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BUILDING A BETTER WORLD

ENVIRONMENTAL ASSESSMENT REPORT FOR

Lincoln Road Corridor Improvements Project Proposed Lighting Upgrade

Prepared for Auckland Transport

AUGUST 2015

QUALITY STATEMENT

PROJECT MANAGER		PROJECT TECHNICAL LEAD

PREPARED BY		
Ian Campbell	.....	17 / 08 / 2015
CHECKED BY		
Chris Baddock	.....	18 / 08 / 2015
REVIEWED BY		
Graeme Stanton	.....	21 / 08 / 2015
APPROVED FOR ISSUE BY		
Graeme Stanton	.....	21 / 08 / 2015

DUNEDIN
Level 3, John Wickliffe House, 265 Princes Street, Dunedin 9016
PO Box 4, Dunedin 9054
TEL +64 3 477 0885, FAX +64 3 477 0616

REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file).			
			Prepared by	Checked by	Reviewed by	Approved by
A	17/08/15	Preliminary	IC	CB	GS	GS
B	05/11/15	Client Requested Changes	IC	IC	GS	GS
C	15/12/15	Minor wording clarifications	GS	GS	GS	GS
D	16/02/16	Minor wording clarifications	GS	GS	GS	GS
E	31/05/16	Amended project description	GS	GS	GS	GS

AUCKLAND TRANSPORT

Lincoln Road Corridor Improvements Project
Proposed Lighting Upgrade
Environmental Assessment Report

CONTENTS

1 Scope

This report forms part of Auckland Transport's (AT) Notice of Requirement for the Lincoln Road Corridor Improvements (LCRI) project. The LRCI project aims to improve the efficiency of Lincoln Road, Henderson, improve public transport reliability in this area, and improve safety for all road users.

This report has been produced following an assessment of the existing and the proposed indicative road lighting associated with the LRCI project.

The LRCI Project applies to a 1.3 kilometre length of Lincoln Road, between its intersection with Te Pai Place / Pomaria Road to the south and State Highway 16 on-ramp to the north. The Project will upgrade Lincoln Road through the provision of additional transit lanes, dedicated cycle lanes and footpaths in each direction whilst maintaining two lanes for general traffic in each direction. Additional or longer turning lanes will be constructed at controlled intersections to improve capacity and a raised median will be installed along the centre of the road, with right turning and U-turns provided for at controlled intersections. The improvements will be integrated with the New Zealand Transport Agency's upgrades at SH16 at the Lincoln Road Interchange.

The LRCI Project also involves the collection and treatment of stormwater generated from the road at 312 Lincoln Road and discharge to a new coastal outfall at Daytona Strand (the resource consents necessary to undertake this part of the project will be applied for at a later date). There will be a new public road formed to the rear of 300-312 Lincoln Road, which will provide access to Daytona Reserve and existing properties that will be unable to access directly from Lincoln Road.

Upgraded lighting will be required along the straight and curved sections of roadway, and at other specified locations including channelized intersections, splitter islands, diverging/converging lanes, signalised crossings and pedestrian (zebra) crossings. Sections of the side roads at the main intersections with Lincoln Road within the project area will also be provided with transitional lighting to/from Lincoln Road. These side roads include Triangle Road (140m), Central Park Drive (100m), Universal Drive (120m), Universal Drive Extension (90m), Pomaria Road (60m) and Te Pai Place (70m). A new service lane will also be provided with lighting.

A fuller description of the project is provided in the Assessment of Environmental Effects which supports the Notice of Requirement.

2 Existing Lighting

2.1 Luminaires and Mounting Parameters

The existing lighting along Lincoln Road, the side roads and intersections are made up of a mixture of Sylvania Roadster, Sylvania B2222, Sylvania B3000, Sylvania Urban, Betacom GL600 and GEC Optispan High Pressure Sodium (HPS) luminaires. Most of the luminaires are mounted on stand-alone road lighting columns and joint use signal poles. However there are some that are mounted on Vector power poles along Triangle Road and Pomaria Road. Nearly all of the stand-alone road lighting poles are octagonal steel columns, although there are a small number of concrete lighting poles at the North Western Motorway Interchange and along Poinsettia Place.

The following views have been extracted from Google Images street view with image capture dates of April and June 2014, and they show the types of existing lighting within the project area:

Image 2.1.1: Looking south along Lincoln Road towards Triangle Road

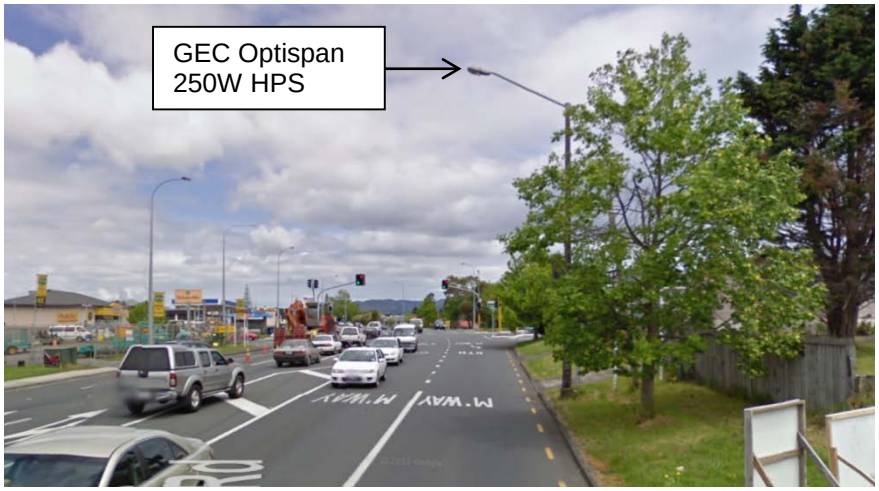


Image 2.1.2: Looking east along Triangle Road towards Lincoln Road

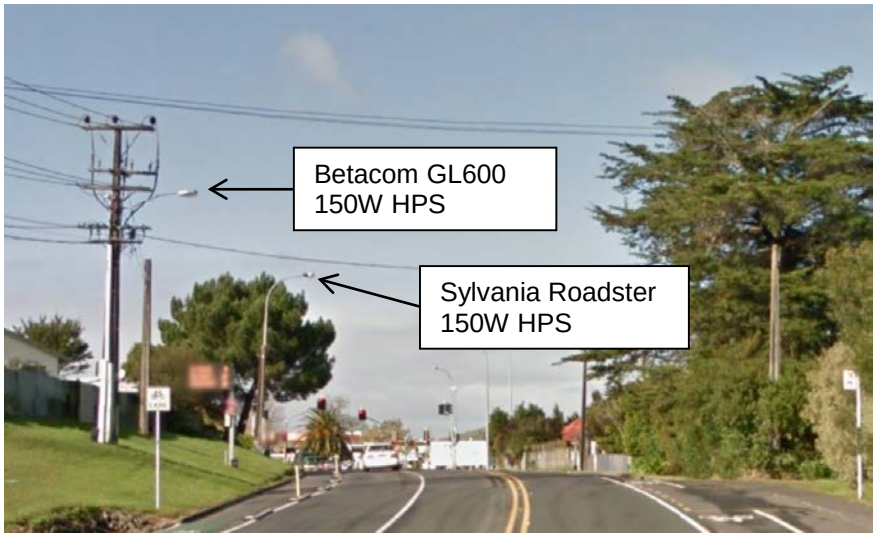
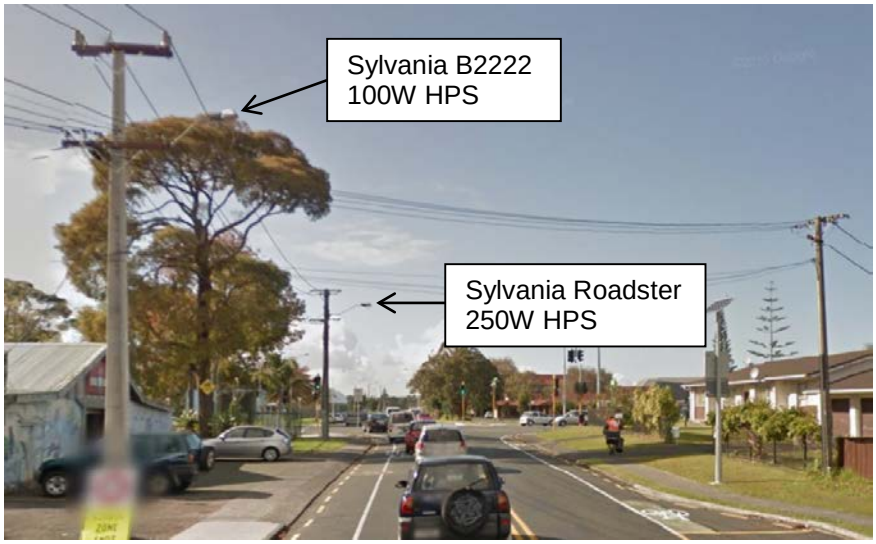


Image 2.1.3: Looking east along Daytona Road towards Lincoln Road

Image 2.1.4: Looking south along Lincoln Road from Paramount Drive

Image 2.1.5: Looking east along Poinsettia Place towards Lincoln Road

Image 2.1.6: Looking east along Pomaria Road towards Lincoln Road



2.2 Luminaire and Lamp Types and Sizes

The existing lamp types and sizes have been extracted from the Auckland Transport RAMM database and are presented in the following table:

Location	Luminaire Types	Lamp Sizes & Types	No. Off
Lincoln Road	Betacom GL600	250W HPS	20
	GEC Optispan	250W HPS	6
	Sylvania Roadster	250W HPS	30
	Sylvania B3000	250W HPS	2
	Sylvania B3000	150W HPS	2
Triangle Road	Betacom GL600	150W HPS	1
	Betacom GL600	250W HPS	1
	Sylvania Roadster	150W HPS	2
Central Park Drive	Betacom GL600	150W HPS	3
	Sylvania Roadster	250W HPS	1
Daytona Road	Sylvania B3000	150W HPS	1
Paramount Drive	Sylvania Roadster	150W HPS	1
Universal Drive	Betacom GL600	250W HPS	2
	Sylvania Roadster	250W HPS	2
	Sylvania B3000	150W HPS	1
Universal Drive Extension	Sylvania Roadster	250W HPS	3
Poinsettia Place	Sylvania Urban	100W HPS	1
Pomaria Road	Sylvania Roadster	250W HPS	1
	Sylvania B2222	100W HPS	1
Te Pai Place	Sylvania Roadster	150W HPS	1

2.3 Existing Levels of Spill Light

The existing HPS lighting will be generating significant levels of spill light, especially to the rear of each luminaire, and this is an unfortunate characteristic of traditional HPS lighting schemes.

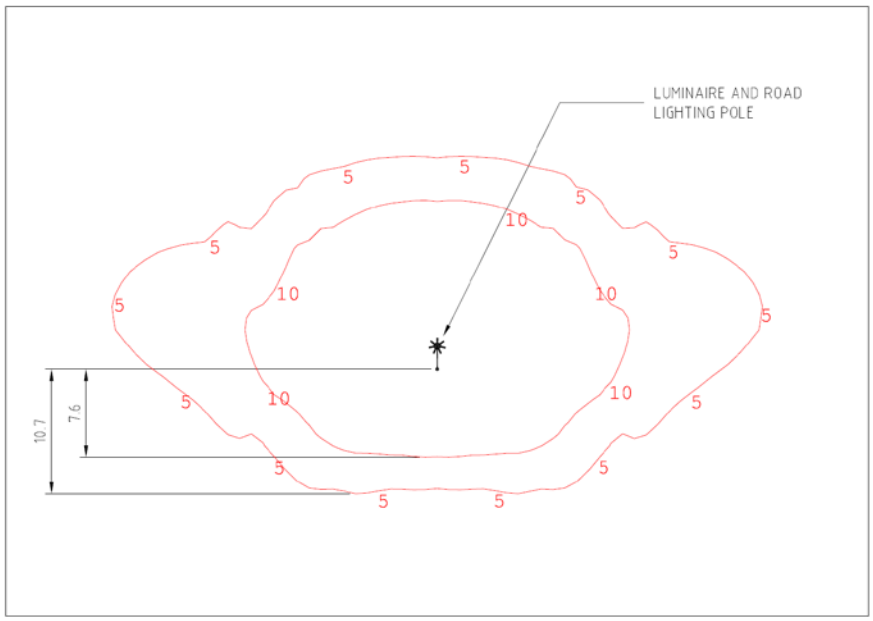
Although a detailed study of the amount of spill light being produced by the existing lighting installation has not been carried out an analysis of the calculated spill light from each of the main types of existing HPS luminaires along the main route (Lincoln Road) has been completed to illustrate the amount of spill light being produced by each individual type of luminaire. Performing computer based calculations are an acceptable method of designing and verifying road lighting installations.

The main 250W HPS luminaire types (currently installed along Lincoln Road) have been modelled, based on the existing mounting parameters (11m mounting heights and 2m outreach arms with a luminaire tilt of 5°), and the 5 Lux and 10 Lux isolux contour lines have been plotted to provide a graphical display of the amount of horizontal light reaching the ground.

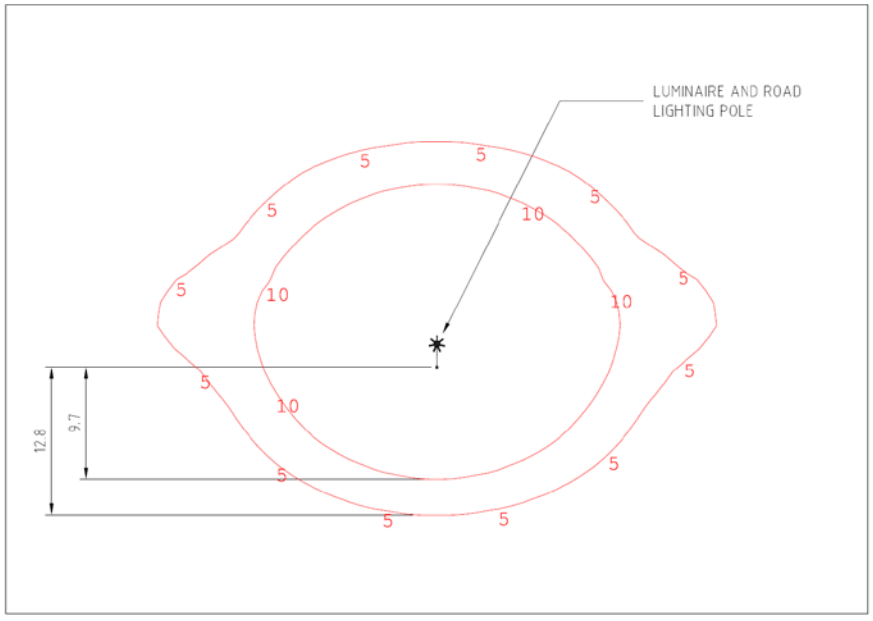
Each plot contains horizontal dimensions from the centre line of the lighting pole to the 10 Lux and 5 Lux isolux lines behind each luminaire. A maintenance factor (MF) of 1.0 was used in these calculations to represent the maximum amount of spill light expected from a new or maintained luminaire. A MF is used in lighting calculations to account for the combined light losses resulting from depreciation in the luminaire's output and accumulation of dirt on the luminaire. Applying a MF ensures that the lighting installation is initially over-lit to ensure that the appropriate lighting levels are maintained over the life of the installation.

Sections 3.1 and 3.2 set out the lighting requirements contained in the Auckland Council District Plan (Waitakere Section) and the Proposed Auckland Unitary Plan. In summary, these plans require any light that spills across a residential property boundary does not exceed 10 Lux.

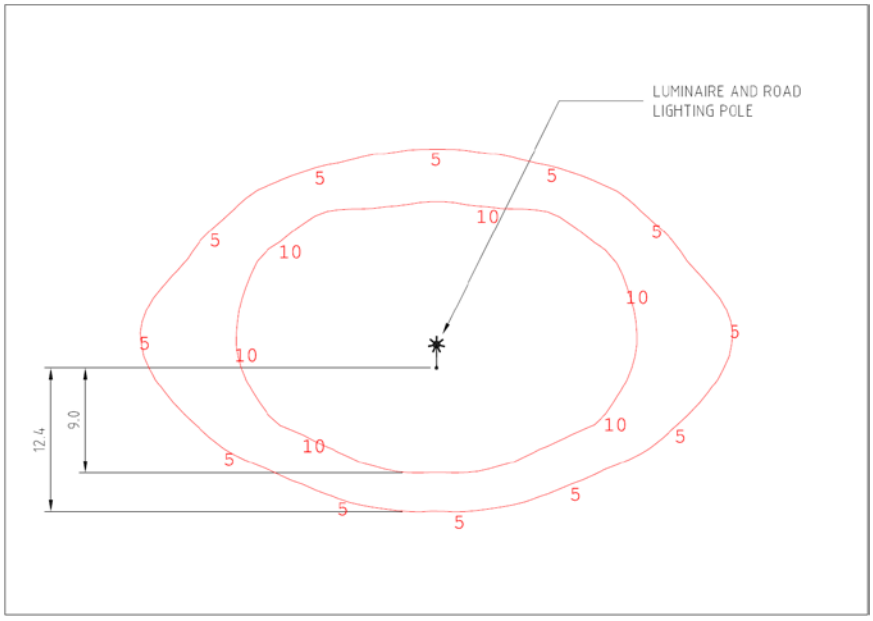
2.3.1 Betacom GL600 250W HPS Isolux Plot



2.3.2 GEC Optispan 250W HPS Isolux Plot



2.3.3 Sylvania Roadster 250W HPS Isolux Plot



2.3.4 Existing Spill Light Summary

The above isolux plots, of the main 250W HPS luminaires (along Lincoln Road), indicate that the distance between each lighting pole and the 10 Lux isolux line (behind each pole) varies from 7.6m (best case) to 9.7m (worst case) depending on each particular luminaire. Although not definitive (without taking site measurements) the isolux plots indicate that if the property boundaries are within those limits (7.6m to 9.7m) then there will be some degree of spill light (within the properties) exceeding 10 Lux.

Although the use of HPS luminaires on new installations has largely been replaced with equivalent lumen output LEDs the use of 250W luminaires on category V main arterial routes (such as Lincoln Road) was common practice. Historically luminaire sizes (400W, 250W or 150W) were selected for main (Category V) arterial roads based on achieving compliant lighting over the carriageway. It is normally the category selection (V1 to V4) that takes into account the environment conditions such as traffic composition, location (urban/rural), and particular activities (residential/industrial/commercial).

3 Proposed Lighting

The new lighting installation (luminaires and street lighting poles), within the project area, will be designed in accordance with Auckland Transport's requirements and technical standards, and will consist of energy efficient LED luminaires and octagonal steel street lighting poles approved for use on the Auckland Transport network. At detailed design stage a full set of layout drawings will be produced showing locations of all new lighting equipment.

3.1 Applicable Road Lighting Category

Current vehicle movements are 40,000 vehicles per day (VPD), along this section of Lincoln Road, and according to Table 70 of ATCoP (Chapter 19) traffic counts of over 20,000 VPD indicates a road lighting classification of Category V1 may be required (refer to the table in the following section). This table is an informative guide only and the actual Category of lighting (for all roads with the project area) will be determined by Auckland Transport prior to detailed design.

3.1.1 ATCoP (Chapter 19) Road Lighting Category Classification Table

Road/Area Type	Traffic counts VPD	Category
Major/Minor Roads	>20,000	V1
	15,000 to 20,000	V2
	5,000 to 15,000	V3
	3,500 to 5,000	V4
	750 to 3,500	P3
	<750	P4
Cycleway	N/A	P3

3.1.2 Typical Luminaire/Pole Spacings

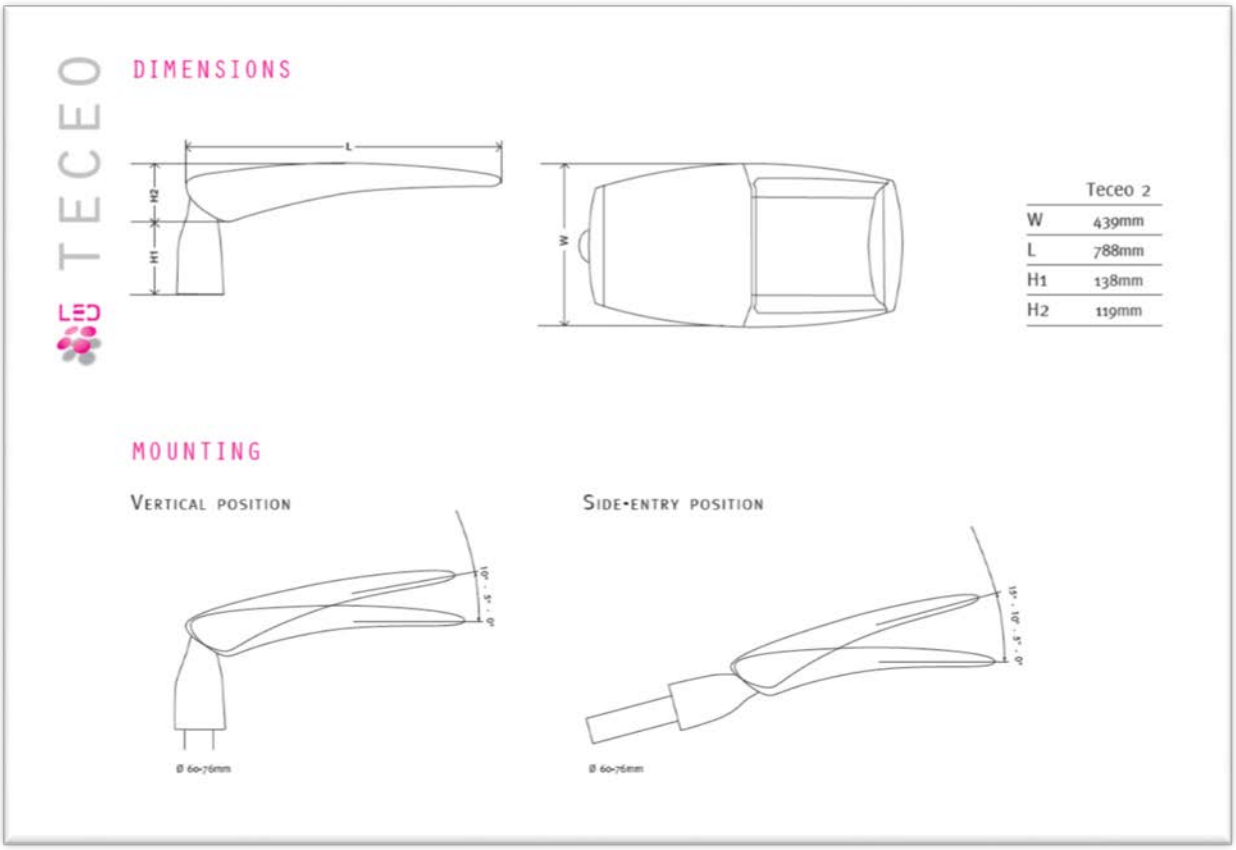
For the purposes of this assessment report luminance modelling was carried out for a six lane divided carriageway (3 x 3.2m lanes on either side of a 4.2m wide median), being a representative section of the proposed Lincoln Road carriageway. A Schreder Teceo 2 (5118) 128LED 500mA 198W LED luminaire (supplied by Betacom) was used based on a 12m mounting height, 3m outreach and 5° luminaire tilt. Two different layout arrangements (opposite and staggered) were modelled for both Category V1 and V2 lighting schemes and the results are presented in the following table.

Teceo 2 (5118) 128LED 500mA 198W LED		
Category	**Arrangement**	**Maximum Spacing (m)**
V1	Opposite	58
	Staggered	29
V2	Opposite	73
	Staggered	37

The V1 spacings are significantly shorter as the minimum required luminance level (1.5 cd/m^2) in each lane is 1.5 times higher than the V2 minimum luminance level (1.0 cd/m^2). V2 lighting can be achieved using the same type of LED spaced further apart.

During detailed design a fully optimised design will be completed following confirmation of the actual Category of lighting required (V1 or V2) and also based on the actual lane configurations and final geometric layouts of all features such as intersections, splitter islands, lane merges/diverges, etc.

3.2 Schreder Teceo 2 LED Luminaire



3.3 Road Lighting Poles

The proposed new road lighting poles shall be octagonal steel ground planted frangible columns complete with curved outreach arms complying with ATCoP (Chapter 19).

3.4 Applicable Lighting Standards

Because this application involves as designation, the limits in the relevant District Plans are not directly applicable. However, they provide a useful guide as to the appropriate lighting levels within the Project area. The applicable lighting standards are:

Auckland Council District Plan (Waitakere Section): Transport Environment Rule 6 and Living Environment 14.1 (c)

In the Transport Environment (i.e. road), lighting complying with AS/NZS 1158 is a permitted activity. The position of the lighting poles will be on land that is currently privately owned (not within the Transport Environment), but the additional land for the widened road will become road (and part of the Transport Environment) once the project is complete.

In addition, when implementing street lighting Auckland Transport ensures that compliance is achieved with the **Auckland Transport Code of Practice (ATCoP - Chapter 19 Street Lighting)** and **AS/NZS 1158 (Lighting for Roads and Public Spaces)**. These documents contain the following requirements:

- Approved equipment including lighting poles and luminaires
- Environmental and performance requirements of all lighting equipment
- Particular design rules and minimum lighting levels required for each type of road or application area e.g. signalised crossings and pedestrian (zebra) crossings

3.5 Spill Light Control

During detailed design the LED luminaires will be selected to comply with the **Auckland Transport Code of Practice (ATCoP - Chapter 19 Street Lighting)** and **AS/NZS 1158 (Lighting for Roads and Public Spaces)** especially around the mitigation of spill light into properties adjacent to the road corridor.

In addition, wherever possible the amount of spill light will be controlled to not more than 10 Lux at each residential property boundary. This is the standard adopted by the Operative District Plan in relation to sites within the Living Environment and although this standard does not apply to street lighting, it does provide some guidance as to the appropriate light environment within the Living Environment. During detailed design spill light calculations will be carried out to demonstrate compliance.

With careful selection of the LEDs, spill light will will be less than 10 Lux at the nearest residential boundary except in two areas:

- **Signalised Crossings:** ATCoP requires a minimum illuminance of 20 Lux over all signalised crossings on Category V1 or V2 roads, and a minimum illuminance of 10 Lux over all signalised crossings on Category V3 or V4 roads. The 10 Lux minimum illuminance requirement for a signalised crossing on a V3/V4 road is unlikely to result in light spill exceeding 10 lux at the nearest residential boundaries. The 20 Lux minimum requirement for a V1/V2 road may do as higher output luminaires are required to achieve 20 Lux over all of the marked crossing that runs across the carriageway. Sometimes the spill light can exceed 10 Lux at the property boundary depending on how wide the road reserve is.

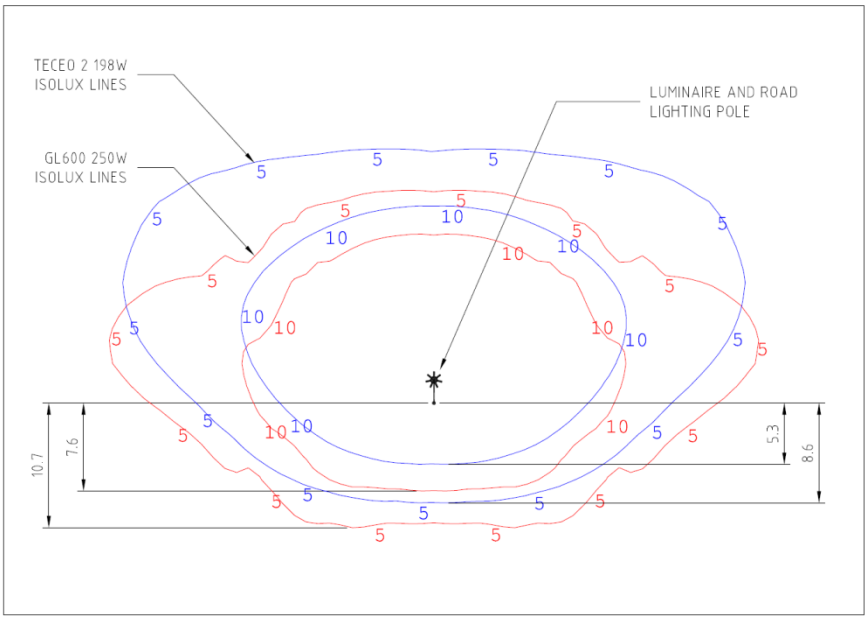
- **Pedestrian (Zebra) Crossings:** For a pedestrian (Zebra) crossing on a Category V road AS/NZS 1158.4 requires 30 Lux over the marked crossing, 10 Lux over a 3m wide surround (beyond the extents of the marked crossing over the footpath), and 20 Lux point vertical (corresponding to 5 vertical points located along the centre line of the crossing at 1m above the carriageway). To achieve all of the minimum illuminance requirements specially designed high output luminaires are required which can result in the spill light exceeding 10 Lux at the property boundary.

Even if there are some selected locations (to be confirmed during detailed design) where the spill light may not be able to be kept below 10 Lux, the use of new technology LED luminaires will result in an overall improvement compared to the existing HPS lighting provided similar distances between the property boundaries and new LEDs can be achieved. There are also LED suppliers that can provide specific backlight control. Refer to section 3.6 for spill light comparisons between the existing 250W HPS luminaires and an equivalent LED luminaire.

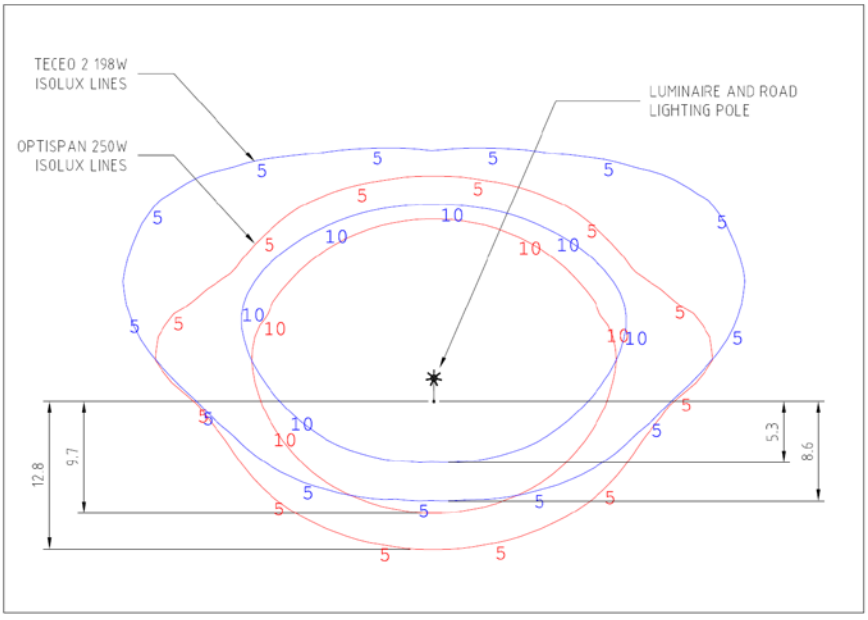
3.6 Spill Light Comparison

Spill light comparisons have been done by plotting the 5 Lux and 10 Lux isolux contour lines of the proposed Teceo 2 LED against those of the three main HPS luminaires currently in service along Lincoln Road. The isolux plots of the proposed LEDs were done based on a 12m luminaire mounting height, 3m outreach and 5° luminaire tilt. Although the existing lighting poles consist of 11m mounting heights (according to RAMM data) ATCoP only allows standard mounting heights of 6m, 8m, 10m, 12m and 14m therefore a 12m lighting pole was selected based on its suitability for V1/V2 applications. Refer to the following sections. Each plot contains horizontal dimensions from the centre line of the lighting pole to the 10 Lux and 5 Lux isolux lines behind each luminaire. A maintenance factor (MF) of 1.0 was used in these calculations to represent the maximum amount of spill light expected from a new or maintained luminaire.

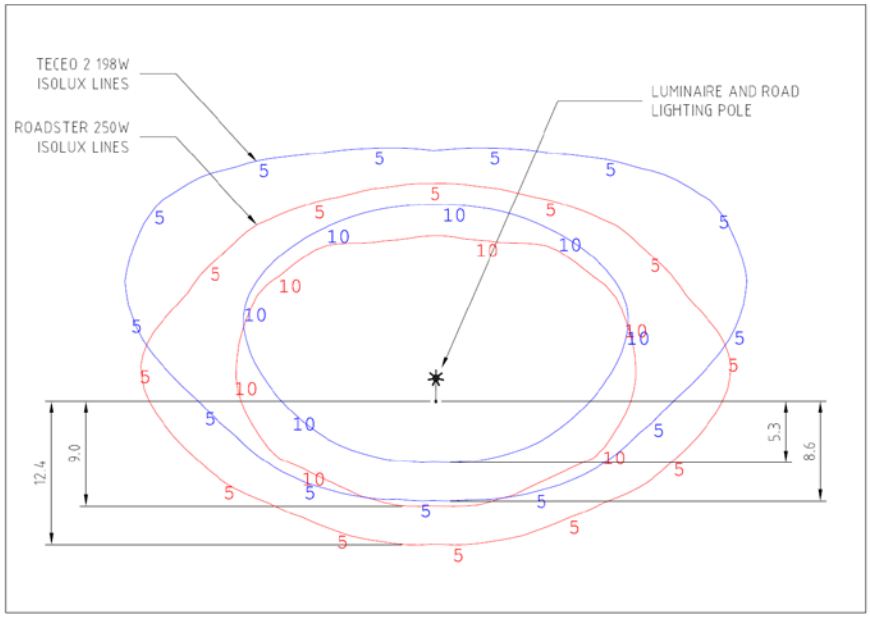
3.6.1 Teceo 2 198W LED and Betacom GL600 250W HPS Isolux Plots



3.6.2 Teceo 2 198W LED and GEC Optispan 250W HPS Isolux Plots



3.6.3 Teceo 2 198W LED and Sylvania Roadster 250W HPS Isolux Plots



3.6.4 Spill Light Comparison Summary

The above isolux plots, comparing the existing 250W HPS luminaires (along Lincoln Road) with the proposed 198W LEDs, indicate that the distance between each lighting pole and the 10 Lux isolux line (behind the pole) has reduced to 5.3m (from 7.6m, 9.7m and 9.0m). This reduced distance translates to a reduction in rear spill light and is an improvement over the amount of spill light currently being produced by the existing 250W HPS luminaires.

Depending on where the property lines are with regard to the proposed new road lighting poles there may still be some degree of spill light above 10 Lux associated with the proposed Teceo 2 LEDs. During detailed design any problem areas will be identified and measures shall be taken to mitigate any non-complying spill light.

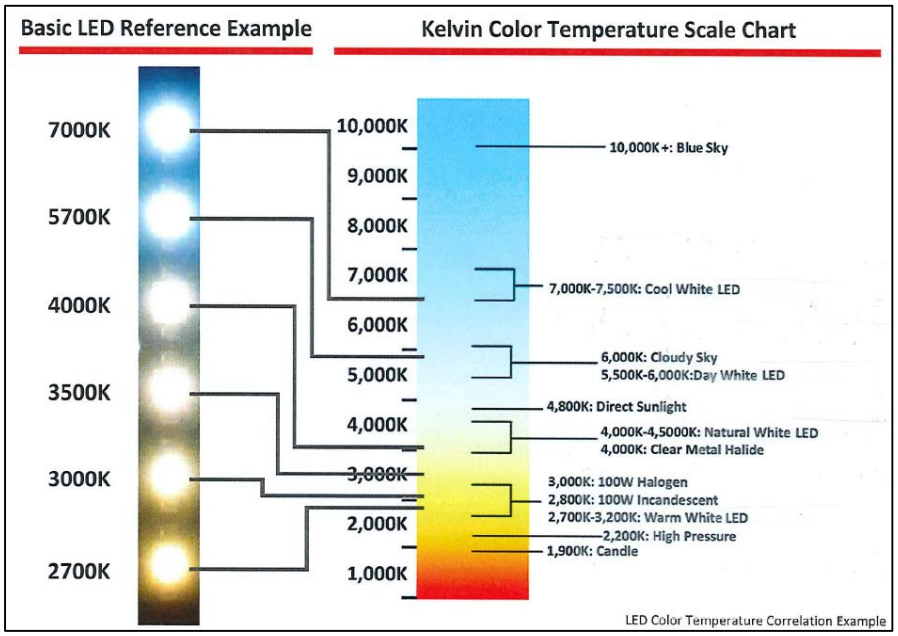
3.7 Whole of Life Savings

The use of LED technology will generate whole of life savings for the LRCI project as LEDs consume less power than HPS equivalents (198W for the LED and 278W for the HPS luminaire) and LEDs have longer lifecycles and require less maintenance over the lifetime of the installation.

3.8 Quality of Light

LED lighting is of a higher quality than traditional HPS lighting as LEDs produce “white light” which has better colour rendering properties and generates a feeling of security and wellbeing.

“White Light” is commonly described by its correlated colour temperature (CCT) which relates to the colour of the light produced by a light source and uses the Kelvin (K) temperature measurement scale (SI unit of absolute temperature). The CCT describes the relative colour appearance of a light source, indicating whether it appears more yellow/gold (“warm”) or more blue (“cool”), in terms of the range of available shades of white. See the following chart for a range of CCT temperatures and associated colour appearance.



Auckland Transport requires the CCT of all LED road lighting luminaires to be 4000K ± 300K which represents a “natural white” appearance and will provide very good colour rendering.

HPS luminaires (as per the existing Lincoln Road lighting installation) are typically 2000K and produce a warm yellow/gold appearance which has poor colour rendering properties.

The “white light” that LEDs produce also makes city centres and places of interest appear more natural and attractive, and research indicates that “white light” reduces an observer’s reaction time and increases safety.

4 Conclusions

The road lighting upgrade utilising new technology energy efficient LEDs mounted on octagonal steel lighting columns will have a positive impact on the surrounding amenity within the vicinity of the LRCI project.

In comparison to old technology HPS technology LED lighting is attractive, of good quality, easy to maintain and cost effective.

The new road lighting will comply with ATCoP and AS/NZS 1158.

LED lighting has numerous advantages over traditional HPS lighting including:

- Reduced spill light
- Reduced energy costs
- Reduced maintenance costs
- Improved quality of light (better colour rendering properties)
- Improved safety and security
- Improved control options (dimming and remote monitoring/controlling)

Where required the levels of spill light will be mitigated to 10 Lux at property boundaries unless these mitigation measures compromise the required carriageway lighting levels, in which case road user safety will take precedence.

In terms of the proposed new lighting poles the existing lighting poles (along Lincoln Road) are predominantly octagonal steel columns complete with curved outreach arms, which are the same as the proposed new lighting poles. The only difference is that the existing steel octagonal poles are 11m and the new ones will be 12m.

It is considered appropriate for conditions to be applied to the designation that:

- require all street lighting to be designed to comply with AS/NZS 1158.1.1:2005, and any subsequent versions, and ATCoP
- require the Outline Plan to include finalised proposed lighting specifications, locations, illumination levels, shielding and any relevant industry standards, and demonstrate that lighting minimises light spill and glare for neighbouring residences.