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Asset Valuation (Roads) – Summary Report

AM-GEN-00002
July 2021




Prepared by Pavement Management Services Ltd. & Staveley & Partners

AM Asset Management & Maintenance

Technical

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TII Publications

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List of Abbreviations

BI - Business Intelligence

CIPFA - Chartered Institute of Public Finance and Accountancy

DRC - Depreciated Replacement Cost

GRC - Gross Replacement Cost

HAMFIG - Highways Asset Management Financial Information Group

IMF International Monetary Fund

LA – Local Authority

MMaRC - Motorway Maintenance and Renewals Contract

OSI - Ordnance Survey Ireland

PMS – Pavement Management Services

PPP - Public Private Partnership

PS&D - Planning Supervision and Design

RMP - Requirements for Measuring and Pricing

TII – Transport Infrastructure Ireland

VAT – Value Added Tax

VC - Video Conference

Executive Summary

Following the recommendation of an International Monetary Fund (IMF) report on Irish Public Asset Management in 2017, PMS on behalf of Transport Infrastructure Ireland were tasked with the development of a comprehensive Asset Inventory and related Asset Valuation for the TII Networks. The scope of this project included all components of the TII Road Network, regardless of legal ownership i.e. all roadways and associated roadway assets including land, pavements, structures, ITS, signs, road markings, drainage etc.

Some of the key methodologies applied in the valuation exercise were originally incepted at an early stage of the inventory phase and further developed to support the two processes. A key development was an appropriate structure of inventory data to enable componentisation of assets for effective use in valuation. Efficiency and effectiveness objectives were achieved, firstly in the appropriate structuring and alignment of datasets, and secondly in the relationship of asset subcomponents such as age, type and condition to unit rates in the subsequent valuation phase. The methodology used in the application of rates, as described in this report, were developed to align with the IMF recommendation of asset valuation and depreciation being utilised as a tool within asset management.

Following the successful development and implementation of a comprehensive asset inventory for the TII road network, up to end of 2019, an exercise was undertaken to derive a Gross Replacement Cost (GRC). PMS in conjunction with project partners Staveleys undertook a valuation exercise which involved building unit rates for each of the assets collated in the inventory exercise and grouping together under main headings in line with best international practice. All rates applied were then subject to review by project partners Hyperion, based in the UK.

The GRC was derived using a combination of methods including composite or individual element rates and base rates for construction activities including all factors typically included in unit rates such as Contractor's overheads and profit but exclusive of VAT. The following elements were considered in the derivation of the GRC valuation methodology: Carriageways, Structures including Major Bridges and Tunnels, Technology / ITS, Buildings & Toll Plazas, Planning Supervision and Design (PS&D), Other Costs and Land.

Rates were obtained by the following methods:

- Composite rate build-up to align with dataset using typical market unit rates related to the element scope, e.g. some composite rates involved a 1st and 2nd measure or more
- Individual rate calculations based on first principle rate build-up
- Benchmarked rates using the TII Unit Rate Database
- Consultation with trade specialists on market rates
- Benchmarking of rates using data from recent projects
- Benchmarking of rates using data from historic projects adjusted for inflation
- Use of industry data and cost reports on typical building and site development costs

These composite or individual rates were calculated to form a base or "Leinster" rate for a particular asset. As construction costs can vary throughout the country, a regional factors table was compiled and the regional factors were applied to the final Leinster base rates for each asset element to calculate the appropriate corresponding regional rates.

Each base rate includes for key elements and are nett of a range of base cost uplifts required to give full construction cost coverage including ancillary costs for works which are not included for within the key asset element base rate.

Other uplifts to the base rates include preliminaries, detailed design, supervision and risk. An overview of the Asset Valuation methodology and implementation is presented in Chapters 2 and 3.

A total GRC valuation of €31.0 billion was derived from the valuation methodologies applied. To align with previous GRC exercises the total valuation was broken out into seven main headings, Carriageway & Earthworks, Structures, Major Structures, Land, Drainage, Other Assets, and Utilities & Accommodation Works.

The project team developed a reporting dashboard for the inventory data using Tableau software, a business intelligence (BI) tool used for various dynamic reporting purposes. The dashboards have the capability of reporting asset values at various levels such as Region, Local Authority, Route, Subnetwork, Maintaining Authority, Maintaining Authority Network and enable a hierarchy of reporting data to be viewed in both tabular and spatial format. A copy of this Tableau dashboard is available to TII for review and future consultation. A summary of the Tableau reporting results is presented in Chapter 4. The project team also developed a web portal on ArcGIS online for sharing the valuation information.

A number of positive outcomes were achieved in the application of innovative solutions to challenges encountered throughout the valuation phase of the project. A summary of these challenges and solutions as well as a review of objectives, conclusions and recommendations is outlined in Chapter 5.

1. Introduction

PMS on behalf of Transport Infrastructure Ireland were tasked with the development of a comprehensive Asset Inventory and related Asset Valuation for the TII Networks. The following report summarises the work carried out to deliver a Gross Replacement Cost for the network, presents the key results or findings and makes recommendations on the next steps and way forward.

1.1 Background

The International Monetary Fund (IMF), in their 2017 report entitled 'Ireland – Public Sector Investment Management' recommended that Ireland should establish a Central Register of Infrastructure Asset valued at either book (initially) or (ultimately) market value, in order to facilitate effective management of these assets.

In order to enhance visibility over the management of the assets which make up the Network, and in support of further development of a cohesive maintenance strategy, with ongoing attention on demonstrating accountability and value for money in relation to expenditure on the Network, PMS on behalf of TII were tasked with developing a comprehensive Asset Inventory Register. This register includes all key components of the National Road Network, regardless of where the legal ownership resides (TII, Local Authority or Private Contractor).

1.2 Scope of Work

The scope of this project includes all components of the Road Network i.e. all roadways and associated roadway assets including land, pavements, structures, ITS, signs, road markings, drainage etc.

The key outcomes of the project were to develop;

- A central register of infrastructure assets
- A valuation mechanism for assigning Gross Replacement Costs (GRC) to all of the assets
- An approach to depreciation of the GRC reflecting market value or fair value of the assets and incorporating condition of the assets in the depreciation mechanism where this information is available
- A standard methodology to assess asset performance levels
- A tool to assist in demonstration of asset governance and value vs investment profile
- Capability to report asset inventory and asset valuation on a route by route basis
- Capability to report asset inventory and asset valuation for each local authority
- Capability to report asset inventory and asset valuation on a subnetwork basis

1.3 Tasks & Deliverables

The following is an overview of the tasks and deliverable requirements relating to the GRC element of this project

Tasks

- Review of Existing Valuation Rates including rates used in CIFRA approach and rates used in 2012 National Roads Network Valuation Report
- Adjustment to 2019 asset valuation unit rates for Ireland
- Application of 2019 rates to Asset Inventory to determine GRC

Deliverables

- Unit rates for Asset Valuation based on Irish conditions in 2019
- Asset Valuation for National Road network based on Gross Replacement Cost (GRC)
- GRC Asset Valuation on a route by route basis
- GRC Asset Valuation on a local authority basis

1.4 TII Network

The TII road network consists of c. 5300km, of which c.4000 km is managed and maintained by 31 local authorities. Over 800 km is operated and maintained by Contractors via the Motorway Maintenance and Renewals Contract (MMaRC) which is broken out into three networks, A, B and C, and c.400km is operated and maintained by Public Private Partnership (PPP), see Figure 1 below.

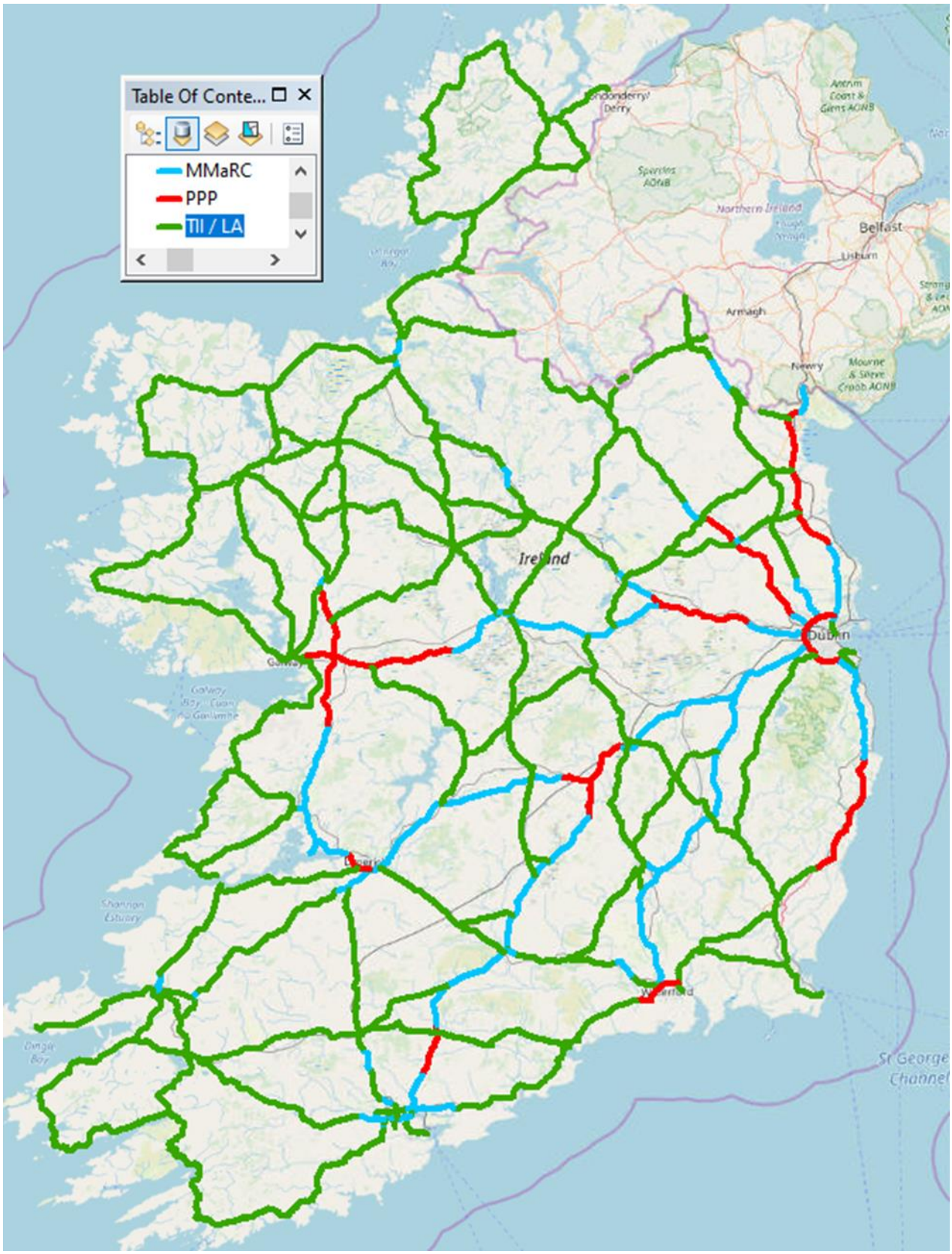


Figure 1 TII Network

From a pavement asset management perspective, the road network is grouped into 5 subnetworks which are largely based on the functional characteristics and strategic importance of the road itself, see Figure 2 below.

Subnet 0 – Motorway and Dual Carriageway Network – c.1200km

Subnet 1 – Engineered Single Carriageway - c.1200km

Subnet 2 – Urban Areas – c.700km

Subnet 3 – Legacy Pavement High Traffic – c.1250km

Subnet 4 – Legacy Pavement Low Traffic – c. 1000 km

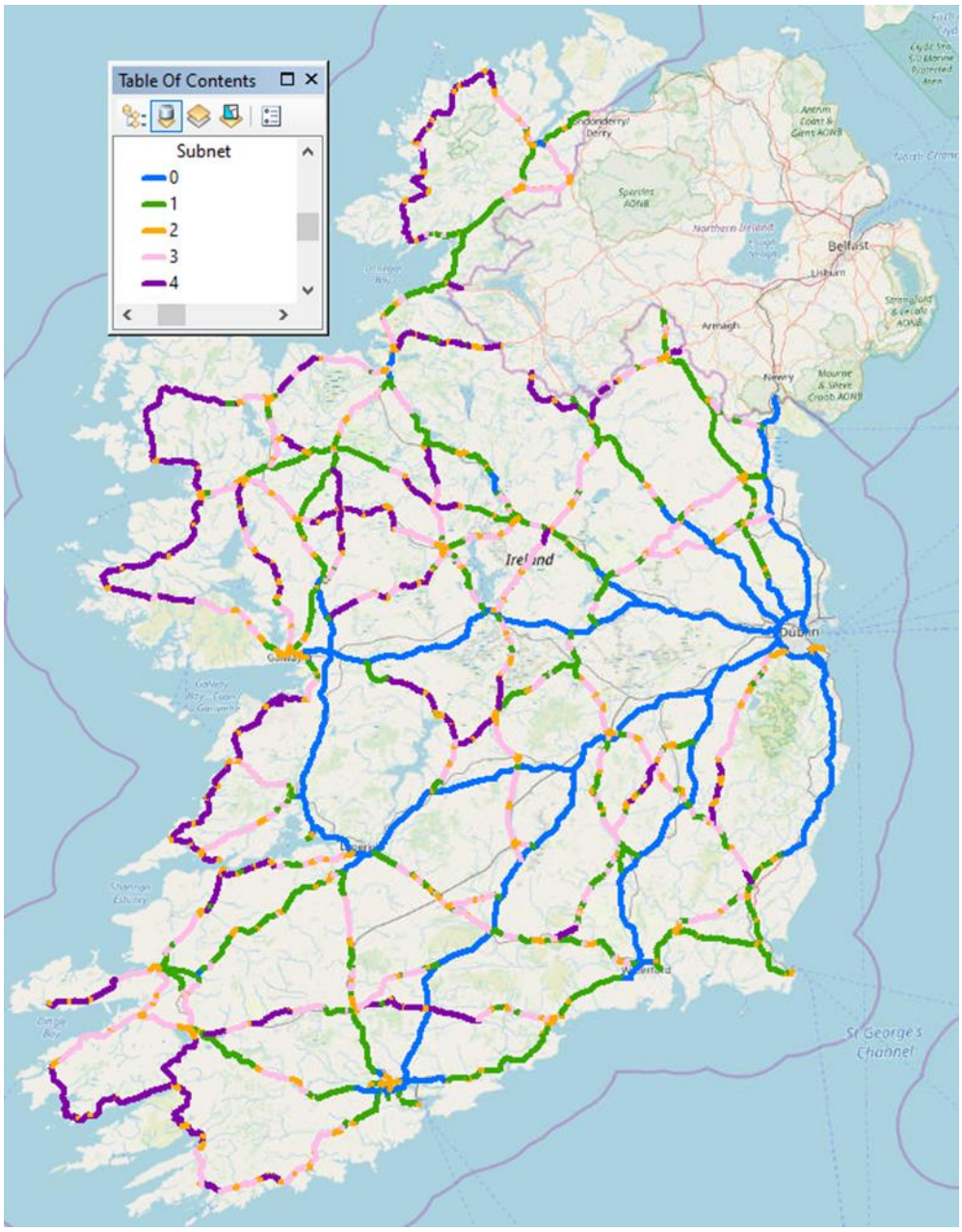


Figure 2 TII Subnetwork

1.5 Correspondence & Meetings

A summary of key correspondence and meetings relating to the Asset Valuation brief are noted as follows:

1.5.1 Pre-consultation Meetings

Pre-consultation meetings were held between PMS, Aptech and TII in January 2019 at (TRB) Transportation Research Board Conference Washington. A follow up progress meeting was held between PMS and TII later in January 2019.

1.5.2 Kick off Meeting with TII Stakeholders

An introductory meeting was held in March 2019 at TII attended by various key stakeholders from TII, PMS, Hyperion, KPMG and Arup. A presentation was made by PMS and Hyperion outlining the overall background, scope, purpose, and expected benefits of the project. A review of International practice from the UK and US was also presented. A discussion was held with regard to the timeline involved and the tasks required to deliver the project successfully.

1.5.3 Summary of Other Correspondence

The following is a synopsis of other correspondence relating to the asset valuation brief and noted in chronological order:

- A progress meeting was held in May 2019 between TII and the Asset Valuation project team, i.e. PMS, Staveleys, Hyperion, Aptech, KPMG, at TII offices. Discussions were aimed mainly around the valuation procedure to be adopted going forward and the suitability of various different approaches adopted internationally such as the Chartered Institute of Public Finance and Accountancy (CIPFA) approach. An update on asset data collated was presented in spatial and tabular format on which a follow up discussion was held around applicable unit rates.
- A progress meeting was held in July 2019 between TII and PMS at TII offices Parkgate Street.
- A meeting was held between the PMS, Staveleys and TII Land Valuation team in September 2019 at TII Offices Parkgate Street in relation to the TII land assets and the potential interactions with TII resources on this project.
- Various forms of correspondence, feedback and reviews have taken place between the project team and TII relating to a report carried out by KPMG on the “Review of accounting considerations in relation to the creation and maintenance of a Shadow Asset Register”.
- Correspondence between the project team and TII has taken place with regard to a report carried out by Hyperion on “Current Asset Valuation Practices and Effectiveness Measures and Value for money”.
- A presentation on the project was made by the TII project manager at a TII board meeting in New Ross, County Wexford in September 2019.
- A presentation on the project was made to former TII Chief Executive Michael Nolan and TII Network Management Director Pat Maher in November 2019.
- A Video Conference (VC) meeting to discuss land value was held between TII, PMS, Staveleys and Lisneys on 12 March 2020 to review base rates exercise and compare to CPO value.
- A VC Progress meeting was held on 24 March 2020 between PMS and TII to discuss overall progress on GRC

- A series of follow up meetings relating to Land valuation were held between the project team, TII and Lisneys over the course of 2020 in order to develop a set of appropriate adjustment factors to apply to base rates to generate a fair estimate of land value.
- A presentation on the Asset Inventory and Valuation project was delivered at the TII Network Management Webinar in January 2021.
- A presentation on the Asset Inventory and Valuation project was made to TII Chief Executive Peter Walsh and TII Network Management Director Pat Maher in March 2021.

2. Asset Valuation Methodology

2.1 Development Approach

The approach used to calculate the value of an asset must be repeatable and consistent to meet accounting rules and audit regimes. Applying these principles to the fundamental data for road assets ensures that it is fit for reporting the value of the asset, and also provides high quality information to support the management of the assets.

Within accounting, depreciation is used to provide a measure of the cost of the economic benefits embodied in an asset that have been consumed during the accounting period. It can be assessed in various ways. For long-life public sector infrastructure, an appropriate measure is what needs to be spent to maintain the asset in a stable condition.

An historical cost-based approach to valuing highway infrastructure assets may be used as a starting point. However, this approach is not a good basis for dealing with assets that have very long lives. It provides some information about what is being spent on the assets, but not about the effect the ongoing maintenance expenditure has on the condition of the assets or how well it matches spending needs. A more advanced approach is Gross Replacement Cost (GRC), based on the cost of constructing an equivalent new asset. Depreciated Replacement Cost (DRC) is a method of valuation that estimates deductions for deterioration and impairment. The difference between the Gross and Depreciated Replacement Cost is the cost of restoring the asset from its present condition to “as new” condition. This report outlines the approach taken to derive a GRC for the National Road Network.

2.2 Asset Valuation Module

Asset Valuation translates infrastructure conditions into monetary terms as public wealth or equity. Depreciation captures the loss to public wealth as assets age and deteriorate. Valuation and depreciation help portray infrastructure as part of the public’s “portfolio of wealth” that merits sound management, investment and preservation.

Traditionally, government assets were valued on a historic cost basis, but this has been superseded in recent years by methods such as Gross Replacement Cost (GRC) and Depreciated Replacement Cost (DRC). Applying these methods to the fundamental data for road assets ensures that it is fit for reporting the value of the asset, and also provides high quality information to support the management of the assets.

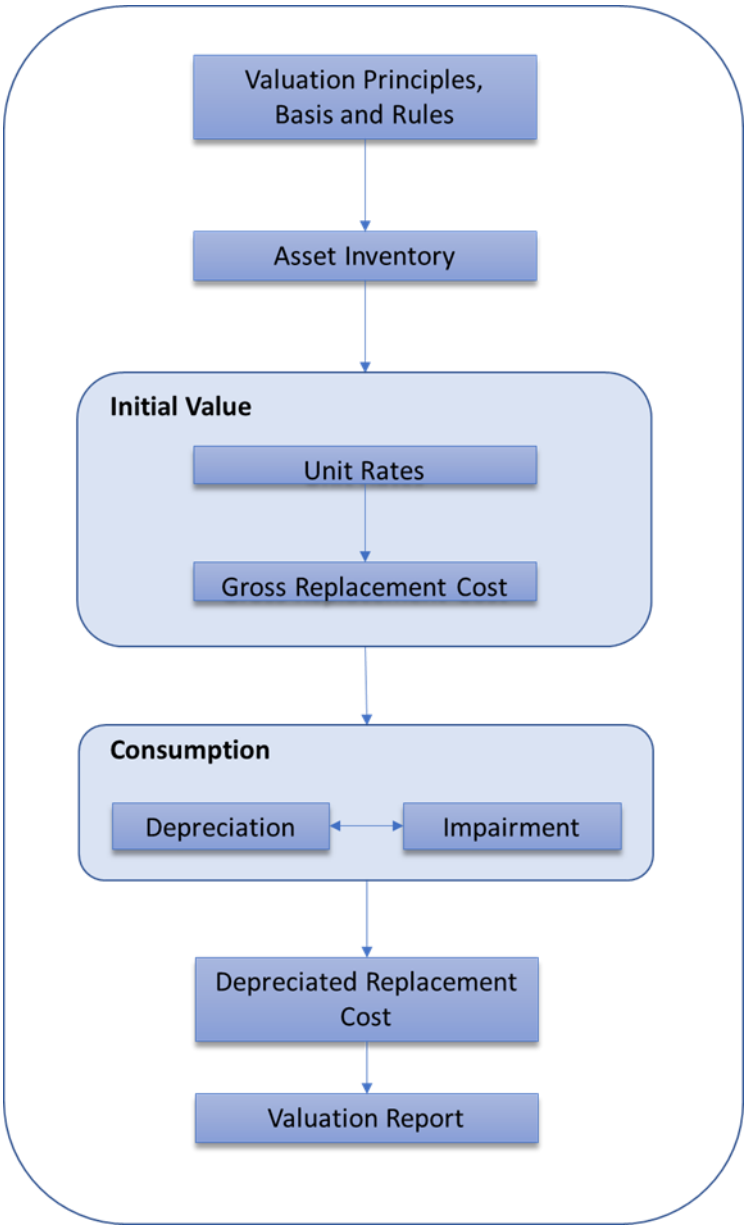


Figure 3 Asset Valuation Methodology

An historical cost-based approach to valuing highway infrastructure provides some information about what is being spent on the assets, but not about the effect the expenditure has on the condition of the assets or how much it matches spending needs. Hence for TII and other road authorities the depreciated replacement cost approach is more aligned with engineering performance methodologies.

The historic cost method values assets based on their original cost, whereas the GRC method determines value based on the cost of replacing or rebuilding the asset today. The DRC method provides the current cost of replacing an asset with its modern equivalent asset, less deductions for all physical deterioration and impairment. An outline of the typical approach to utilisation of engineering and financial management techniques in an asset management system is illustrated below in Figure 4.

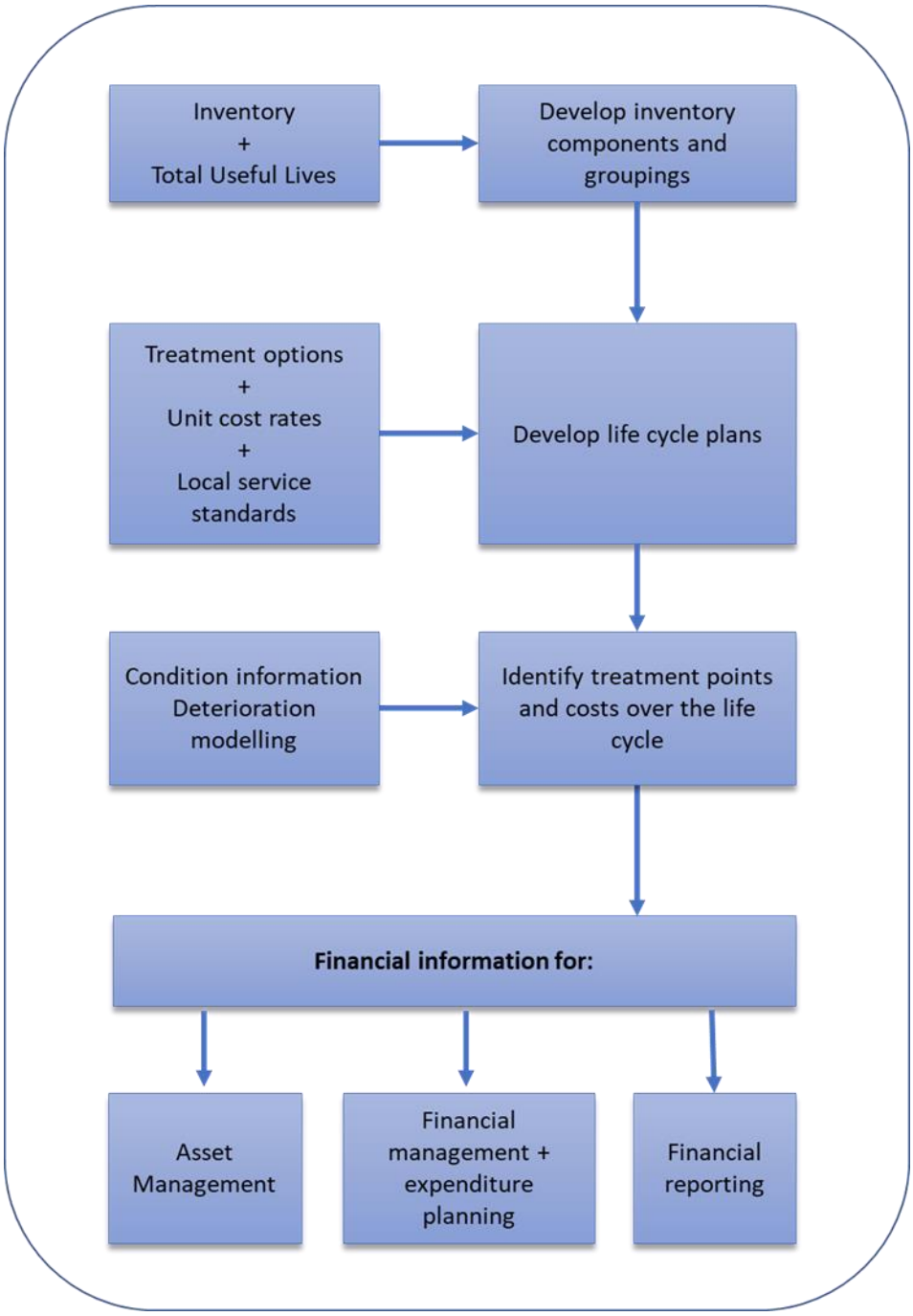


Figure 4 CIPFA Asset Valuation Flowchart

The flowchart is based on UK, CIPFA (Chartered Institute of Public Finance and Accountancy) and HAMFIG (Highways Asset Management Financial Information Group) standards for declaring asset valuation.

The DRC method is generally considered as more aligned with good asset management because the planning of expenditure for maintenance and renewal works on a network is driven by condition, aligned with performance standards set according to strategic objectives.

To comply with International Accounting Standards, an asset should be broken down into identifiable components when they have different useful lives. This means breaking assets down into their key parts but not necessarily separately identifying and accounting for every individual element.

Components need to be distinguished in terms of those that have a finite life, at the end of which they will be replaced, and those that, given appropriate capital maintenance (replacement of subcomponents), will last indefinitely.

Ideally assets need to be grouped in a consistent manner so data can be aggregated for regional or national purposes, to enable tracking of performance over time and facilitate benchmark performance against other organisations. Once a reliable and comprehensive asset inventory is in place, a Gross Replacement Cost (GRC) valuation can be quickly implemented.

A report assessing the advantages and disadvantages of various valuation methodologies such as CIPFA and other accounting standards was compiled by KPMG and issued to TII in Feb 2020.

3. Implementation of GRC Valuation Methodology

3.1 Overview

The focus of this section is in relation to the valuation methodology of the following elements of the GRC, namely:

1. Carriageways
2. Structures including Major Bridges and Tunnels
3. Technology / ITS
4. Buildings & Toll Plazas
5. Planning Supervision and Design (PS&D)
6. Other Costs
7. Land

With the exception of the Major Structures and the Buildings, the GRC for the first four elements was valued using composite or individual element rates – base rates for construction activities including all factors typically included in unit rates including Contractor's overheads and profit but exclusive of VAT.

These composite or individual rates were calculated to form a base or "Leinster" rate for a particular asset. The methods of valuation used to achieve this base rate are:

- Direct valuation of the asset element provided using a market unit rate
- Composite rate build-up to align with dataset using typical market unit rates related to the element scope, e.g. some composite rates involved a 1st and 2nd measure or more
- Individual rate calculations based on first principle rate build-up
- Benchmarked rates using the TII Unit Rate Database
- Consultation with trade specialists on market rates
- Benchmarking of rates using data from recent projects
- Benchmarking of rates using data from historic projects adjusted for inflation
- Use of industry data and cost reports on typical building and site development costs
- Use of the ITS Asset Value Book Version 4.4 as a basis for valuing the ITS

Additionally, cumulative totals for all elements were benchmarked against the following:

- Gross asset cost per kilometre benchmark based on a range of recently completed projects
- Gross asset cost per kilometre using the TII Cost Metric dated March 2019

Recognising that construction costs can vary throughout the country, a regional factors table has been compiled and the factors applied to the final Leinster base rates for each asset element to calculate the appropriate corresponding regional rates. These factors are used to provide a reasonable level of adjustment to account for regional variations. The factors applied were based on rate comparisons from various projects around the country along with consultation with trade specialists in relation to factors that drive regionalised variances.

Each base rate includes for key elements and are net of a range of base cost uplifts required to give full construction cost coverage including ancillary costs for works which are not included for within the key asset element base rate. Other uplifts to the base rates include preliminaries, detailed design, supervision and risk.

Using lighting as an example, e, the base rate is for the supply and installation of the lighting column while an ancillary on-cost for public lighting covers the civils works associated with the lighting column installation, Preliminaries cover typical main contractor and/or specialist preliminary site costs. Design and supervision cover either detailed employer design or any contractor and/or specialist design and supervision costs. The risk percentage covers for additional scope outside the key elements including risk associated with methods, seasonal working and employer risk under typical construction contracts. These uplift percentages vary depending on the asset element, e.g., the risk percentage addition for the earthwork's valuation is set higher than that of fencing as there is a greater risk of unforeseen events occurring when designing and carrying out earthworks.

The detailed approach and methodology for carrying out the valuation of the individual assets is set out below.

3.2 Carriageway Valuation Methodology

The carriageway asset in this valuation section is sub-divided into the following asset types. These are scheduled as follows in descending value order.

Table 1 List of assets in the Roads GRC

3.2.1	Pavement Macadam & Granular
3.2.2	Earthworks
3.2.3	Drainage
3.2.4	Ducting
3.2.5	Safety Barrier
3.2.6	Landscaping
3.2.7	Public Lighting
3.2.8	Signs
3.2.9	Roadmarkings
3.2.10	Noise Barrier
3.2.11	Gantries
3.2.12	Fencing
3.2.13	Site Clearance
3.2.14	Kerbs & Footways
3.2.15	Safety Bollards
3.2.16	Utilities & Accommodation Works
3.2.17	Pedestrian Guardrails

The measurement and pricing of employer designed projects is carried out in accordance with the TII method of measurement, which is titled: Requirements for Measuring and Pricing (referred to as the RMP). The RMP contains an index of road elements that align with the above list of elements. The asset data provided was presented in a similar fashion to the level 3 category headings in the RMP index. This enabled the basis of the rate build ups and the sanity check on rates to align where possible with the measurement and pricing rules in the TII RMP.

3.2.1 Pavement Macadam and Granular Sub-Base

The datasets for the bound pavement layers contain cubic meter quantities which were derived from the pavement widths and depths inventory dataset. The pavement rate build-up was derived using market rates for macadam layers, i.e. base, binder and surface layer to give an overall combined rate in cubic meters. This rate was then applied to the volume of each 100m pavement segment. As per the Earthworks and all other carriageway assets, the base cost uplifts are then applied to the base rates producing an overall rate per cubic meter of macadam. Rates have been checked against recent road projects in the Leinster area and with suppliers in the market. This Leinster Rate Area is used in the GRC and the various regional weightings are applied. The same methodology is applied to the granular sub-base rate.

3.2.2 Earthworks

The earthworks dataset consists primarily of two volumes – a cut and a fill volume – and hence requires two composite rates, a “cut” rate and a “fill” rate.

The cut composite rate is made up of and includes for excavation, topsoil strip, dealing with hard material and disposal of surplus / unacceptable material. The surplus disposal proportion is based on the overall dataset volumes. A provision for treatment below formation level is also included in the rate. These various allowances are then brought together to form a composite base rate to which the base cost uplifts are then applied. To avoid repetition in this document all rates, unless otherwise stated, include for these uplifts. This provides a rate to be incorporated to the dataset quantity where in turn the regional factors are then further apportioned to give the overall GRC value of the earthworks “cut”.

The fill composite rate follows a similar methodology, i.e., allowances for processing, deposition, compaction, capping and sub-formation treatments are used to form the overall composite base rate. This provides a rate to be incorporated to the dataset quantity where regional factors are then also apportioned to give the overall GRC value of earthworks “fill”. Note to avoid repetition of effort and to ensure consistency, all rates, unless otherwise stated, have regional weightings applied in the overall GRC value per asset.

The overall rates used in the build up to the base rates are checked and benchmarked against various projects and the TII Road Type Cost Metric dated March 2019. These checks confirm the rates used are a reasonable estimate of the current cost of completing the work in question.

3.2.3 Drainage

The drainage rates were also calculated using a similar methodology. However, this was refined to incorporate a mixture of the valuation of the actual data received and then to make assumptions on “hidden” or unknown data or assets that are below ground and were not possible to be captured or georeferenced. Examples of the “hidden” data include attenuation ponds, headwalls, penstocks, culvert crossings, petrol interceptors and over the edge drainage.

The rated assets (available data) include concrete channels, filter and carrier drains, manholes and gullies. Some assets have a standard construction and therefore a single rate is used to value these assets, e.g., concrete channels. Other assets can vary in size, depth and type, e.g., manholes, gullies and drains. In those variable instances, the base rate-build up assumed various types of each asset that is typically specified.

The average of these rates is used to get to a reasonable composite base rate per manhole, gully and drain. The rates incorporated into the composite build-up were checked against recent projects as a market check and found to be reasonable in comparison.

For the “hidden” data, assumptions are made as to the quantity per km of these items and they are valued accordingly using the same methodology. These assumptions are based on projects similar in scale for each of the sub-networks. For example, attenuation ponds are excluded from SN2, 3 and 4 but are in included in the rate build up for SN0.

The rate per km for drainage for each subnet is therefore made up of the combined value of the data and the value of the “hidden” data. Overall rates applied are cross checked against recent projects which confirm the rates per KM used are reasonable market rates.

3.2.4 Ducting

A typical estimate of the scope of ducting for each sub-net was prepared and then a base rate is applied against this scope and ducting type. This base rate is a composite rate taking account of the ducting type with an allowance for chambers. As expected, the Subnet 0 network makes up the majority of the ducting GRC as it is assumed that ducting is in place across the entire sub-network. A smaller percentage length of ducting has been assumed on Subnets 1 and 2. Subnet 3 and 4 are excluded from this dataset as no ducting is envisaged in these carriageways.

3.2.5 Safety Barrier

The dataset specified various barrier types and these were refined to three types of barrier: Steel, Concrete and Wire Rope. The concrete barrier and wire rope type barrier are both consistent in type and size. The rates derived for the concrete barrier and wire rope are therefore single base rates. Steel barriers can vary based on impact severity and containment level; the derived rate for the steel barrier is therefore an average rate taking account of the various typical types of steel barrier. The rates used are checked against recent projects and with specialist suppliers.

3.2.6 Landscaping

A similar method is used on the Landscaping asset to that applied to the ducting asset, i.e. assumed scope for the quantities of seeding, planting and hedging per KM and the market rates against these items are used to form a base rate per KM of carriageway.

3.2.7 Public Lighting

Contacts were made with specialist sub-contractors and based on market consultation; the dataset is split into four different lighting categories based on lighting column heights. Four different rates for these different column lighting height categories, including provision for ancillary items, are compiled. These are, Columns less than 10m, Columns 11 to 15m, Masts 16 to 20m and High Masts greater than 20m. Base rates are then checked with the market and an allowance for trenching and ducting added to the base rates. Base cost uplifts are then applied to arrive at the final rates.

3.2.8 Signs

The signs asset data contains two sets of data. The first set of data is where sign face areas are available (almost 110,000 assets) and the second set of data is where only the sign count is available (sign count data is the MMaRC’s and PPP proxy). Two rates are therefore compiled and used to form the GRC: the rate per square area of sign face and an average individual rate per sign. These composite rates were checked against the market and they reflect market rates and recent projects. It should be noted that the composite rate per sign assumes that 15% of the signs within the MMaRC’s and the PPP’s are regulatory signs, i.e. standard signs from the Traffic Signs Manual, and the remaining 85% are larger directional and/or information signs. The composite rate per sign is built up based on this scope.

3.2.9 Road markings

A similar approach to the landscaping methodology was applied to value the road markings asset. An assumed quantity of lines is taken per KM of each subnet and the market rates applied to form a composite rate per / KM.

3.2.10 Noise Barrier

The data provided contained the noise barrier asset quantity issued in m² area format. A composite rate per m² is derived to cover the various types of barrier typically used on mainline routes, including absorptive and standard/reflective type noise barriers, varying in height from 1.5 to 3.5m. This base rate was checked with market specialists in this area and base cost uplifts were applied.

3.2.11 Gantries

Following inspection, the initial data provided was further refined to enable a more reasonable assessment of the widths of the gantries on the network. This is important as width is a key driver in ascertaining the cost of a Gantry. Fabricators consulted advised that the gantry data be split into four pricing categories. Four rates were then derived and in turn cross checked with specialists in the market to ensure these reflected the average supply and install costs. The four categories are cantilever/ single lane gantries, full width 15 to 20 meters, full width 19 to 28 meters and full width greater than 28 meters wide. Base cost uplifts cover the risk of ground conditions, civils works, foundations and any other ancillary costs.

3.2.12 Fencing

This is scoped as boundary fencing and the base rate is derived from composite rates for typical TII fence types. The rates used to derive the base rate are checked against recent projects and with specialist suppliers. It is noted that the SN0 subnet data is the only fencing data available. The utilities and accommodation work percentage cost allocation covers any fencing and/or boundary treatments in the other sub networks.

3.2.13 Site clearance

An average width is allowed for each subnet and this converts a site clearance hectare rate (per the TII RMP) into a base rate per meter. This is then used to value each subnet.

3.2.14 Kerbs and Footways

These are two separate datasets and are again valued using the same method as above whereby a composite linear rate is derived for each asset element. For the purposes of a rate per meter for footways, a 1500mm wide footway is taken as the standard width. The footway rate allows for instances where macadam paths exist. These rates are further checked and benchmarked against recent projects and are subject to the base rate uplifts.

3.2.15 Safety Bollards

Three main types of bollard are identified in the datasets - Plastic, Steel and Concrete. The rate applied for the plastic / rubber type allows for reboundable bollards and junction definition type bollards. Concrete and Steel bollard types can vary depending on the streetscape. Taking account of the available data, average rates for typical standard concrete and steel bollards are used. The steel rate also allows for steel junction definition type bollards. Market checks from recent projects are used to confirm the rates reflect market rates.

3.2.16 Utilities and Accommodation Works

The utilities and accommodation works provision is based on a percentage allowance per subnet derived from data captured from actual projects, where sufficient information was available to calculate the overall percentage of the cost of the works which was attributed to this element.

This is also benchmarked against the TII Cost Metric dated March 2019. Both checks produced consistent results once any significant project specific features/outliers were removed from the reference projects.

3.2.17 Pedestrian Guardrails

A market rate for this item is applied and the base rate is cross checked against recent projects to validate the value obtained.

3.3 Structures including Major Bridges and Tunnels

3.3.1 General Methodology and Typical Overbridge and Underbridge Base Rates

The structures datasets were presented as overbridges, underbridges, footbridges and retaining walls. The datasets for the bridge structures included a passage type (e.g. underbridge, overbridge, footbridge) crossing (e.g. road, river, rail), a foundation type and a deck area for each bridge. On that basis, two typical deck area base rates are calculated: one for overbridges and one for underbridges. The base rates are based on benchmark comparisons between a range of recently completed projects including similar bridge types and assume the crossing type is a road and the bridges have conventional spread or pad foundations. To calculate the final base rate for each bridge, the valuation methodology then applies factors to reflect whether or not a particular bridge is likely to be piled and/or, crosses water, and/or is a railway over or underbridge. Base rates are then subject to the base rate uplifts as per the carriageway rates.

3.3.2 On-cost factors, Piling, Crossing Type and Rail Bridges

The on-cost factor for piling is calculated using recent project data. Typically structures with piled foundations are more costly than those with conventional pad or spread footings. The on-cost percentage for piling reflects the typical extra over cost and is based on reviewing the actual additional extra cost and benchmarking using a number of recent projects. The same methodology is used to calculate the on-cost factor for water crossings and for rail over and underbridges.

3.3.3 Major Structures

Bridges either known or believed to be over €10mil in value were isolated from the datasets and valued independently. Outturn costs were available for a number of the major structures - some in the public domain - and these are either used as the allowance for the particular structure or for checking the application of the base rates applied to the deck areas as a basis for valuing the structure. As with the typical over and underbridge rates, the base rate uplifts are also applied. In some instances, depending on the information included in the dataset particularly in relation to prevailing ground conditions and the likely foundation solution, further adjustments were required to ensure that there was no duplication in the application of the foundation type and crossing factors e.g. if a major bridge was a piled river crossing, the impact of the factors was reduced.

The major tunnels were valued based on the extent of the tunnel bores only and a range of specific construction cost data and information in the public domain. Carriageway costs in approaches and Toll Buildings are accounted for separately under the appropriate headings.

3.3.4 Footbridges

Most footbridges are either steel or concrete or a mix of both. The calculated typical deck area base rate per square meter covers for both steel and/or concrete decks. This rate is also based on a comparison with data available from recent projects. It is noted that footbridge cost can vary much more significantly than typical overbridges and underbridges with the cost being dependent on the structural solution adopted and features associated with the bridge. Designs can be “location specific” and the extent and nature of the approaches can involve significant work in themselves.

The rate applied is considered to be a typical rate which takes account of this potential for significant cost variance.

3.3.5 Retaining Walls

The retaining walls datasets identified the walls in a m² area format measured on one side. This facilitated the use of a composite m² unit rate. Datasets also described the walls as either concrete or stone masonry. Two rates were derived, one for in-situ / precast concrete walls and a second rate for walls with stone masonry facing. The ancillary works uplift covers the cost of any particular special features and coping details. The rates applied also include for diaphragm type walls. The base rates were benchmarked against a number of recently completed projects and were adjusted to allow for the base rate uplifts.

3.4 Technology / ITS

The range of data on the ITS included for up to twenty different asset types contained in a master spreadsheet format. ITS assets range in value from €600 per item to €160k per item.

The TII ITS Asset Value Book Version 4.4 rates were used and uplifted to reflect any additional civils and installation costs. These base rates also applied the uplift percentages for ancillaries, preliminaries design, supervision and risk.

Where no rates were available, market checks were carried out to establish a base rate. One example of this was for weather stations where a market check was carried out to derive an average rate per weather station.

The master data was filtered which enabled each individual asset/asset type to be priced. The level of the base rate uplifts was assessed taking account of the scope and adjusted upwards or downwards depending on the envisaged risk (e.g. many ITS items were supply and install items with small design/supervision and risk requirements, the percentages applied therefore reflected this scope).

All the ITS rates were regarded as national rates and the regional factors are not applied to these items.

3.5 Buildings and Toll Plazas

This asset dataset is comprised of office and maintenance buildings for the maintenance depots and toll booths and related buildings for both the MMaRC's and PPP's. The dataset includes site areas and building floor areas. In relation to the motorway service areas, the data contains the floor area of the amenity building. Other available data includes the number of toll booths, toll lanes and the square area of the toll canopy structures.

For the buildings, rates were compiled to suit the available data and checked by comparison to both historic project data costs that were adjusted for inflation and recent market industry reports on building construction costs.

The toll lanes and booths were assessed and an average price per lane and booth was used based on an assumed typical scope of work. The toll canopies were valued based on the square area rate of the canopy structure. Market consultation was carried out to check the rates used to value these items.

The building rates per m² included for preliminaries and ancillary costs. Where site areas are available in the datasets, a site development cost is applied to the site area. Where site areas were unavailable, an uplift allowance is included for site development and applied to the building rate. The other uplifts that apply are the design, supervision and risk allowances.

3.6 Planning Supervision and Design (PS&D)

In addition to the cost of detailed design and construction, TII also incur costs associated with pre and post construction activities including scheme planning and development and construction supervision and design.

Provision has been made for these Planning Supervision and Design costs on the basis of a percentage addition derived from historical data. As set out in Section 4.3 of this report, the total uplift based on historical data for both Planning Supervision and Design and Other Costs is 17.5%, and a 10.9% portion of this relates to TII/Employer Planning Supervision and Design costs incurred through all Phases of Scheme Development.

3.7 Other Costs

In order to deliver the capital works comprising of the assets in asset portfolio, TII also has to carry out a range of activities, typically in advance of but sometime also during the Construction phase, other than Planning and Design. These typically include archaeology, upgrading of local road network - referred to as 'residual network' works – and advance and/or enabling works.

Provision has been made for these 'other costs' on the basis of a percentage addition derived from historical data and the uplift accounts for a 6.6% portion of the 17.5% uplift set out in Section 4.3 of this report.

3.8 Land Valuation

A land dataset was prepared based on land take areas derived from network geodata and zoning types mapped by Ordnance Survey Ireland (OSI) and the Department of Housing, Local Government and Heritage Open Data portal : https://data-housinggovie.opendata.arcgis.com/.

The land dataset reflects the land take from both recently constructed schemes and legacy routes. Land is a complex asset to value due to the very wide variation inter alia, of quality, function, zoning, business interdependence and layout. Plot-specific land assets of similar size need detailed individual assessment due to the wide range of attributes. It is however possible to group similar aspects of dominant features such as type (e.g. agriculture, industrial, housing) based on geographical location across the state. Cost estimates based on this approach yields a valuation quantum that is aligned with the purpose of this project, namely to provide a gross replacement cost of the road network.

In addition to the base asset valuation per hectare/acre, the final valuation includes agency costs which are typically incurred by TII when purchasing land for scheme construction. Such additional costs include Valuer fees, Severance, Injurious Affection, Disturbance and goodwill payments.

3.9 UK Rates Comparative Review

A detailed review and comparison of rates was carried out by project partners, Hyperion UK. This rates comparison was applied across all asset series using a variety of UK reference sources where available. In general, accounting for market variances, it was found that the rates applied were well founded and compared well overall across each of the series, in particular for the asset groups which have the largest GRC such as the pavement and granular material. A report detailing this comparative assessment was compiled by Hyperion.

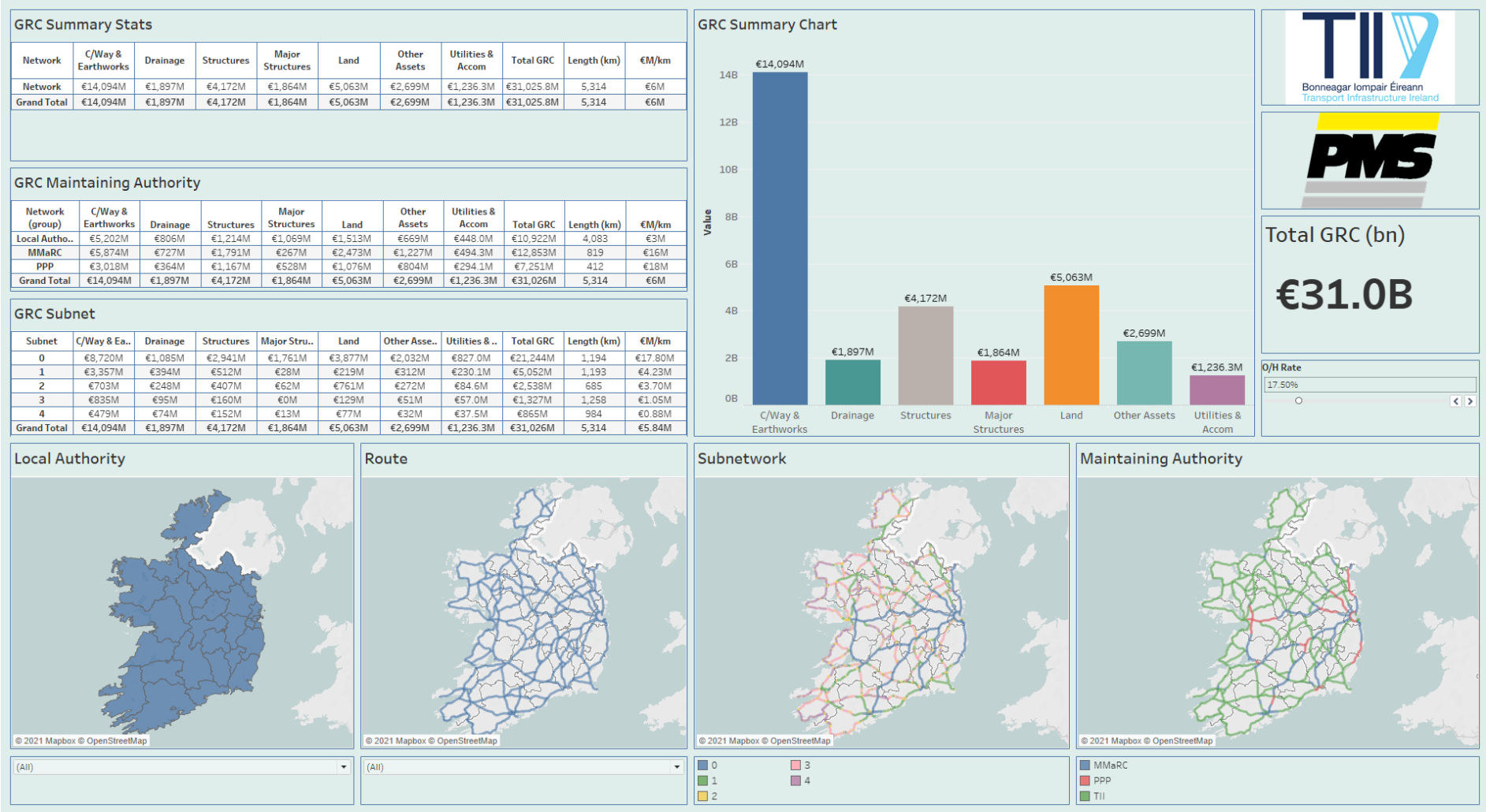
4. GRC Results

4.1 Asset Data Reported for Valuation

All asset datasets as noted in Chapter 3, were compiled, reported to MS Excel spreadsheets in a consistent format and uploaded in batches to a sharefile location for valuation by QS project partners Staveleys. All asset data was georeferenced by route, local authority and subnetwork. An extrapolation of assets in areas where gaps in data were identified was undertaken using existing representative data and/or data gathered by sampling.

4.2 Reporting Dashboards BI

PMS developed a front-end reporting dashboard using Tableau software, a Business Intelligence (BI) tool which can be customised for various reporting purposes. Inventory dashboards were presented to TII Chief Executive in November 2019 to demonstrate the capability of reporting asset quantities at various levels such as Region, Local Authority, Route, and Subnetwork and viewing the hierarchy of data both in tabular and spatial format. These dashboards were subsequently developed to include valuation estimates for the derived GRC. See Figures 5 and 6 below showing reporting dashboards developed in both Tableau and ArcGIS Online. Valuation results can be filtered for any particular local authority, route or subnetwork by drilling down through the reporting tables or maps and selecting the desired results. Section 4.3 to 4.11 detail a tabular breakdown of these results exported from the Tableau dashboards.



Network	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Network	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236.3M	€31,025.8M	5,314	€6M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236.3M	€31,025.8M	5,314	€6M

Network (group)	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Local Autho..	€5,202M	€806M	€1,214M	€1,069M	€1,513M	€669M	€448.0M	€10,922M	4,083	€3M
MMaRC	€5,874M	€727M	€1,791M	€267M	€2,473M	€1,227M	€494.3M	€12,853M	819	€16M
PPP	€3,018M	€364M	€1,167M	€528M	€1,076M	€804M	€294.1M	€7,251M	412	€18M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236.3M	€31,026M	5,314	€6M

Subnet	C/Way & Ea..	Drainage	Structures	Major Stru..	Land	Other Asse..	Utilities & ..	Total GRC	Length (km)	€M/km
0	€8,720M	€1,085M	€2,941M	€1,761M	€3,877M	€2,032M	€827.0M	€21,244M	1,194	€17.80M
1	€3,357M	€394M	€512M	€28M	€219M	€312M	€230.1M	€5,052M	1,193	€4.23M
2	€703M	€248M	€407M	€62M	€761M	€272M	€84.6M	€2,538M	685	€3.70M
3	€835M	€95M	€160M	€0M	€129M	€51M	€57.0M	€1,327M	1,258	€1.05M
4	€479M	€74M	€152M	€13M	€77M	€32M	€37.5M	€865M	984	€0.88M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236.3M	€31,026M	5,314	€5.84M

Figure 5 GRC Dashboard Overall – Tableau

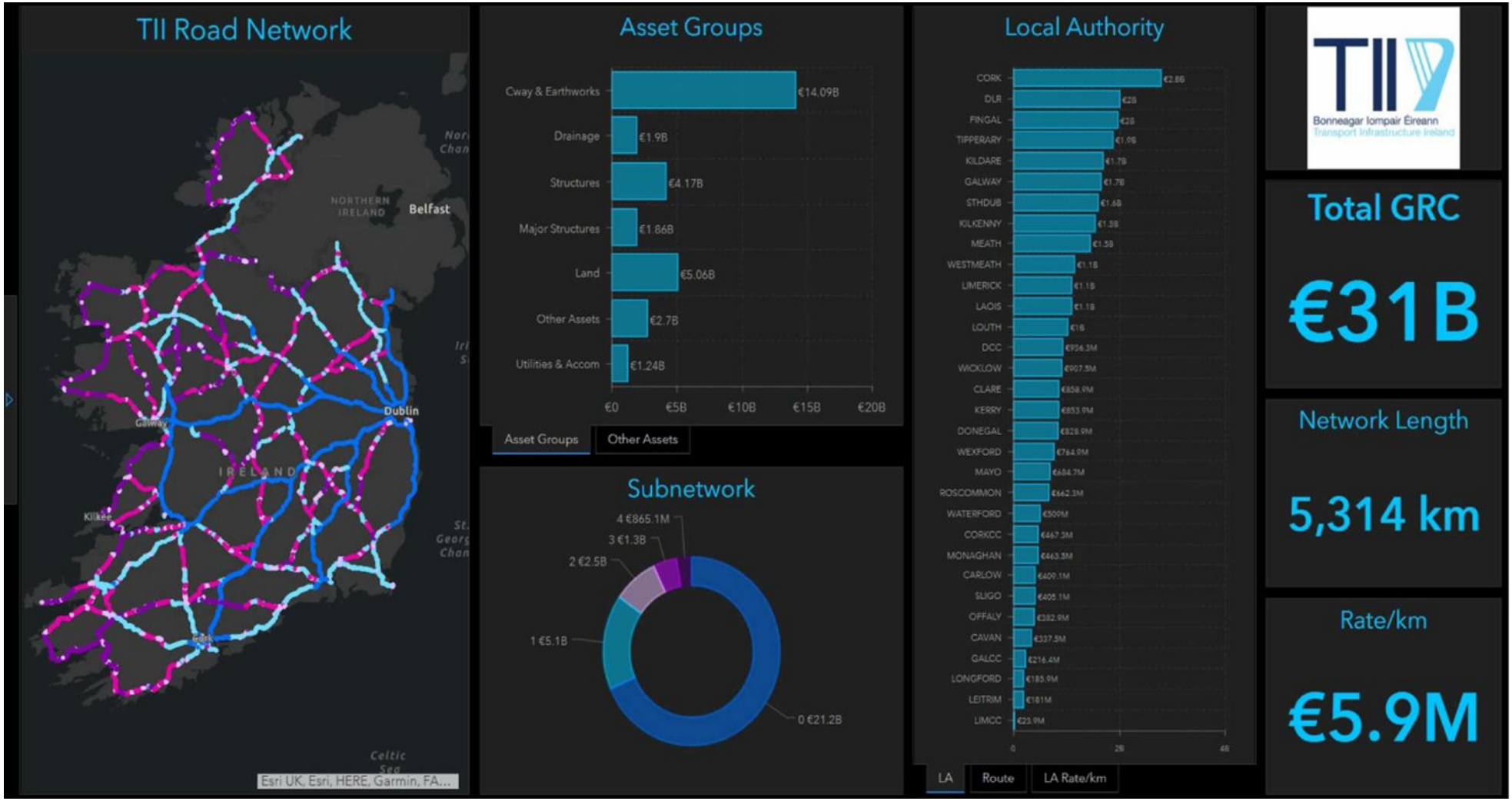


Figure 6 GRC Dashboard Overall – ArcGIS Online

4.3 GRC Overview

A total GRC of €31.0bn at 2020 Q1 prices (exclusive of VAT) was generated following the insertion of all individual rates to the inventory data. Table 2 below provides an overall breakdown of GRC by asset group and subgroup, including the 17.5% uplift, which accounts for Planning, Supervision and Design (PS&D) and Other Costs, as noted in Section 3.6 and 3.7 above. This uplift is applied to all assets except land, which was valued in a separate process as outlined in section 3.8 above.

Tables 3 to 10 provide a summary of GRC results at a network level and broken out by region, local authority, route, subnetwork, maintaining authority and maintaining authority network. The GRC is reported by asset groups, as noted above, and to align with previous GRC exercises undertaken. These asset groups consist of, carriageway and earthworks, drainage, structures, major structures, other assets and utilities and accommodation works. The 'Other Assets' group is made up of a series of smaller asset groups which have been collated for reporting purposes.

Table 2 GRC Breakdown by Asset Group and Subgroup

Series	Asset Group	Asset Subgroup	GRC (€Mil)
00200	Other Assets	Site Clearance	84.4 M
00300	Other Assets	Fencing	124.8 M
00300	Other Assets	Noise Barriers	126.0 M
00300	Other Assets	Pedestrian Guardrails	8.9 M
00400	Other Assets	Safety Barriers	470.9 M
00500	Drainage	Drainage	1897.1 M
00500	Other Assets	Ducting	563.1 M
00600	Carriageway & Earthworks	Earthworks	5468.0 M
00700	Carriageway & Earthworks	Pavement & Granular Mainline	8124.0 M
00700	Carriageway & Earthworks	Pavement & Granular Interchanges	502.4 M
01100	Other Assets	Footways	73.7 M
01100	Other Assets	Kerbs	61.9 M
01200	Other Assets	Signs	133.1 M
01200	Other Assets	Lines & Studs	145.1 M
01200	Other Assets	Traffic Signals	96.8 M
01200	Other Assets	Safety Bollards	14.5 M
01300	Other Assets	Lighting	175.7 M
01500	Other Assets	ITS	48.0 M
01700	Non-Standard Structures	Major Structures & Tunnels	1864.0 M
01700	Structures	Structures	4047.0 M
01700	Structures	Gantries	125.2 M
02600	Other Assets	MMaRC Building & Depots	53.9 M
02600	Other Assets	Motorway Service Areas	193.6 M

Series	Asset Group	Asset Subgroup	GRC (€Mil)
02600	Other Assets	PPP Buildings & Depots	55.0 M
02600	Other Assets	Toll Plazas	15.5 M
02600	Other Assets	Weather Stations	9.9 M
02700	Utilities & Accom	Utilities & Accommodation Works	1235.6 M
02700	Other Assets	Landscaping	241.4 M
04000	Land	Land	5063.1 M
		Total	31025.8 M

4.4 Network

As can be seen from Table 3 below the majority of GRC value is associated with the carriageway and earthworks asset group making up just over 45% of the total, followed by structures and major structures at c. 20%, land at c. 15% and drainage, other assets, utilities and accommodation works making up the remaining 20%. An average of €6M per kilometre GRC for the network was derived and the following tables detail a breakdown of this by region, local authority, route, subnetwork and maintaining authority.

Table 3 Network GRC

C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€/km
€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.5 Region

Table 4 below shows are breakdown of GRC by region. A list of counties by region can be seen in Table 5. It can be seen that the Southeast region makes up the largest proportion of the GRC total followed by the southwest, border midlands and west. This is largely due to the volume of motorway and dual carriageway networks in each region.

Table 4 Region GRC

Region	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
West	€1,920M	€319M	€449M	€78M	€370M	€341M	€155M	€3,6322M	1,249	€3M
South West	€3,977M	€546M	€1,203M	€498M	€727M	€671M	€345M	€7,966M	1,707	€4M
Border Midlands	€3,156M	€408M	€762M	€116M	€354M	€574M	€251M	€5,621M	1,161	€5M
South East	€5,042M	€624M	€1,758M	€1,173M	€3,612M	€1,113M	€486M	€13,808M	1,196	€12M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.6 Local Authority by Region

Table 5 below shows are breakdown of local authorities by region. As before it can be seen where the largest proportion of GRC value is derived in the local authorities from the south & east region.

Table 5 Local Authority by Region GRC

Region	Local Authority	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
West	Galway	€894M	€149M	€224M	€15M	€110M	€198M	€74.0M	€1,663M	431	€4M
	Galway City	€41M	€7M	€18M	€39M	€98M	€8M	€5.7M	€216M	20	€11M
	Mayo	€361M	€69M	€81M	€0M	€99M	€47M	€27.9M	€685M	398	€2M
	Roscommon	€394M	€63M	€72M	€12M	€39M	€53M	€29.7M	€662M	247	€3M
	Sligo	€231M	€31M	€55M	€11M	€24M	€35M	€18.1M	€405M	153	€3M
Southwest	Clare	€423M	€75M	€140M	€28M	€67M	€89M	€37.7M	€859M	235	€4M
	Cork	€1,415M	€174M	€363M	€289M	€219M	€203M	€122.1M	€2,784M	495	€6M
	Cork City	€76M	€14M	€124M	€26M	€184M	€29M	€13.5M	€467M	23	€20M
	Kerry	€473M	€69M	€160M	€0M	€61M	€54M	€37.8M	€854M	426	€2M
	Limerick	€524M	€74M	€171M	€130M	€61M	€88M	€49.3M	€1,097M	191	€6M
	Limerick City	€9M	€1M	€9M	€0M	€1M	€3M	€1.1M	€24M	1	€18M
	Tipperary	€1,058M	€140M	€235M	€25M	€133M	€206M	€83.2M	€1,881M	336	€6M
Border Midlands	Cavan	€205M	€26M	€24M	€31M	€16M	€20M	€15.3M	€338M	123	€3M
	Donegal	€529M	€62M	€112M	€0M	€42M	€46M	€37.5M	€829M	303	€3M
	Leitrim	€106M	€17M	€27M	€0M	€8M	€14M	€8.2M	€181M	56	€3M
	Longford	€97M	€20M	€26M	€0M	€18M	€18M	€8.0M	€186M	98	€2M
	Louth	€517M	€61M	€136M	€60M	€69M	€129M	€45.2M	€1,019M	98	€10M
	Meath	€753M	€107M	€244M	€25M	€109M	€159M	€64.3M	€1,460M	202	€7M
	Monaghan	€320M	€27M	€48M	€0M	€22M	€26M	€21.0M	€464M	106	€4M
	Westmeath	€629M	€88M	€145M	€0M	€69M	€163M	€51.3M	€1,146M	174	€7M

Region	Local Authority	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Southeast	Carlow	€196M	€31M	€65M	€26M	€32M	€41M	€18.0M	€409M	78	€5M
	Dublin City	€32M	€5M	€1M	€705M	€139M	€17M	€38.0M	€936M	6	€156M
	Dun L. Rat.	€237M	€28M	€117M	€41M	€1,497M	€62M	€24.3M	€2,007M	33	€61M
	Fingal	€538M	€57M	€316M	€126M	€688M	€181M	€60.9M	€1,967M	55	€36M
	Kildare	€901M	€105M	€272M	€12M	€122M	€212M	€75.1M	€1,700M	135	€13M
	Kilkenny	€774M	€92M	€232M	€133M	€101M	€134M	€68.3M	€1,535M	197	€8M
	Laois	€534M	€74M	€205M	€46M	€77M	€109M	€48.4M	€1,092M	168	€6M
	Offaly	€227M	€33M	€47M	€0M	€25M	€33M	€17.1M	€383M	116	€3M
	Sth. Dublin	€391M	€45M	€220M	€1M	€781M	€120M	€38.8M	€1,597M	47	€34M
	Waterford	€286M	€33M	€57M	€34M	€41M	€36M	€22.3M	€509M	106	€5M
	Wexford	€449M	€58M	€82M	€10M	€47M	€85M	€34.2M	€765M	164	€5M
	Wicklow	€476M	€63M	€144M	€38M	€62M	€84M	€40.3M	€907M	91	€10M
Grand Total		€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.7 Local Authority

Table 6 below is similar to Table 5 above with region excluded and local authorities displayed in alphabetical order for ease of reference. As expected, Cork has the largest GRC followed by Dun Laoghaire Rathdown, Fingal, Tipperary, Kildare and Galway, again this is largely due to geographical size, land value, and the length of motorway dual carriageway. It can also be seen that the four local authorities of Dublin; Dublin City, Fingal, South Dublin and Dun Laoghaire Rathdown have the highest value per kilometre largely due the length of motorway and dual carriageway, structures, major structures, land and other assets such as ITS, e.g. M50.

Table 6 Local Authority GRC

Local Authority	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Carlow	€196M	€31M	€65M	€26M	€14M	€41M	€18.0M	€409M	78	€5M
Cavan	€205M	€26M	€24M	€31M	€7M	€20M	€15.3M	€338M	123	€3M
Clare	€423M	€75M	€140M	€28M	€30M	€89M	€37.7M	€859M	235	€4M
Cork	€1,415M	€174M	€363M	€289M	€108M	€203M	€122.1M	€2,784M	495	€6M
Cork City	€76M	€14M	€124M	€26M	€111M	€29M	€13.5M	€467M	23	€20M
Donegal	€529M	€62M	€112M	€0M	€19M	€46M	€37.5M	€829M	303	€3M
Dublin City	€32M	€5M	€1M	€705M	€78M	€17M	€38.0M	€936M	6	€156M
Dun L. Rat.	€237M	€28M	€117M	€41M	€852M	€62M	€24.3M	€2,007M	33	€61M
Fingal	€538M	€57M	€316M	€126M	€386M	€181M	€60.9M	€1,967M	55	€36M
Galway	€894M	€149M	€224M	€15M	€39M	€198M	€74.0M	€1,663M	431	€4M
Galway City	€41M	€7M	€18M	€39M	€61M	€8M	€5.7M	€216M	20	€11M
Kerry	€473M	€69M	€160M	€0M	€28M	€54M	€37.8M	€854M	426	€2M
Kildare	€901M	€105M	€272M	€12M	€49M	€212M	€75.1M	€1,700M	135	€13M
Kilkenny	€774M	€92M	€232M	€133M	€43M	€134M	€68.3M	€1,535M	197	€8M
Laois	€534M	€74M	€205M	€46M	€32M	€109M	€48.4M	€1,092M	168	€6M
Leitrim	€106M	€17M	€27M	€0M	€3M	€14M	€8.2M	€181M	56	€3M
Limerick	€524M	€74M	€171M	€130M	€26M	€88M	€49.3M	€1,097M	191	€6M
Limerick City	€9M	€1M	€9M	€0M	€1M	€3M	€1.1M	€24M	1	€18M
Longford	€97M	€20M	€26M	€0M	€9M	€18M	€8.0M	€186M	98	€2M
Louth	€517M	€61M	€136M	€60M	€31M	€129M	€45.2M	€1,019M	98	€10M
Mayo	€361M	€69M	€81M	€0M	€54M	€47M	€27.9M	€685M	398	€2M
Meath	€753M	€107M	€244M	€25M	€46M	€159M	€64.3M	€1,460M	202	€7M
Monaghan	€320M	€27M	€48M	€0M	€10M	€26M	€21.0M	€464M	106	€4M

Local Authority	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Offaly	€227M	€33M	€47M	€0M	€10M	€33M	€17.1M	€383M	116	€3M
Roscommon	€394M	€63M	€72M	€12M	€16M	€53M	€29.7M	€662M	247	€3M
Sligo	€231M	€31M	€55M	€11M	€11M	€35M	€18.1M	€405M	153	€3M
Sth. Dublin	€391M	€45M	€220M	€1M	€444M	€120M	€38.8M	€1,597M	47	€34M
Tipperary	€1,058M	€140M	€235M	€25M	€53M	€206M	€83.2M	€1,881M	336	€6M
Waterford	€286M	€33M	€57M	€34M	€20M	€36M	€22.3M	€509M	106	€5M
Westmeath	€629M	€88M	€145M	€0M	€26M	€163M	€51.3M	€1,146M	174	€7M
Wexford	€449M	€58M	€82M	€10M	€21M	€85M	€34.2M	€765M	164	€5M
Wicklow	€476M	€63M	€144M	€38M	€27M	€84M	€40.3M	€907M	91	€10M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€2,663M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.8 Route

Table 7 below provides a breakdown of GRC by route. It can see seen the majority of GRC value is associated with the national primary routes (N01 – N50) which, as expected, have the highest cross sections and related assets.

Table 7 Route GRC

Route	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
N01	€804M	€88M	€301M	€107M	€172M	€255M	€77.8M	€1,957M	90	€22M
N02	€505M	€52M	€116M	€0M	€80M	€56M	€36.5M	€915M	133	€7M
N03	€604M	€79M	€173M	€75M	€94M	€117M	€52.4M	€1,283M	128	€10M
N04	€947M	€111M	€256M	€11M	€166M	€211M	€76.8M	€1,930M	198	€10M
N05	€191M	€34M	€64M	€0M	€21M	€24M	€15.6M	€368M	131	€3M
N06	€870M	€124M	€238M	€66M	€54M	€242M	€77.0M	€1,746M	148	€12M
N07	€1,445M	€163M	€486M	€72M	€171M	€270M	€121.8M	€2,917M	187	€16M

Route	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
N08	€1,119M	€127M	€305M	€65M	€57M	€213M	€91.4M	€2,059M	151	€14M
N09	€813M	€97M	€241M	€72M	€31M	€160M	€69.2M	€1,541M	119	€13M
N10	€60M	€7M	€12M	€0M	€6M	€13M	€4.6M	€106M	17	€6M
N11	€805M	€101M	€225M	€61M	€392M	€159M	€67.5M	€2,134M	129	€16M
N12	€5M	€1M	€1M	€0M	€0M	€0M	€0.4M	€8M	7	€1M
N13	€136M	€15M	€8M	€0M	€4M	€14M	€8.7M	€190M	44	€4M
N14	€17M	€2M	€7M	€0M	€1M	€1M	€1.4M	€31M	17	€2M
N15	€285M	€29M	€52M	€0M	€7M	€21M	€19.3M	€422M	111	€4M
N16	€33M	€8M	€8M	€0M	€2M	€5M	€2.7M	€62M	47	€1M
N17	€280M	€46M	€57M	€0M	€9M	€50M	€21.6M	€481M	120	€4M
N18	€542M	€85M	€218M	€144M	€21M	€137M	€56.3M	€1,242M	91	€14M
N19	€12M	€3M	€8M	€0M	€2M	€6M	€1.4M	€33M	5	€7M
N20	€328M	€39M	€80M	€13M	€33M	€40M	€25.0M	€588M	95	€6M
N21	€260M	€28M	€49M	€0M	€9M	€25M	€18.1M	€401M	84	€5M
N22	€338M	€36M	€66M	€0M	€35M	€41M	€24.0M	€567M	118	€5M
N23	€9M	€1M	€6M	€0M	€0M	€1M	€0.9M	€19M	9	€2M
N24	€162M	€28M	€54M	€0M	€15M	€25M	€13.5M	€314M	116	€3M
N25	€709M	€81M	€155M	€122M	€54M	€90M	€57.8M	€1,322M	188	€7M
N26	€30M	€5M	€4M	€0M	€3M	€4M	€2.1M	€51M	30	€2M
N27	€29M	€3M	€14M	€0M	€11M	€6M	€2.6M	€73M	6	€12M
N28	€39M	€4M	€10M	€0M	€3M	€3M	€2.8M	€65M	12	€6M
N29	€6M	€1M	€0M	€0M	€1M	€1M	€0.4M	€11M	4	€3M
N30	€23M	€6M	€7M	€0M	€4M	€5M	€2.1M	€51M	33	€2M
N31	€10M	€3M	€0M	€0M	€82M	€8M	€1.1M	€154M	7	€22M
N33	€13M	€3M	€5M	€0M	€1M	€2M	€1.1M	€26M	8	€3M

Route	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
N40	€123M	€21M	€82M	€248M	€60M	€37M	€25.6M	€644M	15	€42M
N50	€495M	€50M	€300M	€792M	€755M	€139M	€88.9M	€3,206M	46	€70M
N51	€49M	€10M	€19M	€0M	€11M	€10M	€4.4M	€111M	53	€2M
N52	€236M	€35M	€41M	€0M	€13M	€33M	€17.3M	€391M	177	€2M
N53	€19M	€3M	€2M	€0M	€1M	€2M	€1.3M	€29M	18	€2M
N54	€24M	€6M	€2M	€0M	€3M	€6M	€1.9M	€46M	37	€1M
N55	€64M	€11M	€7M	€0M	€6M	€10M	€4.6M	€109M	79	€1M
N56	€127M	€23M	€43M	€0M	€10M	€14M	€10.4M	€238M	157	€2M
N58	€8M	€1M	€3M	€0M	€1M	€1M	€0.7M	€16M	12	€1M
N59	€135M	€37M	€49M	€0M	€32M	€23M	€12.2M	€316M	300	€1M
N60	€60M	€12M	€12M	€0M	€13M	€7M	€4.6M	€120M	92	€1M
N61	€78M	€12M	€5M	€0M	€3M	€8M	€5.2M	€117M	75	€2M
N62	€82M	€15M	€10M	€0M	€10M	€15M	€6.1M	€147M	97	€2M
N63	€60M	€15M	€12M	€0M	€7M	€15M	€5.1M	€122M	89	€1M
N65	€55M	€9M	€9M	€0M	€3M	€9M	€4.1M	€93M	53	€2M
N67	€94M	€21M	€11M	€0M	€19M	€13M	€7.0M	€181M	142	€1M
N68	€32M	€6M	€5M	€0M	€4M	€3M	€2.2M	€55M	41	€1M
N69	€104M	€16M	€30M	€0M	€9M	€11M	€8.1M	€188M	99	€2M
N70	€57M	€15M	€20M	€0M	€7M	€9M	€5.0M	€121M	142	€1M
N71	€157M	€30M	€127M	€0M	€20M	€20M	€16.7M	€389M	188	€2M
N72	€93M	€25M	€29M	€0M	€14M	€16M	€8.1M	€198M	165	€1M
N73	€30M	€5M	€5M	€0M	€2M	€3M	€2.2M	€51M	34	€1M
N74	€15M	€3M	€3M	€0M	€2M	€2M	€1.2M	€29M	20	€1M
N75	€5M	€1M	€2M	€0M	€1M	€1M	€0.5M	€13M	8	€2M
N76	€33M	€7M	€7M	€0M	€4M	€5M	€2.6M	€63M	44	€1M

Route	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
N77	€43M	€10M	€17M	€0M	€7M	€8M	€4.0M	€97M	49	€2M
N78	€39M	€10M	€11M	€0M	€7M	€7M	€3.4M	€85M	51	€2M
N80	€93M	€21M	€19M	€0M	€15M	€18M	€7.5M	€186M	114	€2M
N81	€73M	€13M	€24M	€0M	€46M	€16M	€6.2M	€208M	77	€3M
N83	€56M	€15M	€5M	€0M	€11M	€8M	€4.2M	€108M	74	€1M
N84	€48M	€11M	€7M	€0M	€16M	€7M	€3.7M	€105M	74	€1M
N85	€42M	€6M	€10M	€14M	€4M	€7M	€4.0M	€90M	32	€3M
N86	€26M	€6M	€12M	€0M	€3M	€5M	€2.5M	€58M	50	€1M
N87	€14M	€3M	€5M	€0M	€1M	€2M	€1.2M	€28M	28	€1M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€2,663M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.9 Subnet

Table 8 below provides a breakdown of GRC by subnetwork. As noted above it is clear that a significant proportion of the GRC is associated with Subnet 0 at over 68% of the total followed by Subnets 1 to 4 consecutively. The value per kilometre rate also reflects this with Subnet 0 averaging at c.€18M per kilometre. A further break down of this can be seen in tables 9 and 10 below which details a breakdown of rate per kilometre for PPP and MMaRC schemes.

Table 8 Subnet GRC

Subnet	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
0	€8,720M	€1,085M	€2,941M	€1,761M	€3,877M	€2,032M	€827M	€21,244M	1,194	€17.80M
1	€3,357M	€394M	€512M	€28M	€219M	€312M	€230M	€5,052M	1,193	€4.23M
2	€703M	€248M	€407M	€62M	€761M	€272M	€84.6M	€2,538M	685	€3.70M
3	€835M	€95M	€160M	€0M	€129M	€51M	€57M	€1,327M	1,258	€1.05M
4	€479M	€74M	€152M	€13M	€77M	€32M	€37.5M	€865M	984	€0.88M

Subnet	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236M	€31,026M	5,314	€5.84M

4.10 Maintaining Authority

Table 9 below shows a breakdown of GRC by maintaining authority which consists of MMaRC, PPP and Local Authority/TII networks. It can be seen that the MMaRC and PPP network which is c.1200km of primarily motorway and dual carriageway amounts to €20.3bn, c 68% of the total GRC with the remaining c.4000km of single carriageway making up the 9.6bn, 37% of GRC total.

Table 9 Maintaining Authority GRC

Maintaining Authority	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
TII/LA	€5,202M	€806M	€1,214M	€1,069M	€1,513M	€669M	€448.0M	€10,922M	4,083	€3M
MMaRC	€5,874M	€727M	€1,791M	€267M	€2,473M	€1,227M	€494.3M	€12,853M	819	€16M
PPP	€3,018M	€364M	€1,167M	€528M	€1,076M	€804M	€294.1M	€7,251M	412	€18M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€5,063M	€2,699M	€1,236M	€31,026M	5,314	€6M

4.11 Maintaining Authority – Networks (TII, MMarc, PPP, Tunnels)

Table 10 below shows a breakdown of GRC by maintaining authority network which consists of the various MMaRC, PPP and Local Authority/TII networks as well as the major tunnels schemes. It can been seen that the rate per kilometre varies significantly depending on the location of the scheme, e.g. a typical rural PPP network such as the M17/M18 Gort to Tuam PPP or M06 Galway to Ballinasloe PPP has an average rate of c. €12M/km whereas a more urban scheme such as M50 PPP or N18 Limerick tunnel PPP can average up to greater than €30M/km.

Table 10 Maintaining Authority Networks GRC

MA Network	C/Way & Earthworks	Drainage	Structures	Major Structures	Land	Other Assets	Utilities & Accom	Total GRC	Length (km)	€M/km
TII/LA	€5,178M	€803M	€1,174M	€116M	€827M	€663M	€396.6M	€9,842M	4,078	€2M
MMaRC_A	€1,666M	€196M	€666M	€106M	€1,055M	€388M	€151.1M	€5,081M	197	€26M
MMaRC_B	€1,748M	€246M	€528M	€64M	€67M	€397M	€149.1M	€3,321M	286	€12M
MMaRC_C	€2,460M	€284M	€598M	€96M	€165M	€441M	€194.0M	€4,450M	336	€13M
M01 PPP	€477M	€51M	€161M	€60M	€29M	€131M	€44.0M	€987M	53	€19M
M03 PPP	€314M	€43M	€109M	€14M	€13M	€76M	€27.9M	€621M	49	€13M
M04 PPP	€300M	€31M	€71M	€0M	€9M	€107M	€25.4M	€562M	38	€15M
M06 PPP	€343M	€45M	€88M	€15M	€8M	€80M	€28.5M	€628M	53	€12M
M7M8 PPP	€270M	€34M	€123M	€32M	€10M	€67M	€26.2M	€579M	42	€14M
N08 PPP	€150M	€16M	€37M	€54M	€4M	€32M	€14.4M	€313M	17	€18M
N25 PPP	€147M	€15M	€52M	€112M	€15M	€32M	€17.9M	€406M	19	€21M
M11 PPP	€333M	€41M	€95M	€38M	€16M	€83M	€29.6M	€662M	46	€14M
M17M18 PPP	€222M	€41M	€77M	€0M	€8M	€66M	€20.3M	€455M	52	€9M
M50 PPP	€374M	€36M	€257M	€59M	€435M	€104M	€41.5M	€1,643M	31	€53M
N18 Limerick Tunnel PPP	€87M	€12M	€98M	€144M	€3M	€28M	€18.4M	€394M	10	€39M
M50 Dublin Port Tunnel	€23M	€3M	€0M	€705M	€0M	€6M	€36.8M	€774M	5	€168M
N40 Jack Lynch Tunnel	€2M	€0M	€40M	€248M	€0M	€0M	€14.6M	€306M	1	€511M
Grand Total	€14,094M	€1,897M	€4,172M	€1,864M	€2,663M	€2,699M	€1,236M	€31,026M	5,314	€6M

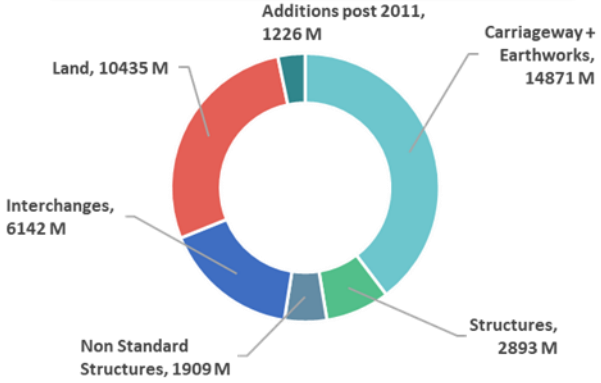
4.12 Comparison to Earlier GRC Exercises

Figure 7 shows a comparison to GRC totals derived from previous valuation exercises in 2018. Total GRC estimates including land for the 2018 Update and 2018 Modified Approach were valued at €37.5bn and €31.5bn respectively. It can be seen that the 2020 GRC totals are largely in line with previous estimations on carriageway and earthworks, and major structures. Interchanges were merged with the overall mainline inventory in 2020 GRC due to more detailed information on interchange assets being available. This balance of this can be seen by the increase in GRC in other assets, structures, utilities and accommodation works. As shown the 2020 GRC land value aligns more closely with what was estimated in the 2018 modified approach.

GRC 2018 Update

€37.5bn

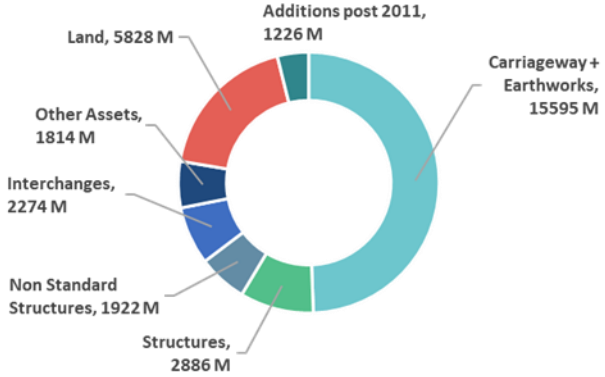
Asset Type	GRC 2018 Update
Carriageway + Earthworks	€ 14,871 M
Structures	€ 2,893 M
Non Standard Structures	€ 1,909 M
Interchanges	€ 6,142 M
Other Assets	€ -
Land	€ 10,345 M
Additions post 2011	€ 1,226 M
Utilities & Accom.	€ -
Grand Total	**€ 37,476 M**



GRC 2018 Modified

€31.5bn

Asset Type	GRC 2018 Mod.
Carriageway + Earthworks	€ 15,595 M
Structures	€ 2,886 M
Non Standard Structures	€ 1,922 M
Interchanges	€ 2,224 M
Other Assets	€ 1,814 M
Land	€ 5,828 M
Additions post 2011	€ 1,226 M
Utilities & Accom.	€ -
Grand Total	**€ 31,545 M**



GRC 2020 Current

€31.0bn

Asset Type	GRC 2020
Carriageway + Earthworks	€ 14,094 M
Structures	€ 4,172 M
Non Standard Structures	€ 1,864 M
Interchanges	€ -
Other Assets	€ 4,596 M
Land	€ 5,063 M
Additions post 2011	€ -
Utilities & Accom.	€ 1,236 M
Grand Total	**€ 31,025 M**

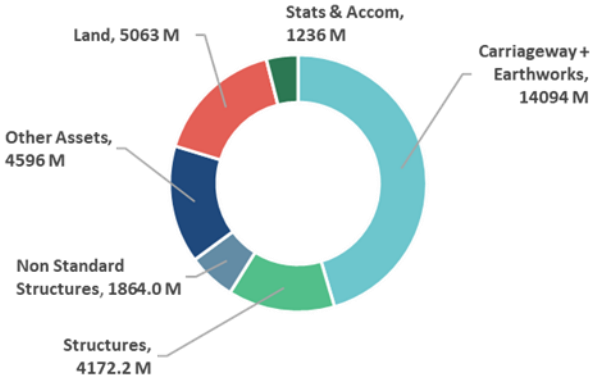


Figure 7 2020 GRC comparison to 2018 GRC

Figure 8 shows a more detailed breakdown of GRC for the various asset groups and subgroups.

GRC 2020 – Asset Breakdown

Series	Asset Group	Asset Subgroup	2020 GRC (Mil)
00200	Other Assets	Site Clearance	84.4 M
00300	Other Assets	Fencing	124.8 M
00300	Other Assets	Noise Barriers	126.0 M
00300	Other Assets	Ped Guardrails	8.9 M
00400	Other Assets	Safety Barriers	470.9 M
00500	Drainage	Drainage	1885.8 M
00500	Other Assets	Ducting	563.1 M
00600	Carriageway & Earthworks	Earthworks	5468.0 M
00700	Carriageway & Earthworks	Pavement Mainline	8124.0 M
00700	Carriageway & Earthworks	Pavement Interchanges	502.4 M
01100	Other Assets	Footways	73.7 M
01100	Other Assets	Kerbs	61.9 M
01200	Other Assets	Signs	133.1 M
01200	Other Assets	Lines & Studs	145.1 M
01200	Other Assets	Traffic Signals	96.8 M
01200	Other Assets	Safety Bollards	14.5 M
01300	Other Assets	Lighting	175.7 M
01500	Other Assets	ITS	48.0 M
01700	Non Standard Structures	Major Structures & Tunnels	1864.0 M
01700	Structures	Structures	4047.0 M
01700	Structures	Gantries	125.2 M
02600	Other Assets	MMaRC Building & Depots	53.9 M
02600	Other Assets	Motorway Service Areas	193.6 M
02600	Other Assets	PPP Buildings & Depots	55.0 M
02600	Other Assets	Toll Plazas	15.5 M
02600	Other Assets	Weather Stations	9.9 M
02700	Utilities & Accom	Utilities & Accom	1235.6 M
04000	Land	Land	5062.6 M
05000	Other Assets	Landscaping	241.4 M
		Total	31025.8 M

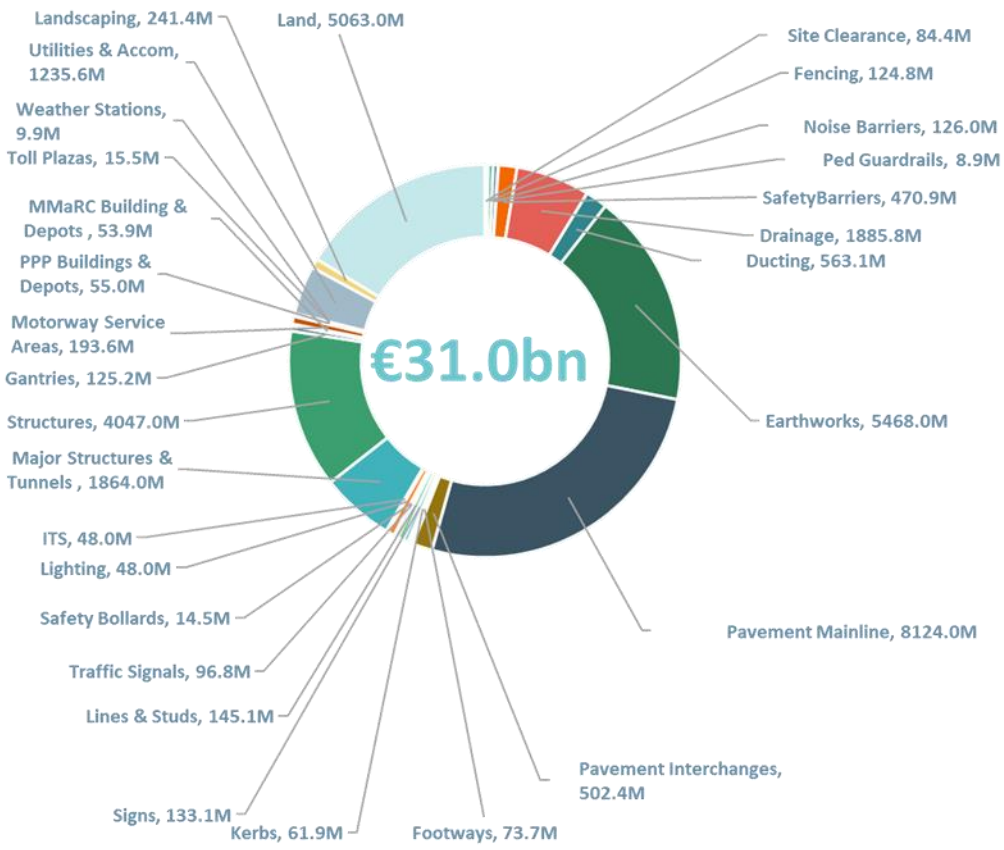


Figure 8 2020 GRC Breakdown

5. Conclusions

5.1 Introduction

On review of the project objectives, the team were successful in meeting the deliverables and tasks set out in the derivation of a Gross Replacement Cost for the TII National Road Network. It can be seen from this report that results broadly align with previous GRC exercises carried out in 2018, which gives further confidence in these exercises as they were based on a significantly lower level of detail than that now available. The development of a Business Intelligence (BI) dashboard to filter and display valuation information has been a powerful advantage and benefit of this exercise.

5.2 Review of Objectives

The following is a summary of tasks and deliverables completed under the asset valuation brief.

Tasks

- A review of existing valuation rates including rates used in CIFRA approach and rates used in 2012 National Roads Network Valuation Report
- Adjustment to 2019 asset valuation unit rates for Ireland
- Application of 2019 rates to asset inventory to determine GRC

Deliverables

- Unit rates for Asset Valuation based on Irish conditions in 2019
- Asset Valuation for National Road network based on Gross Replacement Cost (GRC)
- Asset Valuation on a route by route basis - GRC
- Asset Valuation on a local authority basis – GRC

5.2.1 Delivery of Objectives

As detailed in this report, the GRC was derived using a combination of methods including composite or individual element rates and base rates for construction activities including all factors typically included in unit rates. These unit rates were compiled from a range of benchmarked sources such as TII Unit Rate Database, recent and historic projects adjusted for inflation etc. These rates were subject to further comparative review and validation by project partners Hyperion.

The project team were successful in delivering the capability to report GRC information by route, local authority and subnetwork. The team expanded this objective further to enable reporting of asset data by region, maintaining authority and maintaining authority network, such as MMaRC and PPP. This was further enhanced in the development of a BI toolkit for reporting the valuation information at various levels.

The development and implementation of a comprehensive asset inventory was fundamental to the delivery of an appropriate GRC valuation. Structuring each of the asset datasets consistently and aligning them to a common linear referencing system enabled the rates information to be inserted with relative ease and also allows for future rates updates to be applied.

5.3 Challenges and Solutions

5.3.1 Challenges

Various challenges were encountered throughout the project which required the application of innovative solutions. Some of these solutions, which were initially applied to challenges encountered during the inventory phase, also led to a successful application in the valuation phase e.g. geospatial alignment of data which enabled application of regional factors and the Tableau reporting dashboard developed to include GRC

A summary of some of the key challenges encountered in the valuation phase are noted as follows:

- Rationalising the extensive data available/captured for use in the valuation process
- Development of unit rates for a range of asset series
- Review and comparison of unit rates
- Linking GRC rates data to inventory data
- Application of regional factors
- Linking land valuation zoning matrix to inventory data
- Reporting GRC Data by Asset Group/Subgroup, Route, Local Authority and Subnetwork

5.3.2 Solutions

Several direct and indirect positive outcomes were achieved through the development and application of innovative solutions to challenges encountered.

The following is a summary of some of the added value achieved in the application of these solutions.

Linking GRC Rates to Data

The development of a comprehensive asset inventory linked to a geodatabase and TII GIS routes model provided the foundation for the successful alignment of GRC data. Geospatially aligning all datasets enabled regional factors to be applied to base rates with relative ease. This also enabled the composite or individual element rates to be plugged directly into the inventory datasets singularly or to defined linear segments. e.g. the pavement and granular rates which were based on €/m3 was applied directly to each 100m segment volume producing a GRC for each individual segment. The data is structured in such a way that will facilitate a streamlined update to GRC should the unit rates change in the future, and also allows for aligning a DRC if applicable.

Land Valuation

Linking the local authority land value and zoning rates matrix to the inventory database led to the development of a powerful and innovative dataset which can be readily refreshed or updated as required into the future. This matrix was also adjusted to reflect network level land valuation in GRC terms by inserting appropriate adjustment factors as described in this report.

Reporting GRC

The generation of the Tableau dashboard for the reporting of inventory data also resulted in a major beneficial outcome in subsequent development of the toolkit for reporting asset valuation information. The dashboards were designed to enable both high level and detailed reporting of GRC data which can fulfil various reporting objectives at a corporate and strategic level. This toolkit delivers the capability to report at various levels such as region, local authority, route subnetwork, maintaining authority and networks such as MMaRC and PPP.

5.4 Recommendations

There are limitations in the current GRC valuation exercise given the data extracted for valuation is based on a 'point in time' dataset. It is not a dynamic real time dataset as currently this is not possible due to the nature and format of the various data repositories across the organisation. In order to move forward towards a unified approach to asset management it is recommended that a corporate policy is developed across all organisational departments managing asset data. This policy should clearly delineate how asset information is to be recorded, referenced and maintained, as well as enforcing a format and level of detail which facilitates cross-asset management and reporting. As well as this, it is recommended that a sustainable approach is developed for updating the data, including inventory, condition and replacement rates, and for the carrying out of periodic revaluation of TII road assets. The outcomes of this project should provide a platform for the development of an asset management system incorporating these features and which at the very least links the various data repositories to a common linear and geospatial referencing system.

A policy which sets out an appropriate and consistent structure of inventory and valuation data will unlock a range of potential for the organisation into the future. It would also be a major step forward in meeting the recommendations of the IMF report which advised that Ireland should establish a Central Register of Infrastructure Assets valued at either book (initially) or (ultimately) market value, in order to facilitate effective management of these assets.

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