

Date:

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JW

STATEMENT OF MILES VASS

I, Miles Vass of 295 Ann Street, Brisbane in the State of Queensland, General Manager (Program Delivery and Operations) of the Department of Transport and Main Roads, state as follows:-

Requirement from the Queensland Floods Commission of Inquiry

1. I have received a letter from the Queensland Floods Commission of Inquiry dated 30 September 2011 and understand that I am required to provide information on the following topics pursuant to the *Commission of Inquiry Act 1950*:
  - (a) My role and position within the Department of Transport and Main Roads (**Requirement 1**);
  - (b) The flood immunity levels (if known) and the proposed flood immunity road betterment projects (if any) at the following locations:
    - (i) Capricorn Highway – Gracemere to Rockhampton, Charlevue Creek (west of Dingo), Comet River (west of Comet) and Nogoia River (Emerald);
    - (ii) Gregory Highway – Emerald;
    - (iii) Ipswich – David Trumpy Bridge and One Mile Bridge;
    - (iv) New England Highway – Madsen Bridge, Warwick;
    - (v) Peak Downs Highway – Thirty Mile Creek, Boundary Creek, Bee Creek, North Creek, Wolfgang Creek, Moranbah to Clermont;
    - (vi) Warrego Highway – Toowoomba Range and Toowoomba to Dalby; and
    - (vii) Wurba Road, Minerva (**Requirement 2**); and
  - (c) Any information, studies or reports about the known or modelled hydraulic effects of the following roads, on the areas adjacent to them, at the locations specified:
    - (i) Bruce Highway at King John Creek (in the vicinity of Male and Flowers Roads), Caboolture; and
    - (ii) Gregory Highway in Emerald (**Requirement 3**); and
  - (d) Any design features of the roads (such as culverts) at the locations mentioned in Requirement 3 that are intended to mitigate the effects of flooding in the areas adjacent to those roads, including any assessments of the efficacy of those features (**Requirement 4**).
  - (e) In addressing these matters, I am asked to:
    - (i) provide all information in my possession and identify the source of sources of that information; and
    - (ii) make commentary and provide opinions I am qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion.

[Redacted Signature]

Miles Vass

[Redacted Witness]

Witness

### **Requirement 1 - Qualifications and experience**

2. I am currently employed as the General Manager (Program Delivery and Operations) Division of the Department of Transport and Main Roads (DTMR) and I have held this position for approximately 7 months.
3. I report through the Chief Operations Officer to the Director-General of DTMR. Program Delivery and Operations Division (formerly known as Assets and Operations) is responsible for the management of the road and non-rail transport program delivery and operations; the planning, provision, management and operation of the state-controlled road network; and the primary regional representative for roads.
4. Program Delivery and Operations is comprised of 12 regions each led by a Regional Director. The organisational structure for the Division is attached and marked **Attachment A**.
5. I hold the following qualifications: Bachelor of Technology (Civil), Advanced Diploma of Project Management, Company Directors Diploma and an Advanced Diploma in Civil Engineering.
6. I have worked within the transport civil infrastructure industry for over 25 years, with my primary focus being the roads sector of state and local government.
7. Over the past decade I have held several senior roles for the department including Director of Commercial Construction and Maintenance for southern half of Queensland, Regional Director South Coast Region (Gold Coast) and Regional Director, Metropolitan Region (Brisbane). As Regional Director, I was responsible for managing the state government's transport infrastructure including planning and construction, as well as maintenance and operation of the road network and busways in Brisbane and the Gold Coast.

### **Requirement 2 – Flood immunity levels and proposed betterment projects**

8. You have enquired about the flood immunity levels (if known) for the locations specified in Requirement 2. Departmental records indicate flood immunity levels for the following locations to be:
  - (a) Capricorn Highway between Rockhampton and Gracemere: ARI < 10 years;
  - (b) Capricorn Highway at Charlevue Creek Bridge: Average Recurrence Interval (ARI) 5 years;
  - (c) Capricorn Highway at Comet River Bridges: ARI 4 years;
  - (d) Capricorn Highway at the Vince Lester Bridge (Nogoa River), Emerald: ARI 50 years;
  - (e) New England Highway at the Madsen Bridge, Warwick: ARI 10 years;
  - (f) Peak Downs Highway at Thirty Mile Creek: ARI 1 year;

- (g) Peak Downs Highway at Boundary Creek: ARI 2 years; and
  - (h) Peak Downs Highway at Bee Creek: ARI 5 years.
9. DTMR does not hold flood immunity level records for the other locations specified in Requirement 2. I am however, able to offer the following limited comments in relation to some of those locations:
- (a) Flooding was experienced at the Gregory Highway, Emerald at the LN1 Drain during the 2010/2011 flood events, with approximately one (1) metre of water across the road at the peak of the flood. The LN1 Drain forms part of Sunwater's Irrigation network and Sunwater may be able to provide more detailed information about this location;
  - (b) Historical flood level data available from the Bureau of Meteorology is suggestive of the David Trumpy Bridge at Ipswich being a Q100 bridge. The deck of the bridge was not over-topped during the 2010/2011 flood events;
  - (c) The One Mile Bridge at Ipswich is not under the control of DTMR. The Ipswich City Council may be able to provide information about this location;
  - (d) The Peak Downs Highway crosses West Wolfgang Creek; and
  - (e) Wurba Road, Minerva is not a State-controlled road.
10. You have enquired about proposed flood immunity road betterment projects (if any) for the locations specified in Requirement 2. In this regard, I can advise as follows:
- (a) DTMR is planning for flood immunity improvements to the Bruce Highway between Jellicoe Street and the Burnett Highway turn-off (including Yeppen Lagoon), with a view to providing an improved flood immunity route to Gracemere via the Bruce Highway as an alternative to travelling the Capricorn Highway through to Gracemere during flood events. The timing of these upgrades is dependent on the availability of federal funding. Only \$50 million has so far been committed out of a total requirement of \$600 – 700 million. In the circumstances, DTMR has no immediate plans to provide flood immunity upgrades to the Capricorn Highway, between Rockhampton and Gracemere.
  - (b) DTMR has undertaken preliminary design work in relation to a possible replacement of the bridge on the Peak Downs Highway at Boundary Creek, with a view to improving its flood immunity to Q50. Funding for construction has not been committed to the proposal at this stage.
11. Other than as set out in paragraph 10, DTMR does not have any proposed flood immunity road betterment projects for the locations specified in Requirement 2.

**Requirement 3 – Information and reports about hydraulics**

**12. Bruce Highway at King John Creek (in the vicinity of Male and Flowers Roads), Caboolture**

- (a) I am not aware of any current information, studies or reports about the known or modelled hydraulic effects of the above road at the location specified on areas

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adjacent to it, other than the existence of a Flooding Assessment undertaken by the Moreton Bay Regional Council after the 2010/2011 flooding events.

- (b) The southbound carriageway of the Bruce Highway was constructed in 1972 and the northbound carriageway of the Bruce Highway was constructed in 1982. Given that the characteristics of Lagoon Creek and King John Creek are likely to have changed significantly since the highway was built, and the major improvements in flood modelling since that time, any hydraulics reports relating to the construction of the highway (if any) would be of uncertain value.

**13. Gregory Highway in Emerald**

- (a) In February 1997, the (then) Department of Main Roads compiled a Planning Report for the Town of Emerald Heavy Vehicle Bypass Planning Project which included some hydrology information. A copy of the planning report is attached and marked **Attachment B**.
- (b) DTMR's Hydraulics Branch will review the alignment proposed under the planning report to take into account the effects of the 2010/2011 flood events. This review is scheduled for completion in mid 2012.
- (c) I understand that the Central Highlands Regional Council has commissioned a major flood study of the Emerald town environs, but that this study is not yet complete.
- (d) Other than stated above, I am not aware of any current information, studies or reports about the known or modelled hydraulic effects of the Gregory Highway at the LN1 Drain in Emerald on areas adjacent to it.

**Requirement 4 – Design features of road**

- 14. For new and upgraded transport infrastructure, DTMR looks to ensure that as far as practicable, the new or upgraded works do not contribute to any increased flow of water onto existing adjacent areas.
- 15. However, DTMR cannot accept that design features for transport infrastructure should take into account all potential future developments of adjacent areas or future uses to which adjacent areas may be put.
- 16. Where development is proposed in the vicinity of existing transport infrastructure, it would be for the developer to take into account the existence of the transport infrastructure and any potential impacts on the proposed development.
- 17. **Bruce Highway at King John Creek (in the vicinity of Male and Flowers Roads), Caboolture**
  - (a) The northbound and southbound carriageways of the Bruce Highway are supported by bridges over King John Creek.
  - (b) The northbound bridge is flood free. The southbound bridge is regularly impacted by flooding. A proposal is being developed to construct a "cross-over" which will allow two-way traffic on the higher northbound bridge at times when the southbound bridge is closed due to flooding.

18. **Gregory Highway in Emerald**

- (a) Reinforced concrete culverts (5/2.13m x 2.13m) exist under the Gregory Highway at the LN1 Drain. These culverts were constructed in or about the early 1980s.
- (b) The culverts function well, with water flowing through them during normal rain events. In extraordinary events, where the culverts are over-topped, excess water passes over the top of the road with no or negligible afflux upstream.

I make this statement of my own free will believing its contents to be true and correct.

Dated at *Bundaberg* this *12<sup>th</sup>* day of October 2011

[Redacted Signature]

Miles Vass

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**Attachment A**

**Organisational structure – Program Delivery and Operations Division**



Miles Vass



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Document No:

**Attachment B**

Planning Report – Town of Emerald Heavy Vehicle Bypass Planning Project – February  
1997

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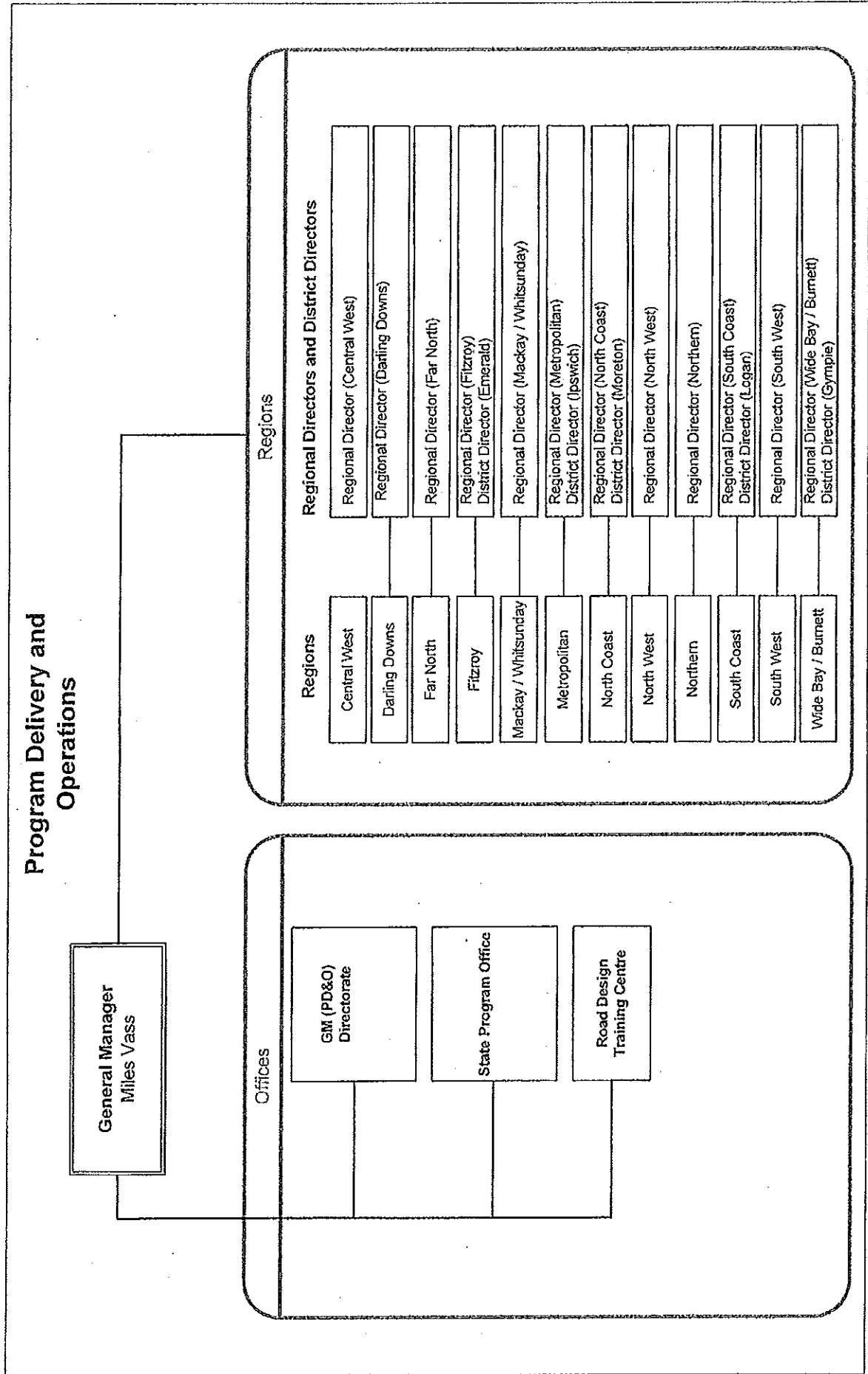
Document No:

# General Manager (Program Delivery and Operations)

Attachment A

OPERATIONS GROUP

Organisational Structure as at 31 August 2011





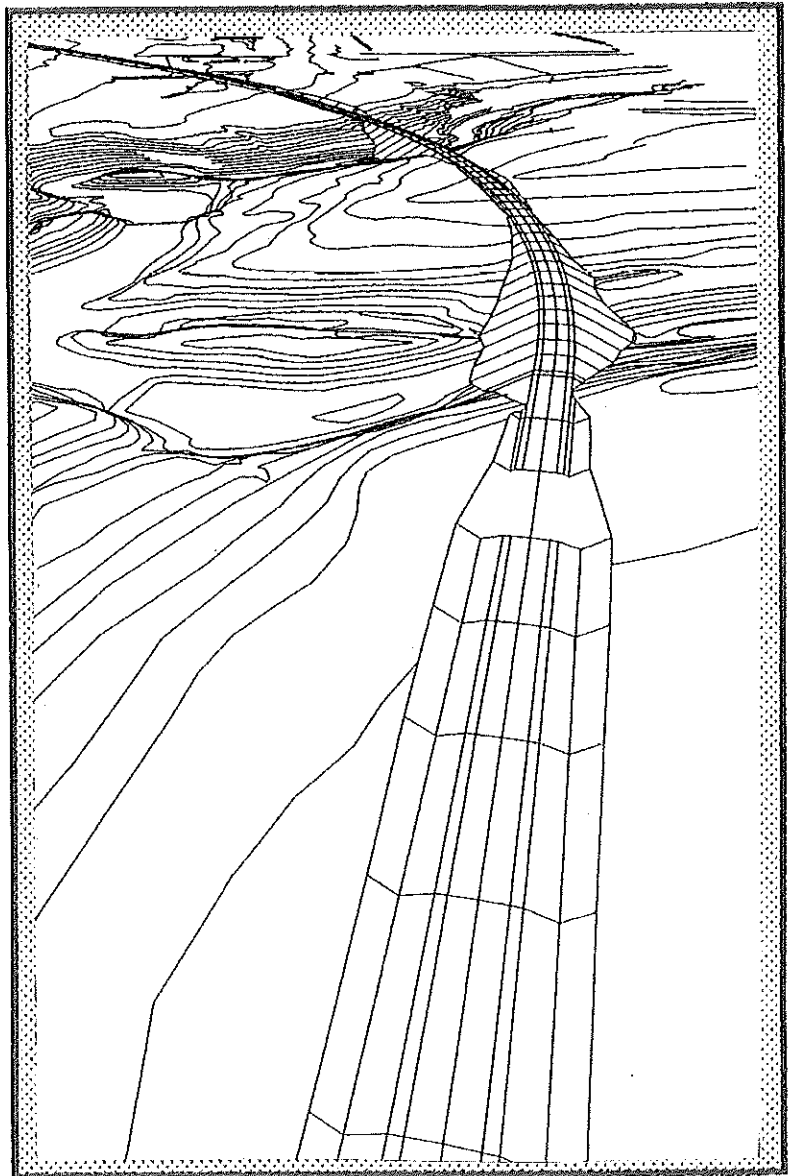
**TOWN OF EMERALD**  
**HEAVY VEHICLE BYPASS**  
**PLANNING PROJECT**

**PLANNING REPORT**

***Prepared for:***  
***Department of Main Roads***  
***Central Highlands***  
***Emerald***

***Prepared by:***  
***RTCS Central (Mackay)***  
***Gordon Street***  
***Mackay***

***February 1997***



## EXECUTIVE SUMMARY

The need for a future heavy vehicle bypass of Emerald was identified in the Emerald Road Network Study of 1992 and the subsequent update of this study in 1994. A Value Management Study of the road network in Emerald was undertaken in December 1995, which reached a consensus that the preferred option for a Bypass was:-

*"This route is a "U" shaped bypass leading around Emerald to the north, commencing at TAFE College; skirting north western industrial estates; northern suburbs and sewage treatment plant; crossing Nogoa River and through "McCosker country" terminating at the Springsure junction."*

In addition to these reports, the Queensland Transport's Road Network Strategy (1994) proposes the upgrading of the Gregory and Carnarvon Developmental Roads to provide an intrastate route from the N.S.W. border to Townsville, via Emerald, for Type 1 and Type 2 road trains, which also reinforces the need to provide a heavy vehicle bypass around Emerald.

This report was therefore commissioned to identify a possible alignment, and road corridor for the bypass route within the study area as outlined in the Value Management Study of December 1995.

The recommended alignment continues along Codenwarra Road from the intersection with the Capricorn Highway to connect to Moffat Road via a crossing of the Nogoa River.

From Moffat Road the bypass joins the Gregory Highway to the Capricorn Highway along the western edge of the existing industrial estate to a point west of the T.A.F.E. college.

The Bypass route consists of the following elements:-

- An at - grade roundabout intersection at the junction of Capricorn Highway, Gregory Highway and Codenwarra Road.
- The Existing Codenwarra Road upgraded.
- A bridge across the Nogoa River
  - Upstream of the "Town Weir" connecting the bypass east of the river to the southern end of Amethyst Drive.
- A bridge across the Irrigation and Water Supply channel adjacent to Moffat Road.
- The existing Moffat Road north of the drainage channel upgraded.
- A roundabout at the intersection with Gregory Highway.
- A Road adjacent to the existing Blair Athol railway line skirting to the west of the industrial estate to Munro Road.
- A road adjacent to the eastern bank of the existing western drainage channel.
- An at - grade "Type C" intersection with Capricorn Highway at Tyson Road west of the TAFE College. (refer Figure 4).

## Heavy Vehicle Bypass - Town of Emerald

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Other elements that were considered as part of the bypass included Chalcedony, Braeside and Pritchard Roads.

Chalcedony Road was abandoned as a viable element of the bypass route because it is not currently a formed road and Codenwarra presently is; It would bisect a residential area, if future development proceeds, east of Codenwarra Road and Chalcedony Road is a less direct route to join to Moffat Road than Codenwarra Road.

Braeside and Pritchard Roads were also rejected as elements of the bypass because the land adjacent to these roads is presently residential or has the potential to be developed as residential or rural residential areas. The introduction of heavy vehicles into existing residential areas and the potential conflict between heavy vehicular traffic and local residential traffic was considered undesirable and unsafe, and not to fulfil the objective of the bypass route.

Five alternative river crossings were also considered, with two of these alignments selected as possible elements within the bypass route.

The preferred crossing, alternative "B", of the river is upstream of the existing weirs and joins the bypass route from the eastern bank of the Nogoia River to the southern end of Amethyst Drive. This option provides a slightly skewed crossing of the Nogoia River, but avoids crossing the anabranch and the flood plain to the north-east of the river. However, more detailed checks of the backwater effect of a bridge on this alignment are required to assess the risk of additional flooding in Emerald.

The second possible alternative, Alternative "D", crosses the river and anabranch downstream of the existing weirs and joins the bypass from the eastern side of the Nogoia River to Amethyst Drive just north of Little Farm Road. This alignment, however, requires bridges over the river and anabranch and would cross the flood plain, north-east of the river, which will require detailed drainage design of the additional structures under the bypass formation across this floodplain.

The Water and Catchment section of the Department of Natural Resources, has created a computer model of the Nogoia River and floodplain, which can be used to assess the effect of the alternative river crossing on flood levels in the Nogoia River. The incorporation of the preferred bypass alignment in this computer model was beyond the scope of this report, however, it is recommended that this be used to determine the backwater effects of the preferred option, before selection of the final alignment of the bypass route across the Nogoia River.

During detailed design, a further refinement of the design speed and horizontal curvature could reduce the amount of resumptions required to provide the connection between Amethyst Drive and Moffat Road, and a suitable crossing of the existing I.W.S. channel.

It is also recommended that a comprehensive drainage study of Emerald be undertaken to resolve existing flood areas within the town and the effect the bypass formation will have on these areas. This study should incorporate the proposed bypass alignment as an integral part of the future development of Emerald.

## Heavy Vehicle Bypass - Town of Emerald

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### 1.0 INTRODUCTION

The Emerald Road Network Study Report of 1992 and the Update Report of 1994 concluded that a Heavy Vehicle Bypass of Emerald township was the optimum long term solution to the problems of heavy vehicles travelling through the commercial centre of town (Clermont and Egerton Streets). Removal of the heavy vehicles from the centre of town would reduce the potential for accidents involving local traffic and the environmental problems of exhaust fumes, dust and debris caused by the heavy vehicles.

Preliminary investigation of several possible routes was undertaken in the report of 1992 and alternatives proposed in the 1994 report. In spite of population growths exceeding the forecasts of the original 1992 report, both reports concurred that a heavy vehicle bypass was not justified in the short to medium term future but that action should be taken to preserve a corridor.

The Queensland Transport's "Road Network Strategy (1994)" proposed the upgrading of the Carnarvon and Gregory Highways and the Carnarvon and Gregory Developmental Roads to provide a Type 2 Road Train Route from the NSW border to Charters Towers via Emerald.

In December 1995 a Value Management Study was undertaken to critically review the findings of both Emerald Road Network Studies and with respect to the Heavy Vehicle Bypass, identify a preferred option. Representatives of stakeholder groups (eg: community, local industry, local authority, Queensland Rail and Queensland Transport) participated.

At that workshop, the study group reached a consensus that:

*"This route is a "U" shaped bypass leading around Emerald to the north, commencing at TAFE College; skirting north western industrial estates; northern suburbs and sewage treatment plant; crossing Nogoa River and through "McCosker country" terminating at the Springsure junction."*

(reference: Value Management Workshop - draft workshop report, December 1995).  
(refer Figure 2).

This planning study will investigate the corridor of interest defined above. It will propose possible alignments that provide the required functionality and will recommend a preferred alignment with supporting reasons.

## 2.0 DESIGN STANDARDS

To encourage transport operators to use a Heavy Vehicle Bypass, the facility needs to offer the driver advantages or convenience that outweighs the inconvenience. The geometric standards that are recommended for the proposed bypass are considered to provide a level of service that will attract drivers away from Emerald's town centre.

Parameters are as follows:

- Speed Environment 80 - 100kph
- Design speed 80 - 100kph
- Horizontal radii 340m. minimum radius (5% superelevation at 80km/h)
- Minimum vertical radii:
  - Crest 6000m
  - Sag 3000m
- Minimum length of vertical curve 90m

### Cross Sectional Elements:

- Stage 1: Initial Two Lane Bypass Road  
2 x 3.5m traffic lanes on an 9.0m fully sealed formation.  
(refer Figures 6 & 7)
- Stage 2: Ultimate Future Four Lanes  
4 x 3.5m traffic lanes  
5.0m median separator  
2.0m outer shoulders (fully sealed). (refer Figures 8 & 9)

## 3.0 PROPOSED CORRIDOR

It is recommended that the adopted corridor be established within Emerald's Strategic Town Plan and that Main Roads Department declare "Limited Access" to facilitate control of access from developments that will inevitably occur adjacent to the bypass.

Developers should be encouraged to incorporate internal access networks within future subdivision proposals to minimise the number of access points required from the bypass and alleviate the requirement for developers to dedicate land or contribute financially to the provision of service roads adjacent to the bypass.

The provision of an internal road system within any future development adjoining the bypass route will reduce the required width of the bypass corridor to 40 metres.

That is, the ultimate 4 lane cross section defined in Section 2.0 - Design Standards (ie: Stage 2) can be accommodated within a 40m corridor hence reducing the amount of land required from property adjacent to the bypass corridor. Figures 6 - 9 show the road

## Heavy Vehicle Bypass - Town of Emerald

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formation within a 40m wide road corridor. The provision of service roads, to access any future subdivision adjacent to the proposed bypass formation, if required, will be the responsibility of that proposal's developer.

Accesses are discussed in more detail in Section 6.2 - Accesses.

### 4.0 ALIGNMENT OPTIONS

Within the corridor of interest the alignment element options considered worthy of investigation are:-

- Codenwarra or Chalcedoney Road
- Nogoia River Crossings:-
  - Upstream of the "Town Weir" connecting the bypass east of the river to the southern end of Amethyst Drive.
  - Downstream of the Town Weir connecting the bypass, east of the river, to Amethyst Drive south of Little Farm Road.
  - Downstream of the Town Weir connecting the northern end of Amethyst Drive but crossing the flood plain north of Little Farm Road.
- Braeside, Pritchard or Moffat Roads
- From the Gregory Highway to join to the Capricorn Highway west of the TAFE College.

This report will detail each element to identify its benefits and disbenefits (refer Figure 3).

This report recommends the Codenwarra/ Moffat Road Alignment as the preferred route for a Heavy Vehicle Bypass of Emerald. The bypass consists of:

- An at - grade roundabout intersection at the junction of Capricorn Highway; Gregory Highway and Codenwarra Road.
- The existing Codenwarra Road upgraded.
- Bridge across the Nogoia River upstream of the Town Weir along Alternative "B" refer Figure B.
- The existing Moffat Road north of the drainage channel upgraded.
- A roundabout at the intersection with Gregory Highway.
- A road adjacent to the existing Blair Athol railway line skirting to the west of the industrial estate to Munro Road.
- A road adjacent to the eastern bank of the existing western drainage channel.
- An at - grade "Type C" intersection with Capricorn Highway at Tyson Road west of the TAFE College. (refer Figure 4)



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Details of the various elements outlined above are as follows:-

### 4.1 Codenwarra Road

Codenwarra Road is an existing bitumen surfaced road within a 30 metre wide reserve. It travels due north from the Capricorn Highway on the eastern side of Nogoia River; skirting clear of currently sparsely populated rural residential development. However, this land has potential for future residential subdivision. To achieve a practical crossing of the river, the proposed alignment extends northwards, adjacent to the river, west of the existing abattoirs to the proposed river crossing. (refer Figure 3)

Benefits:

- More direct, northerly route than the Chalcedony alternative.
- Reduced resumption costs due to:
  - minimal loss of function of affected properties
  - minimal environmental effects on residents.
- By following the river bank, utilises unimprovable land and avoids severing a useful sized allotment.
- Inexpensive to provide a drainage standard consistent with that adopted for the river crossing.

Disbenefits:

- Resumptions required.
- Drainage improvements required to provide standard adopted for the river crossing.

### 4.2 Chalcedony Road

Chalcedony Road is not a formed road but exists only as a gazetted road reserve. The road reserve is 30m wide and travels due north (parallel with Codenwarra Road) but approximately 400m to the east of the proposed intersection with the Capricorn Highway. It skirts to the east of a sparsely populated rural residential development; through open country currently under cultivation and zoned as "rural conservation". It is considered that the land to the east of Chalcedony Road, as far as the Pastoral College, has potential for future subdivision. (refer Figure 16).

Future subdivision of this land east of Chalcedony Road will place the bypass route within a future residential area.

Chalcedony Road, extended northward through the meatworks holding yards, will sever the land north of Codenwarra Road but will provide a good approach to the proposed crossing of the Nogoia River.

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Severing existing blocks of land is not practical when an alignment along Codenwarra Road fulfils the requirements of the bypass route with minimal impact on existing landholders.

### Benefits:

- Good approach to Nogoa River proposed crossing.
- Reduced resumption costs due to:
  - minimal loss of function of affected properties
  - minimal environmental effects on residents.
- Inexpensive to provide a drainage standard consistent with that adopted for the river crossing.

### Disbenefits:

- An impression of "*travelling away from the destination*" is established in the mind of the driver due to the route's north - easterly direction to align with Chalcedony Road.
- Resumptions required.
- Due to future subdivision potential of the land to the east, the bypass will bisect a future rural residential community.
- Impacts on existing abattoir and holding yards.
- Severs useful sized allotment adjacent to abattoir.

### 4.3 Braeside Road

Braeside Road defines the northern extent of current urban residential development within the town. Land adjoining Braeside Road is currently zoned "residential", "rural residential" and "rural conservation". (refer Figure 16). Potentially subdivisible land exists northward as far as the Moffat Road drainage channel. Utility services, including telephone cables, power, water and sewerage reside within the road reserve and will require relocation to accommodate any significant upgrading of Braeside Road.

The residential development surrounding Braeside Road dictates a safe speed environment of 60kph. The curve radii provided at each end of Braeside Road and a roundabout intersection with Gregory Highway may contain vehicle speed; but the 3km uninterrupted straight through the urban area is an enticement to speed. This, with the combination of heavy vehicles and urban traffic produces a safety risk within an existing residential area.

With residential accesses already permitted onto Braeside Road, little opportunity exists to control access (eg: service roads) with safety.

Accesses, local traffic and parking, all conflicting with through travelling heavy vehicles exacerbate the safety problem.

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The residential environment offers little scope to stage the development of the bypass. A first stage construction to 2 lanes is considered impractical and the 4 lane, urban standard with parking lane and kerb and channel (refer Figure 8) is considered to be the minimum requirement and is recommended for construction as the first stage for the upgrading of Braeside and Pritchard roads for the bypass routes.

Without the physical separation provided by a service road and with limited scope for installing ameliorative devices such as barriers and shrubs, noise and dust will be a disbenefit.

An established schoolchildren pedestrian route and bikeway crosses the western end of Braeside Road adjacent to the Gregory Highway.

Both Braeside and Pritchard road terminate at the intersection with the Gregory Highway. Alignments from these roads projected west across the Gregory Highway will bisect the existing industrial estate and require resumptions of establish industrial premises and realignment of the internal road network with the industrial precinct.

The Emerald Shire Council requested that only one access point be provided from the proposed bypass to the industrial area. This will allow council to control the development of the internal road network within the industrial precinct and this strategy will be jeopardised, if either Braeside or Pritchard roads were adopted as part of the bypass route.

A large open drainage channel flowing north - east is traversed by Braeside and Pritchard Roads and requires a drainage structure of significant size and skew.

An alternative also exists to divert bypass traffic from the intersection of Braeside Road and the Gregory Highway, south along the highway, via Munro Road to the bypass route to join to the western intersection with the Capricorn Highway. (Refer Figure 3)

The incorporation of a Heavy Vehicle Bypass route into an existing residential community is considered highly undesirable, and objections from the public to this proposal have been received.

### Benefits:

- Shortens the length of the bypass.
- The Munro Road connection eliminates the poor alignment of the proposed railway crossing.

### Disbenefits:

- Passes through existing and future residential development causing environmental and safety issues.
- Bisects a developing industrial estate causing access issues.

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- Does not fulfil Emerald Shire Council's development strategy for the industrial precinct.
- Offers little flexibility for staged development of the bypass. (ie: 4 lanes + parking required to accommodate urban environment and traffic resulting in higher first stage costs)
- Need to relocate existing utility services and provide for future requirements.
- Requires significant drainage structures to accommodate open drainage channel.
- Introduces inconsistency into the speed environment (ie: rural/ urban).

This report rejects Braeside Road as a viable element of the proposed Heavy Vehicle Bypass. It is considered not to satisfy the stated objectives of the bypass which is to remove heavy vehicle traffic from the town environment.

### 4.4 Pritchard Road

Like Braeside Road, Pritchard Road travels east - west across the northern end of town. Whilst the land adjacent to Pritchard Road is currently zoned "rural residential" and "rural conservation", the potential exists for future residential subdivision south and west of the existing drainage channels. (refer Figure 16).

This report rejects Pritchard Road as a viable element of the proposed Heavy Vehicle Bypass for the same reasons that Braeside Road is rejected.

### 4.5 Moffat Road

Moffat Road is an unsealed formation adjacent to the existing east - west drainage channel at the northern extremity of town. It lies within a 30m road reserve on the northern bank of the channel. Agricultural cultivation extends northwards from the road, while the existing drainage channel on the southern side forms a natural barrier to Emerald's urban spread.

The remoteness from town permits a higher speed environment and satisfies the safety and environmental considerations of the bypass route.

Compared with Braeside and Pritchard Roads, the higher speed environment, free from conflict with local traffic, will yield improved travel times and lower transport costs for transport operators.

To maintain the higher speed environment on the Moffat Road section of the bypass route at the northern end of Moffat Road a large curve or a severely skewed crossing of the existing drainage channel is required.

## Heavy Vehicle Bypass - Town of Emerald

A skew angle of  $60^\circ$  maintains this design speed (i.e. 100km/h) however this requires a 120 metre long structure to span the existing channel. This structure would be possibly a four span bridge with three piers within the channel at a skew angle of approximately 60 degrees.

Concerns have been expressed, by local residents, regarding the adverse effect of obstructions within the existing drainage channel on flood levels in Emerald. It is therefore proposed that the crossing of the drainage channel must span the channel above the level of the top of the channel banks with minimal obstruction in the channel.

A square crossing at this location will require a 50 metre long structure to span from bank to bank which will require only one pier within the drainage channel. The construction of a single pier is considered to an acceptable option to both provide a crossing of the channel, and minimise backwater effects. However a square crossing will require realignment of Moffat road to join to this crossing and will also require additional resumptions from land to the north-east of Moffat road.

Changing this skew angle to 30 degrees, lengthens the required crossing to 70 metres but will reduce the resumption requirement for the square crossing. Refer Figure A. A 70 metre crossing will still require a two span structure with only one central pier within the drainage channel. A singular circular pier is suggested to minimise any backwater effect from the construction of a crossing of this channel. A curved crossing on a radius of 340 metres on a 30 degrees angle will maintain a maximum length of crossing of 70 metre (i.e 2 x 30 metre spans) and also reduce the amount of land needed to be resumed to accommodate this realignment. Refer Figure A.

However, a curve of 340 metres, (with 5% Super elevation) equates to a design speed of 80km/h, which is acceptable for vehicles approaching from the east, but for vehicles approaching from the west an intermediate curve with a design speed between 85 and 90 km/h is required prior to the radius 340 metres. This curve is required to reduce the 85th percentile speed of vehicles travelling the 2 kms of straight approaching this curve. A radius 450 metre curve is proposed as this intermediate curve within the Moffat Road alignment, to reduce the 85th percentile speed along this element of the bypass. Refer Figure A.

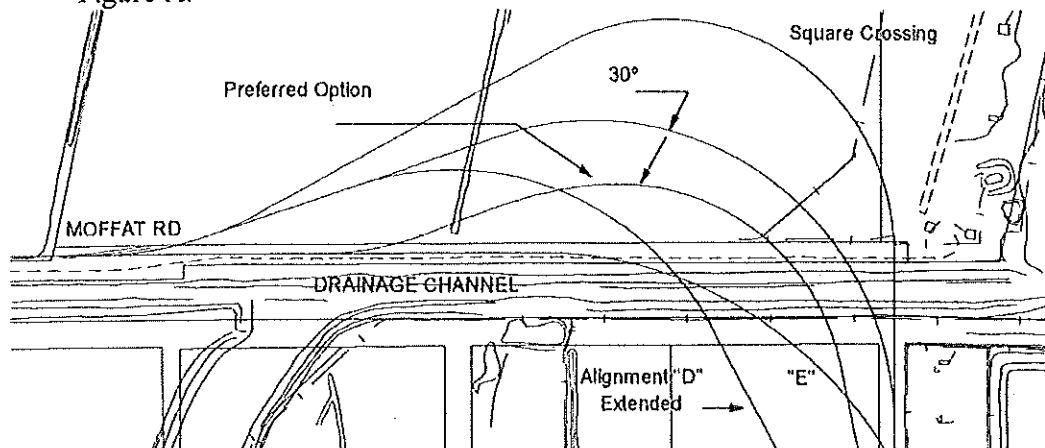


FIGURE A: CROSSING AT DRAINAGE CHANNEL - MOFFAT ROAD

## Heavy Vehicle Bypass - Town of Emerald

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During detailed design, a further refinement of the design speed and horizontal curvation could reduce the amount of resumptions required to provide the connection between Amethyst Drive and Moffat Road, and a suitable crossing of the existing drainage channel

Moffat Road poses no flooding problems as sheet flow across the cultivation flows east into the flood plain of Nogoia River. The adjacent channel contains drainage flows from Emerald within its banks and diverts these flows also to the flood plain to the east, away from the town environs.

### Benefits:

- Removed from urban residential development yielding improved safety.
- Provides a higher speed environment than Braeside and Pritchard Roads consistent with that of the eastern leg of the bypass.
- Utilises the existing road formation and corridor.
- Flood free alignment.
- Joins to the northern side of the industrial estate.

### Disbenefits:

- Adds length to the bypass route
- Requires resumptions to provide for ultimate 4 lane development.
- Requires resumptions for approach alignment to the crossing of the drainage channel.
- Requires large, bridge over the open channel.

This report recommends Moffat Road as an element of the preferred route for the bypass.

## 4.6 Gregory Highway - Capricorn Highway

As discussed in Section 4.3 and 4.4, Braeside and Pritchard Roads extended west from the Gregory Highway bisect the industrial estate. This requires resumptions from useable land and necessitates, at least, 2 accesses in close proximity. An alternative is to divert traffic along the Gregory Highway to Munro Road and then to the western leg of the bypass route. This directs heavy vehicles back into the town environment and will require construction of a channelised intersection on the Gregory Highway to provide access to Munro Road and will create additional conflict between heavy vehicular traffic on the bypass and local traffic along the Gregory Highway.

## Heavy Vehicle Bypass - Town of Emerald

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Moffat Road extended, skirts around the industrial estate to the north and west following generally existing road corridors of sufficient width. The estate is bounded by an existing road reserve which is in turn bounded by the Blair Athol railway branchline.

The existing road reserve is 40m wide and also provides a stock route to the saleyard on the western side of Emerald.

At the first stage construction of the bypass, i.e. 2 lane formation, the stock access to the saleyards can be maintained within the existing corridor parallel to the new construction. When the ultimate future 4 lane development of the bypass is required, the movement of stock to the saleyard along this corridor will need to be reassessed.

Access to the industrial estate from the bypass can be provided along this western leg as shown on Figure 4. This fulfils Council's requirement to limit access to future developments within the industrial estate to only one access point from the bypass.

On the north-western outskirts of Emerald, a drainage channel forms a natural barrier between the town environs and farmland to the west. It is proposed that the bypass follow the southern bank of this channel to join with the Capricorn Highway, at Tyson Road, west of the TAFE College. (refer Figure 4). This will involve an at-grade crossing of the railway line and culverts over the drainage channel. Partial road reserves exist along this route. Where resumption is required, land is currently undeveloped.

The grade levels on this section of the proposed bypass will correspond to the level at the top of the bank on the adjacent drainage channel.

### Benefits:

- Provides access to the industrial estate without severing useable land.
- Skirts the western extremity of town without severing useable land.
- Removed from residential development.
- Allows consistent speed environment.
- Reduced resumption costs.

### Disbenefits:

- Crosses railway line and drainage channel on a poor alignment.
- Crosses existing stock route.
- Reduces the width of corridor for stock route.

## Heavy Vehicle Bypass - Town of Emerald

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### 4.7 Nogoia River General

The Nogoia River, defines generally the eastern limit of Emerald's present urban development. Twenty kilometres upstream, the Fairbairn Dam was constructed in 1975 to provide irrigation to the surrounding agriculture. The dam allows discharges into Nogoia River to be regulated in times of flood.

Within the town reach, clearly defined banks contain the Nogoia's flow and protect the town from flooding.

Only to the north of town does the river break out into flatter country and flood waters spread. The level of flood water across this area can be affected by flows in Theresa and Retreat Creeks further downstream of this flood plain. These creeks and the Nogoia River eventually join the Comet River and flow into the Mackenzie River north of Comet township, consequently flows in these rivers can also effect the flood level within the Nogoia River and flood plain. Small weirs have been constructed at the northern end of the town reach where the main channel narrows and turns towards the east.

Five possible crossing sites have been investigated and descriptions of each site, their benefits and disbenefits are shown in Section 4.8.

The following parameters were adopted as the design requirements for all crossings. Details of the drainage calculations are shown in Section 7.

- AATOS 10 hours
- 1 in 10 years ARI immunity and 1 in 12 years trafficability for heavy vehicles (approximately)
- Maximum TOS of 6.4 days (1 in 50 year ARI)

In times of severe flooding, when the bridges on the bypass become untrafficable, an alternative route via the existing bridge over the Nogoia River on the Capricorn Highway and through Emerald will remain trafficable. During these events the movement of heavy vehicles through the township for short periods is considered tolerable.

### 4.8 River Crossings

#### Alternative A:

An alternative river crossing that links Codenwarra Road (east of the river) directly to Amethyst Drive (north - west of the river) was considered. This offered:

#### Benefits:

- Direct and straight alignment
- Minimal resumptions required because road reserve exists.



## Heavy Vehicle Bypass - Town of Emerald

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### Disbenefits:

- Excessive length of crossing required to bridge bank to bank on a severe skew.
- Excessive cost. (refer Attachment 13).

The length and severe skew of the crossing makes this alternative impractical and is rejected. (refer Figure 15)

### Alternative B:

Alternative B links Codenwarra Road (east of the river) to Amethyst Drive (north - west of the river) as in Alternative A; but with a shorter, squarer bridge crossing immediately upstream of the Town Weir.

A deviation of the approach alignment to this crossing towards the east is required to achieve the required curvature onto the proposed bridge. A curve radius of 340 metres is proposed as the desirable minimum curve to maintain a design speed of 80km/h.

The level of the bridge on this alignment is 173.7m which gives the required flood immunity of A.R.I. -10 years.

The waterway channel on this alignment consists of the main river channel and two adjacent overflow channels, giving a length of waterway area to span these channels of approximately 250 metres. This alignment is skew 10° to the existing river flow.

A bridge upstream of the Town Weir could be perceived to cause additional flooding within Emerald. To verify the extent of the backwater effect of this embankment and bridge, it is recommended that this alignment be incorporated in the Department of Natural Resources' computer model of the Nogoia River and floodplain. The results of this modelling will indicate the additional drainage required under the approach embankment to minimise backwater prior to the adoption of this alternative as part of the alignment for the bypass route.

### Disbenefits:

- Location upstream of "Town Weir" could be perceived to cause additional flooding within Emerald.
- Reduction of design speed on these elements of the bypass.
- Requires additional land to be dedicated to the bypass corridor on the eastern side of the Nogoia river.
- Introduces an "S" shaped bend into the bypass alignment.

## Heavy Vehicle Bypass - Town of Emerald

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### Benefits

- Joins bypass route to southern end of Amethyst Drive and hence utilises existing road corridor.
- No impact on existing residences on Little Farm Road.
- Does not require realignment of Little Farm Road.
- Utilises existing road formation.

### Alternative C:

Alternative "C" crosses the Nogoia River and Anabbranch downstream of their respective weirs and connects the bypass to Amethyst Drive, south of Little Farm Road.

This alignment also requires realignment of the eastern approach onto a similar alignment as per Alternative B along the eastern side of the Nogoia River and joins the bypass to Amethyst Drive south of Little Farm Road. Bridges across the Anabbranch and River at a level of 173.0 metres are required to achieve the required immunity. The first bridge over the Anabbranch is within a radius 340 metre curve, while the second bridge across the river channel will be straight between two curves. Between these bridges there is another opening that will require major drainage structure or an additional bridge. The total length of these waterway areas is 280 metres.

### Disbenefits:

- Reduction in design speed on these elements.
- Requires a combination of curve and straight crossing of river.
- Construction of embankment square to flow within river channel.

### Benefits:

- Joins to Amethyst Drive and utilises existing road corridor.
- Avoids flood plain to the north-east.
- Does not require realignment of Little Farm Road to join to bypass route.

### Alternative D

Alternative "D" crosses the Nogoia River and Anabbranch approximately 150 and 100 metres respectively downstream of the existing weirs.

The eastern approach of this alignment can remain adjacent to the eastern bank of the Nogoia River and hence minimise resumption requirements in this area. The alignment then crosses Little Farm Road and joins to Amethyst Drive, 250 metres north of Little

## Heavy Vehicle Bypass - Town of Emerald

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Farm Road and consequently avoids the most low lying areas of the flood plain to the north-west.

Two bridges, 190 metres long in total, on a radius 450 metre curve at an RL of 173.0 metres are required at both the weir and Anabanch. The location of these bridges downstream of the weirs and approximately 1 kilometre downstream of the urban development in Emerald will produce no additional flooding in Emerald.

### Disbenefits:

- Lower design speed through this section.
- Bisects existing residences.
- Resumptions required between Nogoia River and Amethyst Drive.
- Requires reconstruction/realignment of Little Farm Road.
- Crosses section of flood plain and requires low level formation.
- Additional drainage required on flood plain section.

### Benefits:

- Provides better alignment through river than Alternative C.
- Joins to Amethyst Drive and will utilise existing road corridor, north to Moffat Road.
- Avoids the low level area of the flood plain to the north east.

### Alternative E:

Alternative "E" is the eastern most alignment investigated in this report and crosses the Nogoia River and Anabanch downstream of the existing weirs. The larger curve radii on this alignment maintains a design speed of 100 km/h and remains on a similar approach to these crossings as Alternative "D" and therefore minimises the resumption requirements from the land adjacent to the existing abattoir.

This alignment also requires bridges at the river and anabanch, approximately 100 metres and 90 metres long respectively at RL 173.0 metres.

From the river crossing, the alignment crosses Little Farm Road, 250 metre east of Amethyst Drive and then join to the northern end of amethyst Drive before crossing the drainage channel beside Moffat Road. A section of this alignment crosses an area of "melon hole" country between Little Farm Road and Amethyst Drive and requires specific ameliorative techniques to construct the road formation in this area.

## Heavy Vehicle Bypass - Town of Emerald

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A low level formation with additional drainage is also required through this section to minimise any backwater effect from the proposed bypass. This part of the bypass will be untrafficable during flooding of the river and flood plain.

### Disbenefits:

- Bisects Little Farm Road.
- Crosses flood plain/"melon hole country" between Little Farm Road and Amethyst Drive.
- Severs blocks of land to the east of Amethyst Drive.
- Requires more resumption than Alternative B, C or D.

### Benefits:

- Maintains higher design speed through river crossing.
- Avoids the introduction of "S" bend into alignment.

### Recommendation

Alternative "B" is recommended as the preferred alignment for the crossing of the Nogo River because this alignment:-

- only requires one bridge;
- does not cross the anabranch or the overflow channel between the river and anabranch;
- avoids the flood plain to the north-east and does not require special design to construct through "melon-hole country";
- joins to the southern end of Amethyst Drive and does not require realignment of Little Farm Road;
- utilises the existing road formation and corridor along Amethyst Drive, and
- does not effect any existing residences.

However, this alignment requires a further assessment of the backwater effect of the bridge and road embankment before final adoption of this element as part of the bypass route.

Alternative "D" would also be a viable option if the backwater calculation on option "B" proved unacceptable. Alternative D provides appropriate sites for bridges over the river and anabranch while maintaining the required design speed on these elements of the bypass. It joins to Amethyst Drive and avoids the worst areas of "melon holes" within the flood plain to the north east and joins to a proposed crossing of the drainage channel at Moffat Road.

## Heavy Vehicle Bypass - Town of Emerald

Alternative "C" is discounted as an element of the bypass route because of the combination of curved and straight alignment through the river channel and the impact on existing residences on Amethyst Drive and Little Farm Road.

Alternative "E" is discounted because it traverses an area of "melon-hole country" within the flood plain to the north-east of the river and will require specific ameliorative techniques to construct this road formation. Alternative E will also have a major impact on Little Farm Road and the existing residences and does not utilise the existing road corridor along Amethyst Drive.

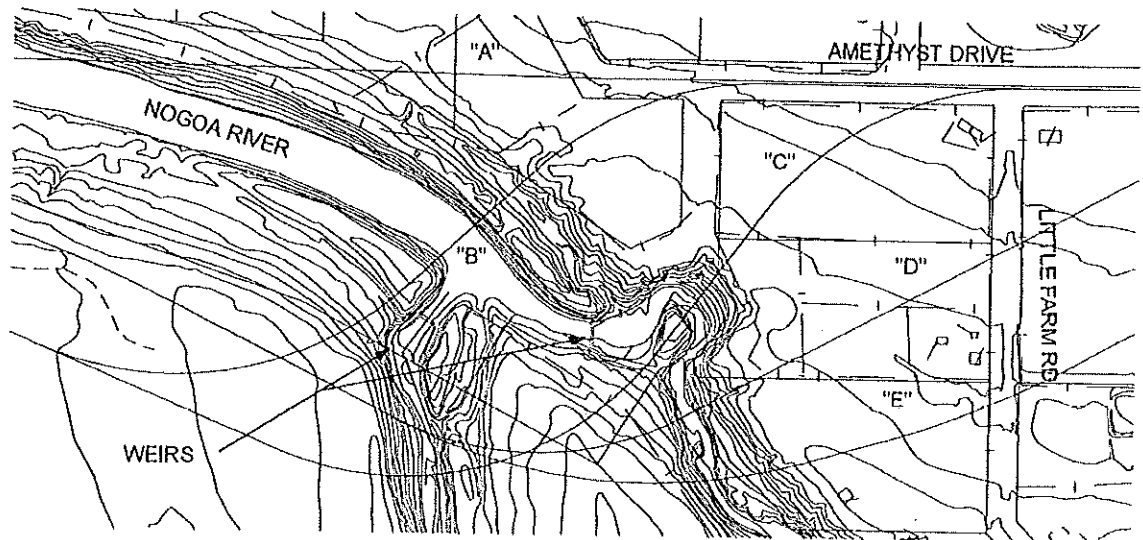


FIGURE B: ALTERNATIVE RIVER CROSSING

## 5.0 TRAFFIC PREDICTIONS

### 5.1 Methodology

From the data available, it is difficult to predict the volumes of traffic that may use the Heavy Vehicle Bypass. Traffic growth is inevitable. Completion of the North - South link through Emerald; local mining and agricultural development will impact on the traffic using the bypass. This rate of traffic growth will also influence when construction of a bypass is warranted. It is recommended that further investigation be undertaken (eg: driver origin/ destination surveys) to better understand the traffic patterns.

From the Emerald Road Network Studies and traffic counts undertaken by Main Roads, an assessment of volumes for the bypass has been made. The figures quoted in Emerald Road Network Strategy - 1992 are representative of historical and current volumes on the Capricorn Highway in Emerald. These are summarised in Table 1.

## Heavy Vehicle Bypass - Town of Emerald

Traffic Count Location	Emerald RNS 1992 (vpd)	Adjusted Volumes 1994 (vpd)	Projected Volumes 1996 (vpd)
Tyson Road (5012)			1740 171 48 10
Ruby Street (5008)	4430 380 110 15	6541 (475)	7457 542 152 33
Clermont Street	6000 ( <i>total vehicles</i> ) 580 ( <i>total commercials</i> ) 168 ( <i>semi - trailers</i> ) 35 ( <i>road trains</i> )	8655 (548) ( <i>total commercials</i> )	9867 625 175 38
Opal Street	3150 250 45 10		4257 (213)
Springsure Road 5003	2400 380 100 15	4344 (696)	5636 793 317 48

Table 1 - Summary of Traffic Volumes - Capricorn Highway (24 hr /pd)

From Table 1, an average of 5600 vpd (1996) is adopted as the volume approaching Emerald on the Gregory and Capricorn Highways. A proportion of this volume will choose to use the bypass.

Using Clermont Street - RNS (1992) figures from Table 1 as being representative of vehicle type dissection, Table 2 presents a dissection expressed as "percentage of total vehicles" and "percentage of commercial vehicles". Table 3 presents the adopted 5600 vpd dissected as in Table 2.

Clermont Street - RNS Report (1992)		Percentage of Total Vehicles	Percentage of Commercial Vehicles
Total Vehicles	6000		
Commercial Vehicles	580	10%	
Semi - trailers	160	3%	28%
Road Trains	35	0.6%	6%

Table 2 - Percentages of Semi Trailers & Road Trains

## Heavy Vehicle Bypass - Town of Emerald

	Adopted 1996 vpd	Assumed 1996 vpd on Bypass	Projected 2001 vpd on Bypass
<b>Total Vehicles</b>	5600	1400 (25%)	1970
<b>Commercial Vehicles</b>	560 (10%)	340 (60%)	480 (24%)
<b>Semi - trailers</b>	170 (3%)	170 (100%)	240 (12%)
<b>Road Trains</b>	35 (0.6%)	35 (100%)	50 (2.5%)

Table 3 - Assumed and Projected Bypass Volumes (1996) - Dissected by Vehicle Type

As previously stated it is difficult to predict the traffic using the bypass. For the purpose of this report the following assumptions are made.

- 5600 vpd approach the bypass of which:
- 25% will use the bypass
- 60% commercial vehicles will use the bypass
- 100% semi trailers will use the bypass
- 100% road trains will use the bypass
- traffic growth at 7% to 2001

Table 3 presents the traffic volumes assumed to be using the bypass in 2001. A different vehicle type dissection has emerged.

### 5.2 Additional Factors

There are a number of additional factors that may have significant effect on traffic volumes within the study area and warrant the construction of a bypass route around Emerald.

- A revision of the road train / B double routes could force these vehicles out of the centre of Emerald and onto a possible bypass route. Currently Type 1 Road Trains are permitted through Emerald, as shown in Figure 10. However with the provision of an alternative route and restrictions on allowable movement these vehicles could be forced onto a bypass.
- Completion of the bitumen surfacing of the Carnarvon Developmental Road from Injune to Rolleston and the Gregory Developmental Road from Clermont to Charters Towers will provide an alternative route for transporters carrying commodities between Brisbane and North Queensland.

This route has been identified in the Road Network Strategy (1994) for upgrading to a Type 2 Road Train Route from the NSW border to Charters Towers. (refer Figures 11 - 13).

- The cartage of cotton from the north and west of Emerald to the Ginnery (south east of town) could also, with appropriate restrictions, be forced onto a bypass route.

## Heavy Vehicle Bypass - Town of Emerald

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- The location of the Emerald Airport on the Springsure Road, south of Emerald.
- The supply of heavy equipment for the coal mines to the north of Emerald.
- An increase in tourist traffic accessing the north and west of Queensland.

### 6.0 INTERSECTIONS AND ACCESSES

#### 6.1 Intersections

Roundabouts are recommended for the intersections of the bypass route and the Capricorn and Gregory Highways on the eastern and northern outskirts of Emerald. (refer Attachments 4 and 5). These intersections are 4 way junctions in semi-rural locations. At these locations, on the outer urban areas of Emerald, roundabouts are considered the most appropriate treatment because:

- the major traffic movements are turning movements.
- traffic volumes do not warrant traffic signals and traffic signals may result in increased delays.
- traffic volumes are difficult to predict especially with the addition of the bypass route.
- it is not desirable to give any road priority.

The roundabouts will form the entrances to Emerald from the north; south and east and can be signed to indicate the start of the town environment.

The intersection of the bypass with the Capricorn Highway on the western outskirts of Emerald, is proposed as a "Type C" channelised intersection. This is considered the appropriate treatment at this intersection due to the higher volume of through traffic on the Capricorn Highway than the proposed bypass.

A "Type B"; painted intersection exists at this location joining Tyson Road to the Capricorn Highway. Tyson Road will be realigned to join to the bypass route prior to the proposed intersection. (refer Attachment 6)

#### 6.2 Accesses

As discussed in Section 3 - Proposed Corridor, limitation of access is considered necessary to control access to the bypass consistent with the rate and nature of redevelopment. The provision of an internal road system within any future subdivision that may abut the bypass route should be encouraged as this will alleviate the need for service roads beside the bypass formation and therefore reduce the width of the proposed bypass corridor. This will also reduce the area of land required to be resumed from adjacent properties for the corridor.



## Heavy Vehicle Bypass - Town of Emerald

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The following access arrangements are considered acceptable. These are based on the assumption that the current state of development exists at the time of construction of the first stage (2 lane) bypass.

- Shared accesses to intermediate allotments along Codenwarra Road (to be phased out as redevelopment of rural residential land with internal road systems occurs).
- Penrose Avenue and Codenwarra Road extended.
- Amethyst Drive - left hand side to connect to "Alternative B", and right hand side at the western side of the drainage channel
- Little Farm Road - right hand side
- The eastern end of Moffat Road to existing commercial developments. (eg. crop spraying shed)
- the northern edge of the industrial estate.
- Cameron Road - left hand side to provide access to the bypass in lieu of Munro Road. Munro Road to be terminated before proposed railway crossing (Refer Attachment 7).
- Hogan Road (Gays Road) - left hand side.
- Chainage 10300 to provide access to existing properties north of the drainage channel. (refer Attachment 7)
- Tyson Road - realigned to join the bypass route.

### 7.0 DRAINAGE

#### 7.1 General

For the recommended alignment (refer Figure 4), drainage structures are proposed at:

- Minor culverts along Codenwarra Road and the bridge approach.
- Bridges at Nogoia River and Anabranch.
- Major culverts across the flood plain north-east of the Nogoia River.
- Crossings of the existing drainage channels.

#### 7.2 Minor Catchments

Additional drainage structures are required along Codenwarra Road and adjacent to the intersection of Moffat Road and the Gregory Highway. These watershed areas; a summary of discharges and suggested culvert sizes are shown in Attachment 8.

## Heavy Vehicle Bypass - Town of Emerald

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Crossings of the existing drainage channels will require structures at:

- (a) eastern end of Moffat Road
- (b) northern corner of the Industrial Estate
- (c) the railway crossing adjacent to Munro and Hogan Roads
- (d) Tyson Road

A culvert similar in area to the existing structure in the drainage channels under the Gregory Highway is adequate for crossings b, c and d. The existing structure in the drains are 5/2100 x 2100 RCC and 6/1500 RCP. A suggested structure for the crossing of this channel on the proposed alignment is 5/2100 x 2100 RCBC. Costs of these structures are allowed in the summary of the estimate of cost in Section 10 of this report.

The crossing of the drainage channel at the eastern end of Moffat Road will require a skewed bridge, approximately 70 metres long, with one central pier within the drainage channel. A bridge spanning this channel from bank to bank with minimal obstruction of the channel is required due to concerns regarding flooding of urban areas in Emerald upstream of the bypass route.

The Pritchard Road and Braeside Road options, if considered, will also require structures across these existing drainage channels. The channels are 120 metres wide from bank to bank and will require major drainage structures to provide adequate immunity of any proposed crossing. A typical culvert size for this structure is a 10/3000 x 1500 RCBC or similar, and will add approximately \$600,000 to the cost of the Pritchard and Braeside Road options.

### 7.3 River Crossings and Flood Plain

The drainage investigation for the crossing of the Nogoia River and flood plain consider the discharges and proposed road levels for flood events with Recurrence Intervals of 5, 10 and 20 years.

The discharges for Recurrence Intervals of 10, 20 and 50 years were obtained from the Department of Primary Industries' computer model of the Nogoia River and flood plain. The discharge for the 5 year event was interpolated from this and recorded discharges from the Fairbairn Dam and Town Weir.

A summary of the discharges and the corresponding levels in the Nogoia River is shown in Table 4.

### Heavy Vehicle Bypass - Town of Emerald

Recurrence Interval	Discharge (cumecs)	Corresponding Levels			
		Exist Bridge Capricorn Hwy	Town Weir	Proposed Alignment	
				"D"	"B"
5	1000	172.7	172.8	171.9	172.8
10	1329	173.4	173.7	173.0	173.7
20	1938	175.1	175.15	174.2	175.1
50	3077	177.1	176.8	175.5	176.8

Table 4 - Discharges and Flood Levels - Nogoia River  
(Preferred Alignment - "B")

Times of submergence for the 5, 10 and 20 year Recurrence Intervals, at the proposed downstream crossing, are shown in Table 5. The maximum time of submergence is based on the hydrographs for a 50 year discharge.

Catchment Area (hectares)	Years at Gauge Records	RETURN PERIOD					
		5 years		10 years		20 years	
		AATOS hrs/yr	Max TOS Days	AATOS hrs/yr	Max TOS Days	AATOS hrs/yr	Max TOS Days
16720	35	20	7.7	10	6.4	4	4.5

Table 5 - Times of Submergence - Proposed Crossing

The relationship between cost and Average Annual Time of Submergence is shown in Figure A below. The point where the graph curves, approximately A.R.I 10 years, represents the most economical combination of flood immunity and cost.

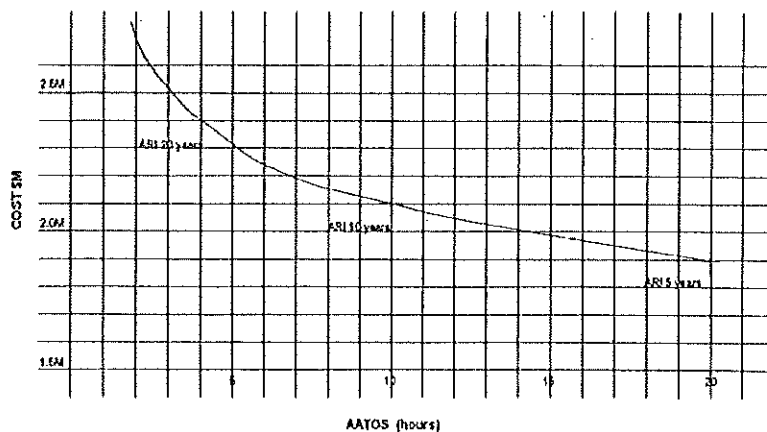


Figure C - Immunity vs Cost - Nogoia River Bridge

A backwater level for the bridges is estimated between 75mm - 100mm. However at the bridge level proposed, its effect on flooding in Emerald will be minimal. For major flooding events (ie: above 10 year Average Recurrence Interval (A.R.I.)), the bridges will be submerged.

## Heavy Vehicle Bypass - Town of Emerald

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More detailed calculations and utilisation of the Department of Primary Industries' computer model is required to refine the levels for the proposed crossings of the Nogoa River. It is recommended that the proposed alignment and the proposed river crossing be incorporated into the Department of Primary Industries' computer model to determine the backwater effect of construction in the Nogoa River and flood plain.

### 7.4 Summary

The recommended level of the proposed crossing of the Nogoa River along Alternative B is 173.7 while the level for the bridges across the river and anabranch along Alternative "D" is RL 173 which equates to a Recurrence Interval of 10 yrs. Sufficient underdrainage is also required on the bridge approach roadway to Alternative "B" or under the low level road formation across the flood plain from the Nogoa River to Moffat Road along Alternative "D" to minimise the headwater caused by the proposed roadway.

Construction of the bridges on either alternative alignment can be staged by providing for future widening to the ultimate 4 lanes during construction of the initial 2 lane bridge.

### 8.0 RESUMPTIONS

Resumption costs for the bypass road are based on the corridor required for the ultimate 4 lane proposal as shown on the cross sections. (refer Figures 8 and 9)

Land zoning within the study corridor was obtained from the Emerald Shire Council. (refer Figure 16). Values for different zones are based on information supplied by the Property Services Branch of Main Roads.

The total area required for resumption is 51.10 hectares with the majority zoned as "rural conservation". The total cost of resumption is approximately \$1.73 million. (refer Table 6).

Land Zoning	Area Required	Rate to Resume	Cost
Rural Residential	27,200m <sup>2</sup>	\$25 / m <sup>2</sup>	\$68,000
Particular Development	750m <sup>2</sup>	\$250 / m <sup>2</sup>	\$187,500
Rural Conservation	47.01 ha	\$500 / m <sup>2</sup>	\$23,505
General Industrial	12,950m <sup>2</sup>	\$65 / m <sup>2</sup>	\$841,750
TOTAL	51.10 ha		\$1.73 m

Table 6 - Cost of Resumptions

A cost to resume only that land required for a 2 lane corridor has not been determined. It is recommended that resumptions or dedication of land be negotiated on the basis of the ultimate 4 lane corridor.

## Heavy Vehicle Bypass - Town of Emerald

### 9.0 UTILITY SERVICES

Services including underground telephone cable and overhead power lines exist along most of the proposed route.

To accommodate the first stage 2 lane construction, relocation and / or protection of power and telephone cables, including optic fibre, will be required at all intersections. (ie Springsure, Clermont and Tyson Roads). Relocation of the 22kv power line from Codenwarra Road to Moffat Road and from the industrial estate to the Capricorn Highway will be necessary.

At second stage construction, sections of 66kv power line will require relocation at Codenwarra Road and the railway crossing west of the industrial estate. Details of locations of power and telecom services are shown in Attachment 14.

Queensland Rail and Emerald Shire Council had not replied to requests for location of their existing and future services at the time of writing this draft report.

### 10.0 ESTIMATE OF COSTS

The cost to provide a 4 lane heavy vehicle bypass on the proposed route is \$34 million. The cost of a 2 lane bypass road including the cost of resumptions for the future 4 lane construction is \$19.4 million. A dissection of costs for the 2 and 4 lane proposals is shown in Table 7.

Item	Proposed Alignments	
	2 lane option	4 lane option
Earthworks	1,198,200	3,247,500
Pavement	5,740,000	9,270,000
Drainage	1,100,000	2,050,000
Bridges	2,800,000	5,400,000
Bitumen Surfacing	743,000	1,200,000
Service Road	--	742,000
Intersection	440,000	440,000
Lighting	235,000	235,000
Railway Crossing	75,000	75,000
Channel Crossing	404,000	650,000
Services	75,000	75,000
<b>Comparison</b>	<b>\$12.8M</b>	<b>\$23.3M</b>
Contingencies (30%)	3.6M	6.7M
Design and Project M'ment (10%)	1.2M	2.2M
Resumptions	1.8M	1.8M
<b>Total Cost</b>	<b>\$19.4M</b>	<b>\$34M</b>

Table 7 - Cost Summary

## Heavy Vehicle Bypass - Town of Emerald

### 11.0 BENEFIT COST ANALYSIS

An analysis of the benefits and costs of providing a bypass; compared with heavy vehicles continuing to use the Capricorn and Gregory Highways has been undertaken. The Main Roads Department's computer program and analysis methodology was used. The assumptions are as follows:

- analysis period of 30 years.
- the capital outlay to provide the bypass is offset by some residual asset value beyond 30 years.
- capital outlay (approximately \$1.0 million) will be required to allow Type 2 road trains to negotiate Clermont and Ruby Streets intersection.
- traffic using the bypass will maintain a minimum of 80 kph speed.
- the same traffic using existing Gregory Highway will suffer a lower level of service (maximum 50 kph) because of conflict with local traffic.
- existing roughness counts indicate that Hospital Road and Ruby Street will require pavement rehabilitation within 10 years.

Whilst traffic volumes on the existing highways remain low and cause only minor impediment to heavy vehicles, the benefits of a bypass route are difficult to justify. However as traffic on Ruby and Hospital Roads increase and maintenance expenditure is incurred, the benefits of a bypass are realised.

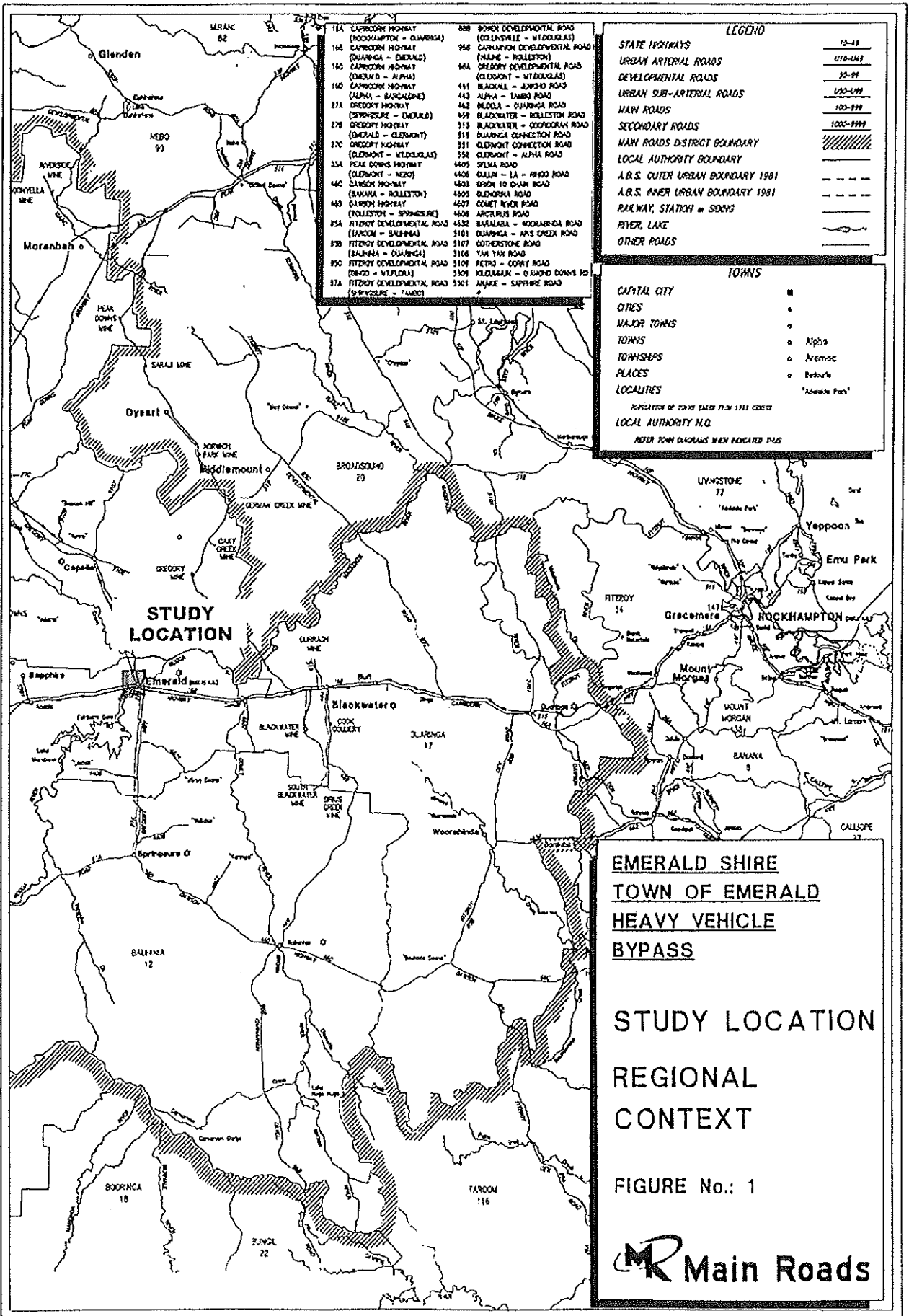
Table 8 below shows the Benefit Cost Ratio that results from delaying the construction of the bypass while traffic volume on existing Capricorn and Gregory Highways grow.

	1996	2001	2002	2003	2004	2005	2006
Traffic Volume on Bypass (vpd) (refer Table 3)	1400	1900	2000	2100	2200	2300	2400
Traffic Volume on Gregory H'way (vpd) (refer Table 1)	7400	10000	10500	11000	11500	12100	12600
Benefit Cost Ratio	0.3	0.5	0.8	0.9	1	1.2	1.2

Table 8 - Benefit Cost Ratios

As stated in Section 1 - Introduction, the Emerald Road Network Study Reports (1992 and 1994) indicated that a heavy vehicle bypass is not required in the short to medium term future. This is confirmed by Table 8.

It is recommended that traffic conditions on existing Capricorn and Gregory Highways be closely monitored to more accurately predict the inevitable decline in the level of service. In the meantime, this report recommends that planning proceeds in anticipation of the need for a heavy vehicle bypass around Emerald in approximately 10 years hence. (ie: years 2004 - 2006).



**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**STUDY LOCATION  
REGIONAL  
CONTEXT**

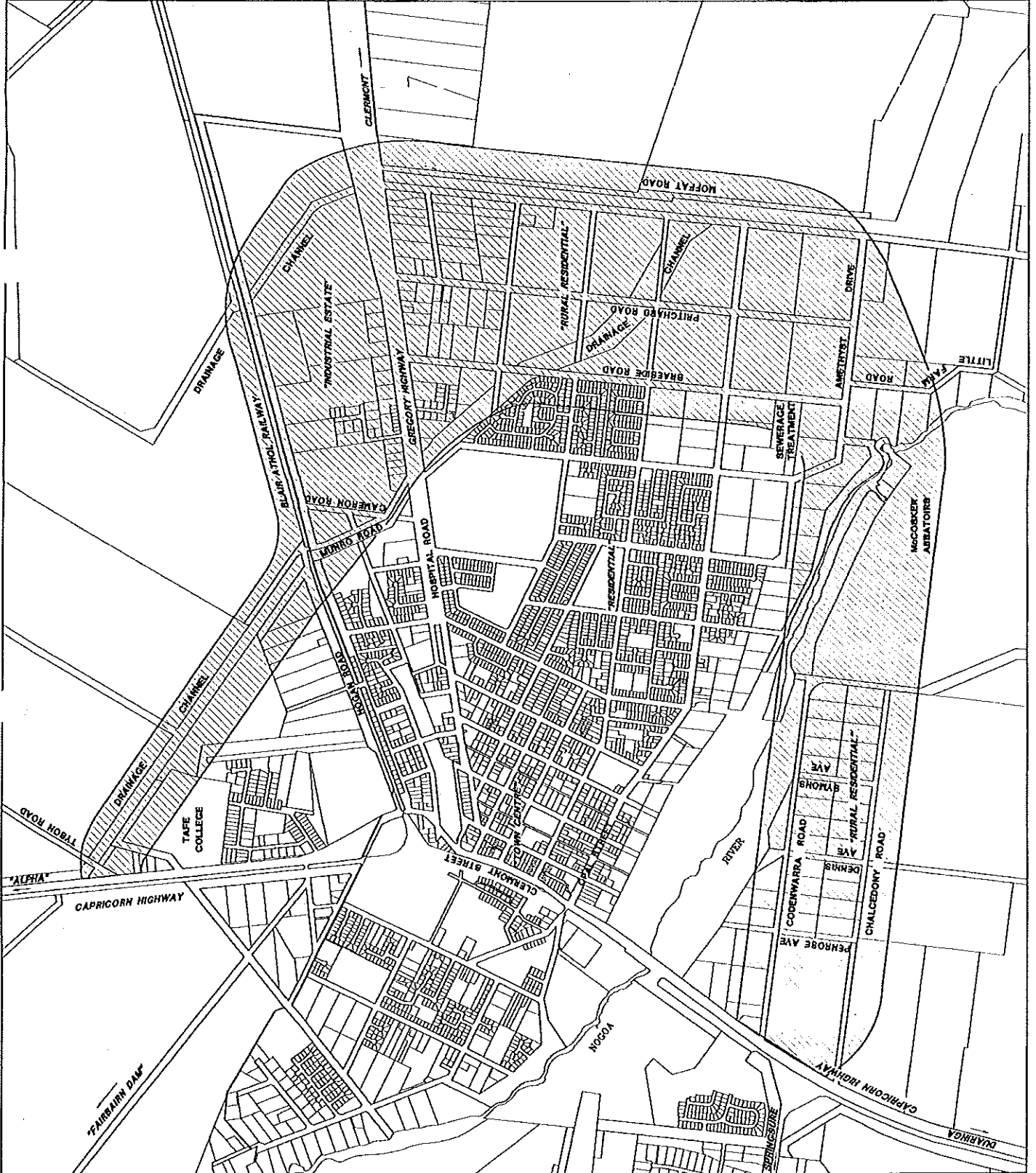
FIGURE No.: 1



**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**STUDY  
CORRIDOR**

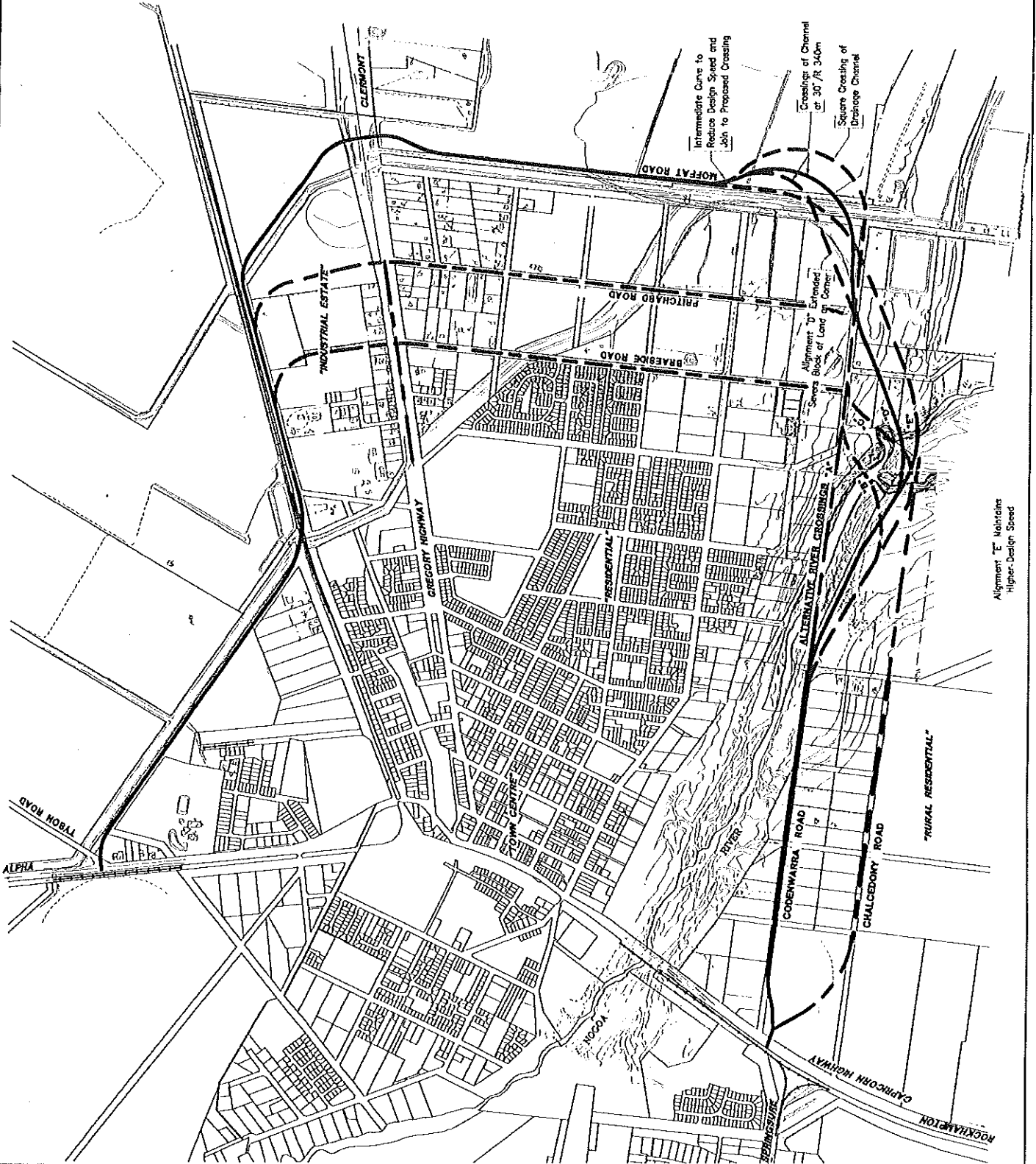
FIGURE No.: 2





# ROUTES ASSESSED

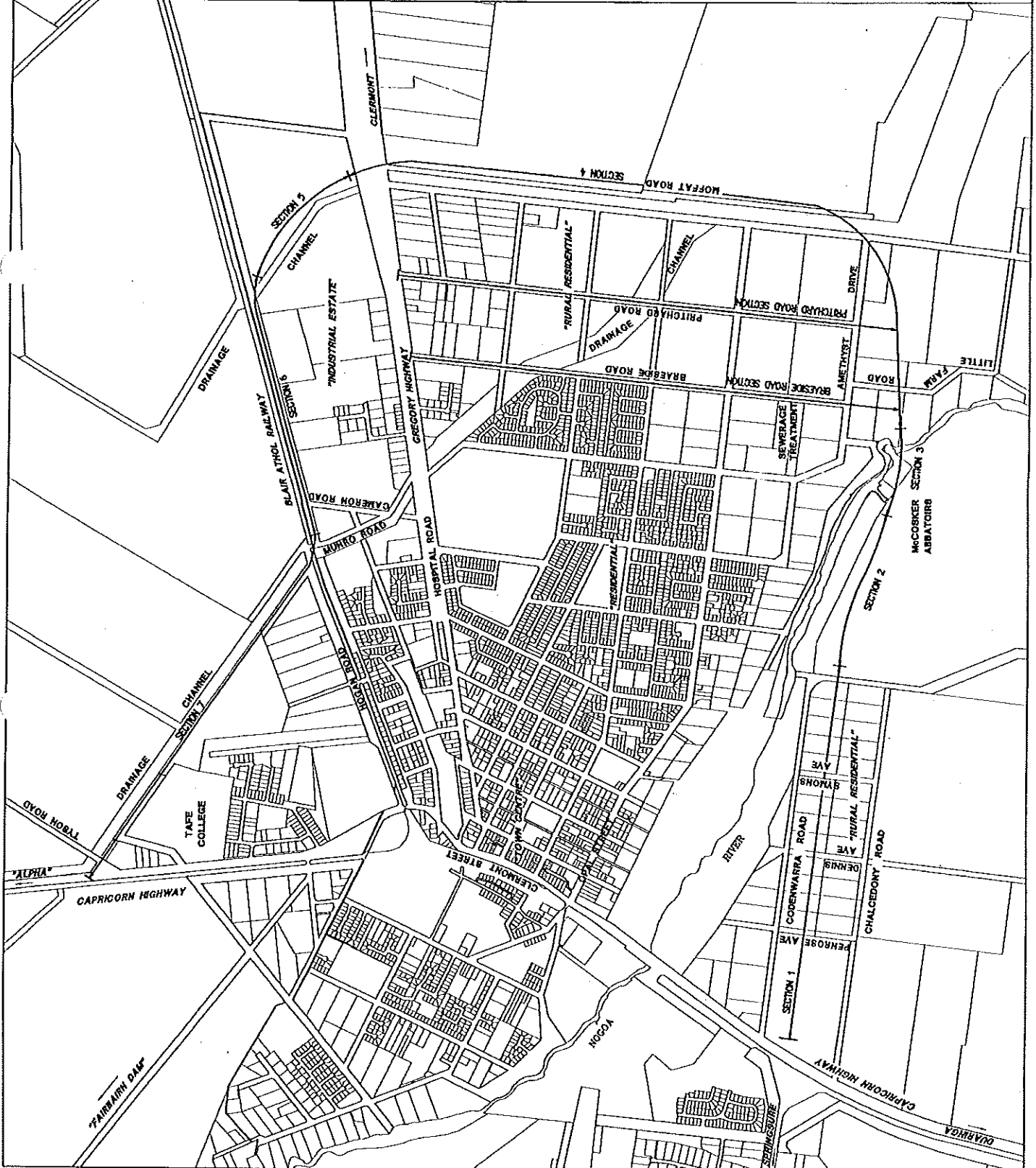
FIGURE No.: 3



EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS

# EXTENT OF CROSS SECTION TYPES

FIGURE No.: 5



**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**PREFERRED  
OPTION**

**FIGURE No.: 4**

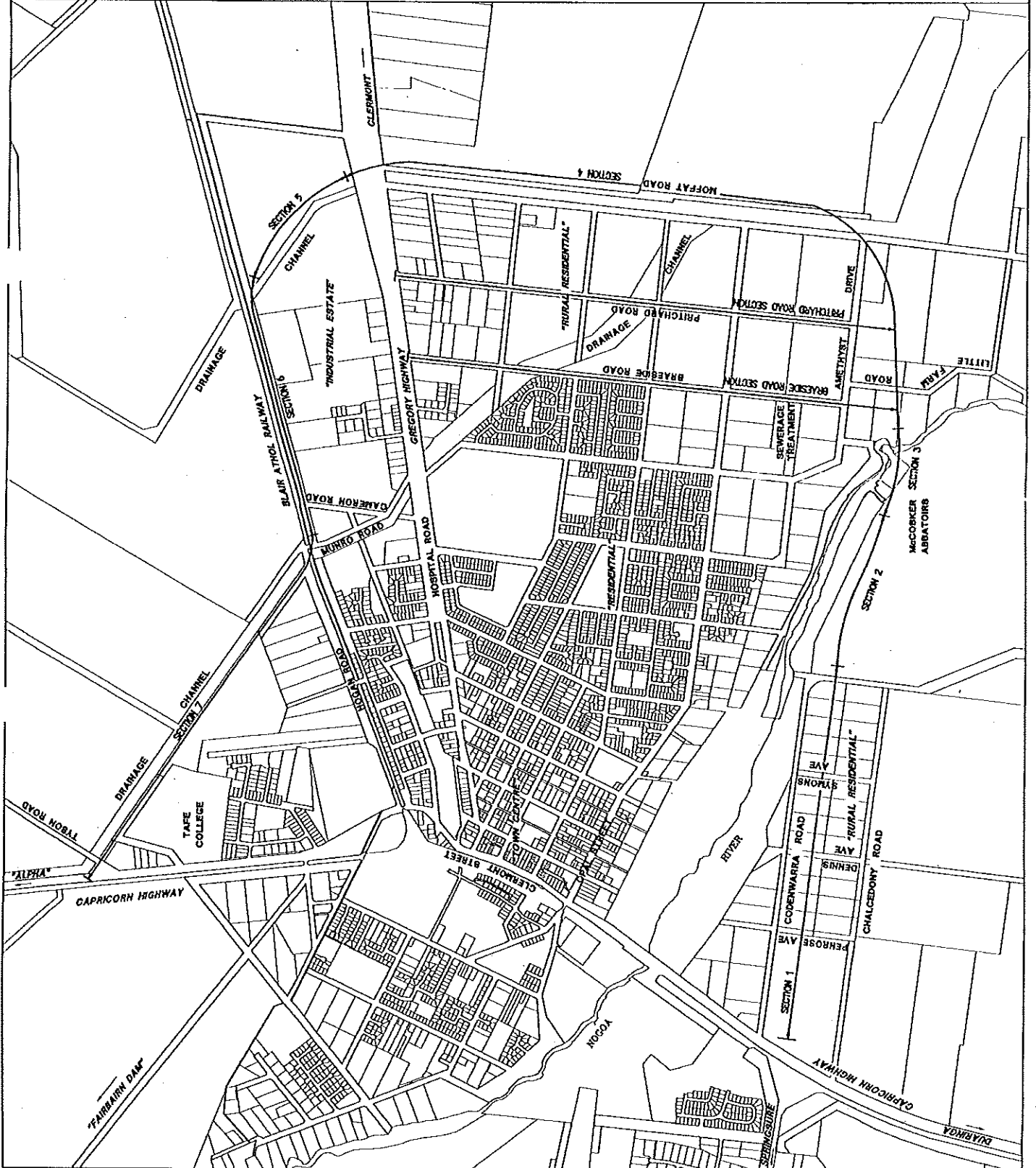


EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS

# EXTENT OF CROSS SECTION TYPES

FIGURE No.: 5

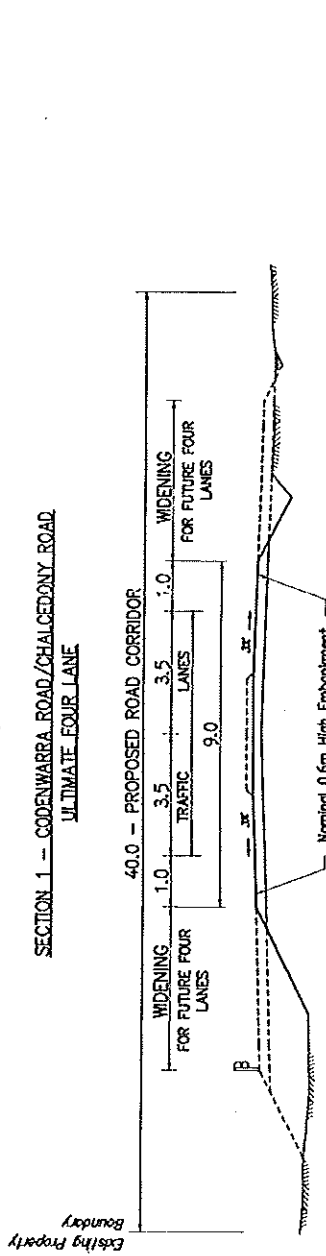
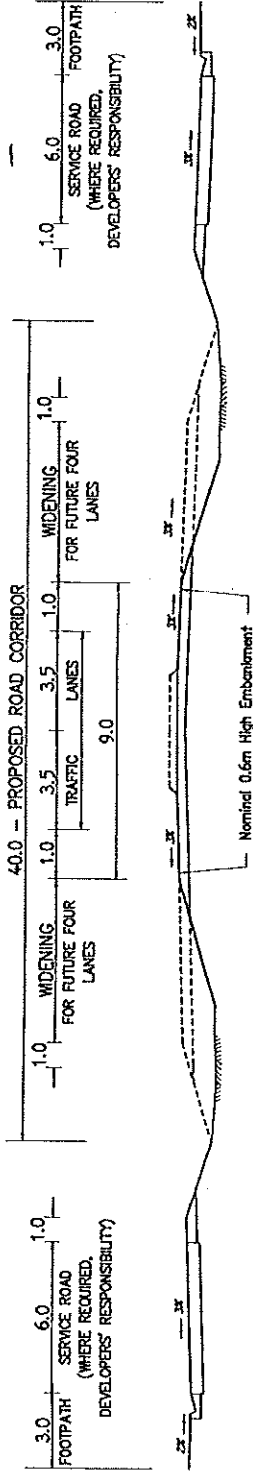
 Main Roads



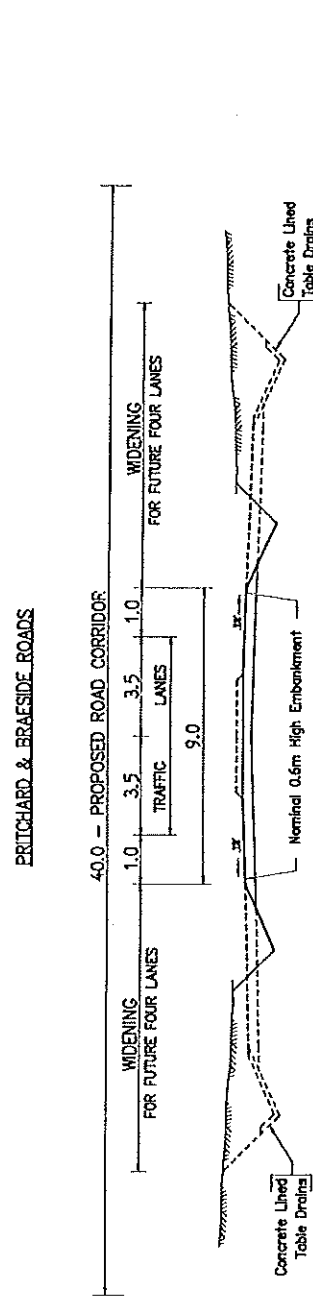
**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**TYPE CROSS  
SECTIONS  
- 2 LANES**

**FIGURE No.: 6  
SECTION No.s 1, 2 & 3**



No Proposal for a Two Lane Development of Pritchard or Braeside Roads has Been Presented. Reconstruction of These Roads to Four Lanes as Shown in Figure 8 is Considered to be Necessary if These Options Were to be Adopted.



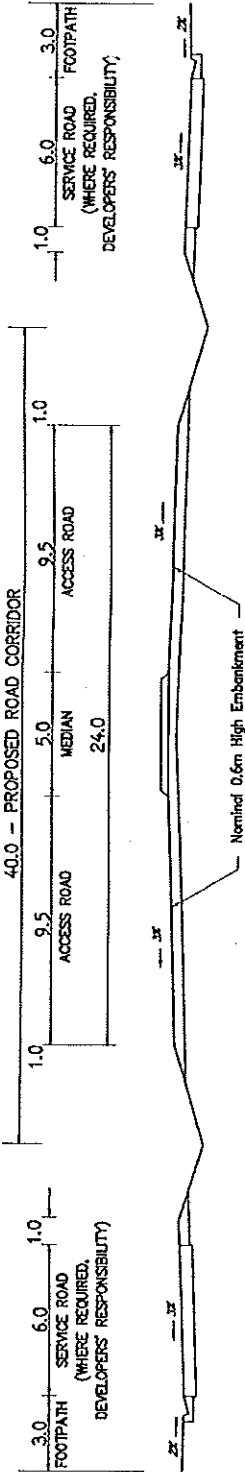
Construction of Two Lane Formation to Suit Future Four Lane Proposal - Sections 2 & 3 - Will Depend on Bridge Design :-  
 1) Two Lane Bridge with Allowances to Widen for Future Four Lane  
 2) Two Lane Bridge Built on Split Alignment to Allow Duplication in Future to Provide 2 x Two Lane Bridges.



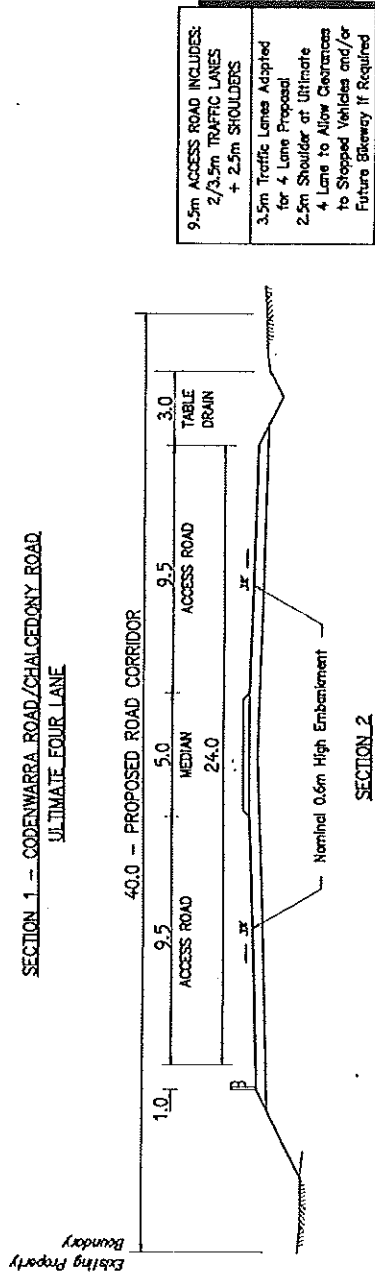
**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**TYPE CROSS  
SECTIONS  
- 4 LANES**

**FIGURE No.: 8  
SECTION No.s 1, 2 & 3**



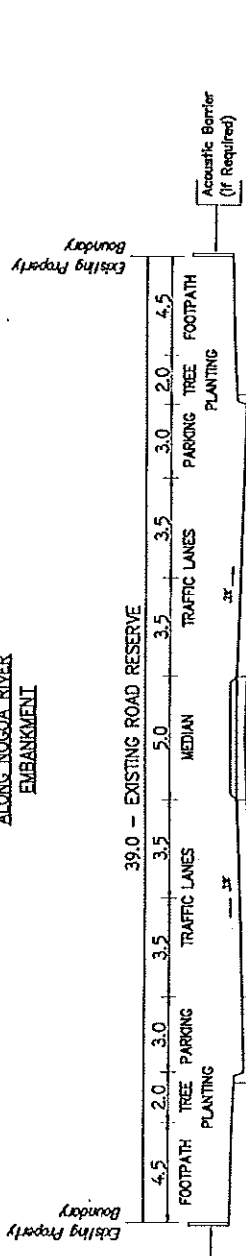
**SECTION 1 - CODENWARRA ROAD/CHALCEDONY ROAD  
ULTIMATE FOUR LANE**



**SECTION 2  
ALONG NOGOA RIVER  
EMBANKMENT**

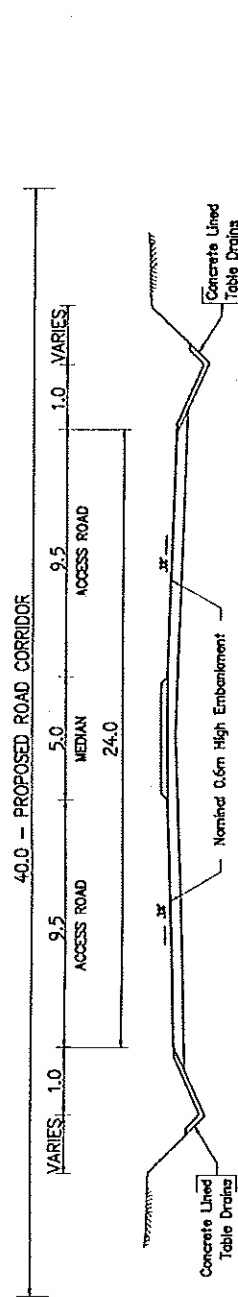
9.5m ACCESS ROAD INCLUDES:  
2/3.5m TRAFFIC LANES  
+ 2.5m SHOULDER

3.5m Traffic Lanes Adapted  
for 4 Lane Proposal  
2.5m Shoulder or Ultimate  
4 Lane to Allow Constraints  
to Stopped Vehicles and/or  
Future Bypass if Required



**PRITCHARD & BRAESIDE ROADS**

3.0m Parking Lane Plus 3.5m Traffic Lane  
Provides Liberal Allowances for Parking Movements  
and High Volumes of Through Traffic



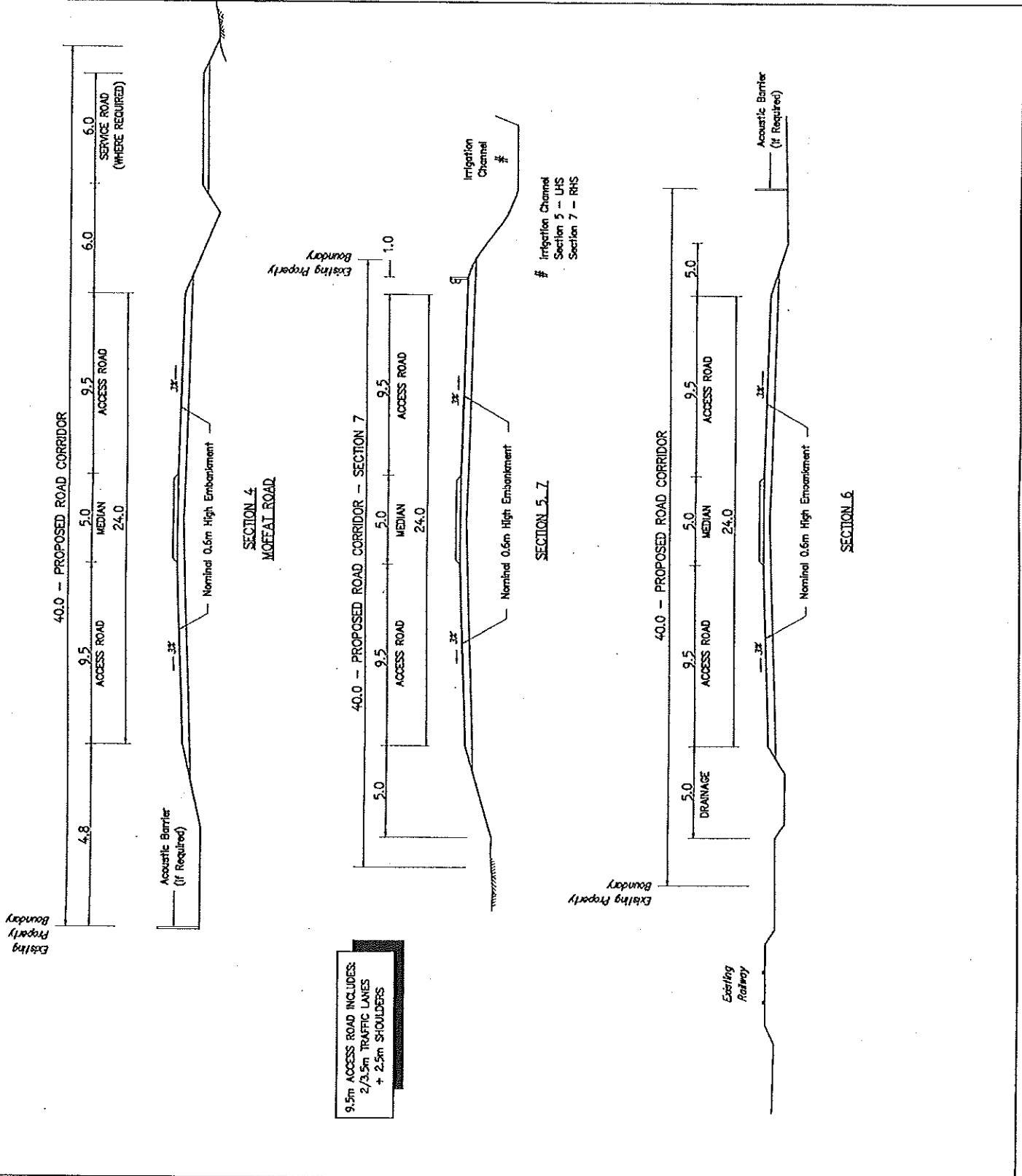
**SECTION 3  
APPROACH TO RIVER CROSSING**



**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**TYPE CROSS  
SECTIONS  
- 4 LANES**

**FIGURE No.: 9  
SECTION No.s 4, 5, 6 & 7**



9.5m ACCESS ROAD INCLUDES:  
2/3.5m TRAFFIC LANES  
+ 2.5m SHOULDERS



# Road Trains in Queensland

**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

## OPERATION ON DECLARED ROADS

- TYPE 1 ONLY
- TYPES 1 & 2
- NO ROAD TRAINS

## OPERATION ON UNDECLARED ROADS

- ▬ TYPE 1 ONLY
- ▬ TYPES 1 & 2
- ▬ NO ROAD TRAINS  
(Without specific Local Government approval)

## ALLOWABLE COMBINATIONS OF VEHICLES

**TYPE 1**  
Articulated vehicle + one trailer  
(max. length 33 m)  
or Rigid Truck + one trailer  
(max. length 28 m)

**TYPE 2**  
Articulated vehicle + two trailers  
(max. length 50 m)  
or Rigid Truck + two trailers  
(max. length 44 m)

For details of Road Train Routes and limits (Termini) within principal built up areas refer to town diagrams on the reverse side.

\* Diagram Provided

NOTE - Some Local Governments, as Broadland Shire have a By-Law restricting vehicle loads on certain roads under their control. These routes will be appropriately marked.

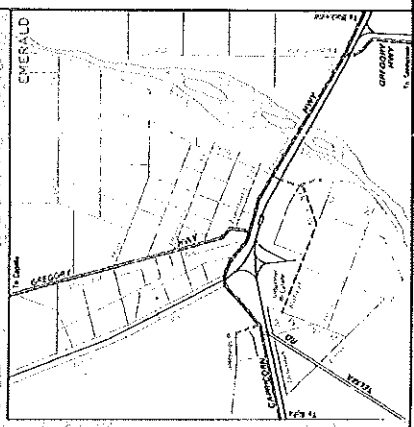
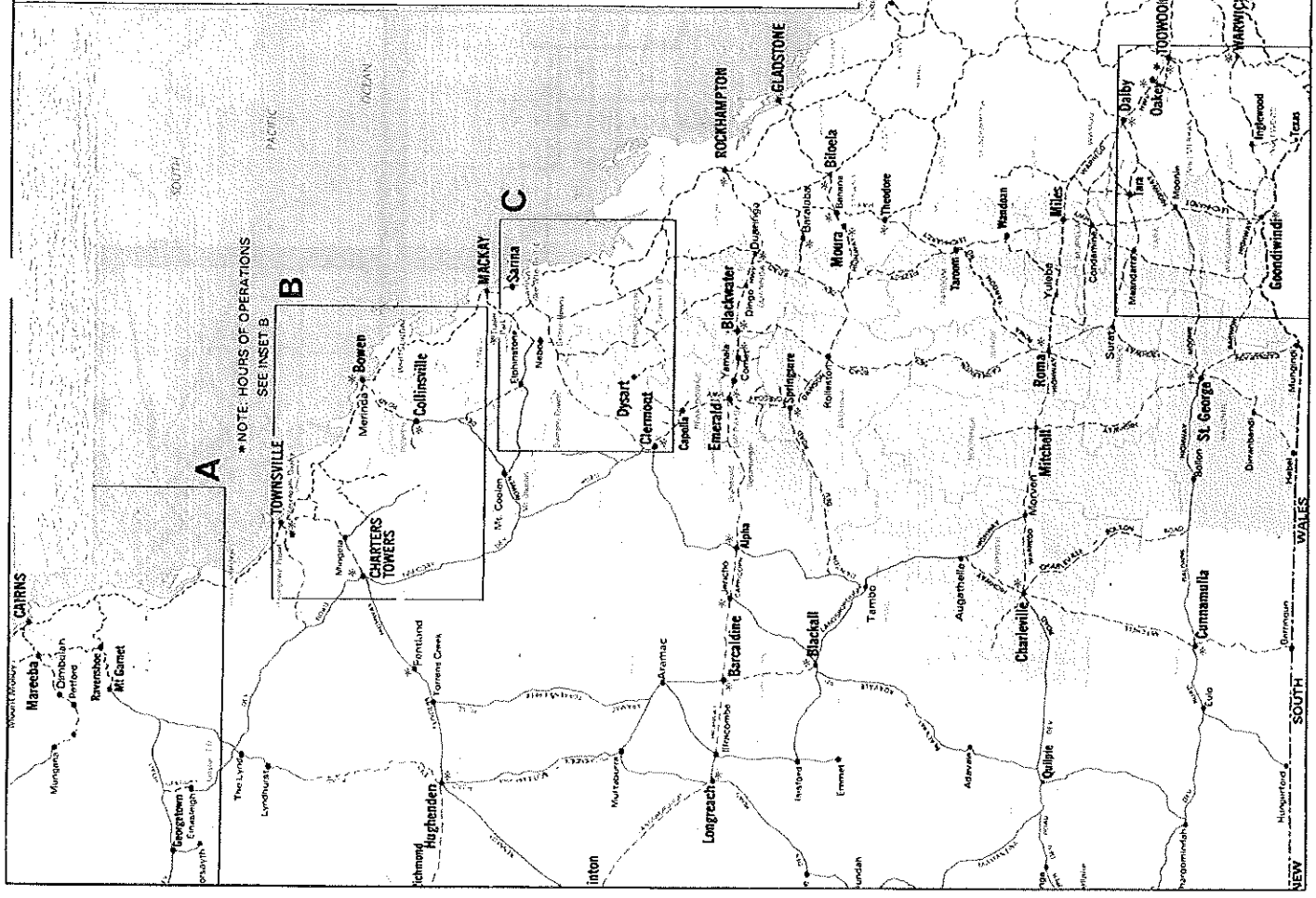
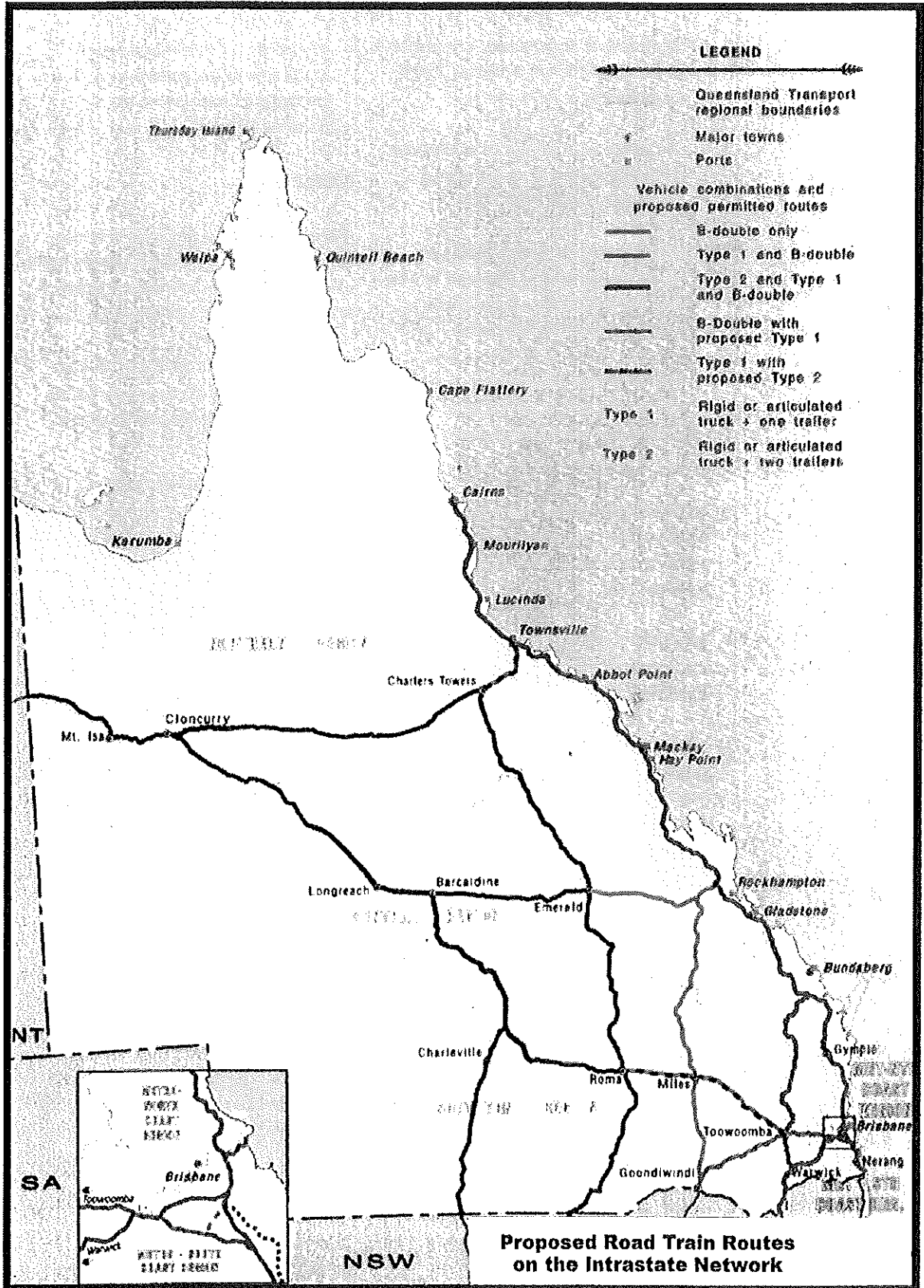


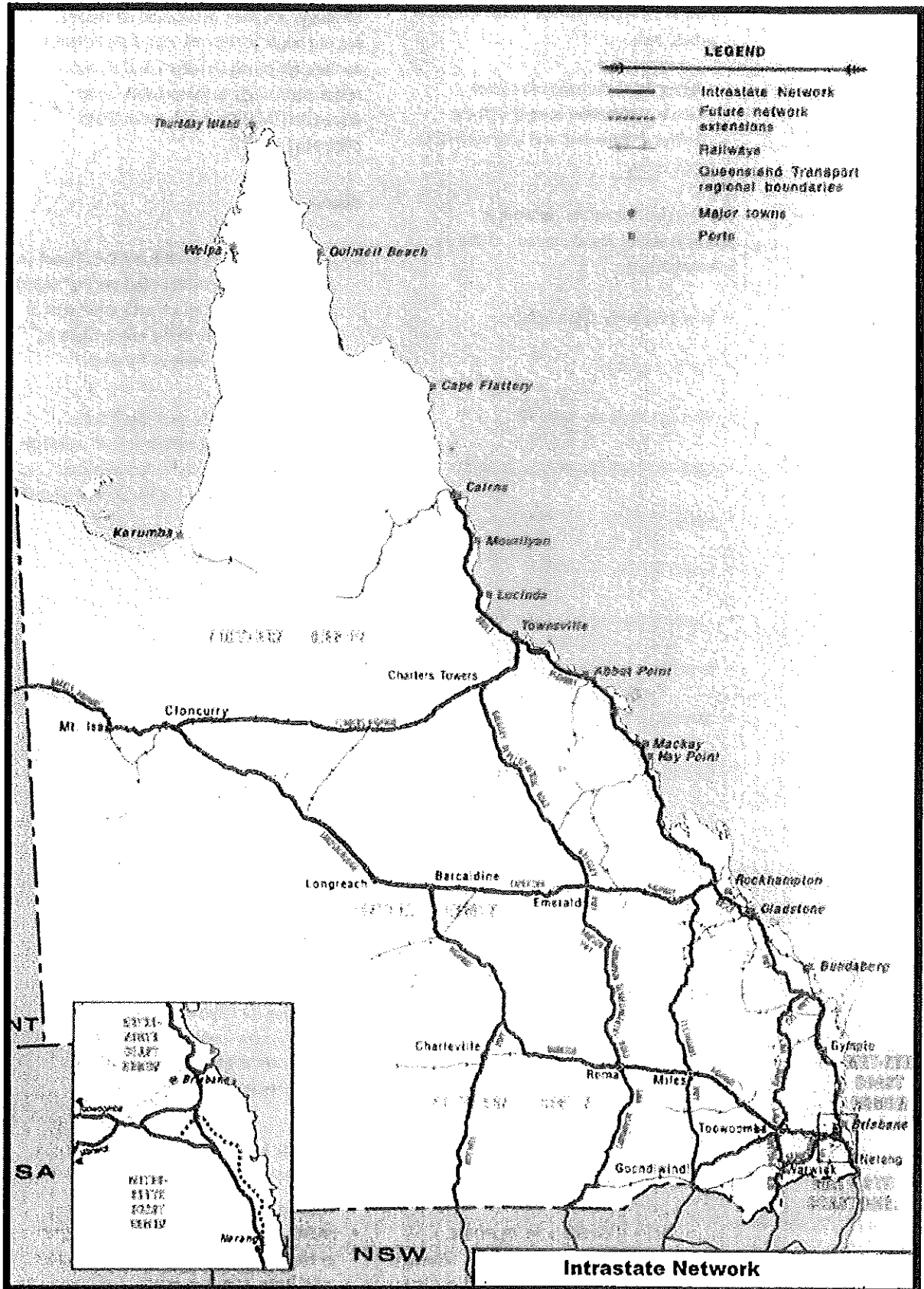
FIGURE No.: 10

# MR Main Roads



EXTRACT FROM THE "ROAD NETWORK STRATEGY (1994)"  
 FIGURE No. 12

# MR Main Roads



EXTRACT FROM THE "ROAD NETWORK STRATEGY (1994)"  
FIGURE No. 11

# INTRASTATE NETWORK DEVELOPMENT

ROAD	DEMAND AND ISSUES	STRATEGY	SPECIFIC MAJOR ACTIVITIES PROPOSED	OUTCOMES
NSW border (at Goodwin Rd) - Rockhampton	<p>Demand: total 300 to 500 ktpa</p> <ul style="list-style-type: none"> <li>• Traffic Volumes 300 to 1,500 vpd</li> <li>• Traffic Composition 20% to 40% freight veh</li> <li>• Tourism 20,000 to 150,000 pt/a</li> <li>• Agriculture 200 to 300 ktpa</li> <li>• Retail and Service Industries 50 to 100 ktpa</li> <li>• Manufacturing 20 to 40 ktpa</li> <li>• Mining 40 to 60 ktpa</li> </ul> <p>Issues:</p> <ul style="list-style-type: none"> <li>• Low standard on some sections is hindering tourism development and adding to transport costs for agriculture;</li> <li>• Potential for major diversion of freight traffic from Bruce Highway with completion of upgrading to allow road trains; and,</li> <li>• Flooding delays, particularly around Theodore.</li> </ul>	<p>To reduce transport costs and improve access by:</p> <ul style="list-style-type: none"> <li>• Widening narrow sealed sections to maintain safety for vehicles mixing with road trains;</li> <li>• Providing for road train travel north to the Capricorn Highway (this would become the most easterly north-south Type 1 road train route);</li> <li>• Improving flood immunity to minimise traffic delays; and,</li> <li>• Improve safety through towns.</li> </ul>	<ul style="list-style-type: none"> <li>• Upgrade north of Banana to road train Type 1 standard</li> <li>• Widen narrow seals north of Taroom to Type 1 road train standard</li> <li>• Improve flood immunity around Theodore</li> <li>• Investigate improvements through towns, particularly Taroom, Banana and Dalby</li> </ul>	<p>Economic and trade development through improved access to southern markets from northern and central Queensland</p> <p>Regional Development</p>
NSW border (at Hebel) - Charters Towers	<p>Demand: total 60 to 450 ktpa</p> <ul style="list-style-type: none"> <li>• Traffic Volumes 100 to 1,500 vpd</li> <li>• Traffic Composition 20% to 40% freight veh</li> <li>• Tourism 10 to 70 pt/a</li> <li>• Agriculture 50 to 400 ktpa</li> <li>• Retail and Service Industries 5 to 10 ktpa</li> <li>• Manufacturing 5 to 10 ktpa</li> <li>• Mining 5 to 50 ktpa</li> </ul> <p>Issues:</p> <ul style="list-style-type: none"> <li>• Unsealed sections are inhibiting use because of lack of reliability of travel; and,</li> <li>• This is potentially a major north-south freight route.</li> </ul>	<p>To provide an efficient transport corridor for industry by:</p> <ul style="list-style-type: none"> <li>• Sealing unsealed sections to provide access for tourists and freight;</li> <li>• Widen narrow seals to provide for Type 2 road trains (this would become the most easterly north-south Type 2 road train route); and,</li> <li>• Improving reliability of travel after rain.</li> </ul>	<ul style="list-style-type: none"> <li>• Complete seal on Injune-Rolleston and Clermont-Belyando River</li> <li>• Widen narrow seals Belyando River to Charters Towers to road train Type 2 standard</li> <li>• Widen narrow seals Roma to Injune to road train Type 2 standard</li> <li>• Improve flood immunity at vulnerable floodways</li> </ul>	<p>Interstate trade and tourism development by provision of a fully sealed direct link from North Queensland to southern markets</p>

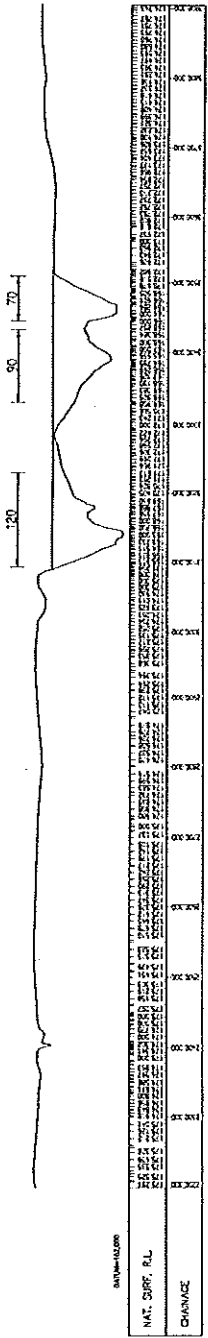
**EXTRACT FROM THE "ROAD NETWORK STRATEGY (1994)"  
FIGURE No. 13**



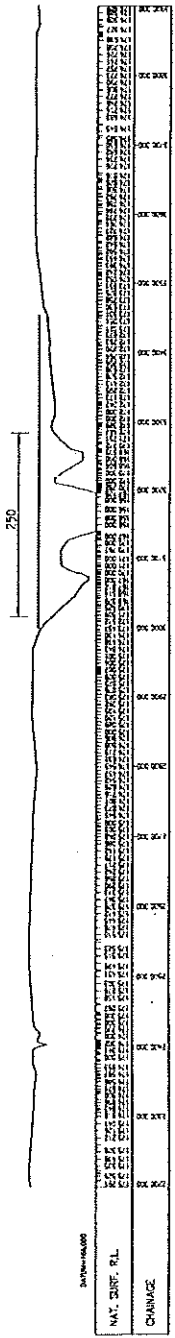
**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**

**ALTERNATIVE  
RIVER CROSSING  
NOGOA RIVER**

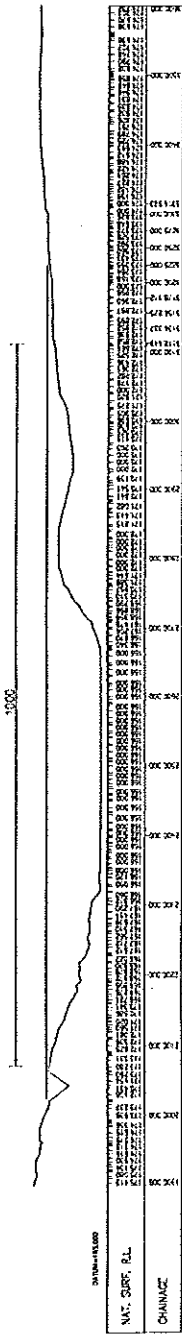
**FIGURE No.: 15  
Sheet 1 of 2**



**ALTERNATIVE C**



**ALTERNATIVE B**



**ALTERNATIVE A**

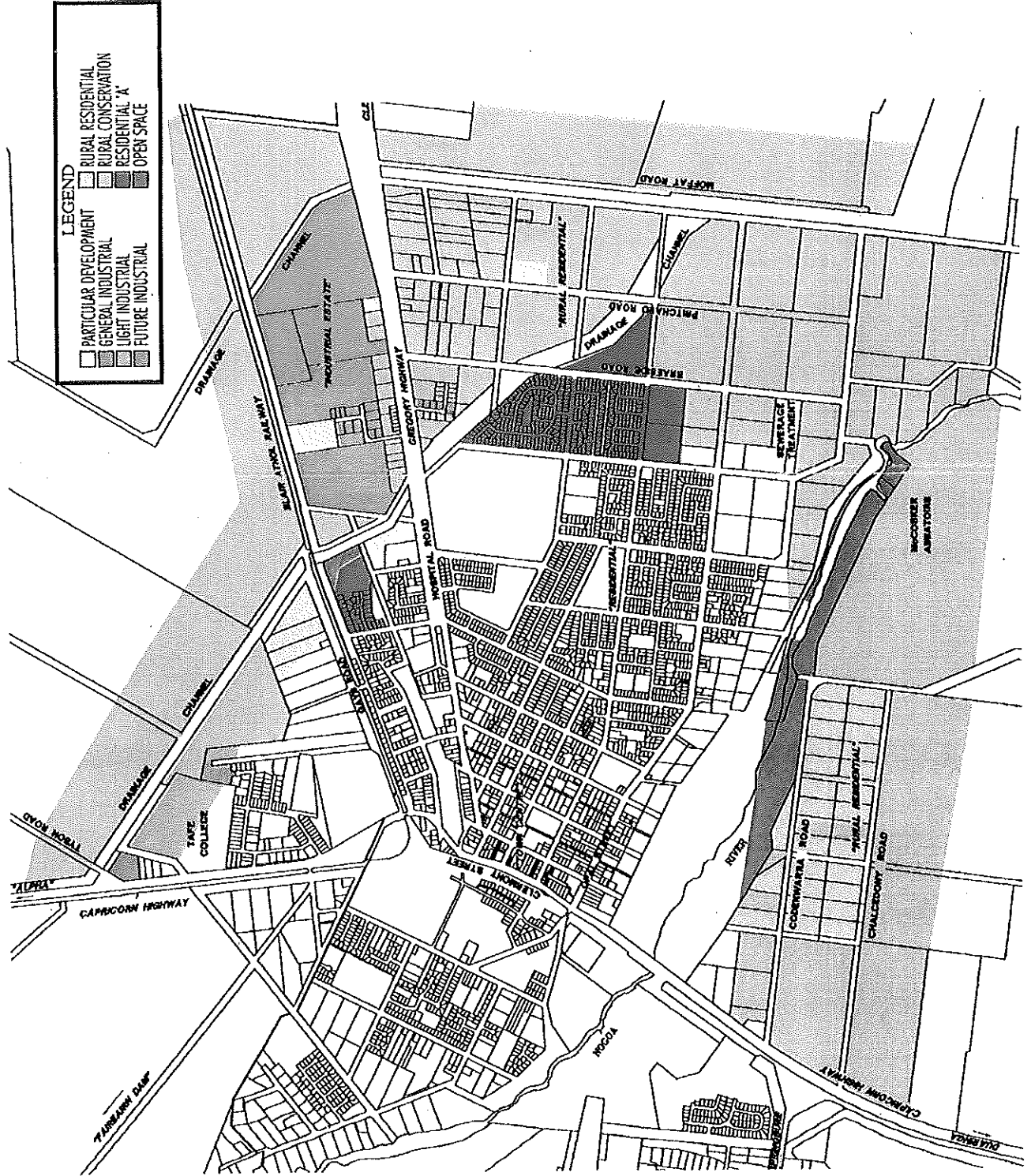
SECTION ALONG ALTERNATIVE CROSSING  
OF THE NOGOA RIVER SHOWING APPROXIMATE  
LENGTH OF WATERWAY OPENINGS FOR A.R.L. OF 10 YEARS



**EMERALD SHIRE**  
**TOWN OF EMERALD**  
**HEAVY VEHICLE**  
**BYPASS**

**LAND ZONING**  
**WITHIN STUDY**  
**CORRIDOR**

**FIGURE No.: 16**





EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS

RESUMPTIONS

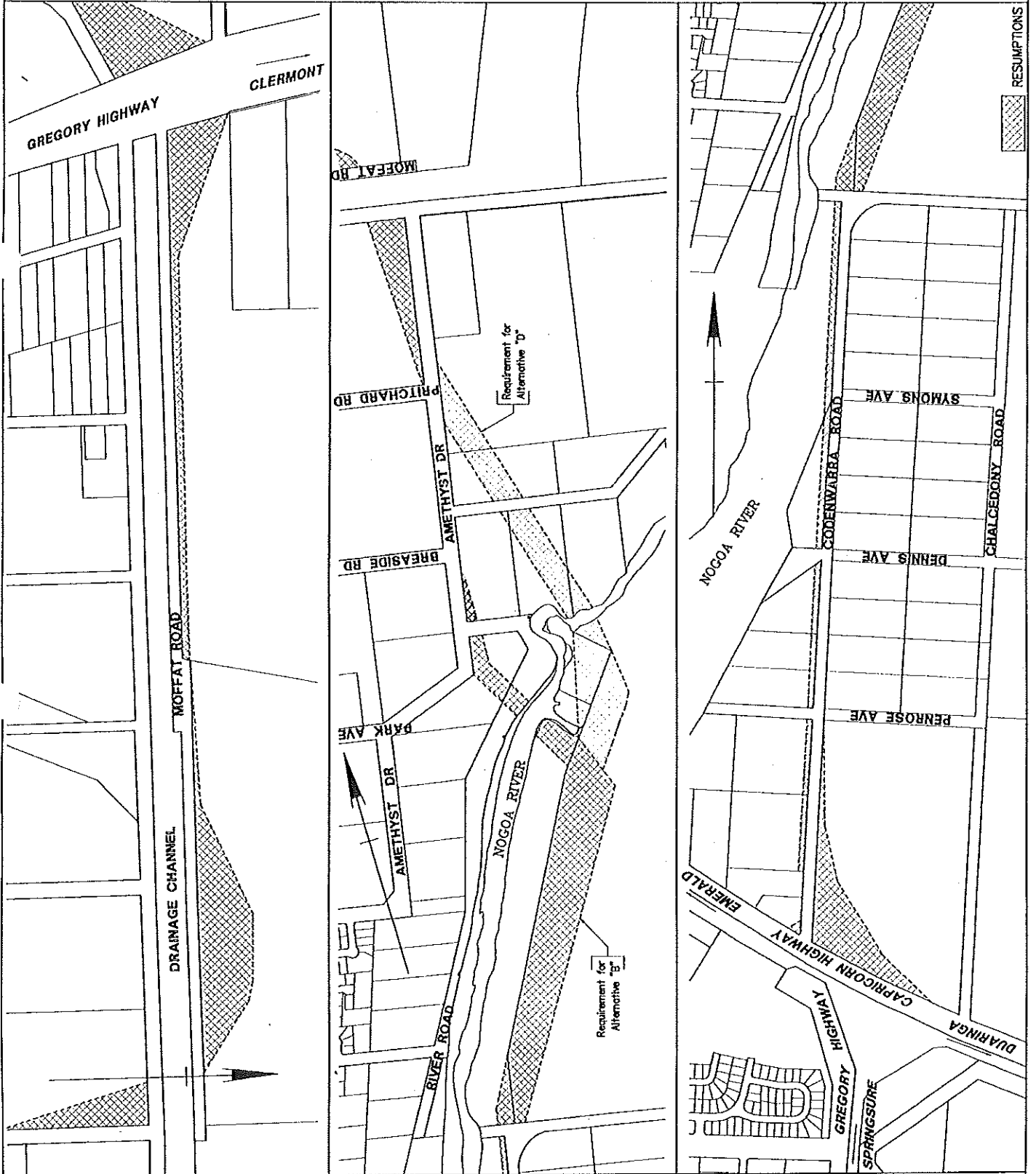
FIGURE No.: 17  
Sheet 1 of 3



EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS

# RESUMPTIONS

FIGURE No.: 18  
Sheet 2 of 3

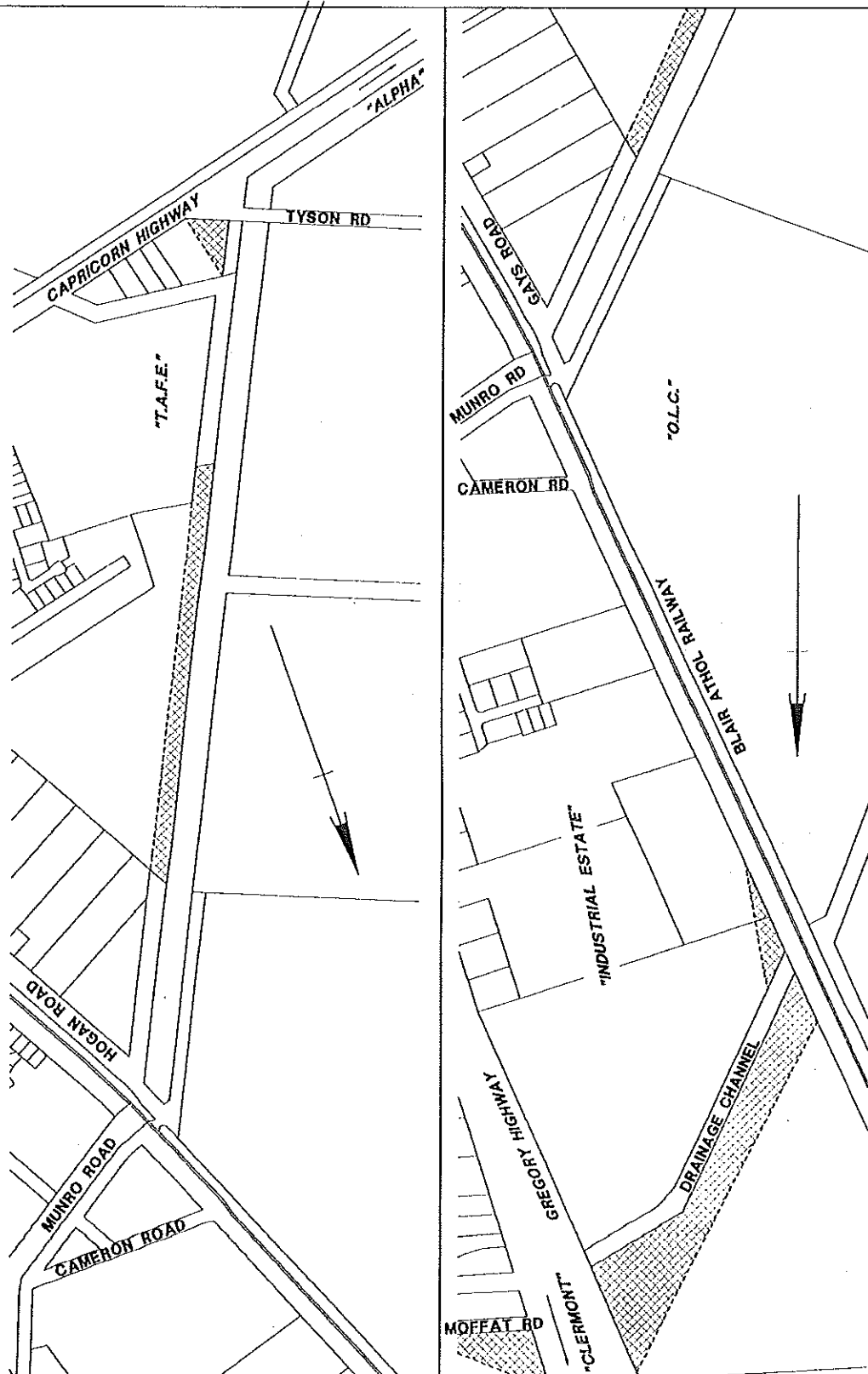


EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS

# RESUMPTIONS

FIGURE No.: 19  
Sheet 3 of 3

**MR** Main Roads

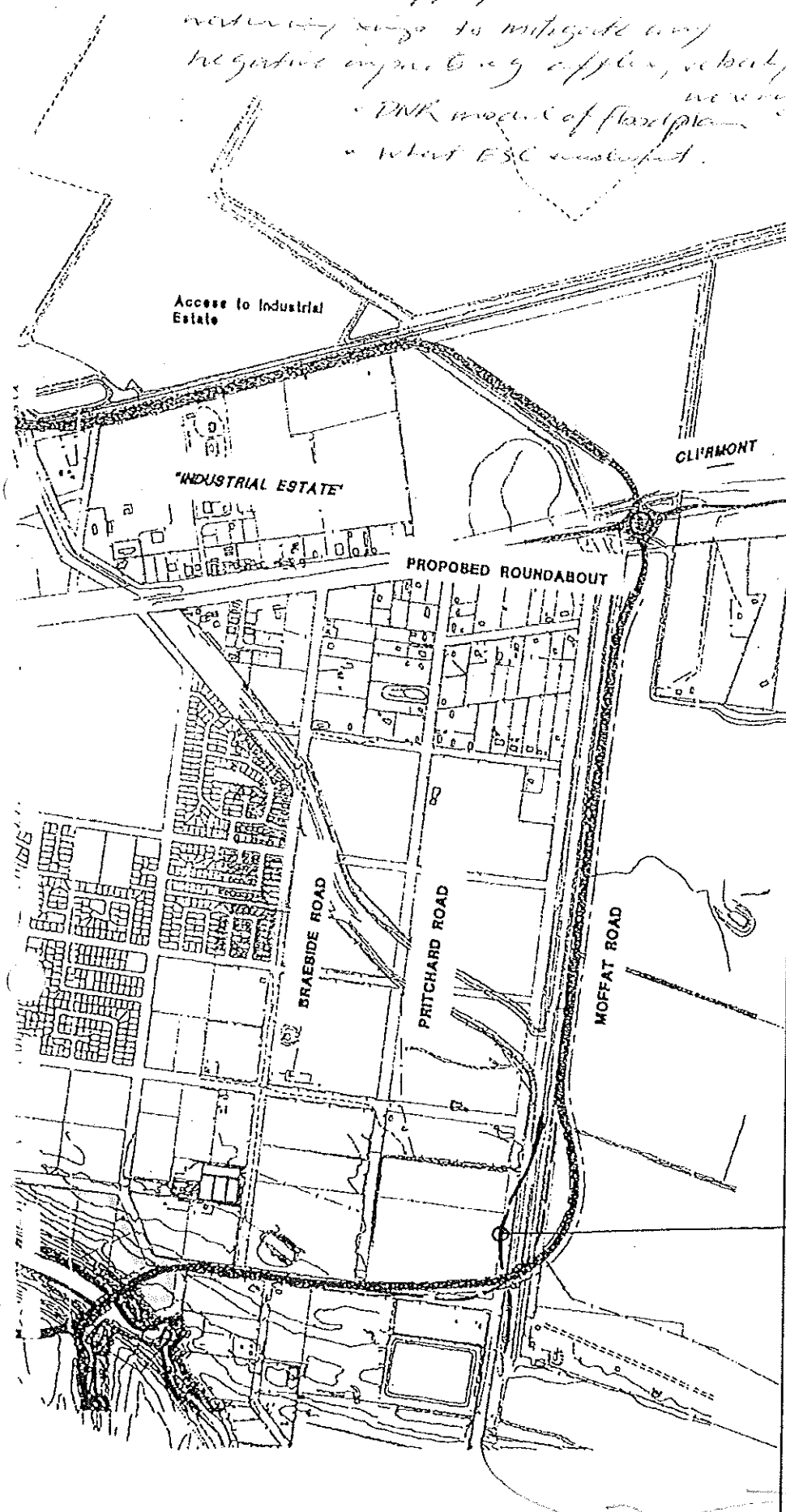


RESUMPTIONS

(1) Investigate the effect of the proposed bypass on the existing flooding levels in Emerald

(3) Review and approve structures at various points to mitigate any negative impacts of the bypass, such as:  
• DNK model of floodplain  
• What ESC involvement

**EMERALD SHIRE  
TOWN OF EMERALD  
HEAVY VEHICLE  
BYPASS**



**PREFERRED  
OPTION**

FIGURE No.: 4

*Divert channel*