AUS-SPEC

Infrastructure Specifications

0052 Geometric rural road design - unsealed

0052 GEOMETRIC RURAL ROAD DESIGN - UNSEALED

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- See ANNEXURE M at the end of this document which contains (where practical) Cessnock City Council customisations (also known as 'office master' text). References to the Annexure are to also be inserted at relevant clauses in the main body of the document.
- Where content is added to the main body of the document, it is to be shown in brown text like this.
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Where there is a conflict between main body text and Cessnock City Council specific clauses, Council's specific clauses shall prevail.

1 GENERAL

1.1 INTRODUCTION

Worksection application

Description: This worksection is applicable to design and documentation requirements for geometric road design of unsealed roads for safety, road alignment and operating speed for estimated traffic.

Also refer to Council's AUS-SPEC 0041 Geometric road design worksection Annexure M for road classification tables that specify which rural roads may be left unsealed and which are required to be sealed. For design of sealed urban or rural roads to Austroads standards, refer to that worksection.

1.2 RESPONSIBILITIES

General

Requirement: Design and document a rural unsealed road system to provide the following:

- A safe, efficient, functional and economical road network, considering the volume, type and distribution of traffic that is appropriate to the existing built fabric and landforms, climate, heritage scenic and cultural context of the area.
- Appropriate access for a range of truck combinations, buses, emergency, agricultural special purpose and service vehicles.
- A quality road network using integrated design that minimises maintenance costs.
- Potential for expansion of the road network with minimum reconstruction by considering traffic growth and development nearby.

1.3 STANDARDS

General

Road design: To Austroads AGRD01 (2021).

Geometric design: To Austroads AGRD03 (2016) and ARRB Best Practice Guide 2 (2020).

NSW specifications: Each Austroads Design Guide is to be read in conjunction with the corresponding **Roads and Maritime Services (RMS) Supplements to Austroads** publications.

1.4 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- AADT: Average annual daily traffic.
- ASD: Approach sight distance.

- AU: Auxiliary.
- BA: Basic.
- CH: Channelised.
- DDA: *Disability Discrimination Act 1992 (Cth)*.
- EDD: Extended design domain.
- HOV: High occupancy vehicle.
- LATM: Local area traffic management.
- MGSD: Minimum gap sight distance.
- NDD: Normal design domain.
- SISD: Safe intersection sight distance.
- TfNSW: Transport for NSW, formerly Roads and Maritime Services (RMS)

Definitions

General: For the purpose of this worksection, the definitions given in Austroads AP-C87 (2015) and Austroads AGRD03 (2016) and the following apply:

The words 'street' and 'road' are interchangeable throughout all parts of this worksection. However, note that 'street' typically exclusively refers to lower order roads where the focus is on local traffic and pedestrian 'movement and place', rather than high speed and efficient movement of traffic on higher-order roads..

- Activity centre: Urban planning term for those places that are vibrant hubs where people shop work, meet, relax and often live.
- Approach sight distance: Relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.
- Batter:
  . The uniform side slope of walls, banks, cuttings, etc. Usually expressed as a ratio of horizontal to vertical.
  . The amount of such slope or rake, usually expressed as a ratio of horizontal to vertical, distinct from grade.
  . To form a uniform side slope to a wall, bank, or cutting.
- Carriageway: That portion of a road or bridge devoted particularly to the use of vehicles, that is between guide posts, kerbs, or barriers where these are provided, inclusive of shoulders and auxiliary lanes.
- Crossfall: The slope of the surface of a carriageway measured normal to the design or road centreline.
- Cycleway: Portion of a road or footpath for the exclusive use of cyclists.
- Extended design domain (EDD): The design domain for the assessment of existing roads. EDD is a range of values below the lower bound of the NDD.
- Footpath (pathway): A public way reserved for the movement of pedestrians, motorised wheelchairs and personal mobility devices.
- Horizontal alignment: The bringing together of the straights and curves in the plan view of a carriageway. It is a series of tangents and curves that may or may not be connected by transition curves.
- Landform: The type and shape of terrain, usually including topography, geological characteristics, coastlines, rivers and water bodies.
- Length of superelevation development: The transition of crossfall from a normal roadway on straight alignment to that of a fully superelevated crossfall on a circular curve.
- Level of service: A qualitative measure describing operational conditions within a traffic stream such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety and their perception by motorists and/or passengers.
- Minimum gap sight distance: Critical acceptance gap that drivers are prepared to accept when undertaking a crossing or turning manoeuvre at intersections.
- ~~Minor~~ Sub-arterial road: All roads which become part of the public road system and are supplementary to State (classified) highways and other arterial roads. Sub-arterial roads~~. Minor roads~~ may include local sub-arterial roads, collector ~~roads~~ streets, local ~~roads~~ streets, and access

streets. The terminology of road hierarchy may be different in different states. Refer to the relevant State Road Authorities for more information.

- Network: Defined as:
  . A connected system of roads and infrastructure that heavy vehicles can travel on. Can be restricted to a certain class(es) of heavy vehicles (NHVR).
  . Set of roads which provide a means of road based travel within a region. In transport terms it is defined in terms of links and nodes.
- Normal design domain (NDD): The design domain for a new road that defines the normal limits for the values of parameters that have traditionally been selected for new roads.
- Outer separator: The portion of the road reserve separating a through carriageway from a service road.
- Pavement: The portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic including subbase and base course.
- Plan transition: The length over which widening and shift is developed from the 'tangent-spiral' point to the 'spiral-curve' point; i.e. the length between the tangent and the curve.
- Reaction time: The time taken for a driver to perceive and react to a particular stimulus and take appropriate action. It is measured in seconds.
- Road network: A framework for movement by other modes, including pedestrian, bicycle and bus and plays a vital role in supporting neighbourhoods and town centres.
- Road reserve: The strip of public land between abutting property boundaries, specifically gazetted for the provision of public road and controlled by the definitions of the *Roads Act* (as per applicable State legislation). It includes the road carriageway, as well as footpaths, verges and landscape.
- Safe intersection sight distance (SISD): Relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration so as to provide adequate stopping distance in potential collision situations.
- Service road: A low traffic volume roadway parallel to and separated from an arterial road by an outer separator to limit vehicular access direct to the low volume road.
- Side friction factor (f): A measure of the frictional force between the pavement and the vehicle tyre. Can be confused with side friction in regard to traffic flow, which is the traffic efficiency and congestion effect that particular uses along the road shoulder have on reducing lane capacity (e.g. due to presence of side roads or on-street parking).
- Sight distance: The distance, measured along the carriageway, over which the visibility occurs between the driver and an object or between two drivers at specific heights above the carriageway in their lane of travel.
- Speed (As defined in Austroads AGRD03 Road Geometric Design Section 3.2 Terminology):
  . 85th percentile speed: The speed at or below which 85% of the vehicles travel:
  . Design speed: A speed fixed for the design and correlation of those geometric features of a carriageway that influence vehicle operation. It is used for the calculation of various geometric design parameters. The design speed should not be less than the expected operating (85th percentile) speed for the road. If the operating speed varies along the road, the design speed may vary accordingly.
  . Desired speed: The speed ~~over a section of a road adopted by a driver as influenced by the road geometry and other environmental factors~~. that drivers want to operate at and is a fundamental component of the Operating Speed Model.
  . Operating speed: ~~The speed for an existing road at a time when traffic volumes are low and which allows a free choice of speed within the road alignment.~~ The 85th percentile speed of cars at a time when traffic volumes are low, and drivers are free to choose the speed at which they travel.
  . Posted speed limit: a posted limit is achieved through signs that apply to a section of road or an area containing roads that have a similar function.
- Stopping sight distance: The sum of the braking distance and the distance the vehicle travels at a design speed during a ~~reaction time of 2.5 seconds~~ specified driver reaction time..
- Superelevation: A slope on a curved pavement selected to enhance forces assisting a vehicle to maintain a circular path.
- Traffic lane: That part of the roadway set aside for one-way movement of a single stream of vehicles.

- Traffic lane width: Traffic lanes are measured to the face of the kerb or to the lane line for multi-lane roads or roads with shoulders.
- Verge (rural): Defined area of the formation in rural roads outside the shoulder at the top of the batter slope.
- Vertical alignment: The longitudinal profile along the centreline of a road consisting of series of grades and vertical curves.

1.5 ROAD CLASSIFICATION

Rural roads

General: Rural roads carry lower traffic volumes and are not subject to as many constraints as urban roads. In developing a road hierarchy, the following functional systems should apply:

- Link to be consistent with adjoining road authorities.
- Functional based, not necessarily related to traffic volumes.
- Not ~~related to~~ defined by the road width.
- Do not use separate classification for special purpose roads such as tourist or logging roads.
- All roads with Council assets that are being maintained by Council ~~are~~ should be treated as Council Public Roads not Crown Roads for the purpose of risk assessment and mitigation. This is to ensure that risks are appropriately managed if a Crown Road is transferred to Council in the future. ~~The liability of Councils exists based on assets being maintained. Do a GIS mapping audit of all roads to ensure that Council is the Road Authority for all roads that it maintains. The correct Road Authority is necessary for legalising any traffic control, by laws enforcement or road widening required from time to time. Refer any anomalies of ownership to the Crown Lands office to implement correction gazetting conversion.~~
- Road safety: Conform to Austroads AGRS01 (2021), Austroads AGRS02 (2021) and Austroads AGRS07 (2021) Section 18.

Where road infrastructure within an existing road reserve is not present or does not meet the requirements of the road authority that owns the road reserve, it must generally be upgraded by the developer to cater for any proposed traffic increase. In NSW legislation including the Roads Act 1993 describes the different road classifications as follows:

The statutory road classification system is described in the Roads Acts of the various States.

Refer to ARRB Best Practice Guide 2 (2020) Table 3.8 for Unsealed roads classification

In NSW the *Roads Act 1993 (NSW)* describes the different Road Authority classifications as follows:

- Council public roads (includes Main Roads and State Highway land)
- Crown public roads (gazetted on cadastral maps as road and includes “paper roads” being rented to landowners by the Crown). These roads if Council elects and the Crown approves can be claimed by Councils for conversion to Council public roads. This is recommended “housekeeping” for Councils to permit legal traffic and other ownership controls required for duty of care. The courts refer liability to Councils where Councils have developed assets on the Crown Road and the Crown is not a road construction nor maintenance authority.
- Forestry Roads. These roads are sometimes maintained by Councils on behalf of the State governments.
- Freeways owned by the State Road Authority as the Road Authority. Sometimes leased as a tollway to private companies for a set time period.

Other Statutory Roads not included in the Roads Acts.

- Road construction on Vacant Crown Land under the Native Title Act 1993 (Cth) being occupied by Councils sometimes with agreements with Local Land Councils.
- Private Subdivision Roads created by subdivision predating the creation of Local Government in the 19th century. Under Common Law they automatically become Council Public Roads if Councils constructs assets on the land. Most Councils avoid doing this new asset construction unless private landowners elect to/collectively pay for the required assets infrastructure needed for urban infrastructure servicing. Councils normally classify land fronting these Private Subdivision Roads as Not Suitable for Building until Councils infrastructure requirements are satisfied by the landowners.

2 PRE-DESIGN PLANNING

2.1 PLANNING

General

Requirement: ~~Arrange Councils GIS officer to draw road alignment centrelines overlaid on Lidar generated contours. Transport information to road design software for trial alignments and calculated earthworks and sight distance evaluations. Trial different alignments. Select best design.~~

Requirement: Within the Cessnock City Council area, classify roads according to their purpose and traffic volume with reference to the Road Classification Tables within AUS-SPEC **0041 Geometric sealed road design** worksection.

Geometric design elements

General: Incorporate the following road network elements in the design:

- Selection of:
  - . Cross section (e.g. widths of lanes, shoulders, medians and verges).
  - . Horizontal curves.
  - . Vertical curves and gradients.
  - . Intersections.
- Sizing of selected road network elements.

2.2 CONSULTATION

Council and other Authorities

Council consultation: Before starting design, liaise with the Council's officer(s) for the following:

- Roadway layout and traffic signs
- Stormwater and subsurface drainage.
- Landscaping.

Other authorities: Consult with and seek approval for the development from the following government authorities:

- Rail authorities if the proposed project crosses the rail network.
- For stream or waterbody crossings, Water NSW for Controlled Activity Approvals and NSW DPI Fisheries.
- Local Land Services for proposed rural vegetation removal.
- Environmental authorities as required by any DA consent conditions.
- Other utility authorities as required by Council.

Public consultation

Requirements: Undertake public consultation on design in conformance with Council policy.

Utilities services plans

Existing services: Obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development. Plot these services on the relevant drawings including the plan and cross-sectional views.

Location of subsurface utilities: Contact BEFORE YOU DIG AUSTRALIA to identify the locations of underground utility services pipes and cables.

3 DESIGN CRITERIA

3.1 DESIGN

Safety in design

Requirement: Provide a design that allows for safe construction, operation and maintenance, and demolition in conformance with statutory requirements.

Traffic volume

Requirements: Identify the expected traffic volume and the percentage of trucks, Annual Average Daily Traffic (AADT) and the design hour volumes.

Design hour volumes: Derived from the traffic flow patterns. Adopt the 30th highest hourly volume.

Design speed

Regulatory speed: To the ~~Road Authority~~ TfNSW guidelines.

85th percentile speed: Is based on measuring the unrestrained actual speed that all drivers ~~elect to~~ travel on the road under investigation. For upgrade of existing roads, Identify the required 85th percentile operating speed and measure for each section of the road sections under review. 15% of drivers exceed the 85th percentile and those 15% speed measures are discarded to get the top speed measure at 85%. Define the operating speed for each section of road as the 85th percentile speed under free flow conditions. Note that the operating speed may differ for different sections of road.

Desired speed

General: Factors affecting drivers' desired speed:

- Roadside environment
- Road characteristics e.g. Sight distance, horizontal and vertical alignments, frequency of intersections, and parking provisions.
- Signposted speed limits
- Drivers less willing to accept reductions in desired speed on high traffic local roads.

~~Operating speed equal to desired speed will often on heavy traffic standard roads.~~

Driver operating speed

General: Determine the driver operating speed by:

- The degree of risk drivers are prepared to accept.
- The regulatory speed limits and the level of enforcement.
- Vehicle performance e.g. Cars versus trucks on grades.

Vehicle operating speed on local roads

Functional classification of rural roads: Classify roads in terms of their general operating characteristics:

- High speed rural roads: > 90 km/hr
- Intermediate speed rural roads: 70 to 90 km/hr

Minimum Road radii: Select from the **Minimum road radii varying with road type and speed table.**

Minimum road radii varying with road type and speed table

Road type	**Proposed posted speed limit km/hour**	**~~Desired~~ Design speed ~~limit~~[a] km/hour**	**Typical Minimum radius (m) ~~that will not reduce driver desired speed~~ to maintain operating speed[b]**
High speed rural roads	~~110~~ 90	~~120~~ 100	~~800~~ 565
	~~100~~	~~110~~	~~600~~
Intermediate speed	80	90	~~300~~ 460
	70	80	~~275~~ 340
	60	70	~~200~~ 260

a. ~~Desired speed is usually speed limit plus 10 km/hr~~ Values based on maximum superelevation of 5% being provided; adopted from ARRB *Unsealed Roads Best Practice Guide* (2020) Appendix C Table C 9.

b. Increase the value for curves on down grades steeper than 3% in line with Section C.3.2 of that guide.

~~Desired speed limited by horizontal alignment for different vertical terrain alignments table~~

Not Used – refer to ARRB *Unsealed Roads Best Practice Guide (2020)* Tables 3.8 and 3.9 instead.

~~Range of road horizontal radius (m)[a]~~	**~~Desired speed (km/hr) – terrain type[b, c]~~**			
	~~Flat~~	**~~Undulating~~**	**~~Hilly~~**	**~~Mountainous~~**
~~Less than 75 m~~	~~-~~	~~-~~	~~75~~	~~70~~
~~75 to 300 m~~	~~-~~	~~90~~	~~85~~	~~80~~
~~150 to 500 m~~	~~110~~	~~100 to 110~~	~~95~~	~~90~~
~~300 to 500 m~~	~~110~~	~~110~~	~~-~~	~~-~~

~~Range of road horizontal radius (m)[a]~~	~~Desired speed (km/hr) – terrain type[b, c]~~			
	~~Flat~~	~~Undulating~~	~~Hilly~~	~~Mountainous~~
~~500 to 700 m~~	~~110 to 120~~	~~-~~	~~-~~	~~-~~
~~a. Not to be used as a design standard.~~ ~~b. Desired speed. 85th percentile speed on unconstrained sections.~~ ~~c. For speed limit < 100 km/hour, desired speed equals speed limit plus 10 km/hour.~~				

Sight distance

General: Ensure that the driver of a vehicle is able to see an obstruction or hazard on the road and has sufficient time to take evasive action.

Stopping Sight Distance (SSD): Provides for a driver at an eye height of 1.1 m travelling towards a 200 mm hazard and comprises of two components:

- Distance travelled during reaction time.
- Distance travelled whilst braking.

Longitudinal deceleration: The values required for longitudinal deceleration are variable depending on the surface, arbitrary assessment of unsealed surface friction and whether it is on an upgrade or downgrade.

Stopping sight distance for cars at various operating speeds on unsealed roads on level grade table

Operating Speed (km/hr)	**Stopping sight distance in metres**		
	Normal design		**Restricted design**
	Reaction 2.5 secs (m)	**Reaction 2 secs (m)**	**Reaction 1.5 secs (m)**
50	Reaction time is excessive for a low speed environment	65 (50) metres	60 (40) metres
60		90 (65) metres	80 (55) metres
70		115 (85) metres	105 (75) metres
80	160 (115) metres	145 (105) metres	Reaction time too low for high speed environment
90	195 (140) metres	185 (130) metres	
100	245 (170) metres	-	

Note: Values shown in brackets relate to sealed roads and are shown for comparison. Adopted from *ARRB Unsealed Roads Best Practice Guide (2020)* Table C 6. Values require correction for roads with up or down grades.

Intermediate Sight Distance (ISD)

Intermediate sight distance: Is based on two drivers at eye height 1.1 metres approaching each other. ISD is the distance the cars can stop within before meeting each other on a single lane road. Multiply Stopping sight distance by a factor of 1.4 to get ISD. Where adequate ISD is not available, consider widening the formation or sealing to improve stopping distance and permit safe passing.

Overtaking Sight Distance (OSD)

General: On a single lane unsealed road, provide sufficient distance (OSD) equal to ISD to allow two approaching vehicles travelling at the operating speed to stop before colliding.

Manoeuvre Sight Distance (MSD)

Manoeuvre Sight Distance: Is the distance required for a vehicle to brake around the hazard at a low speed by travelling on available adjacent space, ~~MSD equals 94% of SSD with that assumption.~~ where minimum SSD cannot be practically applied.

MSD is not used in the *ARRB Unsealed Roads Best Practice Guide (2020)*. Refer to *Austroads Guide to Road Design Part 3: Geometric Design* Section 5.7 for further explanation.

3.2 HORIZONTAL ALIGNMENT OF UNSEALED ROADS

Coordination of vertical and horizontal curves

General: Provide the horizontal alignment on curves to be the highest possible standard to allow future effect of upgrade of the pavement as it is a more difficult task to correct deficiencies later.

Vertical curves: Provide vertical curves contained within horizontal curves. The coordination of horizontal and vertical geometry is important to avoid hiding approaching vehicles.

Superelevation

General: A vehicle turning around a circular arc tends to move towards the outer side of the curve. A radial force required to assist the vehicle on its circular path is provided by designing the road with crossfall to exert ~~is~~ a combination of friction between tyres and the road and the gravity force due to mass of the vehicle.

Traffic volume: Provide superelevation for all roads regardless of traffic volume, with the following exception:

- Long radius curves greater than 3000 metres radius for road speeds 100km/hr, or
- Greater than 600 metres radius for 60 km/hr roads.

Maximum superelevation: Provide 4-6% to match normal crossfall.

Superelevation development transition lengths

Location: Provide superelevation development transition lengths where changed cross-falls are required before the tangent points for the horizontal curve and extending transition into the curve. Generally provide 70% of the superelevation development lengths prior to the tangent point of the curve and 30% within the curve as extended superelevation transition.

Superelevation development lengths for nominal curve crossfall of 5% table

Operating speed (km/hr)	**Development lengths for superelevation curves (m)**
50	40
60	50
70	60
80	90
90	100
100	110
110	120

Minimum radius of curves for different operating speeds on unsealed roads table

Not used – refer to **Minimum road radii varying with road type and speed table** above.

~~**Operating speed (km/hr)**~~	~~**Assumed coefficient of side friction[a] 5% crossfall**~~	**Minimum radius of curve for 5% crossfall (m)**
~~50~~	~~0.12~~	120
~~60~~	~~0.11~~	180
~~70~~	~~0.10~~	260
~~80~~	~~0.10~~	340
~~90~~	~~0.09~~	460
~~100~~	~~0.09~~	565
~~a. Values for unsealed roads side friction~~ ~~Source: ARRB Best Practice Guide 2 (2020) Table C4~~		

Widening curves on unsealed roads

General: Provide full widening to the inside of the curve.

Road widening requirements for unsealed roads table

Curve radius (m)	**Total amount of traffic lane widening where the normal width of the two traffic lanes is (m)**			
	6.0	**6.5**	**7.0**	**7.5**
30 - 50	2.0	1.5	1.5	1.0
50 - 100	1.5	1.0	1.0	0.5
100 - 250	1.0	1.0	0.5	

Curve radius (m)	**Total amount of traffic lane widening where the normal width of the two traffic lanes is (m)**			
	6.0	**6.5**	**7.0**	**7.5**
250 - 750	1.0	0.5		
Note: Requirements for sealed roads are different. Source: Transit New Zealand (2006)				

Horizontal sight distance for trucks on corners

Estimate the radius of an existing road curve: To the ARRB Best Practice Guide 2 (2020) Appendix C Section C 3.8 by using the 20 m chord distance method.

Clearance: Assess requirement for vegetation and earth cutting clearance to provide for adequate horizontal safety sight distance for truck stopping distance on rural road corners. Calculate the offset distances on the inner side of the corners offset from the centre of the existing inner travel lane using ARRB Best Practice Guide 2 (2020) Figure C 10 and Tables C 5, C 6 and C 11.

3.3 VERTICAL ALIGNMENT OF UNSEALED ROADS

Vertical curves stopping sight distances

General: Provide vertical alignment of a road as a series of straight grades connected by vertical curves to serve the following functions:

- Smoothing the transition from one straight grade to another.
- Increasing sight distances over crests and sags where opposing grades meet.

Vertical curvature

Length of the vertical curve: The length of a vertical curve is dependent on the following criteria:

- Driver comfort due to vehicle performance.
- Stopping sight distances due to sight distance reaction times.

Crest curves

General: Design the crest curves using stopping sight distance criteria. The distance measured from the driver's eye to the hazard ahead is always greater than the required stopping sight distance.

Length of the vertical curve: Based on minimum sight distance two conditions exist where the length of the vertical curve is either less than or greater than the vertical curve length. Provide longer vertical curve lengths wherever possible. Sight distance is generally less than the vertical curve length.

Vertical sight distance: Where adequate vertical sight distance cannot be obtained cost effectively, consider to widen the road pavement to give extra manoeuvring space to help avoid oncoming vehicles in the case with one lane roads.

Sag curves

Headlights in short sags: At night headlight performance can cause safety speed limitation for short sag lengths.

The formula for required length of the vertical sag curve is:

- Length minimum sag = KA
- Where A = algebraic difference in vertical gradients (g1 – g2) (%)
- $K = V^2 /1296$ a where "a" is vertical acceleration (m/s^2)

Minimal K values for comfort criterion on sag vertical curves table

Headlight sight distance control	**Vehicle ride comfort control**		
Operating speed (km/hour)	**K value headlight criteria**	**K value vehicle ride comfort control**	
		a = 0.49	**a = 0.98**
40	6	3	1.5
50	8	4	2
60	12	6	3
70	17	8	4
80	22	11	6

Headlight sight distance control	**Vehicle ride comfort control**		
90	29	14	7
100	37	16	8

Adopted from ARRB Unsealed Roads Best Practice Guide (2020) Table C 15

3.4 INTERSECTIONS

Location of intersections

General: Locate intersections for safe manoeuvring of traffic:

- On a long gentle sag.
- With separation spacings as large as possible between intersections.
- With ideal angle between 90 degrees and no more than 70 degrees for intersecting roads.
- With vegetation cleared on the corner taper for sight distance visibility for vehicle approaches.
- With vegetation preferred behind the tee intersection for increased definition.
- With adequate safe intersection sight distance (SISD) for both vertical and horizontal alignment.

Do not locate intersections:

- On high embankments.
- Near bridges, culverts, streams.
- On small radius curves.
- On steep grades.
- On crossroad intersections.

Intersection sight distance requirements

The three sight distance requirement criteria for intersections are:

- ASD provides adequate distance to observe and react to stop before entering an intersection conflict.
- MGSD provides drivers on the intersection minor road visibility to enter the major road without impeding through vehicles travelling on the major road.
- SISD provides sufficient distance for a driver on a major road to avoid a collision with a vehicle entering from the minor road.

Guide to minimum sight distance requirements at intersections on level grade table

Speed (km/ hour)	**Approach sight distance (ASD)[a] (m)**		**Safe intersection sight distance (SISD)[a] (m)**	
	Car[b]	**B-double[c]**	**Car[b]**	**B-double[c]**
50	65	80	115	115
60	90	115	145	150
70	115	145	185	185
80	145	155	225	220
90	185	175	275	305
100	220	200	330	365

a. Based on a reaction time of 2 seconds.
b. Car coefficients of deceleration based on ARRB Best Practice Guide 2 (2020) Table C 2.
c. Truck and B-double coefficient of deceleration based on ARRB Best Practice Guide 2 (2020) Table C 3, with gravel correction factor of 1.2 (well compacted surface) applied to sight distance requirements.
Source: ARRB Best Practice Guide 2 (2020) Table C 16. Assumes gravel correction factor of 1.2 (well compacted surface). Grade is not considered in this table.

3.5 CROSS-SECTION DESIGN

General

Width of unsealed formation: Select width of the unsealed formation based on the traffic volume, type of vehicles (cars, trucks, farm machinery), vehicle speed, and functional use of the road. Provide wide formations and flat shoulders to forgive minor errors of judgement.

Carriageway widths

Formation width: For unsealed roads the carriageway is the formation width.

Nominal Shoulders: Provide nominal shoulders for safety reasons to perform the following functions:

- Incorporated in the formation width for selecting extra width.
- Manoeuvring space for regaining control of the vehicle.
- Surface water drainage.
- Breakdown space for vehicles to stop safely.
- Passing opportunity on single lane roads.

Road cross-section

Low traffic volume roads: For roads with traffic volumes less than 150 vehicles per day (vpd) the unsealed roads should be:

- For two lane unsealed rural road – Provide minimum 7.5 m formation width including verge, not including table drain.
- For single lane unsealed rural road: Provide minimum 6.0 m formation width including verge, not including table drains.
- Heavy Vehicle Haul Routes.

Special consideration: In the case of timber or mine haulage routes special consideration will be required for the geometrics of corner widening. Use swept path modelling to test the adequacy of the existing haul routes for widening needs.

Funding: Private trucking companies will be responsible for funding the cost of widening construction. In the case of the Mining and Logging Companies, Council is to receive financial recompense for future maintenance based on tonnage transported and the length of the local road being incrementally damaged. This can be arranged by developer charges conditioned in their Development Consents.

Road crossfalls

Insufficient cross-fall: Potholes develop on roads with insufficient cross-fall together with flat long-sections allowing water ponding to percolate down to the weaker subgrade. Use high density impermeable gravel pavements to minimised this problem. Blend gravels to create impermeable pavements.

Minimum cross-fall: More than 4%.

Road batter slopes

Flat batters: The use of flat batters in fill ~~greater~~ flatter than 4 to 1 grade increases the safety for vehicles that lose control. The flat batter reduces the severity of any accident. Flat batters or guard rail is required for embankment fill over 2 m depth.

Cuttings: Select batter slopes so that the slope stability of the soil is not exceeded. Do not allow batter slopes to be left smooth to allow the promotion of revegetation such as spray grass.

3.6 DRAINAGE

General

Traffic volume: Determine the traffic loading to design the drainage for unsealed roads.

Subsurface drainage: To *0043r Subsurface drainage (Design)* and *NATSPEC TECHnote DES 036.*

Drainage components: The methods employed to counter the key drainage components:

- Water falling onto the road surface can be transported to the road edge by 4% cross-fall from the road crown.
- Overland flow approaching the road from the high side. Provision of high catch drains and roadside table drains.
- Water collecting in the drains adjacent to the road is transported to under road culvert points by surface or subsurface drainage. Design culverts of adequate size to prevent scouring by overflows.

Permeable road gravel: These materials create problems for unsealed roads whereby rainwater percolates through the permeable pavement into the weaker subgrade causing quick failure and thus potholing.

Solution: Blend or stabilise gravels to get waterproofed or higher density impermeable pavement material by void replacement to *NATSPEC TECHnote DES 035.* Check by testing blended material for permeability coefficient.

Cross drain culvert design

General: Determine the spacing of cross road drain culverts to drain water considering the following factors:

- The slope of the table drain.
- The soil erodibility.
- The quantity of water flow.

Culvert: Design culverts with a minimum diameter of 450 mm reinforced concrete or 375 mm if there are cover ~~requirements~~ constraints. Design large or small diameter culverts with appropriate exit velocities.

Headwalls: Design headwalls to form a maintenance boundary during road grading and to help prevent piping bypass failures around the culvert and across the road.

Catch drains: Design catch drains at the top of large cut batters such that the drains will divert water away from the batter slope and reduce siltation blockage at the culverts.

Gabions: Consider protection gabions or energy dissipaters or a combination of cut-off wall on the headwalls and design filter rock to be installed on the outlets.

Grade: Provide ideal grade for a culvert such that it neither produces silting nor excessive exit velocities on the low side of the road.

Spacing between cross drains (m) = 300 divided by the % grade of longitudinal table drain, alternatively use the **Maximum spacing between cross drains table**.

Maximum spacing between cross drains table

Road grade	Soil erodibility class	Low to moderate (m)	High (m)
1 to 5%	150	120	70
6 to 10%	120	90	40
11 to 15%	95	70	30
16 to 20%	50	35	30
Source: Forest Commission, Tasmania (1993)			

Stream crossings

Location: Provide stream crossing preferably at right angles to the stream.

Crossing structure: Select the crossing structure based on sound engineering judgement of environmental considerations, structural design, hydrology, hydraulics, foundation conditions and costs.

Size of the waterway: Select the size of the waterway area based on stream velocity and acceptable exit velocity.

Structure: Select the suitable structure with the analysis of the upstream catchment area, the gradient of the catchment, the time of concentration and by basic formulae calculate the discharge flow rate Q. Calculate the required waterway area and make selections as to whether to use a ford crossing, causeway crossing with small base low flow culverts, large culverts, or small single span precast bridges.

4 DOCUMENTATION

4.1 GENERAL

Related design documentation requirements

Drainage and run-off: To *0074r Stormwater drainage (Design)* and *0043r Subsurface drainage (Design)*.

Earthworks, contours, cut and fill: To *0021r Site regrading*.

Footpaths, pathways and cycleways: To *0044r Pathways and cycleways (Design)*.

Pavement structure: To *0053 Rural pavement design - sealed* or *0054 Rural pavement design - unsealed*.

Approvals

Requirement: Document any prerequisite for approval of the development advised by the following authorities:

- Council for:
  - . Construction staging and traffic management.
  - . Landscaping and verge design.
  - . Access provisions.
  - . Tree protection and vegetation clearing.
  - . Stormwater drainage control.
- Planning and water resources department: For general land use, salination prevention measures, existing water bodies that may be affected, and areas of heritage significance.
- The EPA: For other general environmental impact requirements.
- Utilities authority: For any public or private utility affected by the development.
- Rail transport authority: For crossings and rail conflicts.

Design reports

Requirements: Provide a design report including the following:

- Design criteria.
- Site investigation reports supporting the design.
- Safety in design report.

Calculations

Requirements: Provide a design report incorporating, computer studies, calculations and references supporting the design.

Design certification

Requirement: Provide a signed and dated design certificate.

Final certification of completed works

Requirements: State Council requirements for final certification. See Clause M3.

4.2 DRAWINGS

General

Requirements: Provide drawings and/or computer output defining the works and assumed operating and maintenance procedures.

Minimum requirements: Complete the relevant checklist in Annexure B of *0010r Quality requirements for design* for the development. Make sure required items are included in the design documentation.

Drawing presentation

Plain English: Drawings form part of the permanent record and are legal documents. Keep terminology in plain English, so that drawings can be easily read and understood by those involved in the construction of the Works.

Drawings size and format: Prepare clear and legible drawings with consistent lettering and style, and clearly referenced with notations and tables as appropriate.

Drawing scales: Conform to the following:

- Plans:
  - . Generally: Minimum 1:500.
  - . Rural plans: Minimum 1:1000.
- Longitudinal sections:
  - . Horizontal: Minimum 1:500.
  - . Vertical: Minimum 1:100.
- Cross-sections: 1:100.

Requirement: Provide the following drawings, describing the geometric road layout for the development:

- Survey(s): Showing contours, original and proposed terrain, locations of existing and new roads. If required, include finished grades on a digital terrain model.

- Plans: Showing alignments of existing and new roads, access treatments, drainage structures, edges of pavement, roadside barriers and flares, clearing and grubbing limits, critical dimensions, cut/fill toes, utility conflicts, objects/items that are to be relocated or removed, fencing, and limits of construction.
- Ground profiles: Showing proposed grades, vertical curve data, horizontal alignment schematic, superelevation, existing and proposed culvert locations, surcharge and preload areas, and original ground profile.
- Typical sections drawings: Showing lane and shoulder widths, clear zone requirements, excavation and embankment slopes, stripping, and special treatments.
- Laneing and geometrics (vertical and horizontal): Showing access movements, intersection movements, design vehicles (and turning templates), design speed, approaches and transitions, vertical clearances, and critical laneing dimensions.
- Signing and pavement marking drawings: Showing new sign locations, schedule of signs required, sign removals and relocations.
- Construction staging drawings: Showing detours if required, any required cross-sections.
- Utility relocation drawings.
- Landscaping drawings: Showing verge treatments.
- Environmental drawings: Showing sensitive zones, limits and setbacks from environmental features.

Work-as-executed drawings

General: Provide an additional digital and hardcopy (if required) set of final construction drawings for the purpose of recording the work-as-executed by the Contractor digitally, in open and native CAD formats (e.g. DXF and DWG) as well as PDF copies.

4.3 SPECIFICATIONS

Construction documentation

Requirement: Prepare technical specifications using the AUS-SPEC Construction worksection Templates from the National Classification System workgroups 02, 03, 11, 13.

5 ANNEXURE A

5.1 ANNEXURE - REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

ARRB BPG2	2020	Unsealed roads
Austroads AGRD		Guide to road design
Austroads AGRD01	2021	Objectives of road design
Austroads AGRD02	2019	Design Considerations
Austroads AGRD03	2016	Geometric design
Austroads AGRS		Guide to road safety
Austroads AGRS01	2021	Introduction and the safe system
Austroads AGRS02	2021	Safe roads
Austroads AGRS07	2021	Road safety strategy and management
Austroads AP-C87	2015	Austroads glossary of terms
AUS Gov Act No. 135	1992	Disability Discrimination Act 1992
NATSPEC DES 035		Improvement and stabilisation of unsealed roads
NATSPEC DES 036		Need for subsurface drainage on local roads
Cessnock City Council		Development Engineering Handbook

6 ANNEXURE M – CESSNOCK CITY COUNCIL SPECIFIC CLAUSES

M1.	Variations to or non-conformances with Council's AUS-SPEC are to be evaluated with reference to the procedure in Council's *Development Engineering Handbook*. Acceptance is to be obtained in writing from: a) an authorised representative of Council's Director of Infrastructure and Engineering Services.	**Variation procedure**
M2.	This specification applies in addition to any development consent (DA) conditions. If there is any inconsistency, the conditions of consent shall prevail.	**DA Conditions**
M3.	Refer to the Cessnock City Council Development Engineering Handbook for final inspection, works-as-executed and handover requirements.	**Completion**

7 AMENDMENT HISTORY

0	15/01/2024	First Published