# Technical Note

ARUP

Level 4, 108 Wickham Street
Fortitude Valley
QLD 4006
GPO Box 685 Brisbane QLD 4001
Australia
www.arup.com

**t** +61 7 3023 6000
**f** +61 7 3023 6023

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|---|---|---|---|
| Project title | GNH CN12 Bindoon | Job number | 256060-18 |
| cc | Cian O'Shaughnessy , Roy Everett | File reference | GNH-CN12-TN_01 |
| Prepared by | Adina Nimas | Date | 6 July 2018 |
| Subject | Lighting - concept design | | |

# 1 General

The concept lighting design serves as a basis for the light spill assessment needed for the Environmental Review Document (ERD) which is to be submitted to the EPA for approval of the Bindoon Bypass.

# 2 Basis of lighting design

The lighting design criteria is defined by the requirements listed in Technical Note GNH-CN00-RW01-TCN-0003 as well as by the environmental constraints in the area.

The intention of the proposed lighting is to provide safe conditions for the motorists and have minimal effects on the environment, especially the surrounding fauna and adjacent residences.

The lighting has been designed generally in accordance with AS/NZS 1158 and in compliance with the Main Roads Western Australia (Main Roads) standards, and is considered for the ultimate Great Northern Highway (GNH) alignment design, i.e. dual carriageway to Cha. 85,500 and grade-separation at Bindoon-Moora Rd.

The lighting design criteria is as follows:

- V3 lighting sub-category at the grade separated interchanges as follows:
    - Southern interchange – on grade-separated ramp, link road, intersections of the link road with proposed Bindoon Bypass and the grade-separated ramp, intersection of the grade-separated ramp with the existing GNH.
    - Mooliabeenee interchange – at the intersections of the eastern and western ramps with the proposed Bindoon Bypass.
    - Bindoon Moora interchange – at the intersections of the northern and southern ramps with the proposed Bindoon Bypass.

- Flag lighting for intersections of the highway with a significant side road accessing a developed area, with channelised right-turn/auxiliary left turn treatment and the Annual Average Daily Traffic (AADT) values for the intersections between 500 and 5000. For intersections meeting this criteria, two spans of light poles on the approach to the intersection are required – at Calingiri Road, at Gray Road East, at Teatree Road East and at the existing GNH connection.
- Flag lighting for the T intersections of the highway with the local gravel roads or minor sealed roads not accessing developed areas, with AADT values for the intersections of minimum 2000 – at Teatree Road West, at Gray Road West, at Barn Rd East, at Barn Rd West, at Cook Rd East, at Cook Rd West and at Hay Flat Rd.

The design luminaires are Thorn Alpha 2000 250W Flat Glass V6L7 for the V3 intersections and the southern interchange and Curved Glass V8L6 for flag lighting. The luminaires have a 13.7m mounting height, 0° tilt, on a 3.5m outreach, or 4.5m outreach for section of road with an unsealed shoulder.

The proposed lighting is to be connected to the mains, with the point of supply from the closest Western Power LV network reticulation.

Minimal lighting is proposed for the truck stopping areas i.e. one light pole per area, for low impact to the environment, but at the same time providing a degree of safety.

# 3 Environmental considerations

## 3.1 Light Spill Assessment – impact on residences and fauna

This lighting assessment considers the light spill that may affect the surrounding residences and fauna. The light spill is mitigated using various solutions without compromising the safety or the lighting's general compliance to standards. The measures taken in the current design are as follows:

a) The use of High Pressure Sodium (yellow light) – the white light emitted by the LED can have some detrimental effects on some types of fauna, particularly nocturnal animals and insects.

b) Luminaire photometry selection – a good side throw, as well as good back cut-off will direct the light to the intended area required to be lit, minimising the light spill to the surrounds.

c) 0° tilt for luminaires – this reduces glare and light spill.

d) Use of aeroscreen (flat glass) luminaires wherever possible for minimal glare and light spill. Please note that the exceptions to this are the luminaires used for flag lighting, as their purpose is to be seen from a distance flagging the upcoming intersection to the motorists, for enhanced safety.

e) New lighting is not provided on the highway mainline – generally there is no lighting on the Great Northern Highway nor on the adjacent roads. Additional lighting could have an adverse effect on adjacent residences and fauna.

f) AS/NZS 1158 requires the use of luminance calculations for a radius over 100m. However, this will result in extremely close spacing between light poles where the radii just exceed

100m. We therefore propose to use illuminance calculations where curved ramps just exceed the 100m. This will allow for a more realistic pole spacing. Main Roads to confirm if this is acceptable.

g) Considering the carriageway width as being only the width of trafficable lanes, excluding shoulders. Main Roads to confirm.

h) The trenches used to accommodate the conduits for the proposed lighting to follow as much as possible the existing and proposed roads, without impacting the areas where no road works are intended.

To further assess the light spill impact on the residences, calculations have been undertaken for the vertical illuminance levels emitted by the proposed lighting. AS 4282 Control of the Obtrusive Effects of Outdoor Lighting recommends that the illuminance on a vertical plane of the windows of habitable rooms of dwellings is maximum 1 lux during curfew hours when in dark surrounds. Please note that AS 4282 specifically excludes light spill for road lighting, however, it can be used as an indication.

Initial calculations indicate that all residences along the proposed alignment for the Bindoon Bypass will be located outside the 1 lux maximum vertical illuminance level.

## 3.2 Headlight Glare Assessment – impact on residences

The following steps were undertaken as part of the headlight glare assessment:

- Identify residences in proximity to the proposed highway alignment;
- Measure the distance between the residences and the position of the vehicle;
- Assign the residences an ID for classification;
- Identify the residence status, i.e. occupied, unoccupied or unverified;
- Classify the residences based on the following criteria:
    - Possible high impact - Residences located 200m from the vehicle in the direction of the highbeam emitted light;
    - Moderate impact - Residences located between 200m and 300m from the vehicle in the direction of the highbeam emitted light;
    - Low impact - Residences located between 300m and 400m from the vehicle in the direction of the highbeam emitted light;
    - Negligible impact - Residences located greater than 400m from the vehicle in the direction of the highbeam emitted light;
    - Analyse each residence against the above criteria.

One common method of minimising headlight glare on curves is to plant suitable vegetation around the outside of the curve.

The results of this assessment are outlined below. Refer to Appendix A1 for location of assessed residences.

| Residence ID | Distance and impact criteria | Residence Status | Analysis |
|---|---|---|---|
| 1 | 363m – Low impact | Unverified | The low impact on Residence 1 is further minimised, due to proposed V3 sub-category lighting on the ramp nearby, therefore less apparent glare. |
| 2 | 601m – Negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source. |
| 3 | 493m – Negligible impact | Unverified | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source. |
| 4 | 510m – Negligible impact | Unverified | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source. |
| 5 | 386m – Low impact | Occupied | The low impact will be further minimised as this residence is not in the direction of the headlight. Moreover, this residence is not adjacent to the highway, but to a side road with lower traffic volume. Hence, the impact on this residence can be considered negligible. |
| 6 | 662m – Negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light coming from a property access road with fairly low traffic volume. |
| 7 | 559m – Negligible impact | Unliveable | Based on the survey, this residence is uninhabitable. Should it be made habitable in the future, the residence 6 analysis will apply to it. |
| 8 | 350m – Low impact | Occupied | The low impact will be further minimised as this residence is not in the direction of the headlight. Moreover, this residence is not adjacent to the highway, but to a property access road with low traffic volume. |

| | | | |
|---|---|---|---|
| 9 | 402m – negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light not coming from the highway, but from a local road with lower traffic volume. |
| 10 | 538m – Negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light not coming from the highway, but from a local road with lower traffic volume. |
| 11 | 524m – Negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light not coming from the highway, but from a local road with lower traffic volume. |
| 12 | 790m – Negligible impact | Unverified | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light not coming from the highway, but from a property access road with low traffic volume. |
| 13 | 440m – Negligible impact | Occupied | It is not considered that headlight glare will have an impact on this residence, due to distance from the light source. |
| 14 | 529m – Negligible impact | Unverified | It not considered that headlight glare will have an impact on this residence, due to distance from the light source. |
| 15 | 682m – Negligible impact | Occupied | It not considered that headlight glare will have an impact on this residence, due to distance from the light source, as well as the source of light coming from the vehicles turning onto a side road with low traffic volume. |

## 4 Assumptions

The design assumptions are as follows:

- The GNH Lighting Guidance Technical note GNH-CN00-RW01-TCN-0003 Rev 1 is approved by Main Roads to be included in the design criteria.
- Any changes in the road alignment may result in additional light poles.
- There is spare capacity in the adjacent Western Power network to accommodate the new lighting.
- Main Roads accepts the proposed departure for the illuminance calculation used for curves with a radius greater than 100m.
- The light glare assessment explores the social surroundings, hence the studied impact is for adjacent residences only.
- No modelling of the light emitted by the headlights has been undertaken.
- No assessment has been undertaken for the headlight glare effects on fauna.
- The length of the highbeam headlight is considered to be 200m long. It is assumed that within this distance there is generally high potential for the headlights to cause glare.
- The AADT used in the calculations are based on projected values for 2051 as per the Traffic Check_Bindoon_DM_JSJ.xlsx spreadsheet.

## 5 Conclusion

Irrespective of the lighting assessment that has been carried out and the lighting precautions that have been undertaken to minimise impact on residences, there is still a possibility that any lighting change from the status quo may result in residents' complaints due to the introduction of a new visual entity in the landscape.

A Road Safety Audit may result in additional lighting requirements, other than the lighting provided as per the Technical Note GNH-CN00-RW01-TCN-0003.

**DOCUMENT CHECKING (not mandatory for File Note)**

| | Prepared by | Checked by | Approved by |
|---|---|---|---|
| Name | Adina Nimas | Roy Everett | Cian O'Shaughnessy |
| Signature | | | |

# A1 Location of assessed residences

Hart Dr
Egret Pl
Residence 2
Residence 3
Sandalford Dr
Great Northern Hwy
Residence 4
Maddern Rd
Residence 1

## Legend

- Occupied House
- Unverified House
- Unverified Structure
- Design - CN12
- Freeway / Highway
- Major Road
- Minor Road
- Cadastral Boundary


Joint Venture Partners:

Arup Pty Ltd
Level 14 Exchange Tower
2 The Esplanade
Perth WA 6000
Tel +61 8 9327 8300 Fax +61 8 9481 1334
www.arup.com

Jacobs Group (Australia) Pty Ltd
Durack Centre, 263 Adelaide Terrace,
Perth WA 6000
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0 150 300
Metres

Scale at A3 1:12,520

Coordinate System: GDA 1994 MGA Zone 50

Main Roads Western Australia
Client

Great Northern Highway
Bindoon Bypass
Project

**Bindoon Bypass**
**Buildings and Structures**

Figure: 1 of 15

| Drawing No | Issue |
|---|---|
| GNH-CN12-RW01-GIS-0039 | A |

| Task No | Drawing Status / Other |
|---|---|
| GNH-CN12 | Draft / Other Info |

| Date | By | Chkd | Appd |
|---|---|---|---|
| 2/07/2018 | BG | XX | XX |

MXD Location: \\Jacobs.com\PERProjects\PBIF\Projects\PB50732\Technical\GIS\ArcMap\RoadWorks\CN12\GNH-CN12-RW01-GIS-0039-A.mxd

Heritage Rd
Windemere Way
Teatree Rd
Residence 5
Cockatoo Dr

## Legend

- Occupied House
- Verified Shed - Workshop
- Unverified Structure
- Design - CN12
- Freeway / Highway
- Major Road
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- Cadastral Boundary


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Figure: 2 of 15

| Drawing No | Issue |
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| GNH-CN12 | Draft / Other Info |

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MXD Location: \\Jacobs.com\PERProjects\PBIF\Projects\PB50732\Technical\GIS\ArcMap\RoadWorks\CN12\GNH-CN12-RW01-GIS-0039-A.mxd

Gray Rd
Residence 7
Residence 6
Woodbridge St
Heritage Rd
Teatree Rd

## Legend

- Occupied House
- Unliveable House
- Unverified Structure
- Design - CN12
- Freeway / Highway
- Major Road
- Minor Road
- Cadastral Boundary

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Figure: 3 of 15

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## Legend

- Occupied House
- Unliveable House
- Unverified Structure
- Design - CN12
- Freeway / Highway
- Major Road
- Minor Road
- Cadastral Boundary

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**Bindoon Bypass**
**Buildings and Structures**

Figure: 4 of 15

| Drawing No | Issue |
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## Legend

- Occupied House
- Unverified House
- Design - CN12
- Freeway / Highway
- Major Road
- Minor Road
- Cadastral Boundary

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Scale at A3
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**Buildings and Structures**

Figure: 5 of 15

| Drawing No | Issue |
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Residence X
Cullalla Rd
Ashworth Rd
Mooliabeenee Rd
Residence 11
Residence 10
Resi

## Legend

- Occupied House
- Unverified House
- Design - CN12
- Freeway / Highway
- Major Road
- Minor Road
- Cadastral Boundary


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**Buildings and Structures**

Figure: 6 of 15

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