for one of the key stages in the SEA of *2030Vision*, namely the assessment of the Strategy Alternatives and then the assessment of the draft Final Strategy. The findings of these assessments will form key components of the draft Environmental Report.

This working note provides the methodologies to be used by ERM in completing their environmental assessments.

The methodologies below will apply to the evaluation of the Strategy Alternatives and the draft Final Strategy, except where different methods are described for the two stages (as in the case of Objectives 9 and 18).

Overall Approach

The overall approach is to use the SEA Objectives at the centre of the assessment process. The SEA currently has 27 SEA Objectives (agreed following the scoping stage of the SEA) and these cover the environmental topics as specified in the SEA Regulations.

The basis of the comparison for the assessment will be:

- the Strategy Alternatives vs the Do-Minimum;
- the draft Final Strategy vs the Do-Minimum.

All assessments will be undertaken for future assessment year 2030.

The SEA will assess the collective effect of each of the Strategy Alternatives and then the draft Final Strategy; drawing out in its reporting, any specific measures which are considered to have a significant effect (positive or negative) in relation to an SEA Objective.

The SEA will assess the impact of the Strategy Alternative and the draft Final Strategy on the environment compared to the Do-Minimum and the consequences of any impacts in terms of meeting the SEA Objectives.

The assessment results will be used to compare the relative performance of the three Strategy Alternatives and the overall comparison will be reported in an Appraisal Summary Table (AST). This will present the relative performance of all three Alternatives against each of the SEA Objectives and then make a direct comparison, highlighting their relative performances. A sample AST is presented later in this Methodology Note.

The Strategy Alternatives assessment stage of the SEA process will not involve a detailed assessment of population and GIS analysis as that will be undertaken for the draft Final Strategy. The reason for this is that the objective of the assessment of Strategy Alternatives is to determine differences between the three alternatives with a view to inputting into the development of the draft Final Strategy process. The objective of the more detailed environmental assessment of the draft Final Strategy is the formal identification of significant effects on the environment and the recommendation of mitigation measures.

It should be noted that relatively large changes in traffic are required to bring about significant changes in the environment with respect to traffic noise and emissions. The DMRB states that traffic noise impacts are unlikely to be perceptible where traffic changes by less than 25%. With respect to air quality at a regional level, DMRB suggests a change of more than 10% in AADT or a change of more than 10% to the number of HGVs.

Classes of SEA Objective

As noted in ERM's note on SEA Indicators, there are four classes of SEA Objective and Indicator. These are summarised in *Table 1* below.

Table 1 Classes of SEA Assessment Objectives and Indicators

SEA Objective-class	Detail
1. Modelling-output Objectives	These Objectives are associated with direct outputs from the NTA transport model.
2. Spatial Objectives	These Objectives are associated with measures which can be spatially identified (e.g. new rail/transport corridors etc.) and specified in the Alternatives and draft Strategy.
3. Qualitative Objectives	These Objectives are associated with measures which are (generally) policy-based and cannot be represented either directly in NTA's transport model and/or spatially.
4. MCA-based Objectives	These Objectives are primarily associated with measures likely to have effects on population and human health and will be based on data obtained from the accessibility and safety elements of the MCA process scoring being undertaken by JMP.

Table 2 Classification of SEA Objectives

Table 2 below presents the SEA Objectives and which class of Objectives they each below to.

	SEA Objectives	Classification[1]
Biodiversity Flora & fauna	1. To avoid impacts on the integrity of European Conservation Sites (SACs and SPAs) and nationally designated sites (NHAs).	2
	2. To support the overall goal of the National Biodiversity Plan.	3
	3. To minimise impacts on locally-important biodiversity in the Greater Dublin Area.	3
Landscape	4. To avoid or, where infeasible, minimise impacts on designated and protected landscapes and conservation areas.	2
	5. To minimise impacts on undesignated landscape resources (townscapes, seascapes, riverscapes, general landscapes).	3
Population	6. To increase accessibility to economic and employment opportunities, in particular for those who are physically, economically or socially disadvantaged within the GDA.	4
	7. To increase accessibility to quality public, cultural and community services, in particular, for those who are physically, economically or socially disadvantaged within the GDA.	4
Human Health	8. To contribute to improvements to transport-related aspects of quality of life for residents, workers and visitors to the GDA.	4
	9. To support the objectives of the Environmental Noise Directive in relation to transport-related noise.	1 & 3
	10. To minimise safety risks to human health arising from transport related activity.	4
	11. To support health improvements and benefits from transport-related activities.	4
Water	12. To support the forthcoming River Basin Management Plans (RBMP) and Programme of Measures (POM). Where these are not available, the objective is to support the aims and objectives of the Water Framework Directive (WFD)	3
	13. To minimise impacts to surface water systems and resources.	3

Water	14. To minimise impacts to groundwater systems and resources.	3
	15. To minimise impacts to coastal systems and resources.	3
	16. To minimise impacts to transitional systems and resources.	3
	17. To minimise the risk of flooding.	3
Air	18. To reduce negative air quality impacts arising from transport-related emissions.	1 & 3
	19. To ensure compliance with the Air Framework Directive and associated daughter Directives (and the transposing Regulations in Ireland).	1 & 3
Climate	20. To contribute to the reduction of greenhouse gas emissions arising from transport-related activities.	1 & 3
Soils & geology	21. To minimise negative impacts on important and vulnerable soils resources used for agricultural purposes.	3
	22. To reduce consumption of construction material and generation of construction waste as part of transport infrastructure projects.	3
	23. To avoid or, where infeasible, minimise impacts to protected and designated geological and geomorphological sites.	2
Material assets	24. To protect public assets and infrastructure.	3
	25. To reduce the fossil fuel demand by the transport sector.	1 & 3
	26. To assist with the reuse and regeneration of brownfield sites.	3
Cultural Heritage (	27. To avoid or, where infeasible, minimise impacts to designated cultural, architectural and archaeological resources.	2

1: Refer to *Table 1* for an explanation of classes 1 to 4.

Modelling - Output Objectives

Overview

The Air Quality, Noise and Climate Change (CO_2) Objectives will be assessed using the Do–Minimum ('before') and Do-Something ('after') traffic data from the NTA model for the Strategy Alternatives and for the Draft Final Strategy. The following sections give, first the details of the traffic and other data that will be used, and then the methods that will be used to quantitatively assess the following.

- Noise:
  - *SEA Objective #9:* To support the objectives of the Environmental Noise Directive in relation to transport-related noise.
- Air Quality:
  - *SEA Objective #18:* To reduce negative air quality impacts arising from transport-related emissions; and
  - *SEA Objective #19:* To ensure compliance with the Air Framework Directive and associated daughter Directives (and the transposing Regulations in Ireland).
- Climate Change:
  - *SEA Objective #20:* To contribute to the reduction of greenhouse gas emissions arising from transport-related activities; and
  - *SEA Objective #25:* To reduce the fossil fuel demand by the transport sector.

Traffic Data

The NTA transport model will give link traffic data for the noise, air quality and CO_2 assessments, as follows. AM peak traffic data was provided for the alternatives and the Strategy assessments, with a more detailed set of traffic data (comprising both AM peak and inter-peak period data) provided for the draft Strategy assessment.

First the Saturn road network will be provided in the form of local geo-referenced coordinates for every node, which facilitates visual presentation of the results of the assessments (see example for noise below). The length of each link is contained in the Saturn model and existing links can be provided in shape file format,

Road traffic flow data provided by the NTA model is used to generate flows as follows:

1. Total vehicle flow – the total two way flow of vehicles on the road link (in vehicles, not pcus and inclusive of buses) averaged as an annual average over an 18 hour day (0600-0000 hours) and the full 24 hours of the day (AADT);
2. Percentage HGV – the percentage of Heavy Goods Vehicles (HGVs); and
3. Speed – the mean two way traffic speed on the road link, excluding peak hour modelled congestion factors at nodes.

For the assessment of the draft Strategy, an additional set of data to be used in the noise and air quality assessments is 2030 POWCAR population data. Both the noise and air quality assessment indicators relate changes in noise and air quality in relation to the proportion of the population exposed to the changes in noise and air quality (see below). Population data from the transport model will be provided on a 250 metre grid basis. Each road link in the model will then be assigned the relevant population through a GIS analysis in MapInfo which is then exported in tabular form (in Excel) to the noise and air quality specialists for analysis. This is described in detail in the following sections.

The NTA traffic model did not explicitly consider every element and component of the preferred Strategy so the resulting traffic model outputs can be considered an over-estimation of the likely traffic volumes on the regional road network in 2030 and this was considered in assessing the significance of the predicted environmental impacts.

Air Quality

For air quality (SEA Objectives #18 and #19), ERM will follow the WebTAG (Transport Analysis Guidance) methodology. The WebTAG methodology applies the UK Highways Agency DMRB (Design Manual for Roads and Bridges) model. This is a well-known and established tool in the field of strategic air quality impact assessment in the UK, and has been applied in large scale assessments in Ireland, for example in both the Metro North and Metro West air quality assessments.

Using the DMRB air quality model, changes in roadside pollutant concentrations brought on by modified traffic flows as a result of the Strategy Alternatives and the draft Final Strategy are estimated. For the assessment of the draft Final Strategy, these changes in pollutant concentrations are then combined with population data and compared to the Do-Minimum in order to rate their performance against SEA Objective #18.

For the alternatives, the assessment of air quality changes will be based on the total number of road links across the network where increases or decreases in air quality emissions from road traffic are predicted. This was carried out for the full regional network and for the metropolitan network, the latter in order to more accurately highlight potential impacts on populated areas.

There are a number of specific outputs from the draft Final Strategy assessment; these are:

1. Air Quality Index;
2. Number of roads with an increase in pollutant concentrations;
3. Number of roads with a decrease in pollutant concentrations;
4. Population exposed to an increase in pollutant concentrations; and
5. Population exposed to a decrease in pollutant concentrations.

The first stage of the draft Final Strategy assessment involves the estimation of the population in a 20m band from each road link. This is done using GIS where the population (POWCAR for the year 2030) data is overlaid on the digitised road network.

ERM focused only on the 20m band as the POWCAR population calculation using the other bands would have resulted in a massive-extent of population over-counting. Additionally, the

POWCAR data was not 'fine-grained' enough to undertake more detailed analysis.. However, 20m is appropriate for this assessment.

For the draft Final Strategy (including the Do-Minimum); the DMRB methodology is used to predict concentrations of NO_2 and PM_{10} at 20m distances from the road centre The pollutant concentrations to be predicted in this assessment are nitrogen dioxide (NO_2) and particulate matter (PM_{10}) as these are the primary pollutants of concern in terms of air quality. The DMRB uses a series of emission factors to estimate concentrations based on traffic composition, speed, HGV% and distance from the road centre.

The change in pollutant concentration is multiplied by the population exposed to generate an air quality index for each road link. The grand total of the individual indices for each road link yields an overall **Air Quality Index** (output #1) that represents the performance of that Alternative or the Draft Strategy. A negative Index will indicate that there is an overall improvement in air quality, whilst a positive value will indicate an overall detrimental effect upon air quality from an alternative. For the draft Strategy, the results are plotted using GIS. The road links would be colour-coded red or blue depending on whether or not there is an increase or decrease in pollutant concentrations.

The WebTAG methodology then requires that the number of road links and the population affected by increases and decreases in pollutant concentrations be estimated. This yields four further outputs (#2 to #5) against which to compare the performance of Strategy Alternatives and the Draft Final Strategy for SEA Objective #18. All these outputs will be cumulatively reported in the context of the relevant SEA Objective.

Relative compliance with SEA Objective #19 is measured using the change in population exposed to pollutant concentrations above the relevant pollution limit values (which are the EU Air Quality Standards and can be found in the SEA baseline chapter in the draft Environmental Report).

As with all models and methodologies, there are inherent limitations with the WebTAG methodology. In densely populated areas (such as city centres) the populations are often within 200m of multiple roads. As noted abiove, This effect is exacerbated by the coarse-nature of the POWCAR data.

This results in many properties being double (or more)-counted and an overall population in the assessment that is greater than the actual population in the study area. The extent of this double-counting limitation is linked to the level of detail and spatial accuracy of the population data being used in the assessment. If the data used is too 'course', then this will place a limitation on the population-aspects of the assessment results. However, potential limitations which may apply to the use of population data will not impact on the SEA results or the conclusions determined from the assessment.

Another limitation is that pollution concentrations are predicted at the roadside of each individual link. These predicted concentrations do not account for contributions from adjacent road links.

ERM have devised a method to reduce the over-counting of population in the WebTAG methodology by applying a correction factor determined through the use of GIS to the population numbers estimated. The correction factor to be used will be calculated by dividing the total population within the 20m of the road network by the grand total of the population assigned to each individual road link. This correction factor will be used in the SEA.

There is no simple way to modify the WebTAG methodology to account for cumulative impacts of multiple roads at any one receptor. WebTAG can assist with the identification of areas where this is likely to be of concern, but a more sophisticated model would be required to assess the roads in an area, although this is more appropriate at EIA level rather than SEA.

Despite these inherent limitations of the WebTAG methodology, it still remains appropriate for the purpose of an SEA and the relative assessment of transport schemes and provides an adequate level of assessment that is fit for purpose. An example of this would be the air quality assessment of the M74 in Scotland: WebTAG was used for the assessment of the surrounding network in and around Glasgow, whilst the direct impacts of the specific road itself were assessed in more detail using ADMS Roads. It should be noted that ERM did not envisage or undertake detailed and road-specific air quality modelling as part of the SEA of *2030Vision*.

ERM goes beyond the basic WebTAG methodology and further analyses the results generated to achieve meaningful information regarding the performance of transport schemes. For the assessment of the draft Final Strategy, road links where significant changes in roadside air quality are predicted are identified and highlighted on maps by colour-coding road links (e.g. a map of the SATURN road links where the links are colour-coded black for insignificant changes in roadside air quality, blue for improvements and red for deteriorations in air quality). In addition to the steps above there will be one additional stage in the assessment. Using GIS the location of the road links where roadside concentrations exceed the European objectives (as identified for the assessment of SEA Objective #19) will be determined. The location of road links where the draft Final Strategy is predicted to directly cause the exceedance of any Air Quality objectives will be identified. ERM envisages producing such GIS outputs for the assessment of the draft Final Strategy, but this additional stage is not necessary for the assessment of the three Strategy Alternatives.

Noise

Noise will be assessed using the WebTAG methodology in an Excel spreadsheet that calculates road noise levels using the UK Calculation of Road Traffic Noise (CRTN) method based on the traffic data from the NTA model described above. The method calculates approximate noise levels for every link in the model for the Do-Minimum, Strategy Alternative and Draft Final Strategy cases, and allows the resultant changes in noise on a link-by-link basis, to be cross-referenced with population data (for the draft Final Strategy only) so as to estimate a 'change in population annoyed' versus the future Do-Minimum.

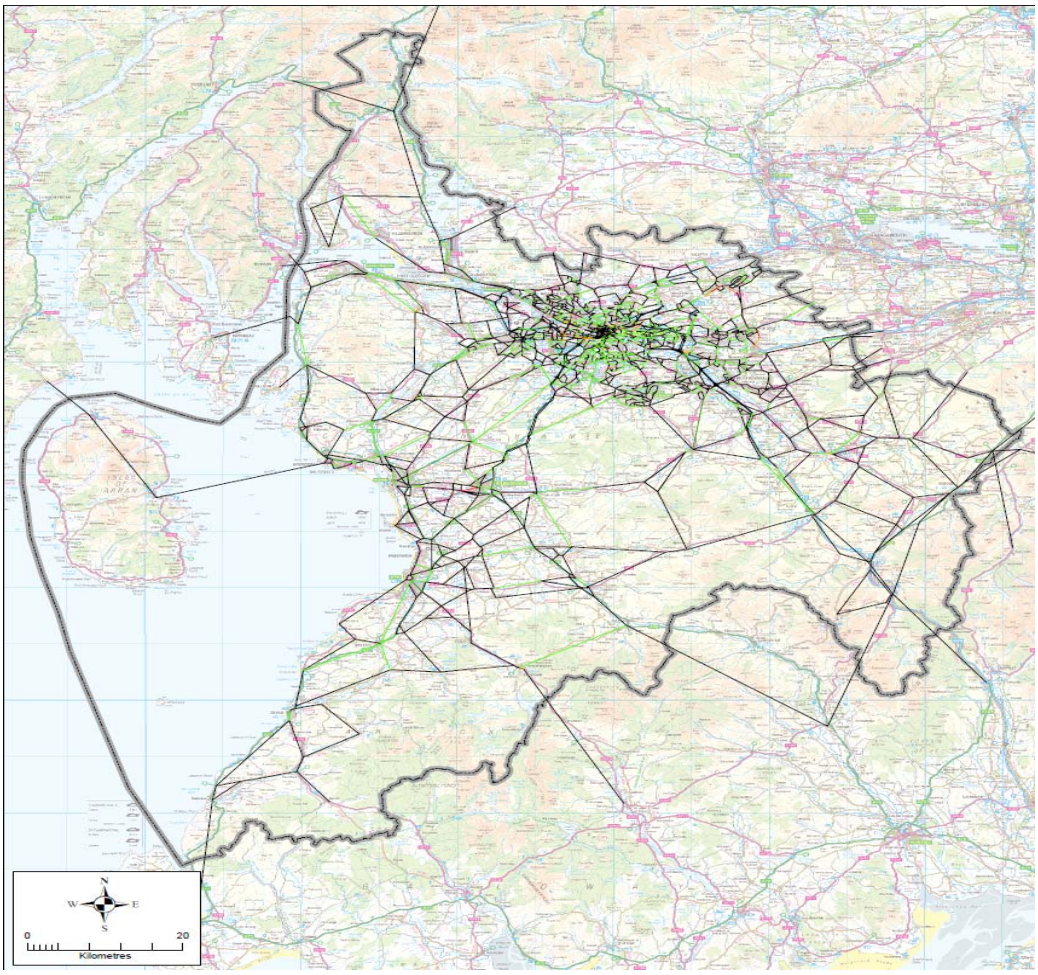
For the Strategy Alternatives, the assessment will focus on the total number of increases and decreases of road traffic noise on road links on the network. This will be carried out for the full regional network (and also for the metropolitan area network), the latter in order to more accurately highlight potential impacts on the most highly-populated urban areas. The length of each link was also used as a proxy for population affected by noise.

The area likely to be impacted by traffic noise is calculated by considering the length of each road link and applying a standard impact corridor width (WebTAG suggests 25m captures most of the population affected in urban/suburban areas). As with the Air Quality methodology, the use of this relatively constricted banding minimises the double-counting of effects on adjacent roads and compensate for teh coarseness of the population data.

These are then summed across the whole network and used to compare the relative performance of the strategy alternatives reported in the quantitative part of the Appraisal Summary Table (AST). Estimated populations affected by increases in noise of >3dBA can also be indicated on the Appraisal Summary Table in relation to the draft Final Strategy.

Regarding railway noise, this typically affects a much smaller number of people, and it is likely that the changes in annoyance due to railway noise will be very small compared to that for road traffic. A sample GIS output from a previous transport-related SEA showing the 'Estimated change in Population Annoyed' ('EPA') link by link is given in *Figure 1* below.

Figure 1 Sample GIS output showing strategic noise impacts



Climate change (CO_2)

The SEA CO_2 objectives (#20 and #25) will be assessed using the NTA traffic model outputs by using the DMRB spreadsheet tool that is based on the WebTAG methodology. Inputs include the AADT, percentage of HGVs, average vehicle speed and road link length will be used to estimate the annual tonnes of CO_2 emitted from road traffic within the study area.

The DMRB estimates the emissions of CO_2 by applying a selection of emission factors to the raw traffic data. This database of emission factors is derived from fuel consumption and engine technology details for the average road traffic fleet for the year of assessment.

The majority of changes in CO_2 arising from the Strategy Alternatives and draft Final Strategy are expected to come from changes in levels of road traffic.

Spatial SEA Objectives

These SEA Objectives will work by 'overlaying' the proposed transport infrastructure schemes of the Strategy alternative packages (e.g. new rail corridor, new road, expansion of a major road etc.) on existing GIS data and then determining the impact on the various environmental resources within the GIS system (such as SACs, SPAs, rivers, groundwater protection zones etc).

This type of indicator will be used for the following SEA Objectives:

- *SEA Objective #1:* To avoid impacts on the integrity of European Conservation Sites (SACs and SPAs) and nationally designated sites (NHAs);

- *SEA Objective #4:* To avoid or, where infeasible, minimise impacts on designated and protected landscapes and conservation areas;
- *SEA Objective #23:* To avoid or, where infeasible, minimise impacts to protected and designated geological and geomorphological sites; and
- *SEA Objective #27:* To avoid or, where infeasible, minimise impacts to designated cultural, architectural and archaeological resources.

The environmental topics within this class of SEA Objective (biodiversity, flora & fauna; landscape & visual; soils & geology; and cultural heritage) are primarily assessed using GIS. The key consideration in assessing these environmental topics is the level of detail of the GIS baseline data and also the ability to spatially describe the Strategy Alternative or draft Final Strategy being assessed. For example, if a transport corridor is depicted on a map, then the nature and level of detail of the assessment will be dependent on the information provided within this corridor (e.g. is it a general public transport corridor, or is it a specific proposal or infrastructural scheme, such as a four-track rail line).

It should be noted that, as stated previously, aspects of the draft Final Strategy in the first class of Objectives (Modelling-output SEA Objectives i.e. those based on the NTA model) may also be assessed using GIS from this specific class of SEA Objective (as shown in *Figure 1* above).

Qualitative SEA Objectives

The next two classes of SEA Objective are generally used for aspects of the Strategy Alternatives or draft Final Strategy, which are not capable of being either considered/evaluated in the NTA model or being spatially depicted and specified. These SEA Objectives will be used by making an informed scaling statement against the various SEA Objectives outlined below:

- *SEA Objective #2:* To support the overall goal of the National Biodiversity Plan;
- *SEA Objective #3:* To minimise impacts on locally-important biodiversity in the Greater Dublin Area;
- *SEA Objective #5:* To minimise impacts on undesignated landscape resources (townscapes, seascapes, riverscapes, general landscapes);
- *SEA Objective #11:* To support health improvements and benefits from transport-related activities;
- *SEA Objective #12:* To support the forthcoming River Basin Management Plans (RBMP) and Programme of Measures (POM). Where these are not available, the objective is to support the aims and objectives of the Water Framework Directive (WFD) [1];
- *SEA Objective #13:* To minimise impacts to surface water systems and resources [1];
- *SEA Objective #14:* To minimise impacts to groundwater systems and resources [1];
- *SEA Objective #15:* To minimise impacts to coastal systems and resources [1];
- *SEA Objective #16:* To minimise impacts to transitional systems and resources [1];
- *SEA Objective #17*: To minimise the risk of flooding [1];
- *SEA Objective #21:* To minimise negative impacts on important and vulnerable soils resources used for agricultural purposes;
- *SEA Objective #22:* To reduce consumption of construction material and generation of construction waste as part of transport infrastructure projects;
- *SEA Objective #24:* To protect public assets and infrastructure; and
- *SEA Objective #26:* To assist with the reuse and regeneration of brownfield sites.

[1] - note: these indicators may be partially spatial, depending on the measure being assessed and the level of detail provided in RPG SEA flood modelling data/mapping.

The application of these Objectives will be dependent on the level of information provided on the relevant aspect of the Strategy Alternatives and draft Final Strategy. And as noted above, some of these Objectives may also be partially assessed using spatial techniques (e.g. GIS).

MCA-Based SEA Objectives

This 4th and last class of SEA Objective will be dependent on specific outputs from the overarching MCA process, being managed by JMP. As with class #3; this class of SEA Objectives is best used for policy-based aspects of the Alternatives and the draft Strategy. Liaison and collaboration with JMP will be required to ensure that the JMP's outputs can provide the SEA process with the required information to address the SEA Objectives below.

The following SEA Objectives fall into this class:

- *SEA Objective #6:* To increase accessibility to economic and employment opportunities, in particular for those who are physically, economically or socially disadvantaged within the GDA - *outputs from appraisal of Sub-objectives 1.1 (general accessibility) and 1.2 (accessibility for vulnerable groups)*.

- *SEA Objective #7:* To increase accessibility to quality public, cultural and community services, in particular, for those who are physically, economically or socially disadvantaged within the GDA - *outputs from Sub-objectives 1.1 (general accessibility) and 1.2 (accessibility for vulnerable groups)*.

- For this SEA Objective (#7) and #6, the same Sub-objectives will be used. But SEA #6 focuses on accessibility to employment and economic aspects whereas SEA #7 is focused on cultural, recreational, social and other services. There is a level of overlap between both SEA Objectives, but ultimately, Sub-objectives 1.1 and 1.2 will need to be examined to deliver two different accessibility data outputs for the destinations represented by SEA's #6 and #7.

- *SEA Objective #8:* To contribute to improvements to transport-related aspects of quality of life for residents, workers and visitors to the GDA - *outputs from Sub-objectives 5.1 to 5.4 (relating to personal travel time, reliability, information and ease of use) and 5.7 (comfort and personal security)*. It is very likely that these will need to be amalgamated into a single score/rating as required to feed into the SEA.

- *SEA Objective #10:* To minimise safety risks to human health arising from transport related activity - *MCA outputs from* Safety (assessment of accident impacts).

- *Additionally, SEA Objective #11* To support health improvements and benefits from transport-related activities (also within class 3: Qualitative SEA assessment objectives) would be informed by *output from Sub-objective 5.5 (Promotion of healthier forms of travel)*.

This last class of SEA assessment objectives is similar to class 3 (Qualitative SEA assessment objectives) in that these SEA Objectives do not make use of direct outputs from the NTA model or GIS and other spatial techniques. However, several of the Strategy Sub-objective and MCA criteria that JMP will use are based on model outputs, so this class of Objective (other than the SO 5.3 and 5.4 elements of SEA objective #8) will be indirectly dependent on modelled appraisal outputs and results.

Assessment and Reporting

The application of the four classes of SEA Objective will be dependent on the form and nature of how the Strategy Alternatives and draft Final Strategy are presented to ERM. Prior to applying each of the various SEA assessment methodologies, the key task will be to identify

the various aspects or constituent parts of the draft Strategy (or Alternatives) to be assessed and then determine the most appropriate assessment tool/technique to use for each of the 27 SEA Objectives.

A key part of the assessment of alternatives is the comparison of the results of the three Alternatives against each other, thereby highlighting the pattern of relative advantages (and disadvantages) of one alternative over another with regards to each of the SEA Objectives. This will be undertaken firstly be completing the assessment and evaluation of each of the alternatives against the SEA Objectives and then preparing a comparison evaluation. This will be done using the AST (as shown in *Table 3* below) which will contain assessment narrative and text explaining and describing the key differences and relative performances against the SEA Objectives. All of the results of the assessment against the SEA Objectives will be rated in the +3 to -3 scale as was used in the first stage of the assessment.

The way in which the assessment of the draft Strategy will be reported is shown in *Table 4*.

The results of the assessment of the Alternatives will be summarised in a chapter in the draft Environmental Report.

Appropriate mitigation will be identified during the assessment process, principally through recommending amendments to the draft Final Strategy.

The final step will involve gathering all the results together, including those for the SEA assessment of the draft Final Strategy and presenting them in the draft Environmental Report.

Table 3 Appraisal Summary Tables (AST) for Alternative Strategies

Assessment Against SEA Objectives and Assessment Scores			
SEA Objective	**Alternative 1**	**Alternative 2**	**Alternative 3**
Biodiversity			
1	Basis of assessment – Do-min vs. Alt 1 Assessment narrative Assessment rating	Basis of assessment – Do-min vs. Alt 2 Assessment narrative Assessment rating	Basis of assessment – Do-min vs. Alt 2 Assessment narrative Assessment rating
2	Etc.	Etc.	Etc.
3			
Landscape			
4			
5			
Population			
6			
7			
Human Health			
8			
9			
10			
11			
Water			
12			
13			
14			
15			
16			
17			
Air			

	Assessment Against SEA Objectives and Assessment Scores
18	
19	
Climatic Factors	
20	
Soils &Geology	
21	
22	
23	
Material Assets	
24	
25	
26	
Cultural Heritage	
27	

+ 3	Major positive impacts
+ 2	Moderate positive impacts
+ 1	Minor positive impacts
0	Neutral
- 1	Minor negative impacts
- 2	Moderate negative impacts
- 3	Major negative impacts

Table 4 Assessment Table for Draft Strategy

SEA Objective	Assessment Against SEA Objectives and Assessment Scores
Biodiversity	
1	Basis of assessment – Do-min vs. Strategy
	Assessment narrative
	Assessment rating
2	Etc.
3	
Landscape	
4	
5	
Population	
6	
7	
Human Health	
8	
9	
10	
11	
Water	
12	
13	
14	
15	
16	
17	
Air	

18	
19	
Climatic Factors	
20	
Soils & Geology	
21	
22	
23	
Material Assets	
24	
25	
26	
Cultural Heritage	
27	

+ 3	Major positive impacts
+ 2	Moderate positive impacts
+ 1	Minor positive impacts
0	Neutral
- 1	Minor negative impacts
- 2	Moderate negative impacts
- 3	Major negative impacts

Appendix B: TUBA and COBA parameters

This appendix lists the parameters that will be used within the TUBA and COBA based analysis of the NTA's transport packages. It uses values from the Department of Transport's Common Appraisal Framework (http://www.transport.ie/upload/general/11801-DOT_COMMON_APPRAISAL_FRAMEWORK1-0.PDF) and also those provided by the National Roads Authority for scheme appraisal (http://www.nra.ie/Publications/ProjectAppraisal/).

1 TUBA parameters

Economics Parameters

Table 1.1 Key Parameters

Parameter	Value
Present Value Year	2002
Discount Rate	4% per annum
Appraisal Period	30 years

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 1

Value of Time

1.1 Note NTA model does not contain a separate LGV matrix – LGVs will therefore be valued at the rates for Car.

Table 1.2 Value of Time (factor costs)

Vehicle Type	Occupant	Journey Purpose	Value (€ per hour)
Car	Driver	Working Time	22.2
	Passenger	Working Time	22.2
	Driver	Commuting	6.8
	Driver	Other	6.1
	Passenger	Commuting	6.8
	Passenger	Other	6.1
LGV	Driver	Working Time	22.2
	Passenger	Working Time	22.2
	Driver	Commuting	6.8
	Driver	Other	6.1
	Passenger	Commuting	6.8
	Passenger	Other	6.1
OGV	Driver	Working Time	22.2
PSV	Driver	Working Time	22.2
	Passenger	Working Time	22.2
	Passenger	Commuting	6.8
	Passenger	Other	6.1

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 3

Table 1.3 Value of Time Growth

Year	Growth Factors (per annum)		
	Working Time	Commuting	Other
2003	1.0389	1.0389	1.0389
2004	1.0139	1.0139	1.0139
2005	1.0057	1.0057	1.0057
2006	1.0162	1.0162	1.0162
2007	1.0045	1.0045	1.0045
2008	0.9747	0.9747	0.9747
2009-2010	1.0270	1.0270	1.0270
2011-2015	1.0237	1.0237	1.0237
2016-onwards	1.0229	1.0229	1.0229

Source: 2003-08 from ESRI National Income and Expenditure Accounts 30 June 2009 - Table A - GNP per person employed. 2008-onwards from DoT Common Appraisal Framework June 2009 5.1

Journey Purpose

Table 1.4 Vehicle Proportions by Time

Vehicle Type	Journey Purpose	Peak	Off-Peak
Car	Work	0.11	0.22
	Commuting	0.58	0.20
	Other	0.31	0.58
LGV	Work	0.880	
	Commuting	0.026	
	Other	0.094	
OGV	Work	1.000	
PSV	Work	1.000	

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 26

Vehicle Occupancy

Table 1.5 Vehicle Occupancy by Time

Vehicle Type	Journey Purpose	Peak	Off-Peak
Car	Work	1.33	1.20
	Commuting	1.34	1.13
	Other	1.83	1.79
LGV	Work	1.36	1.22
	Commuting	1.59	1.62
	Other	1.56	1.62
OGV	Work	1.18	1.00
PSV	Work	1.34	

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 25

Operating Costs

Table 1.6 Fuel consumption rates (litres/km)

Vehicle Type	Fuel Parameters		
	a l/km	b l*h/km^2	c l*h^2/km^3
Car	0.160473178	-0.002686215	1.8233E-05
LGV	0.217687601	-0.003524262	2.82586E-05
OGV1	0.444814203	-0.007185533	5.21836E-05
OGV2	0.902911676	-0.014014129	9.55405E-05
PSV	0.724749670	-0.011355478	7.16045E-05

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 6

Table 1.7 Vehicle Operating Costs – Non Fuel (cents/km): factor costs

Vehicle Type	Fuel Parameters	
	a[1]	b[1]
Car	5.11	26.10
LGV	7.28	64.29
OGV1	14.83	224.60
OGV2	16.56	454.97
PSV	30.71	514.89

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 7

Table 1.8 Vehicle Operating Costs Growth Rates

Year	Growth Rate
2002-2010	0
2011-2015	0
2016 onwards	0

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 10

Indirect Taxes

Table 1.9 Indirect Tax Rates

Item	Indirect Tax Rate (%)
Average tax on final consumption goods petrol and diesel vehicles	19.1

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 11

Table 2.10 Changes in Indirect Tax Rates

Item	Indirect Tax Rate (%)
Average tax on final consumption goods petrol and diesel vehicles	0

Source: NRA Appraisal guidance. March 2008, Appendix 6, Table 12

Carbon Costs

Table 2.11 Carbon Costs Forecasts (market prices)

Year	Value €/tonne Carbon
2009	13.24
2010	13.91
2011	14.61
2012	15.59
2013	16.67
2014	17.93
2015-onwards	39.00

Source: Department of Finance, Guidelines for including CO_{2e} emissions, June 2009

TUBA Economics File

1.2 The National Roads Authority provides a TUBA Standard Economics File[1] (v1.7 September 2006) which replaces economic and traffic related parameters applicable for the UK with values applicable to the Republic of Ireland, based on values contained in the tables above.

1.3 This file was taken as the basis for the appraisal with parameter values updated where applicable.

- CPI deflators were taken from Central Statistics Office Consumer Price Index May 2010 CPI (All Items) Table 1
- The Bus and Rail modes represented in the standard economics file were replaced with a combined PT mode, to allow consistency with the modelling outputs available.
- VAT was assumed to increase to 21.5% for 2009 only and then to 22% in 2013 and 23% in 2014.
- Fuel costs, duty and VAT are consistent with the Revenue Commission Statistical Report 2008, Excise Table EX14 and EX16. Fuel resource costs were assumed to increase in line with UK forecasts post 2010.
- Vehicles petrol/diesel fleet changes were assumed to follow UK values to 2010 then to follow a 1.5% per annum reduction in petrol vehicles to 2025.
- PT journey purpose splits were taken from surveys
- VAT was assumed to be paid on all road tolls.

Table 1.5 TUBA Economics File

```
TUBA 1.7 ECONOMIC PARAMETERS FILE

PARAMETERS
TUBA_version     1.7          the current version of TUBA
base_year        2002         defines base year for economic parameters
pres_val_year    2002          present value year for discounting
RPI_base        88.69         value of CPI in base year
av_ind_tax       19.1         % average final indirect tax rate
carbon_values  10.13 22.52  11.26 base year carbon values in €/tonne (low high central)
```

[1] http://www.nra.ie/Publications/ProjectAppraisal/

```
MODES
*no.     description
 1       Road
 2       Bus
 3       Rail

VEHICLE_TYPE/SUBMODE
*no.     mode  new_mode  P&R   type  description
 1       1     N         N     per   Car
 2       1     N         N     per   LGV Personal
 3       1     N         N     fre   LGV Freight
 4       1     N         N     fre   OGV1
 5       1     N         N     fre   OGV2
 6       2     N         N     per   Freight

PERSON_TYPE
*no.    type(D/P)   description
 1       D          Driver
 2       P          Passenger

PURPOSE
*no.    type(B/C)   description
 1       B          Business
 2       C          Commuting
 3       C          Other

FUEL_TYPE
*no.    name
 1      petrol
 2      diesel

TIME_PERIODS
*no.    description      comments
 1      AM peak          (7-10 weekdays)
 2      PM peak          (4-7 weekdays)
 3      Inter-peak       (10-4 weekdays)
 4      Off-peak         (7-7 weekdays)
 5      Weekend          (weekend)

CHARGES
*no.    sector          description
 1      pri             PT fares (private operators)
 2      loc             PT fares (LA operated)
 3      loc             LA tolls
 4      cen             National tolls
 5      pri             Private tolls
 6      loc             LA on-street parking
 7      loc             LA off-street parking
 8      pri             Private parking

DISCOUNT_RATE
*% change p.a.
*Start_yr     End_yr     Rate
  1           60         4.00

VALUE_OF_TIME
*pence per hour
*Vtype/submode Person_type VOT_purpose1 VOT_purpose2..
  1            1          2220.0        680.0        610.0
```

1	2	2220.0	680.0	610.0
2	1	0.0	680.0	610.0
2	2	0.0	680.0	610.0
3	1	2220.0	0.0	0.0
3	2	2220.0	0.0	0.0
4	1	2220.0	0.0	0.0
4	2	2220.0	0.0	0.0
5	1	2220.0	0.0	0.0
5	2	2220.0	0.0	0.0
6	1	2220.0	0.0	0.0
6	2	2220.0	680.0	610.0
7	1	2220.0	0.0	0.0
7	2	2220.0	680.0	610.0
8	1	2220.0	0.0	0.0
8	2	2220.0	680.0	610.0

VALUE_OF_TIME_GROWTH

*% change p.a.

*Start_yr	End_yr	VOT_Gr_purpose1	VOT_Gr_purpose2 ..	
2003	2003	3.89	3.89	3.89
2004	2004	1.39	1.39	1.39
2005	2005	0.57	0.57	0.57
2006	2006	1.62	1.62	1.62
2007	2007	0.45	0.45	0.45
2008	2008	-2.53	-2.53	-2.53
2009	2010	2.70	2.70	2.70
2011	2015	2.37	2.37	2.37
2016	2060	2.29	2.29	2.29

AV_IND_TAX_CHANGES

*% change p.a.

*Start_yr	End_yr	Growth
2003	2050	0.00

CHARGE_TAX_RATES

*%

*charge	final	intermediate
1	0.0	0.0
2	0.0	0.0
3	21.0	0.0
4	21.0	0.0
5	21.0	0.0
6	0.0	0.0
7	0.0	0.0
8	21.0	0.0

CHARGE_TAX_RATES_CHANGES

*% change p.a.

*Start_yr	End_yr	charge	final	intermediate
2003	2008	1	0.0	0.0
2003	2008	2	0.0	0.0
2003	2008	3	0.0	0.0
2003	2008	4	0.0	0.0
2003	2008	5	0.0	0.0
2003	2008	6	0.0	0.0
2003	2008	7	0.0	0.0
2003	2008	8	0.0	0.0
2009	2009	1	2.38	0.0
2009	2009	2	2.38	0.0

2009	2009	3	2.38	0.0
2009	2009	4	2.38	0.0
2009	2009	5	2.38	0.0
2009	2009	6	2.38	0.0
2009	2009	7	2.38	0.0
2009	2009	8	2.38	0.0
2010	2010	1	-2.33	0.0
2010	2010	2	-2.33	0.0
2010	2010	3	-2.33	0.0
2010	2010	4	-2.33	0.0
2010	2010	5	-2.33	0.0
2010	2010	6	-2.33	0.0
2010	2010	7	-2.33	0.0
2010	2010	8	-2.33	0.0
2011	2012	1	0.0	0.0
2011	2012	2	0.0	0.0
2011	2012	3	0.0	0.0
2011	2012	4	0.0	0.0
2011	2012	5	0.0	0.0
2011	2012	6	0.0	0.0
2011	2012	7	0.0	0.0
2011	2012	8	0.0	0.0
2013	2013	1	4.76	0.0
2013	2013	2	4.76	0.0
2013	2013	3	4.76	0.0
2013	2013	4	4.76	0.0
2013	2013	5	4.76	0.0
2013	2013	6	4.76	0.0
2013	2013	7	4.76	0.0
2013	2013	8	4.76	0.0
2014	2014	1	4.55	0.0
2014	2014	2	4.55	0.0
2014	2014	3	4.55	0.0
2014	2014	4	4.55	0.0
2014	2014	5	4.55	0.0
2014	2014	6	4.55	0.0
2014	2014	7	4.55	0.0
2014	2014	8	4.55	0.0
2015	2080	1	0.0	0.0
2015	2080	2	0.0	0.0
2015	2080	3	0.0	0.0
2015	2080	4	0.0	0.0
2015	2080	5	0.0	0.0
2015	2080	6	0.0	0.0
2015	2080	7	0.0	0.0
2015	2080	8	0.0	0.0

FUEL_COST

*type	resource(c/lit)	duty(c/lit)	VAT(%)	carbon_grammes/litre
1	33.4	40.1	21.0	627.57
2	35.7	30.2	21.0	717.15

FUEL_COST_CHANGES

*% change p.a.

*Start_yr	End_yr	fuel_type	resource	duty	VAT	Carb_Den_change
2003	2003	1	-11.51	-3.39	0.00	0.00
2003	2003	2	-13.00	4.55	0.00	0.00
2004	2004	1	24.84	7.95	0.00	0.00

2004	2004	2	36.16	10.29	0.00	0.00
2005	2005	1	15.34	-2.43	0.00	0.00
2005	2005	2	17.62	-2.43	0.00	0.00
2006	2006	1	-14.83	-3.80	0.00	0.00
2006	2006	2	-14.14	-3.80	0.00	0.00
2007	2007	1	27.01	-4.62	0.00	0.00
2007	2007	2	20.80	-4.62	0.00	0.00
2008	2008	1	-27.15	10.38	0.00	-1.38
2008	2008	2	-10.74	-3.96	0.00	-1.38
2009	2009	1	0.00	0.00	2.38	-0.76
2009	2009	2	0.00	0.00	2.38	-0.76
2010	2010	1	0.00	0.00	-2.33	-0.81
2010	2010	2	0.00	0.00	-2.33	-0.81
2011	2012	1	0.58	0.00	0.00	-0.09
2011	2012	2	0.56	0.00	0.00	-0.09
2013	2013	1	0.58	0.00	4.76	-0.09
2013	2013	2	0.56	0.00	4.76	-0.09
2014	2014	1	0.58	0.00	4.55	-0.09
2014	2014	2	0.56	0.00	4.55	-0.09
2015	2015	1	0.58	0.00	0.00	-0.09
2015	2015	2	0.56	0.00	0.00	-0.09
2016	2020	1	0.57	0.00	0.00	-0.09
2016	2020	2	0.55	0.00	0.00	-0.09
2021	2025	1	0.54	0.00	0.00	-0.09
2021	2025	2	0.54	0.00	0.00	-0.09
2026	2030	1	0.54	0.00	0.00	-0.09
2026	2030	2	0.52	0.00	0.00	-0.09
2031	2080	1	0.00	0.00	0.00	-0.09
2031	2080	2	0.00	0.00	0.00	0.00

CARBON_VALUE_CHANGES

*Start_yr	End_yr	Rel.(%)	Abs.(£/tonne/year)
2010	2010	0.00	0.67
2011	2011	0.00	0.70
2012	2012	0.00	0.98
2013	2013	0.00	1.17
2014	2014	0.00	1.17
2015	2015	0.00	21.07

FLEET

*veh_type	%petrol	%diesel
1	79.0	21.0
2	15.0	85.0
3	15.0	85.0
4	0.0	100.0
5	0.0	100.0
6	0.0	100.0

FLEET_CHANGES

*% p.a.

*Start_yr	End_yr	veh_type	%change_petrol
2003	2003	1	-1.27
2004	2004	1	-1.28
2005	2005	1	-1.30
2006	2006	1	-1.32
2007	2007	1	-1.33
2008	2008	1	-2.70
2009	2009	1	-1.39

2010	2010	1	-2.82
2011	2025	1	-1.5

FUEL_CONSUMPTION

*veh_type	fuel_type	a_fuel	b_fuel	c_fuel	d_fuel	cut-off_speed(km/h)
1	1	0.1639	-0.00275	1.88777E-05	0	140
1	2	0.1213	-0.00197	1.22859E-05	0	140
2	1	0.1919	-0.00311	2.49083E-05	0	140
2	2	0.1919	-0.00311	2.49083E-05	0	140
3	1	0.1919	-0.00311	2.49083E-05	0	96
3	2	0.1919	-0.00311	2.49083E-05	0	96
4	2	0.4446	-0.00718	5.21584E-05	0	96
5	2	0.9025	-0.01400	9.54944E-05	0	96

FUEL_EFFICIENCY

*% p.a.

*Start_yr	End_yr	veh_type	fuel_type	change
2003	2003	1	1	0.74
2003	2003	1	2	1.18
2003	2003	2	1	1.22
2003	2003	2	2	-0.97
2003	2003	3	1	1.22
2003	2003	3	2	-0.97
2003	2003	4	2	-0.46
2003	2003	5	2	0.17
2003	2003	6	2	0.00
2004	2004	1	1	0.75
2004	2004	1	2	1.19
2004	2004	2	1	1.56
2004	2004	2	2	1.40
2004	2004	3	1	1.56
2004	2004	3	2	1.40
2004	2004	4	2	0.00
2004	2004	5	2	0.00
2004	2004	6	2	0.00
2005	2005	1	1	0.76
2005	2005	1	2	1.21
2005	2005	2	1	1.78
2005	2005	2	2	1.78
2005	2005	3	1	1.78
2005	2005	3	2	1.78
2005	2005	4	2	0.00
2005	2005	5	2	0.00
2005	2005	6	2	0.00
2006	2010	1	1	0.85
2006	2010	1	2	1.22
2006	2010	2	1	1.49
2006	2010	2	2	1.49
2006	2010	3	1	1.49
2006	2010	3	2	1.49
2006	2010	4	2	1.23
2006	2010	5	2	1.23
2006	2010	6	2	0.00
2011	2015	1	1	1.22
2011	2015	1	2	1.20
2011	2015	2	1	0.00
2011	2015	2	2	0.00
2011	2015	3	1	0.00

2011	2015	3	2	0.00
2011	2015	4	2	0.00
2011	2015	5	2	0.00
2011	2015	6	2	0.00
2016	2020	1	1	1.48
2016	2020	1	2	1.24
2016	2020	2	1	0.00
2016	2020	2	2	0.00
2016	2020	3	1	0.00
2016	2020	3	2	0.00
2016	2020	4	2	0.00
2016	2020	5	2	0.00
2016	2020	6	2	0.00

NON_FUEL_VOC

*veh_type	a_nonfuel_wrk	b_nonfuel_wrk	a_nonfuel_nw	b_nonfuel_nw
1	6.310	172.840	4.890	0.000
2	0.000	0.000	7.280	0.000
3	7.280	73.050	0.000	0.000
4	14.820	224.590	0.000	0.000

NON_FUEL_VOC_CHANGES

*% p.a.

*Start_yr	End_yr	veh_type	gnf
2003	2080	1	0.000
2003	2080	2	0.000
2003	2080	3	0.000
2003	2080	4	0.000
2003	2080	5	0.000
2003	2080	6	0.000

NON_FUEL_TAX_RATES

*%

*submode	final	intermediate
1	21.0	0.0
2	21.0	0.0
3	21.0	0.0
4	21.0	0.0
5	21.0	0.0

NON_FUEL_TAX_RATES_CHANGES

*% change p.a.

*Start_yr	End_yr	Submode	final	intermediate
2003	2008	1	0.0	0.0
2003	2008	2	0.0	0.0
2003	2008	3	0.0	0.0
2003	2008	4	0.0	0.0
2003	2008	5	0.0	0.0
2003	2008	6	0.0	0.0
2009	2009	1	2.38	0.0
2009	2009	2	2.38	0.0
2009	2009	3	2.38	0.0
2009	2009	4	2.38	0.0
2009	2009	5	2.38	0.0
2009	2009	6	2.38	0.0
2010	2010	1	-2.33	0.0
2010	2010	2	-2.33	0.0
2010	2010	3	-2.33	0.0
2010	2010	4	-2.33	0.0

2010	2010	5	-2.33	0.0
2010	2010	6	-2.33	0.0
2011	2012	1	0.0	0.0
2011	2012	2	0.0	0.0
2011	2012	3	0.0	0.0
2011	2012	4	0.0	0.0
2011	2012	5	0.0	0.0
2011	2012	6	0.0	0.0
2013	2013	1	4.76	0.0
2013	2013	2	4.76	0.0
2013	2013	3	4.76	0.0
2013	2013	4	4.76	0.0
2013	2013	5	4.76	0.0
2013	2013	6	4.76	0.0
2014	2014	1	4.55	0.0
2014	2014	2	4.55	0.0
2014	2014	3	4.55	0.0
2014	2014	4	4.55	0.0
2014	2014	5	4.55	0.0
2014	2014	6	4.55	0.0
2015	2080	1	0.0	0.0
2015	2080	2	0.0	0.0
2015	2080	3	0.0	0.0
2015	2080	4	0.0	0.0
2015	2080	5	0.0	0.0
2015	2080	6	0.0	0.0

DEFAULT_PURPOSE_SPLIT

*Vtype/submode	purpose	Period1	Period2	Period3	Period4	Period5
1	1	11.0	11.0	22.0	10.0	10.0
1	2	58.0	58.0	20.0	32.0	32.0
1	3	31.0	31.0	58.0	58.0	58.0
2	1	0.0	0.0	0.0	0.0	0.0
2	2	0.0	0.0	0.0	0.0	0.0
2	3	100.0	100.0	100.0	100.0	100.0
3	1	100.0	100.0	100.0	100.0	100.0
3	2	0.0	0.0	0.0	0.0	0.0
3	3	0.0	0.0	0.0	0.0	0.0
4	1	100.0	100.0	100.0	100.0	100.0
4	2	0.0	0.0	0.0	0.0	0.0
4	3	0.0	0.0	0.0	0.0	0.0
5	1	100.0	100.0	100.0	100.0	100.0
5	2	0.0	0.0	0.0	0.0	0.0
5	3	0.0	0.0	0.0	0.0	0.0
6	1	15.0	15.0	11.0	11.0	11.0
6	2	53.0	53.0	25.0	25.0	25.0
6	3	32.0	32.0	64.0	64.0	64.0

DEFAULT_PERSON_FACTORS

*Vtype/submode	purpose	person_type	FactorPer1	FactorPer2..		
1	1	1	1.00	1.00	1.00	1.00	1.00
1	1	2	0.33	0.33	0.20	0.20	0.20
1	2	1	1.00	1.00	1.00	1.00	1.00
1	2	2	0.34	0.34	0.13	0.13	0.13
1	3	1	1.00	1.00	1.00	1.00	1.00
1	3	2	0.83	0.83	0.79	0.79	0.79
2	2	1	1.00	1.00	1.00	1.00	1.00
2	2	2	0.59	0.59	0.62	0.62	0.62
2	3	1	1.00	1.00	1.00	1.00	1.00

```
 2          3          2          0.56       0.56       0.62       0.62       0.62
 3          1          1          1.00       1.00       1.00       1.00       1.00
 3          1          2          0.36       0.36       0.22       0.22       0.22
 4          1          1          1.00       1.00       1.00       1.00       1.00
 4          1          2          0.18       0.18       0.16       0.00       0.00
 5          1          1          1.00       1.00       1.00       1.00       1.00
 5          1          2          0.08       0.08       0.08       0.00       0.00

DEFAULT_PERSON_FACTORS_CHANGE
*% change p.a.
*Start_yr       End_yr       Submode   Purpose   Person_type   ChangePer1   ChangePer2   ChangePer3
ChangePer4 ChangePer5
2003       2036       1         1         2         0.00       0.00       0.00       0.00       0.00
2003       2036       1         2         2         0.00       0.00       0.00       0.00       0.00
2003       2036       1         3         2         0.00       0.00       0.00       0.00       0.00


PREPARATION&SUPERVISION
* total preparation (by stage) and supervision costs as % of land and construction costs
*Mode   *Prep:SI   Prep:PC   Prep:PR   Prep:OP   Prep: WC   Super
 1         0.5        0.5        1.5        5.0        5.5        5.0
 2         0.5        0.5        1.5        5.0        5.5        5.0
 3         0.5        0.5        1.5        5.0        5.5        5.0
```

2 COBA parameters

Values of accidents

2.1 All values in Euro. Values in 2002 prices.

Table 2.1 Cost per injury/fatality

Accident Types	Resource costs per casualty
Fatal	1,694,481
Serious Injury	190,400
Minor injury	14,681
Damage only	Not applicable

Source: NRA Appraisal guidance. March 2008 Table 4

Table 2.2 Cost per accident

	Insurance Admin	Damage to Property			Gardai Cost			Total		
		Urban	Rural	Mway	Urban	Rural	Mway	Urban	Rural	Mway
Fatal accident	312	8,103	13,741	17,480	1,983	1,880	2,752	10,398	15,933	20,544
Serious accident	194	4,342	6,263	14,915	165	462	434	4,701	6,919	15,543
Minor accident	118	2,562	4,153	7,546	60	60	60	2,740	4,331	7,724
Damage only	57	1,833	2,737	2,631	4	4	4	1,894	2,798	2,692

Source: NRA Appraisal guidance. March 2008 Table 4

Table 2.3 Values of accidents growth factors

From	To	Growth in value per annum
2002	2010	2.70%
2011	2015	2.37%
2016		2.29%

Source: NRA Appraisal guidance. March 2008 Table 9
Also: DoT CAF June 2009 p53

Accident rates

Table 2.4 Link & junction combined accident rates (2000 Base)

Accident type	Road type	<60 kph	>=80 kph
		PIA/mvkm	
1	Motorways		0.037
4	S2	0.478	0.142
10	Dual carriageways	0.124	0.094
11	2+1 with reserve	0.368	0.107
5	2+1 no reserve	0.419	0.125
8	1 Way	0.110	

Source: NRA Appraisal guidance March 2008 Appendix 6 Table 18

Table 2.5 Accident rate change factors

	β factors
2001	0.955
2011	0.9775
2021	0.98875
2031	1

Source: NRA Appraisal guidance. March 2008 Table 21

2.2 As per the HEATCO guidelines, the serious and minor accident rates that are contained in the tables above (and hence proportions) are increased to reflect accident under-reporting:

Table 2.6 Accident rate and proportion uplifts

Casualty severity	Fatal	Serious	Minor
Uplift	1	1.5	3

Source: NRA Appraisal guidance March 2008 Appendix 8 Para. 2.1.24

Casualty rates

Table 2.7 Link & junction combined casualties (2000 Base)

Accident type	Casualty severity	Fatal		Serious		Minor	
1	Motorways	0.09		0.169		1.253	
	Speed limit	<60 kph			>=80 kph		
	Casualty severity	Fatal	Serious	Minor	Fatal	Serious	Minor
4	S2	0.049	0.237	1.241	0.116	0.396	1.354
10	Dual carriageways	0.032	0.107	1.359	0.074	0.193	1.375
11	2+1 with reserve	0.032	0.107	1.359	0.074	0.193	1.375
5	2+1 no reserve	0.049	0.237	1.241	0.116	0.396	1.354
8	1 Way	0.027	0.233	1.151			

Source: NRA Appraisal guidance March 2008 Table 20

Table 2.8 Casualty rate change factors

	<60 kph			>=80 kph		
	Fatal	Serious	Minor	Fatal	Serious	Minor
β factors	0.997	0.968	1.001	0.997	0.968	1.001

Source: NRA Appraisal guidance March 2008 Table 21

2.3 Guidance on the application of the UK COBA appraisal programme to the Irish context does not provide values for the number of damage-only accidents per personal injury accident – owing to a lack of data in this area. These values are left unchanged from UK COBA, and are therefore:

Table 2.9 Number of damage only accidents per personal injury accident

Urban	Rural	Motorway
17.7	7.8	7.6

Source: COBA Manual June 2006 Vol13 Section 1 Pt.2 Ch.3 table 3/1

Accident proportions

Table 2.10 Link and junction combined accident proportions (2000 Base)

Accident type	Casualty severity	Fatal		Serious		Minor	
1	Motorways	0.06		0.133		0.807	
	Speed limit	<60 kph			>=80 kph		
	Casualty severity	Fatal	Serious	Minor	Fatal	Serious	Minor
4	S2	0.045	0.173	0.783	0.097	0.246	0.657
10	Dual carriageways	0.032	0.088	0.88	0.068	0.149	0.784
11	2+1 with reserve	0.032	0.175	0.793	0.069	0.254	0.677
5	2+1 no reserve	0.051	0.172	0.777	0.11	0.242	0.648
8	1 Way	0.027	0.205	0.767			

Source: NRA Appraisal guidance March 2008 Appendix 6 Table 19