Evaluating Quality of Service for Auckland Cycle Facilities

A Practitioner's Guide

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https://at.govt.nz/cycling-walking/

Contents


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Foreword

We are beginning an unprecedented era of city-shaping in Auckland, one that will have a meaningful impact on how the city works and how people access the diverse opportunities of the city. In order to accommodate the growth in travel expected in Auckland we need to enable more efficient use of our transport network. A key part of Auckland Transport's strategy in creating a resilient system is ensuring more people get around by bike. Our aim is to deliver a safe, connected and convenient cycle network that will support cycling as a transportation choice for more Aucklanders.

There is a growing body of evidence from around the world that shows the importance of providing high quality cycle facilities in order to maximise the effectiveness of investment in cycling infrastructure. When we talk about quality we are addressing most people's reluctance to cycle in stressful conditions alongside (or with) traffic. Quite simply, cities with high levels of cycle use have extensive cycle networks that separate users from fast moving and heavy traffic. By developing high quality, low stress cycling infrastructure we have the potential to attract the widest number of users.

That's why I am asking engineers, project managers, planners, and designers to make high quality facilities the default design objective for new cycleways. On busy streets this will mean protected or separated bike lanes; on neighbourhood streets this may require traffic calming or traffic reduction strategies.

Along with the Cycleway Design Standards, this Practitioner's Guide establishes Auckland Transport's expectations for new and retrofitted cycleways. This Quality of Service evaluation tool seeks to achieve consistency in our approach to designing cycle infrastructure. The intention of this tool is to ensure we are producing designs that maximise our investment in new cycle infrastructure.

Auckland Transport's ambition is for Auckland to be a global leader for every day cycling, to become a city of cyclists. This Quality of Service evaluation tool plays a key role in helping us achieve that goal.

Kathryn King,
Walking, Cycling and Road Safety Manager

Why evaluate cycle facilities?

Ensuring quality infrastructure to support everyday cycling

Auckland Transport is committed to growing the level of cycling in our city. To do this, cycling must become an attractive transport option for a wider range of users. While cycling levels have increased strongly in recent years, they remain far lower than in the world's leading cycling cities.

International research has found that high levels of cycling are generally supported by the provision of high quality facilities. Attracting large numbers of new cyclists will require new facilities that meet high standards for safety, comfort and directness. The major potential market for new Auckland cyclists is among the 'interested but concerned' (see box on this page for more on market segments for cycling). Attracting these users will require a particular focus on facilities that overcome safety concerns, and peoples' reluctance to cycle with fast traffic.

The cycle facility quality of service evaluation tool (QoS tool) has been developed with the 'interested but concerned' target market in mind, and aims to highlight where facilities meet critical minimum standards and will be comfortably used by a broad range of cyclists.

A consistent approach to design for the next generation of facilities

Auckland Transport is undertaking a major capital investment programme in developing the Auckland Cycling Network. Auckland Transport and other funders including the NZ Transport Agency require assurance that new facilities meet consistent quality standards.

The QoS tool provides a method for scoring the quality of facilities from a user perspective. It provides confidence that new facility designs meet design standards that are appropriate and enticing to the mainstream cyclists. This can help maximise return on investment by ensuring that new facilities encourage a broad range of users. Setting quality standards should promote development of a cycling network with more consistently high service levels.

Highlighting critical design features

Cycle facility design is a fast-moving field, with cities around the world undergoing a boom in facility development. Auckland has a limited history of cycle facility provision and limited guidance on what high-quality facility design means.

The QoS tool focuses attention on a set of critical design features that should be considered while planning and designing new facilities or when evaluating the quality of existing facilities. It provides a 'checklist' of factors essential for providing quality facilities.

Purpose of this document

This document provides guidance for using the cycle facility quality of service evaluation tool (QoS tool) for assessing the quality of Auckland cycle facilities. This guidance document is accompanied by a spreadsheet template that can be used to input information and present the results of QoS evaluations. This guidance provides:

- A clear method for evaluating the quality of planned and existing cycle facilities
- Information about the critical features of high-quality cycle facilities
- Explanation of key principles and reference material underlying the evaluation framework
- Information on how the evaluation tool can be used as part of Auckland Transport's project planning and funding processes.

This document is intended for use by practitioners during the planning and design of cycle facilities. It is also relevant for a more general audience, providing information about Auckland Transport expectations for the city's cycle facilities.
This guidance document and the QoS tool do not provide complete guidance on cycle facility design. Practitioners need to use their professional judgement to make trade-offs between design features and identify the most important features for ensuring a high quality facility that meets the needs and constraints of the facility context. Practitioners should also make use of other local, national and international design guidance.

Cycling facilities for the 'interested but concerned'

Research in the United States has identified four 'market segments' among potential cycle facility users. Each of the following user types has a progressively lower tolerance for traffic stress:

- Strong and fearless – are very comfortable on busy city streets without designated cycle facilities. They cycle regardless of facility provision.
- Enthused and confident – are less comfortable on busy city streets, but may be comfortable with minimal cycling facilities.
- Interested but concerned – are interested in cycling, but are uncomfortable cycling on busy streets without dedicated, protected cycle paths. They identify safety fears as the primary barrier to not cycling more.
- No way, no how – have little interest in cycling and are very uncomfortable cycling in all conditions, even with provision of fully segregated facilities.

Market research in Auckland has confirmed that safety concerns are major barriers to higher levels of cycling, and that provision of higher-quality facilities is an important way of overcoming these safety concerns (TRA for Auckland Transport, 2015). North American research has found that among the 'interested but concerned' group, cycle facility quality makes a significant difference to perceived levels of comfort on busy urban streets. Figure 1 shows that 'interested but concerned' users are very comfortable cycling on dedicated cycle paths or on quiet, low speed streets, but are far less comfortable using busy urban streets. For these users, providing protected cycle paths on busy streets increases comfort levels substantially.

Figure 1: Comfort rating for different types of cycling facilities - 'interested but concerned cyclists'

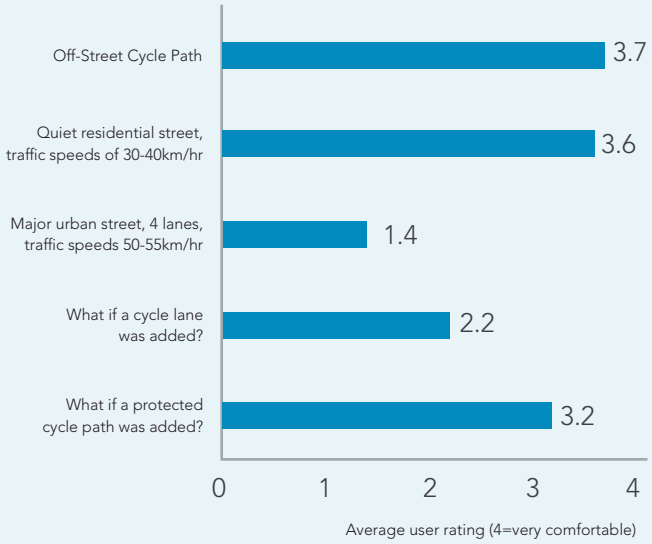


Chart based on Dill and McNeil (2012).

Geller, R. (2006) Four Types of Cyclists. Portland, Oregon: Portland Bureau of Transportation. Available at: http://www.portlandoregon.gov/transportation/article/264746

Dill, J. and McNeil, N. (2012) Four Types of Cyclists? Testing a Typology to Better Understand Bicycling Behavior and Potential. Portland, Oregon: Portland State University.

What can the tool be used for?

Evaluating facility quality from the cyclist's perspective

The QoS tool allows evaluation of cycling facility performance from the cyclists' perspective. The results of a facility assessment can provide information about whether a proposed or existing facility provides a level of quality that will be attractive to a wide range of people who may choose to cycle. This can help decision-making on different design options for a proposed facility and can provide reassurance that facilities meet design standards. The tool can be used at the concept design stage, and repeated evaluations during more detailed phases of design can assist in refining plans.

What the tool does not do

In focusing on cyclists' experience, the tool is solely concerned with revealing how an existing or planned facility meets cyclists' needs. It does not enable evaluation of performance with regard to a broader range of potential transport corridor users. For example, the assessment tool does not provide information about performance of a facility from the perspective of pedestrians or public transport users.

In planning new cycle facilities, other planning and design processes should be used to ensure that facilities are developed in a holistic way that provides appropriate treatment for the entire range of street users. In many cases this will involves making complex trade-offs between users, a task that is outside the scope of this tool. Auckland guidance for integrating the needs of different street users is available from the Auckland Transport Street Design Guide.

The QoS tool is also limited in not providing guidance on the full range of considerations that determine whether or not it may be beneficial to construct a new facility. Factors such as cost, property requirements, implementation challenges and maintenance implications should all be considered, but are not within the scope of this tool.

Assessing cycling facilities rather than networks

The QoS tool is designed to be used to assess cycle facilities. It scores facilities at the spatial scale of individual intersection and mid-block segments, enabling evaluation of how detailed design features contribute to safety and other objectives.

It is recognised that when planning and designing facilities, it will also be desirable to take a 'wider view' to assess how individual facility components fit within a broader cycling infrastructure network and how a facility may provide benefits by linking important destinations. This type of assessment will require other tools and planning processes. This tool is not appropriate for evaluating how well a route is integrated with a wider network, or whether the alignment of a route is optimal. Nevertheless, the findings from the QoS assessment may contribute to testing the quality (from a cyclists' perspective) of various alignment and route options.

Evaluating existing and planned facilities

The QoS tool is intended to be used to evaluate:

a) Existing facilities - to assess the level of quality and appropriateness of an existing 'on the ground' facility.

b) Planned future facilities – to predict how well a planned facility will perform in providing a quality experience for cyclists, using design drawings and plans.

The same approach is used for assessing both existing and planned facilities. The assessment criteria within the QoS tool have been selected to enable evaluation of planned facilities through reference to readily available data. It is intended that the tool will be used at a stage when at least conceptual design drawings and geometric specifications are available. The tool can be used iteratively to test various design alternatives and repeat evaluations as designs become progressively refined.

It is intended that the tool provides consistent results across various contexts that can inform decision-makers and facility designers and planners about facility performance from a user's perspective.

Guiding decisions on facility type

The standards set by the QoS tool can guide initial design thinking on what type of cycle facility may be appropriate for a given street context. The evaluation tool establishes thresholds for combinations of traffic speeds, volumes and street lane widths where protected cycle paths, cycle lanes or mixed traffic may be appropriate when catering to the 'interested but concerned' target market (see more guidance on page 13).

Using the tool within AT's planning and funding processes

AT has a gateway system to inform decision making and provide quality assurance across projects when moving between delivery phases. The QoS evaluation tool should be considered as early as practical in the planning stages to help guide design choices. The evaluation should be undertaken as part of the Design phase and can be included as part of the documentation to support the transition from the Design to the Construction phase.

Some projects implemented by AT are eligible to received funding through the New Zealand Transport Agency. The Transport Agency requires funding applications to follow a Business Case Approach. Business Cases align closely to AT's delivery phase gateways and include robust documentation on which investment decisions are made. The QoS evaluation should be included in the Business Case for Implementation to support funding for Construction.

Design principles and assessment criteria

Five principles are commonly used internationally to guide cycle facility design. The principles of safety, directness, comfort, coherence and attractiveness are at the core of design guidance in countries including the Netherlands, UK and Australia[1].

The QoS tool evaluates the extent to which a facility achieves these high-level ideals. The QoS tool is focused on evaluating facility design (the details of mid-block and intersection components of a cycling route) rather than network design (the location and alignment of routes and how they are integrated).

With the focus on facility design, the selected assessment criteria evaluate features that contribute to the safety, directness and comfort principles, but exclude consideration of the coherence and attractiveness principles. Coherence is more appropriately evaluated as part of network design processes that consider how an individual facility can be well-integrated into a continuous and consistent network. Attractiveness is also partly determined by route selection and alignment, but can also be influenced by detailed design features including material choice and integration with the overall streetscape.

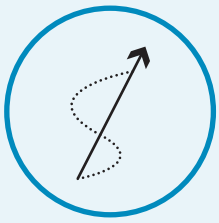
The QoS tool does not attempt to assess attractiveness due to difficulties in using quantitative measures to evaluate attractiveness. It is recommended that attractiveness is considered in facility planning through separate urban design assessment processes.

Five Design Principles

A cycle facility or network provides users with a high-quality experience by being:

Safe

It feels safe for users and helps overcome safety concerns associated with cycling.

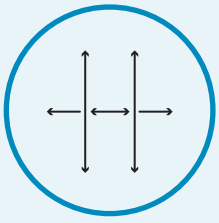


Direct

It follows direct routes with minimal detours and waiting times.

Comfortable

It provides an easy and pleasurable cycling experience.



Coherent

It is well integrated into a continuous and consistent cycling network.

Attractive

It is aesthetically pleasing and attracts users.

[1]CROW (2007) Design Manual for Bicycle Traffic, The Netherlands: CROW; Transport for London (2014) London Cycling Design Standards, consultation draft, London, UK: Transport for London; Sustrans (2014) Sustrans Design Manual: Handbook for cycle-friendly design, Bristol, UK: Sustrans; State of Queensland Department of Transport and Main Roads (2015) Selection and Design of Cycle Tracks, Technical Note 128, Brisbane, Australia: State of Queensland Department of Transport and Main Roads.

From principles to assessment criteria

The QoS tool evaluates facilities by scoring against a series of assessment criteria. The assessment criteria have been selected to identify the critical factors that contribute to achieving the design principles. In focusing on the most critical factors, the tool inevitably does not consider all design features that contribute to quality. Assessment criteria have been selected that are easily measurable, for which data is readily available, and which capture critical factors that contribute to user experience.

The tool uses different assessment criteria for evaluating mid-block and intersection segments of facilities. This is because intersections and mid-block segments require a very different range of design features to ensure quality. There are 12 assessment criteria for mid-block segments and 10 criteria for intersections.

The selected assessment criteria place emphasis on achieving the safety principle, with 8 of the 13 criteria for assessing mid-block segments dealing with features contributing to safety. Criteria for safety are organised by three sub-categories:

- Safe- facility type suitable for street conditions. Is the facility type appropriate to the street conditions?
- Safe- appropriate facility dimensions. Does the facility have adequate dimensions to support its users?
- Safe- potential conflicts minimised. Does the facility include features that reduce the risk of conflicts between cyclists and general traffic or other facility users?

Table 1: Assessment criteria for mid-block and intersection segments of facilities

Design Principle	Assessment criteria for mid-Block Segments of cycle facilities	Assessment criteria for intersection segments of cycle facilities
Safe- Infrastructure type suitable for street conditions 	Traffic speed	Traffic speed
	Traffic volume	Traffic volume
	Number of street traffic lanes	Intersection crossing distance
Safe- Appropriate facility dimensions 	Cycle lane/ path width	Corner kerb radii
		Cycle queue space
Safe- Potential conflicts minimised 	Facility blockage	Signals
	Interaction with on-street car parking	Continuity across intersection
	Interaction with public transport stops	Mixing zone
	Treatment at driveway intersections	
Direct 	Geometric directness	Geometric directness
		Intersection wait time
	Presence of pedestrians on shared paths	
Comfortable 	Gradient	
	Social safety	

Scoring facilities against assessment criteria

Using the QoS tool involves scoring facility segments against the assessment criteria. A separate score is given for each segment, allowing for the tool to highlight particular sections of a facility where quality standards may be weaker and where further design attention may be required. A segment is classified as either a:

- Mid-block segment (parts of a facility that run alongside a street between intersections, or are off-street facilities)
- Intersection (parts of a facility that interact with intersections, including street crossing points for off-street facilities).

A separate mid-block segment is defined for each section between two intersections. Segments for street-side facilities should be defined and scored separately for facilities that are on different sides of a street.

Every intersection (even minor intersections) should be treated as separate and scored independently.

Further information on classifying segments of a facility is provided on the following page. Separate standards for scoring are defined for both mid-block and intersection segments as the design requirements are distinct for these two components of facilities.

A score of 1-4 is given for each segment and each intersection for each relevant assessment criteria. The scores represent the following levels of facility quality:

- QoS 1: facility is consistent with, or exceeds best practice design guidance. Facility is suitable for a very wide range of users.
- QoS 2: facility meets best practice design guidance. Facility is suitable for a wide range of users, including the 'interested but concerned'.
- QoS 3: facility does not meet best practice design guidance and may introduce safety concerns for users. Facility is likely to only be attractive for confident cyclists.
- QoS 4: facility presents shortcomings in design that are likely to introduce major safety concerns for most users, or other quality problems that will detract many potential users.

In summary, a QoS1 or 2 facility should be considered appropriate for a wide range of users, while a QoS3 or 4 should highlight potential problems with the facility design if it is intended to attract large numbers of users, including the 'interested but concerned'.

For some assessment criteria, standards for scoring differ depending on the facility type. For example, scoring against the street traffic speed criteria will depend on whether the facility is classified as 'mixed traffic', a 'cycle lane' or a 'protected cycle path' (see Table 2 below).

Table 2 illustrates how standards for the traffic speed criteria vary across facility types. Where a protected cycle path or a shared path is provided, the traffic speed criteria is not applicable (NA), as it is assumed that adequate protection for cyclists will mean that the speed of traffic on adjacent streets will not impact on the safety of the facility. Where a cycle lane is provided, adjacent traffic speed of 50km/hr will mean a score of QoS2 for the traffic speed criteria, whereas if no distinct cycle facility is provided (mixed traffic) the same 50km/hr traffic speed will result in a score of QoS3. This reflects that when catering to a broad range of potential users, different street-side cycle facility types are appropriate for different levels of adjacent traffic speed (see box on page 13 'Determining appropriate cycle facility types for different street conditions').

Table 2: Standards depend on facility type – an example using the traffic speed criteria

	QoS1	QoS2	QoS3	QoS4
Mixed traffic	<30 km/h	<30 km/h	31-50 km/h	51 km/h+
Cycle Lane	<30 km/h	31-50 km/h	51-60 km/h	61 km/h+
Protected Cycle Path	NA	NA	NA	NA
Shared Path	NA	NA	NA	NA

Note that the QoS score for a facility also depends on a number of other assessment criteria including traffic volume, path width and interaction with public transport. See Table 1 for the full list of criteria contributing to scores.

Classifying mid-block segments of cycle facilities

- Mixed traffic: A type of on-street cycle facility that involves people using bikes and motorised vehicles sharing the same carriageway space. Specific infrastructure treatments are not necessarily provided, but may involve traffic calming measures or painted sharrows.
- Cycle lane: A type of on-street cycle facility that provides surface treatment on part of the street carriageway that is dedicated for people using bikes. Treatment is usually coloured paint. The facility may or may not include a painted buffer separating the lane from general traffic lanes or on-street parking.
- Protected cycle path: A type of on-street or off-street cycle facility that provides a dedicated path for people using bikes that is physically separated from general traffic lanes. On-street separation between the path and general traffic may include on-street parking space, vertical separation (e.g. Copenhagen Lane) or various forms of horizontal separation (e.g. planter boxes, concrete kerbs, flex-posts or berm space). Also includes off-street dedicated cycle facilities (distinct from shared paths that are also open to people walking).
- Shared path: A type of off-street cycle facility that is open to people on bikes and people walking. May be entirely off-street (e.g. a local path running through a park) or alongside a street (e.g. a modified street-side footpath). When running alongside a street, vertical or horizontal separation between general traffic lanes will be provided (as for a protected cycle path).

Classifying intersection segments of cycle facilities

- Signalised intersection/ crossing – a street intersection (T or Y) or cyclist crossing point of a street regulated by traffic signals.
- Un-signalised intersection/ crossing – a street intersection or cyclist crossing point without traffic signals. Crossings may include informal crossing points, or various treatments including provision of refuges or surface treatments. Where facilities cross driveways with high volumes of vehicle traffic (1,000+ vehicles/ day), these points should be treated as un-signalised intersections.
- Roundabout.

Using the cycle facility QoS spreadsheet

This guide is accompanied by a spreadsheet-based tool that can be used to help organise the scoring of facilities and to present a summary of assessment results. The spreadsheet is designed for scoring a single facility design. Comparison of design options requires completing a separate spreadsheet for each option and manually summarising scores for comparison purposes.

Facility assessment using the spreadsheet tool involves four steps:

1. Divide facility into segments
Establish a separate segment for each intersection and mid-block section. Mid-block segments will generally be defined as the section between two intersections (including minor intersections). Where a on-street facility uses both sides of a street, separate mid-block segments should be defined for each side as conditions and designs may differ. A distinct segment should be defined for different parts of a single mid-block section where the adjacent street condition changes significantly (e.g. speed limit change or street lane number change).

2. Classify each segment by facility type
Determine the facility type for each segment, based on features of the cycling infrastructure provided (as described on page 11). Mid-block segments will be classified as either 'mixed traffic', 'cycle lanes', 'protected cycle paths' or 'shared paths'. Intersection segments will be classified as either 'signalised', 'un-signalised' or 'roundabouts'.

3. Score each segment against each of the relevant assessment criteria
Each segment will be scored against all assessment criteria that are relevant for the facility type. This may mean up to 13 scores for a single segment. The scores will be based on assessment against the standards summarised in the tables on pages 14 – 17. The scores can be inputted into the spreadsheet using dropdown menus.

4. Summarise the scores for each segment by each design principle
A summary score for each segment is automatically produced in the spreadsheet 'dashboard'. This is based on the lowest score for the segment against any criteria relevant to the design principle.

The QoS tool is designed to reveal the quality of a cycle facility across multiple criteria, and across different segments of the facility. It is not designed to determine a single score for an entire facility or route. Determining a single score would hide the variation in scores across facility segments and across various facility features.

Determining the appropriate cycle facility type for different street conditions

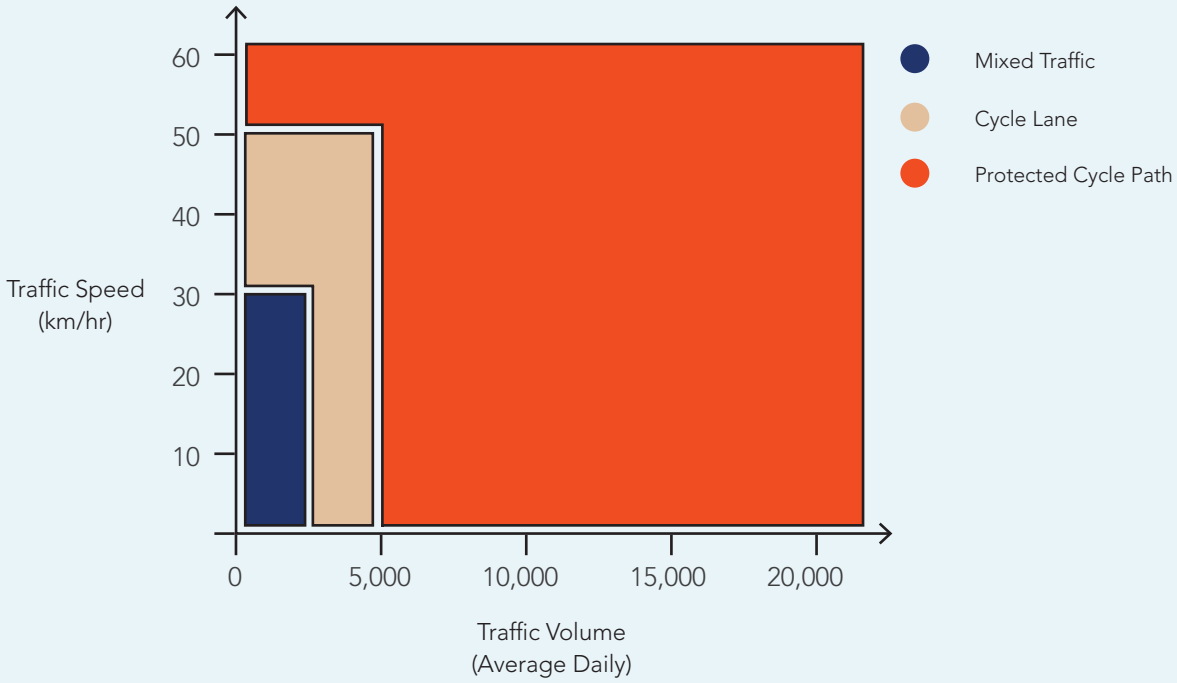
A cycle facility that will attract a broad range of users needs to be of an appropriate quality for the adjacent street conditions. The facility type (whether a painted cycle lane, protected cycle path or facility in mixed traffic) has a major impact on users' perceptions of safety and attractiveness. While protected cycle paths are not always the appropriate treatment, they are required on busy streets with fast traffic if the aim is to attract a wide range of users.

The QoS evaluation tool uses three assessment criteria to determine whether the planned or existing facility is the appropriate treatment, given the street conditions: traffic speed; traffic volume; and number of street traffic lanes.

For facilities to score QoS1 or QoS2 (and be appropriate for a wide range of users), mixed traffic facilities such as greenways will only be appropriate on low-speed, low traffic-volume streets. Cycle paths may provide an acceptable level of quality on streets with slightly higher traffic speeds and volumes. On streets where average daily traffic volumes are greater than 5,000 vehicles and speeds are more than 50km/hr (85th percentile observed speeds), protected cycle paths are considered the appropriate facility type (illustrated in Figure 2).

A score of QoS 3 or 4 for any of the three assessment criteria above indicates that the facility type is likely to be inappropriate for the street conditions, if it intended for use by a broad range of cyclists.

Figure 2: Street conditions where different facility types will score highly and are appropriate for a broad range of potential cyclists (QoS1 or QoS 2)



Note: Facility choice should be determined with consideration of a variety of factors. While traffic speed and traffic volume are the most important factors, other factors such as on-street parking should also be considered. These factors are included as assessment criteria in the table on pages 14-15.

Summary of standards: mid-block segments

Design Principle	Criteria	QoS1	QoS2	QoS3	QoS4
Safe- infrastructure type suitable for street conditions	A. Traffic speed (85th percentile observed speed)	<30km/h <30km/h NA	<30km/h 31-50km/h NA	31-50km/h 51-60km/h NA	50km/h+ 61km/h+ NA
	B. Traffic volume (AADT)	<1,000 <2,500 NA	1,001-2,000 2,501-5,000 NA	2,001-4,000 5,001-15,000 NA	4,001+ 15,001+ NA
	C. Number of street traffic lanes (per direction)	1 NA	1 NA	2 NA	3+ NA
Safe- appropriate facility dimensions	D. Cycle lane/ path width (per direction)	2.1m+ 4.0m+ NA	1.8m- 2.1m 3.0m- 4.0m NA	1.2m- 1.8m 2.0m- 3.0m NA	<1.2m <2.0m NA
Safe- potential conflicts minimised	E. Facility blockage (by traffic, parked vehicles or other obstructions)	Not Possible NA	Rare NA	Frequent NA	Very Frequent NA
	F. Interaction with on-street car parking	Car parking separated from cycle facility by horizontal surface treatment 1.0m+ NA	Car parking separated from cycle facility by horizontal painted buffer of 0.8-1.0m NA	Car parking separated from cycle facility by horizontal painted buffer of 0.6-0.8m NA	Car parking separated from cycle facility by horizontal painted buffer of <0.6- NA
	G. Interaction with public transport stops (criteria only applicable where average weekday bus or light rail vehicle frequency >4 vehicles/hour.)	Cycle facility passes behind public transport stop NA	Cycle facility may pass in front of public transport stop but doesn't share carriageway space with public transport NA	No facility at public transport stop NA	No facility at public transport stop NA

Mixed Traffic Cycle Lane Protected Cycle Path Shared path

Design Principle	Criteria	QoS1	QoS2	QoS3	QoS4
	H. Treatment at driveway intersections	Raised table, limited or few right turns into driveway Clear surface markings across driveways, limited or few right turns into driveway, corner radii and ramp profile slows turning vehicles NA	Clear surface markings across driveway, corner radii and ramp profile slows turning vehicles NA	No surface marking or raised table NA	No surface marking or raised table, frequent conflicts with turning traffic into driveway NA
Direct	I. Geometric directness	Route minimises geometric directness between intersections	Minor deviations from most direct route	Obvious deviation from most direct route	Major deviation from most direct route prompting frequent bypassing of route by cyclists
	J. Presence of pedestrians on shared path (weekday peak-hour pedestrian flows)	<100 NA	100-150 NA	150-500 NA	500+ NA
Comfortable	K. Gradient	0-3% (uphill) 0-10% (downhill)	3-7% (uphill) 10-15% (downhill)	7-10% (uphill) 10-15% (downhill)	>10% (uphill) >15% (downhill)
	L. Social Safety	Frequent sections with human activity, or buildings overlooking path. Good path lighting. Clearly identifiable escape routes	Some human activity or buildings overlooking path. Good path lighting. Escape routes available	No human activity. Path is visibly blocked from buildings by walls or cegetation. Adequate path lighting. No escape route available	No human activity. Path is visualy blocked from buildings by walls or vegetation. No path lighting. No escape route available

Mixed Traffic Cycle Lane Protected Cycle Path Shared path

**QoS 1 and 2 scores represent a facility that is likely to attract the widest range of cyclists. QoS 3 and 4 scores represent a facility with a design feature(s) that is likely to detract some types of users.*

The following criteria are not applicable to off-street shared paths: Interaction with on-street car parking, interaction with public transport stops, treatment at driveway intersections.

Summary of standards: intersection segments

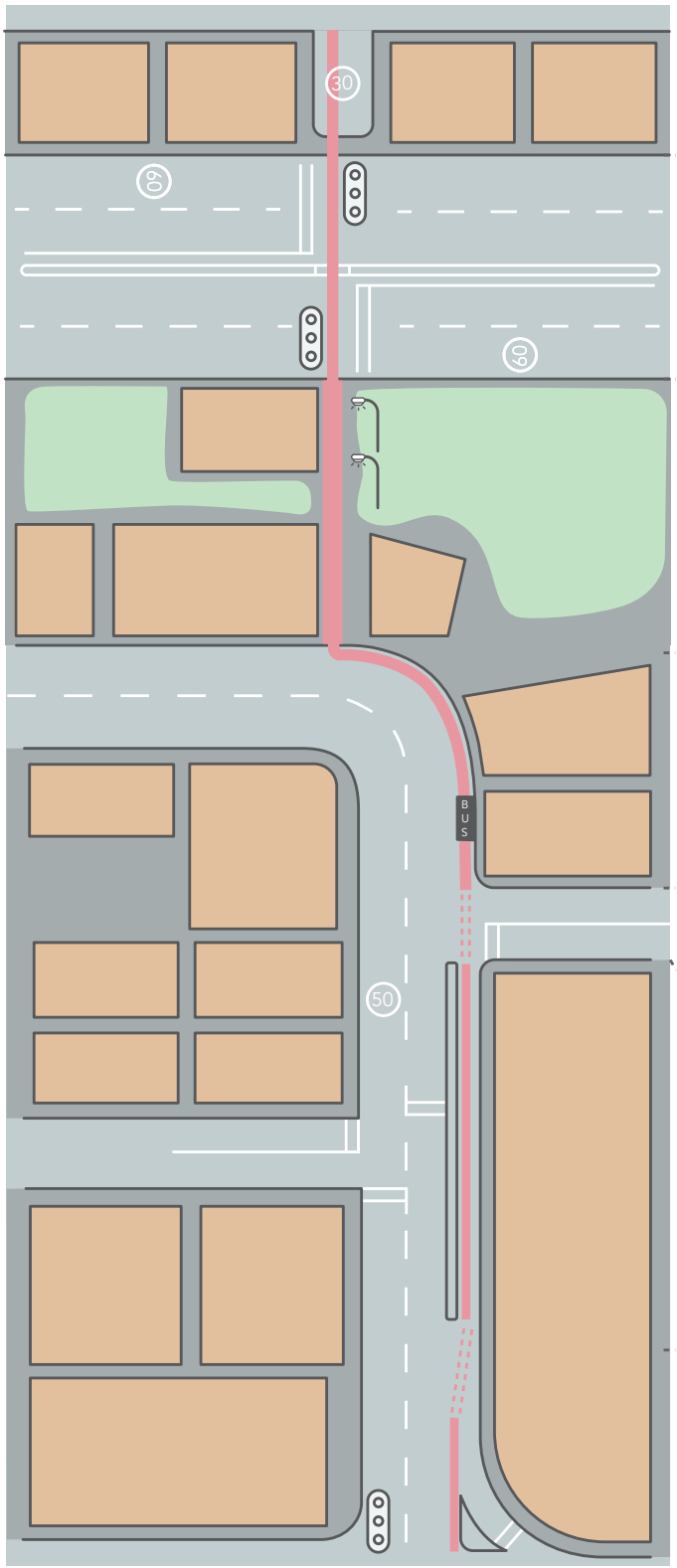
Design Principle	Criteria	QoS1	QoS2	QoS3	QoS4
Safe - infrastructure type suitable for street conditions	A. Traffic speed on street crossed (85th percentile observed speed)	≤30 km/h (un-signalised intersection, roundabout) ≤50 km/h (signalised intersection)	31-50 km/h (un-signalised intersection, roundabout) 51-60 km/h (signalised intersection)	51-60 km/h (un-signalised intersection, roundabout) 61-70 km/h (signalised intersection)	61 km/h+ (un-signalised intersection, roundabout) 71 km/h+ (signalised intersection)
	B. Traffic volume on street crossed (AADT)	≤1,000 (un-signalised intersection) ≤ 4,000 (roundabout) NA (signalised crossing)	1,001 - 2,000- (un-signalised intersection) 4,001-6,000 (roundabout) NA (signalised crossing)	2,001 – 4,000 (un-signalised intersection) 6,001-8,000 (roundabout) NA (signalised crossing)	4,000+ (un-signalised intersection) 8,001+ (roundabout NA (signalised crossing)
	C. Intersection crossing distance (maximum distance between kerbs)	<10m (un-signalised crossing) NA (signalised crossing)	10-20m (un-signalised crossing) NA (signalised crossing)	20m+ (un-signalised crossing) NA (signalised crossing)	20m+ (un-signalised crossing) NA (signalised crossing)
Safe – appropriate facility dimensions	D. Corner kerb radii	≤3.0m (signalised and un-signalised intersections) NA (roundabout)	3.1-5.0m (signalised and un-signalised intersections) NA (roundabout)	5.1 - 6.0m (signalised and un-signalised intersections) NA (roundabout)	6.1m+ (signalised and un-signalised intersections) NA (roundabout)
	E. Provision of queue space for cyclists	Space to safely wait for signals outside of the path of turning vehicles and turning cyclists. Physically protected eg. Raised kerb (signalised intersection) NA (un-signalised intersection, roundabout)	Space to safely wait for signals outside of the path of turning vehicles and turning cyclists. Painted, or demarcated by materials eg. Raised kerb (signalised intersection) NA (un-signalised intersection, roundabout)	No queue space provided or provided in places subject to conflicts with other cyclists (signalised intersection) NA (un-signalised intersection, roundabout)	No queue space provided or provided in places subject to conflicts with vehicles (signalised intersection) NA (un-signalised intersection, roundabout)

Design Principle	Criteria	QoS1	QoS2	QoS3	QoS4
Safe – potential conflicts minimised	F. Signals	Separate phase for cyclists reduces potential conflicts (signalised intersection) NA (un-signalised intersection, roundabout)	Separate phase for cyclists reduces potential conflicts (signalised intersection) NA (un-signalised intersection, roundabout)	No separate phase for cyclists (signalised intersection) Low left turning volumes NA (un-signalised intersection, roundabout)	No separate phase for cyclists (signalised intersection) NA (un-signalised intersection, roundabout)
	G. Continuity across intersection (not applicable to mixed traffic facilities)	Prominent surface treatment provides visible continuity of cycle facility across intersection, eg. painted lane (all intersection types)	Prominent surface treatment provides visible continuity of cycle facility across intersection, eg. painted lane (all intersection types)	No surface treatment across intersection (all intersection types)	No surface treatment across intersection (all intersection types)
	H. Mixing zone (not applicable to mixed traffic facilities)	No mixing zone due to presence of protected intersection or absence of left turning lane (all intersection types)	Short mixing zone with physical protection (all intersection types)	Long mixing zone (all intersection types)	No cycle facility (all intersection types)
Direct	I. Geometric directness	Straight line for intersection crossing (signalised and unsignalised intersection) Minor deviation from straight line (roundabout).	Minor deviation from straight line (all intersection types).	Obvious deviation from straight line (all intersection types).	Significant deviation from straight line (all intersection types).
	J. Wait time at intersections (average wait time for cyclist crossing opportunity)	≤20 seconds (all intersection types).	21-40 seconds (all intersection types).	41-60 seconds (all intersection types).	61+ seconds (all intersection types).

**QoS 1 and 2 scores represent a facility that is likely to attract the widest range of cyclists. QoS 3 and 4 scores represent a facility with a design feature(s) that is likely to detract some types of users.*

Scoring facilities – an example

The map on this page illustrates a cycle facility passing through various contexts and street conditions. It shows how each mid-block and intersection segment would score using the QoS tool. The text on the facing page explains the key features that contribute to the score and changes that could made to improve the score to at least QoS2 (a facility that caters to a broader range of cyclists). While some features of designs and context can be changed to improve the score, some features are less able to be easily changed and may require reconsidering the route alignment.



Segment facility type and score

Mixed traffic
QoS1

Signalised intersection
QoS2

Shared Path
QoS2

Cycle Lane
QoS3

Un-signalised intersection
QoS3

Protected cycle path
QoS4

Signalised intersection
QoS4

Features contributing to score	Potential changes to improve score
30 km/h traffic speed 600 vehicles/ day AADT	*NA- Already scores QoS1*
60 km/h traffic speed 20,000 vehicles/ day AADT Clear surface treatment on cycle crossing Direct path Short wait time for cyclists (30 seconds)	*To achieve QoS1:* Reduce speed to <50 km/h Reduce wait time to less than 20 seconds
3.5m path Good path lighting Passive surveillance from adjacent buildings 120 pedestrians/ peak hour	*To achieve QoS1:* Widen path to 4.0m Select alternative alignment with increased human activity adjacent to path. Provide separate paths for people walking and cycling
50 km/h traffic speed 7,000 vehicles/ day AADT 1.5m lane cycle lane width Cycle lane shares carriageway space with bus stop.	*To achieve QoS2:* Reduce traffic speed to <30km/hr OR Change facility type to protected cycle path Increase path width to 1.8m Allow dedicated cycle lane space at bus stop.
3,500 vehicles/ day AADT on street crossed 1 traffic lane per direction on street crossed marking cyclist path Corner kerb radii, 6m No surface treatment across intersection marking cyclist path	*To achieve QoS2:* Reduce traffic volume to <2,000 AADT OR change to signalised intersection Tighten corner kerb radii to 4m Clear surface treatment for cyclists across intersection
1.3 m path width	*To achieve QoS2:* Increase path width to 1.8m
10,000 vehicles/ day on street crossed 50 km/ h traffic speed 10m+ corner kerb radii (slip lane) No queue space for cyclists No separate signal phase for cyclists. Long mixing zone.	*To achieve QoS2:* Remove slip lane and reduce corner kerb radii to 4m. Provide queuing space outside of path of turning traffic (e.g. cycle box) Provide separate signal phase for cyclists. Shorten mixing zone and provide separation.

References

The assessment criteria and standards specified by the QoS tool were developed with reference to local and international literature on cycle facility design. The tool aims to identify the most critical criteria that impact on user experience and use current international best practice standards for facility design.

In specifying standards, international practice has in some cases been adapted for local Auckland conditions. For example, standards for facility gradient are more lenient than international guidance to account for Auckland's extensive hills.

Identification of assessment criteria and specification of standards has drawn particularly on the following cycle facility guidance:

CROW (2007) *Design Manual for Bicycle Traffic,* The Netherlands: CROW

Furth, P. (2012) 'Bicycle Infrastructure for Mass Cycling' in Pucher, J. and Buehler, R. (eds.) *City Cycling,* Cambridge, MA: MIT Press.

Mekuria, Maaza, C., Furth, Peter G. and Nixon, Hilary (2012) *Low-stress Bicycling and Network Connectivity,* San Jose, CA: Mineta Transportation Institute.

National Association of City Transportation Officials (NACTO) (2016), *Transit Street Design Guide.*

New Zealand Transport Agency (NZTA) (2016) *Cycling Network Guidance,* available online at: https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-network-guidance/

San Francisco Department of Public Health, Program on Health, Equity and Sustainability (2009), *Bicycle Environmental Quality Index (BEQI), Draft Report.* San Francisco, CA: San Francisco Department of Public Health.

State of Queensland Department of Transport and Main Roads (2015) *Selection and Design of Cycle Tracks,* Technical Note 128, Brisbane, Australia: State of Queensland Department of Transport and Main Roads.

Sustrans (2014) *Sustrans Design Manual: Handbook for cycle-friendly design,* Bristol, UK: Sustrans.

Transport for London (2014) *London Cycling Design Standards, consultation draft,* London, UK: Transport for London.

Effort has been made to ensure that the assessment criteria and standards specified in this document are consistent with current international best practice. Nevertheless, cycle facility design is currently a rapidly evolving field and ongoing changes to accepted best practice are likely during the near future.

Practitioners involved with planning and designing cycling facilities should make use of a wide range of design guidance, and not rely exclusively on this guide, to ensure development of high quality facilities.

Glossary

Corner kerb radii: The radius of a circle that matches the geometry of a street corner, measured by the curve of a corner kerb. The corner radius impacts the speed of turning traffic at an intersection.

Cycle facility: An infrastructure facility that provides for people using bikes. This QoS evaluation tool classifies facilities according to four types: mixed traffic, cycle lane, protected cycle path and shared path.

Cycle lane (facility type): A type of on-street cycle facility that provides surface treatment on part of the street carriageway that is dedicated for people using bikes. Treatment is usually coloured paint. The facility may or may not include a painted buffer separating the lane from general traffic lanes or on-street parking.

Cycle network: The combination of individual cycle facilities that connect together within a particular geographic area.

Intersection (segment type for assessment): Part of an on-street or off-street cycle facility, defined for the purposes of QoS assessment, and distinct from 'mid-block' segment. The part of a facility that interacts with a street intersection, or involves a facility crossing a street.

Mid-block (segment type for assessment): Part of an on-street or off-street cycle facility, defined for the purposes of QoS assessment, and distinct from 'intersection' segment. The part of a facility that runs between intersections (e.g. alongside a street for on-street facilities, or through parks for off-street facilities).

Mixed traffic (facility type): A type of on-street cycle facility that involves people using bikes and motorised vehicles sharing the same carriageway space. Specific infrastructure treatments are not necessarily provided, but may involve traffic calming measures or painted sharrows.

Protected cycle path (facility type): A type of on-street or off-street cycle facility that provides a dedicated path for people using bikes that is physically separated from general traffic lanes. On-street separation between the path and general traffic may include on-street parking space, vertical separation (e.g. Copenhagen Lane) or various forms of horizontal separation (e.g. planter boxes, concrete kerbs, flex-posts or berm space). Also includes off-street dedicated cycle facilities (distinct from shared paths that are also open to people walking).

Quality of service: For the purposes of this evaluation tool, the level of quality provided by a cycle facility, from the perspective of cycle users. This tool states that 'quality' is a function of multiple factors including how the facility provides for safety, comfort and directness.

Segment: A section of a cycle facility (either an intersection or mid-block section), defined for the purposes of QoS assessment.

Shared path (facility type): A type of off-street cycle facility that is open to people on bikes and people walking. May be entirely off-street (e.g. a local path running through a park) or alongside a street (e.g. a modified street-side footpath). When running alongside a street, vertical or horizontal separation between general traffic lanes will be provided (as for a protected cycle path).