ASSISTING LOCAL GOVERNMENTS - ONLINE ROUTE ASSESSMENT TOOL

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Abstract

As the Australian freight task grows, local governments are coming under increasing pressure to allow access to larger, more efficient heavy vehicles on local roads. Matching more efficient heavy vehicle operations to local road infrastructure considerations is an increasingly important issue in the context of national productivity and carbon minimisation initiatives.

This paper presents a new online tool that has been developed to address local-government specific challenges to manage the route assessment workflow and provide suggested classifications to support and inform local governments in their access decision making processes.

Keywords: road network classification, guidelines, route assessment, local government, Performance Based Standards, heavy vehicle access, last mile access

1. HEAVY VEHICLE ACCESS ON LOCAL GOVERNMENT ROADS

Roads in Australia generally fall under three levels of jurisdiction (federal, state and local), with heavy vehicle trips often including roads spanning multiple jurisdictions across one, two or all of these levels. For freight and other heavy vehicle transport, a typical route includes local roads at the beginning and end of the journey, generally referred to as the 'first and last kilometre'.

As with all asset owners, local governments are also responsible for making decisions on allowing access to heavy vehicles on their roads. There are approximately 500 local governments across Australia, covering a diverse range of resources and experience. There is no standard to which assessments of network capacity are performed, which, coupled with a diverse range of resources, data and experience within local governments, can lead to difficulty in the access decision making process, and the consistency of such decisions across different regions.

There are many types of vehicle access in Australia. The recent introduction of the Performance Based Standards (PBS) Scheme for vehicles and infrastructure has seen the first national scheme that allows networks and vehicles with particular characteristics be more closely matched. Although the PBS Network Classification Guidelines (NTC, 2007) have been developed, they are largely focussed on national and state road networks, which can be characteristically different to local road networks.

ARRB, in collaboration with the Municipal Association of Victoria (MAV), and with the support of a number of state and national stakeholders, worked to develop a set of PBS guidelines for local government, and a web-based tool that applies those guidelines and allow local governments to follow a consistent workflow to support and inform the access decision making process for heavy vehicles.

2. THE PERFORMANCE BASED STANDARDS SCHEME

In a general sense, conventional methods of heavy vehicle regulation tend to place focus on achieving vehicle compliance using prescriptive controls, which can include maximum or minimum dimensions (e.g. overall vehicle length), or the maximum mass for a single or multiple axle group. Such schemes have been in operation for many years and throughout most countries in the developed and developing world, and are generally able to effectively regulate heavy vehicle operations.

In the present time however, there exist a wide range of economic and environmental factors which are demanding improved freight efficiency, higher vehicle productivity, and better utilisation of the available road network. In order to address these demands, regulators in Australia have developed and adopted a 'performance based' approach to heavy vehicle regulation, which is known as the Performance Based Standards (PBS) Scheme.

The PBS Scheme started development in the late 1990's, and has been in operation throughout Australia since 2007. It allows the potential for freight transporters to operate vehicles with improved productivity and better operational safety via innovative vehicle

designs. In this context, the term ‘innovative’ can refer to general improvements to existing vehicles in the form of more appropriate designs for carrying specific payloads, the addition of axles to carry extra mass, the employment of new technologies to overcome safety or operational concerns, or completely new transport equipment and vehicle combinations designed for specific transport tasks, such as actively-steered trailer axle groups. The range of benefits that the performance based approach encourages are generally difficult or impossible to realise with a framework of prescriptive regulations.

The regulatory controls under the PBS scheme focus on investigating how well the vehicle performs, rather than what the vehicle looks like (through specification of maximum dimensions or characteristics such as length, width and height), through a set of twenty individual standards which address performance in either safety or infrastructure-related criteria (NTC, 2008). The safety-related standards focus on the dynamic aspects of vehicle behaviour while travelling at highway speeds, the vehicle’s lateral stability limit, acceleration and braking capabilities, and the low-speed turning performance (swept path). The infrastructure standards address static vertical and horizontal loads applied to the pavement, the distribution of pressure as a result of vertical force at the tyre contact patch, and the impact of the vehicle on bridges. At present, most of the infrastructure standards, and the braking standard, rely purely on prescriptive controls, as the scientific research required to help define them has either not reached maturity, or there is insufficient agreement regarding the interpretation of the existing research results.

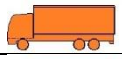
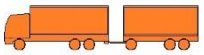
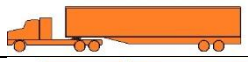
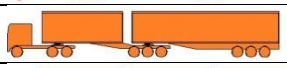
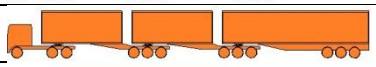
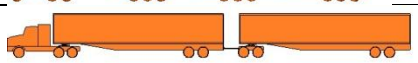
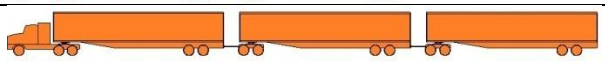
The central requirement of the PBS Scheme is the assessment of performance in each of the standards via an individual study of the vehicle and its various possible load configurations (e.g. unladen, partially laden, and fully laden). While the Scheme provides the scope for performance studies to be conducted via either computer simulation or field testing, the former is usually preferred due to the reduced cost and simplicity offered.

The basic concept of the PBS Scheme is that vehicle performance matches the capacity of the road that it is intended to operate on. In order for this to be achieved in practice, the National Transport Commission (NTC) supplemented the vehicle assessment guidelines with a framework under which asset owners and managers could assess and classify their road networks, and match them to vehicles and access classes defined under the PBS Scheme. The: *PBS Network Classification Guidelines* (NTC, 2007) links eight vehicle characteristics directly to four levels of network access, and provided advice on ten specific road parameters that should be considered in the process of assessing and classifying routes from a geometrical perspective.

The four access levels under the PBS scheme translate to four vehicle classes. The access levels range from greatest access to Australia’s road network (Level 1) to least (most-restricted) access (Level 4), and generally correspond to a single articulated vehicle, such as a six-axle semi -trailer (Level 1), a B-double or Truck-trailer combination (Level 2), a double road train (Level 3), and a triple road train (Level 4).

Table 2.1 is a guide to common vehicle configurations and their associated PBS level based on length and typical performance. Vehicle length is the most visible indicator of level, however, being a prescriptive limit, is not an absolute requirement, it is the performance standards that must be met. The images in the table are a guide only, with many different variations in body shape, trailer types and number of axles in operation.

Table 2.1 Typical vehicle configurations for the four levels of the PBS Scheme

PBS Level	Maximum combination Length	Description (typical length)	Example
1	20 m	Rigid truck (12.5 m)	
		Rigid truck trailer (19 m)	
		Semi-trailer (19 m)	
2	30 m	Long semi-trailer (23 m)	
		B-double (25 or 26 m)	
3	42 m	B-triple (35 m)	
		A-double (36.5 m)	
4	60 m	A-triple (53.5 m)	

3. DEVELOPMENT OF LOCAL GOVERNMENT GUIDELINES

In 2007, the NTC released national guidelines for the classification of road networks (NTC 2007). In 2008, the Queensland Department of Transport and Main Roads (TMR) used the NTC guidelines and other resources to develop a set of guidelines for classifying PBS Class B networks (TMR 2008). The first step in the development of a supporting online tool was the development of the *PBS Network Classification Guidelines for Local Government* (ARRB 2012).

These two guidelines were aimed at the national and state road networks which include freeways, highways and major arterial roads. Local road networks differ to state roads in a number of areas such as:

- Lower traffic levels
- It is not uncommon for centrelines to be unmarked
- Speed limits are generally lower (e.g. 50 km/h, or even 40 km/h in school zones)
- Local road environments can include more varied infrastructure and anomalies (e.g. trees, school crossings, roadside or median parking, etc.)

In addition, local councils are less resourced than a state road authority. For this reason, it was deemed important to adapt the NTC and TMR guidelines for local governments based on both the different character of the local road networks and the capacities of local governments to gather and assess networks.

The local government guidelines were developed in close consultation with local government representatives and based upon the NTC and TMR guidelines. The following classification items adapted to the local government case:

- Road and lane width
- Overtaking
- Signalised intersections*
- Railway crossings*
- Intersection approach sight distance
- Vertical clearance
- Road grade
- Stacking distances
- Storage Lanes
- Bridges, overpasses and culverts
- Swept path of turns.

**although railway crossings, and in some cases, intersection signal timings, are not under the jurisdiction of a local government, a local government route may include these elements.*

4. DEVELOPMENT OF THE PBS ROUTE ASSESSMENT TOOL

The Performance Based Standards Route Assessment Tool (PBS RAT) was developed to be a highly accessible and easy to use tool for local governments to support the PBS assessment of routes within their networks. The following fundamental tenets underscored the development:

- **Usability**: the tool must be easy-to-use and not place extra burden on the undertaking of assessments
- **Support and inform**: the tool must support and inform the access decision making process, but not replace it.
- **Consistency**: the tool must provide a consistent approach to route assessment for all local governments
- **Flexibility**: the tool must recognise the importance of local knowledge and judgement

The tool is web-based and provides workflow and reporting functionality as well as being a repository for help resources and information on the PBS Scheme and other relevant topics.

4.1 Route-based assessment

The tool enables classification of the desired routes of the local government. This will likely be based on operator requests for access, but can also incorporate a strategic element of pro-actively classifying portions of the network that is important for freight movement. With local government networks accounting for approximately 80% of the Australian network, this approach allows local governments to assess only the routes of interest, which are then retained and built up over time.

Routes are generally split into elements, such as intersections, mid-block road segments, bridges, railway crossings, etc., and are in one direction. This means that a classification from point A to B is not necessarily valid for the route from B to A. Furthermore, all manoeuvres through an intersection are considered separate route elements. As the local government's classified network grows, routes can be constructed from existing route elements where overlap occurs.

The route-based approach allows the flexibility of only classifying the desired sections of the network (even partial roads), as well as enabling network to be split into a level of detail that will not lead to unnecessarily restrictive access. For instance, if a 50 km long road section narrows after 40 km, access may be restricted beyond that point only, as opposed to classifying the entire road at the more restrictive level.

4.2 Classification of Routes and Elements

Routes are classified using a number of criteria that a linked to certain types of elements along the route. For example, signal timing is relevant only to intersections, but not to road segments. Table 4.1 illustrates some criteria that are relevant to each route element type.

Table 4.1- Sample criteria for each route element type

Route element type	Relevant criteria
Road segment	Lane width, overtaking, approach sight distance, vertical clearance, grade, stacking distance
Intersection	Signal timing, approach sight distance, swept path, vertical clearance, grade
Bridge/Overpass	Bridge capacity assessment (separate to tool), lane width, overtaking, approach sight distance, vertical clearance
Tunnel/Underpass	Lane width, overtaking, vertical clearance
Railway crossing	Railway crossing assessment (separate to tool), vertical clearance, grade

Each assessed criteria results in a classification (e.g. a single road segment may produce a result of Level 2A for lane width, Level 4B for overtaking, Level 3B for grade, etc.), and the overall classification given to a route element is dictated by its most restrictive. Similarly, the overall classification given to the route is dictated by the most restrictive element classification. By applying such detailed assessments, 'pinch points' at the route, and ultimately network, level may be identified.

In order to undertake a full assessment of a route, every criterion must be assessed. Recognising that local governments may want to focus on particular areas on a route, the assessment is undertaken by answering a series of questions on individual elements that are not linear, and do not require any particular previous elements to have been assessed. Instead, questions are formed in a branching structure, where both the questions displayed and the values appearing in multiple choice answers will change depending on how previous

questions are answered. A simple example is shown in Figure 4.1 for the case of classifying lane width for a road that may or may not include bends.

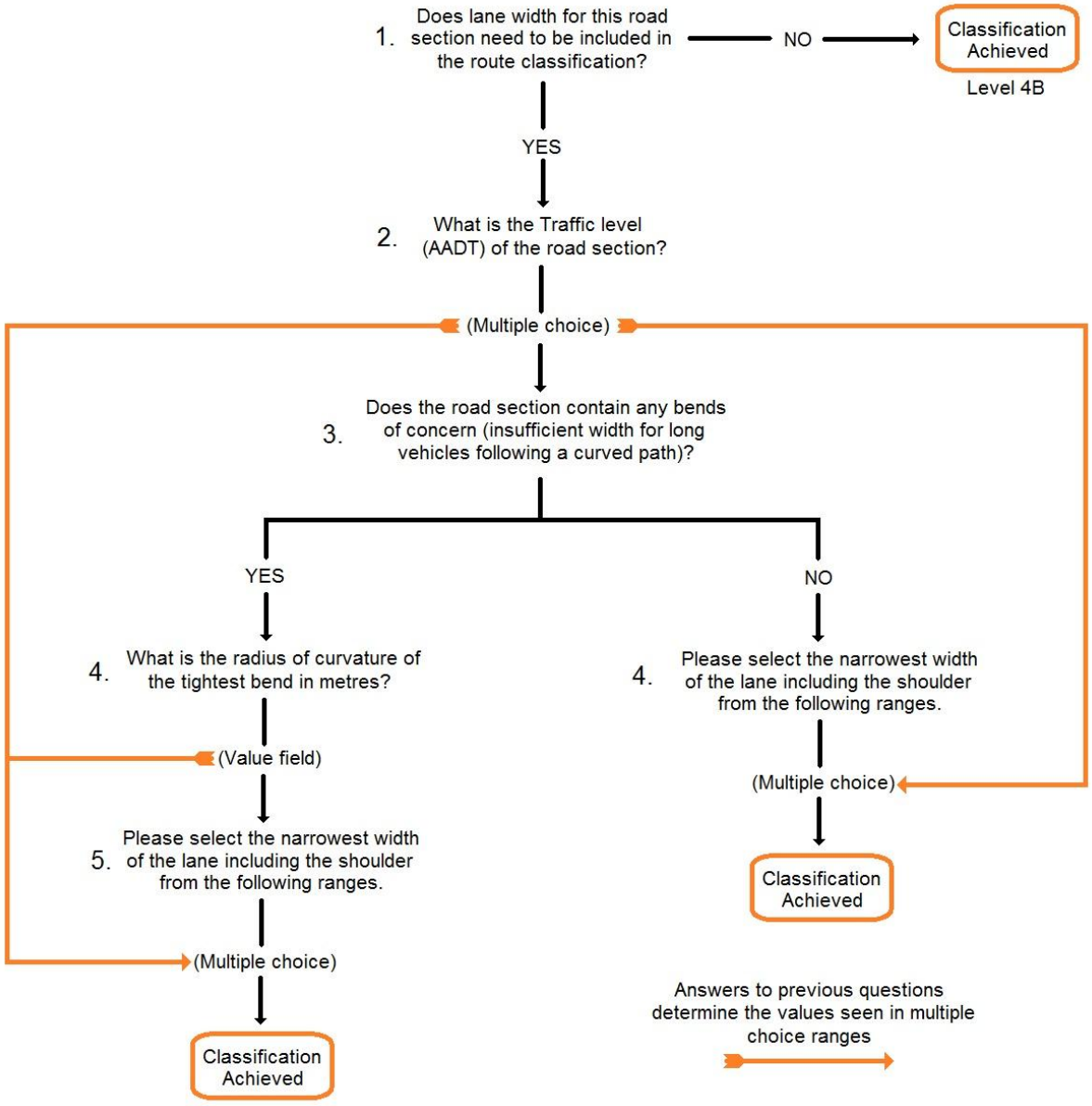


Figure 4.1 - Diagram of branching question structure for lane width of a road

Rather than ignoring criterion that are of no interest, these can be marked as being not relevant to the current assessment. This means the criterion will have no restriction on the route classification (as seen in answering 'No' to Question 1 in Figure 4.1), but will have an impact of the reliability of the result as explained in the next section.

Criteria requiring external assessment

There are a number of criteria that are included in the tool requiring external assessment for a number of reasons. Railway crossings are required by legislation to be assessed using a certain methodology by owners of the railway. There are currently no national assessment guidelines for bridges, and due to their complexity, a qualified engineer is required to

undertake such assessments. Furthermore, swept paths assessments are very difficult to automate, primarily due to input data requirements for describing intersection geometry.

The tool includes these criteria to allow local government to centralise the route assessment workflow and documentation. For these criteria, the question structure will ascertain that the relevant external assessment has occurred, and allow the user to directly enter the classification. This allows the tool to still consider the classifications of these criteria in the overall route classification and identification of 'pinch points'.

4.3 Reliability of classifications

The overall route classification is initially classified by default as Level 4B (the least restrictive). As route elements are classified, this result will be modified according to the results of individual criterion, usually becoming more restrictive. This means that a route can achieve an overall classification based on a single criterion. It may be that the user is only interested in this one criterion for the moment, so the result is useful, however, the resulting overall route classification must be considered unreliable.

For this reason a Reliability Index was introduced. This provides a simple indication of the reliability of the overall route classification based upon two general factors: the proportion of criteria that have been assessed, and the source of the data used in the assessment. The source of data used to answer questions containing values is required to be selected from three levels of reliability: Measured Value, Expert Judgement, and Estimate. For example, a required minimum lane width for a road section may be estimated at 4 m, but could be measured at (say) 3.85 m.

The Reliability Index is calculated on a points system, with the three levels of reliability assigned 4, 2 and 1 point(s) respectively.

The equation to produce the Reliability Index is:

$$Reliability\ Index = \left(0.5\frac{S}{W} + 0.5\frac{A}{N}\right)\left(1 - \frac{C}{N}\right) \quad (1)$$

where:

S = Total of all points for data sources

W = Total of all possible points for data sources

A = Number of criterion assessed

N = Number of criterion on the route

C = Number of Critical* criterion on the route but NOT assessed.

* Critical criteria refer to all bridges, railway crossings, and swept path elements.

The coefficients of 0.5 provide an even weighting to the sum of the data source reliability points ratio and the ratio of assessed to total number of criterion. The Reliability Index is

displayed to the user as a graphics bar as it was found to provide more meaning to users as a general indicator of reliability.

5. ADDITIONAL RESOURCES

The PBS RAT was intended to provide additional resources to assist local governments to undertake PBS assessments on their network. To this end, a number of different help resources have been developed, as listed in Table 5.1.

Table 5.1 - Help resources available in the PBS RAT

Resource	Description
Criterion descriptions	Brief description of what the criterion applies to.
In-question Help Box	Additional level of detail to assist answering individual questions
Sidebar Help	More detailed information about the criterion to explain some of the concepts behind the assessment process.
Sidebar User Input	Where assessment of a criterion is not straightforward, a 'Status' dropdown box ('None', 'Site inspection needed', 'Site inspection in-progress' and 'Site inspection complete') and a text box for user notes is included.
Frequently Asked Questions (FAQ) page	Page of frequently asked questions. Users can add questions at any time.
Document repository	Repository of documents and tutorials such as slideshows for route setup and assessment, PBS Network Classification Guidelines for Local Government

The tool is also designed to help manage the workflow of the route assessment process, which lead to the development of the Sidebar User Input area. This allows users to highlight particular criteria that are to be assessed, but for which data is not currently available. By entering notes, and setting the status, the local government can identify data required for the assessment to continue, and to manage the process of acquiring that data.

6. MANAGEMENT OF DATA AND CLASSIFICATIONS

The tool ultimately generates suggested classifications for routes, intended to inform local governments in their access decision making. Recognising that the decision for access is still in the hands of the local government and may involve other considerations such as community, environmental and/or political concerns, functionality is provided for users to set the overall classification, regardless of what is suggested by the tool. Notes can be entered to outline the reasons for the differing classification, providing local government with secure documentation on the assessment task.

Local governments are also able to map classifications onto a common mapping tool, manage permission and access to data, and publish outputs to interested third parties, such as state road authorities, or national databases.

To assist with reporting of the assessment outcomes, and identification of tasks and 'pinch points', the tool automatically generates a number of report listed in Table 6.1.

Table 6.1 - Reports available to be generated from the PBS RAT

Report	Format	Description
Route summary	PDF	Summary detail and presentation of the route, the element classifications and overall route classification.
Route detailed	PDF	A more detailed presentation of the route and classification results with descriptions of each route element, including a record of the comments and other information added by the user during the assessment process.
Route checklist	PDF	This is a report of all of the route elements flagged during assessment using the Sidebar User Input area as requiring a site inspection
Route Q&A	PDF	A record of how all of the questions that make up the assessment were answered.
Network summary	CSV	A collection of all routes on the system (published and unpublished) for the local government, giving a brief summary of each route.
Network pinch points	CSV	A list of all restrictive elements for all of the local government's routes on the system.
Published routes	CSV	A collection of all published routes on the system for all users, giving a summary of each route within one line of data.

7. SUMMARY

The PBS RAT was developed and trialled with local governments in the state of Victoria in Australia. It is now operating in production to undertake PBS route assessments. The tool has greatly simplified a previously complex and, arguably, neglected area that will allow local government network capacity to be more efficiently realised.

Although still very new, there is considerable interest from other local government associations with Australia. Future development is expected to allow similar benefits for other route assessment methodologies (e.g. over-dimensional vehicles), as well as at state and national levels in Australia and possibly internationally.

8. REFERENCES

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