APPENDIX 24

LIGHTING EFFECTS

pedersen read
consulting electrical engineers

LYTTELTON PORT OF CHRISTCHURCH

RECOVERY PLAN

ASSESSMENT OF ENVIRONMENTAL EFFECTS:

LIGHTING

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14A Leslie Hills Drive
Riccarton
Christchurch | 8011
PO Box 8864 | 8440
New Zealand

t +64 3 343 4916
f +64 3 343 4908
choffice@pedersenread.co.nz

www.pedersenread.co.nz

QUALITY ASSURANCE STATEMENT

Prepared by:	John Forrester, Electrical Engineer, Pedersen Read Limited
Internal review by:	Andrew Read, Principal, Pedersen Read Limited

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1. Introduction

This report has been prepared by Pedersen Read Limited in response to the Canterbury Earthquake Recovery Act 2011 New Zealand Gazette, No. 65 "Direction to Develop a Lyttelton Port Recovery Plan" for the assessment of the environmental effects associated with the lighting required to facilitate the long term vision of the Port of Lyttelton as set out in the Port Lyttelton Plan.

The Port Lyttelton Plan shows the long term vision of the Lyttelton Port of Christchurch for the rebuilding and enhancement of the Port. This is to allow the Port to cater for the region's present and future freight demand.

This report considers the environmental effects on the existing environment, consequences of the proposed installation, and related mitigation.

Lyttelton Port of Christchurch endeavours to adopt best-practice techniques to reduce environmental impacts.

By minimising the impacts of artificial light on the night environment it is possible to minimise energy use and minimise the impacts on human health, cultural and natural systems.

2. Description

The purpose of the Lyttelton Port Recovery Plan is to address the recovery of the port. This includes the repair, rebuild and reconfiguration needs of the port, and its restoration and enhancement, to ensure the safe, efficient and effective operation of Lyttelton Port and supporting transport networks

By nature the recovery will be highly complex, involving a multitude of individual yet interrelated projects many of which will need to be carefully coordinated with each other as well as the operational activities at the Port. The ultimate outcome of this repair, rebuilding and reconfiguration work is the moving east of port operations in a timely manner, which results in:

- The container terminal being established up to 37ha of reclaimed land in Te Awaparahi Bay;
- The shifting of some types of general cargo from the Inner Harbour to Cashin Quay; and
- The development of public access to the Inner Harbour in two stages (Dampier Bay and potentially the Dampier Bay Extension) to provide a commercial marina and associated activities, with public access and connectivity between Lyttelton and other parts of Naval Point.

At this stage it is assumed that the direct repairs or rebuild of existing wharf structures, seawalls and hard-standing areas and the construction of the reclamation would take in the order of fifteen years, being completed in about 2028. However, the complete migration of the Port's operation to the east could well take up to 30 years.

Some of the repaired or rebuilt berths at Cashin Quay, Naval Point and the new berths at Te Awaparahi Bay will be designed to handle larger vessels with a deeper draft. The deepening and widening of the current navigation channel to enable access of these larger vessels is therefore inextricably linked to and forms an important part of the Port's Recovery.

The Figures contained in Chapter 2 of the Lyttelton Port Recovery Plan provide an outline of proposed Recovery. The Recovery description below is discussed under four headings:

- Reclamation, Container Terminal and Quarry;
- Cashin Quay;
- Inner Harbour;
- Cruise Berth Options.

It must be emphasised that the descriptions below are based on our current understanding of the economic and commercial drivers which shape the Ports infrastructure needs. It is possible that the infrastructure needs of the Port and the freight mix could change over the next 15 years, in response to worldwide economic factors and industry changes. More detailed descriptions, including the project codes, of each individual project are included in Chapter 2 of the main report.

Areas where development of the Port is likely to result in significant changes to the lighting include:

- Dampier Bay and Inner harbour

The development of Dampier Bay and Inner harbour will include a ferry terminal and encourage public access to the area for recreation activities and sympathetic commercial use.

- Te Awaparahi Bay

The reclamation of Te Awaparahi Bay is to enable the Port to move inner harbour general cargo onto Cashin Quay and the container terminal to relocate onto this reclaimed land.

The Port Lyttelton Plan sets out LPC's 30 year vision for the repair, rebuild, enhancement and reconfiguration of the port. A large number of construction projects are required as part of the vision, and these are expected to occur over a period of approximately 12-15 years. These construction projects will enable the port to continue to reconfigure to meet the growing freight demands for the next 30 years as well as providing community access to the waterfront.

It is not anticipated that changes of use in other areas will necessitate fundamental changes to the present lighting solutions.

This does not preclude changes and improvements that may be made to the existing lighting in these areas by installation of new light fittings (luminaires) using new technology lamps; for example LED (light emitting diodes).

3. Current Lighting Installations

The current lighting methods and lighting arrangements at the port generally have;

- been developed with incremental changes as the Port's operations have evolved and expanded over time.
- conventional luminaires that have provided reliable performance and adequate service life.
- high pressure sodium (HPS) discharge lamps giving a distinctive orange illumination.
- been limited to a maximum 30 metre pole height.
- relatively high illumination levels required to suit the Port's operational needs and health and safety requirements.
- high luminaire aiming angles (above the horizontal) as necessitated by:
  - The required illumination levels and uniformity
  - The 30 metre maximum pole height
  - The optical control limitations of the available luminaires
  - Difficulties and restrictions on poles locations to suit Port operations.

4. District Plan Lighting Requirements

The Banks Peninsular District Plan (included in the Christchurch City Plan) Rule 2.3 specifies the performance standard for the Lyttelton Port Zone as follows:

> *2.3 Light*
>
> *Activities conducted within the Lyttelton Port Zone shall comply with the following glare conditions:*
>
> *No operation or activity shall be conducted so that direct illumination exceeds 10 Lux (Lumens per square meter) within the boundary of any site within the Residential Zone, Residential Conservation Zone, or Town Centre Zone. Light shall be measured on an instrument meeting the requirements of the New Zealand Standard C.P.22 (1962) and amendments.*

Note: Rule 2.3 "Light" makes reference to "glare" which in terms of the Rule's condition should more correctly refer to "light spill".

To provide some context to an illumination level of 10 lux, the following are some typical illumination levels.

• Under a clear sky on a sunny day	100,000 lux
• In the shade of a tree	10,000 lux
• Inside, adjacent to a north facing window	2000 – 3000 lux
• In a typical office	300 – 750 lux
• Inside a domestic house at night	50 - 100 lux
• Under a suburban streetlight	<5 – 30 lux
• Moonlight	0.5 – 1 lux

The direct illumination level of 10 lux within the existing Plan's Rule 2.3 can be seen to be in the realm of that found in a typical suburban street lighting environment.

The light spill illumination level of 10 lux is seen as an appropriate balance between the operational requirements of the Port and the amenity needs of the residents (including sleeping amenity).

The existing Rule does not address either "glare" or "sky glow" which are both important in the context of Lyttelton harbour.

5. Illumination Requirements in the Port Areas

International guidelines and recommendations indicate that appropriate illumination conditions are as follows:

- Waterfront areas - 30 lux average horizontal illuminance at ground level
- Container handlings areas - 50 lux average horizontal illuminance at ground level

Other important features include:

- Lighting from more than two directions to mitigate the effect of obstructions and to provide "depth of field" to assist with visual assessment of distance to objects.
- Appropriate levels of vertical illuminance.
- Freedom of stronger shadows
- Minimising disability glare to vehicle drivers
- Avoiding navigation hazard to shipping.

The Australian / New Zealand Standard AS/NZS 1680.5:2012 "*Interior and workplace lighting Part 5: Outdoor workplace lighting"* provides recommended lighting technical parameters in Table 3.1. Recommendations for situations relevant to the Port are shown below in Table 1.

Table 1 - Recommended Light Technical Parameters for General Outdoor Areas

Description	Basic operating characteristics	Average illuminance (lux)	Minimum illuminance (lux)	Uniformity of illuminance	CIE glare rating (maximum)
Loading and unloading – manual	Loading and unloading of trucks by manual labour including manually moving objects between truck and another form of transport.	40 lux	5 lux	5	45
Loading and unloading – fork lift	Loading and unloading of trucks by forklift, the area surrounding the truck and the route of the forklift.	40 lux	5 lux	5	45

Uniformity is given in AS/NZS 1680.5 as the ratio of maximum illuminance to the average illuminance.

The illuminance requirements of the container terminal areas are considered more demanding than that required for "loading and unloading – forklift" given in Table 1 above. This is due to the operation of the straddle carriers, where the drivers are situated well above the ground and have a restricted view from the straddle cabin.

Lighting level and good uniformity are necessary for creating a safe working environment with high-speed movement of large machinery and heavy containers in confined areas.

6. Lighting Effects

6.1 Environmental Effects

The impact of artificial lighting on the night environment can be characterised by the following effects:

VISUAL AMENITY

The aesthetic influence of artificial lighting on the night time landscape.

GLARE

Visual impairment or discomfort resulting from the intensity of a light source and the brightness contrast with the associated surroundings. It is affected by the light source size and intensity, background brightness, and the location relative to the viewing position.

LIGHT SPILL

Illumination which trespasses beyond the related application area, typically a property boundary.

SKY GLOW

The combined luminous effect of direct and indirect lighting on the appearance of the night sky.

It should also be noted that these effects are subject to the variable influence of weather conditions. In particular, atmospheric water vapour content (i.e. mist and cloud) accentuates sky glow appearance and has a diffusing effect on glare.

6.2 Cultural Effects

The Cultural Impact Assessment identifies potential effects of the Port Lyttelton Plan and Lyttelton Port Recovery Plan on Ngāi Tahu values and interests.

One of the areas of concern is the proposed reclamation in Te Awaparahi Bay and the "visual impact on the harbour landscape through loss of coastal space and the further industrialisation of this area of the harbour".

The requirement to provide lighting throughout this area for operational and safety reasons will reinforce the perception at night of the "*industrialisation of this area of the harbour".*

7. Existing Night Environment

7.1 General Night Sky

The night sky environment in Lyttelton harbour is significantly modified by the flood lit Port areas, particularly in the vicinity of the township and the port. The harbour basin is isolated from Christchurch city by the Port Hills, which at their lowest point (to Christchurch) are approximately 330 metres at the Sign of the Kiwi above Governors Bay.

Lyttelton, Governors Bay and Diamond Harbour are the main residential centres. Land areas between these centres are rural and sparsely populated and with minimal artificial lighting.

The township of Lyttelton and Lyttelton Port of Christchurch provide the only significant artificial light sources at night. The lighting from the Port areas is the dominant source.

The Port areas are clearly visible from Diamond Harbour, Governors Bay and many other points around the harbour basin.

The appearance of the night sky is subject to the variable influence of weather conditions. In particular, atmospheric water vapour content (i.e. mist and cloud) accentuates sky glow appearance and has a diffusing effect on glare.

The background night sky luminance above Cashin Quay and the reclaimed land in Te Awaparahi Bay viewed from within the harbour or from the opposite side, is elevated by the existing artificial lighting. The effect is augmented by the contribution from the eastern extremity of Christchurch City on the other side of the Port Hills, and is most noticeable in conditions of extensive low cloud.

7.2 Cashin Quay Waterfront

Cashin Quay, from the hillside to the waterfront, is illuminated by groups of high pressure sodium vapour floodlights which have an orange coloured output. The floodlights are pole-top mounted in a radial arrangement, at a typical height of 30m. They are of a fully enclosed reflector type with a design downward tilt orientation varying from 20° to 50^0 below the horizontal.

Floodlighting is also provided by the container terminal cranes when in operation at night.

There is also a relatively small amount of low power local lighting (i.e. typically bulkhead type) associated with buildings and major plant items, and vehicle lighting.

The Cashin Quay wharf area is mainly concealed from Lyttelton township, and the prevalent view to the area is from within the harbour, or from the opposite side at a distance in excess of 2km. The inner harbour and Cashin Quay wharf area can be clearly seen from Governors Bay at approximately 6km distance.

From these perspectives the present visual effects of lighting can be summarised as follows:

- Points of brightness / glare associated with the direct output from some floodlights (i.e. those where the tilt angle and southern or eastern aspect result in direct line of sight. The intensity of the brightness is increased on calm clear nights when reflection of the light sources on the water adds to the lighting effect. Contribution from secondary light sources (i.e. vehicles, plant, etc) is insignificant in this context.

- Glow beneath the floodlights with an orange colour appearance. The density varies according to atmospheric particle content, although conditions such as fog also reduce observation visibility.
- Low intensity indirect illumination of the hillside immediately behind Cashin Quay, and a reduction in the darkness of the hillside above, particularly in the presence of low cloud.
- Visibility of the illuminated plant, buildings and shipping containers.
- Illumination of cloud within the harbour basin.

The lighting from the Port can also be observed as an orange glow in the sky above the Port Hills from areas in Christchurch. This includes Sumner, Mt Pleasant, Heathcote and areas further to the north and west.

The environmental effects of the existing Cashin Quay lighting are typical of an expansive industrial site. With the contrast to mostly dark surroundings the lighting is a prominent visual feature at night.

The following photographs were taken between 20.00 and 21.30 pm on the 9th and 24th September 2014 to identify the relative intensity of the Port lighting compared to the surrounding night-time harbour environment. The weather conditions on both occasions were partially over-cast skies and with light easterly breeze. Refer to Appendix B for locations where the photographs were taken.

Image 1 – Cashin Quay Container Terminal with Lyttelton Town Behind
Taken from Spur above Ferry Jetty in Diamond Harbour
Distance approximately 1.4 km to the ship at berth
Focal Length (35mm film equivalent): 99mm

Image 2 – Cashin Quay Container Yard (left) and Coal Facility (right)
Taken from Spur above Ferry Jetty in Diamond Harbour
Distance approximately 1.3 km to the containers and 1.6km to the coal facility
Focal Length (35mm film equivalent): 75mm

Image 3 – Lyttelton Port and Township
Taken from Koromiko Crescent, Diamond Harbour
Distance approximately 1.4 km to the ship at berth
Focal Length (35mm film equivalent): 78mm

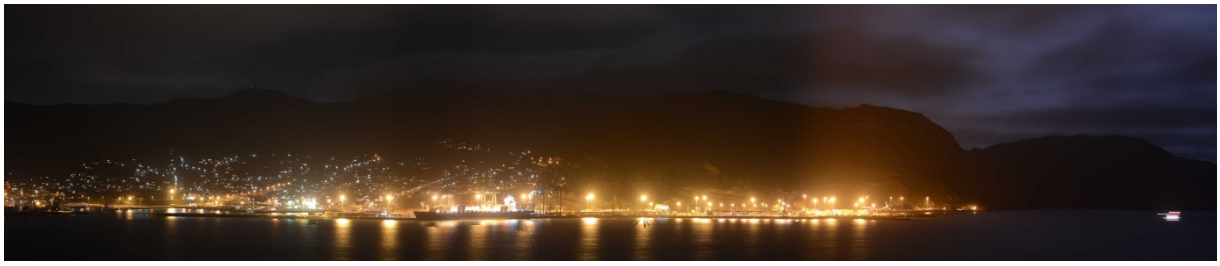


Image 4 – Lyttelton Port and Township
Taken from intersection of Main Road and Merlincote Crescent, Governors Bay
Distance approximately 5km to oil tanks and 6 km to container terminal
Focal Length (35mm film equivalent): 127mm

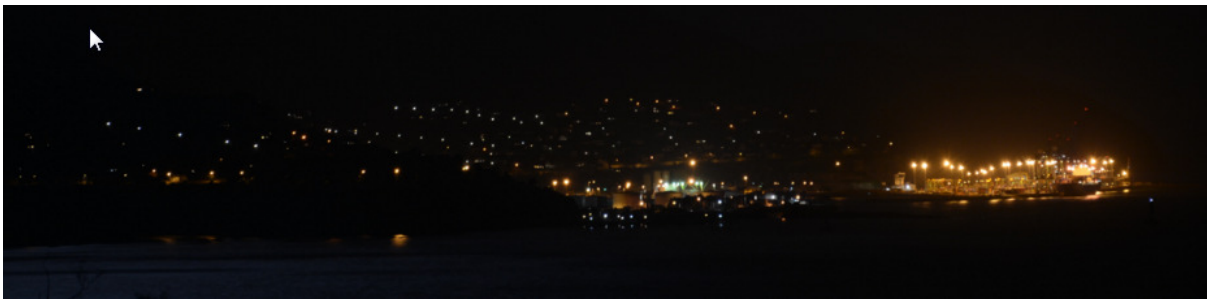


Image 5 – Lyttelton Inner Harbour
Taken from intersection of Jacksons Road and Keebles Lane, Lyttelton
Focal Length (35mm film equivalent): 37mm

Image 6 – Lyttelton Dampier Bay

Taken from Simeon Quay, Lyttelton

Focal Length (35mm film equivalent): 27mm

Image 7 – Lyttelton Inner Harbour with Diamond Harbour in distance top right

Taken from intersection of above Walkers Road, Lyttelton

Focal Length (35mm film equivalent): 48mm

Image 8 – Lyttelton Inner Harbour

Taken from Brittan Terrace above oil tanks, Lyttelton

Focal Length (35mm film equivalent): 45mm

7.3 Dampier Bay and Inner Harbour

The lighting in these areas is generally provided by groups of high pressure sodium vapour floodlights. The illumination levels are lower than the Cashin Quay waterfront.

These areas can be observed from both Diamond Harbour and Governors Bay, however the intensity from these areas is significantly less compared to Cashin Quay waterfront.

7.4 Ship, Crane, Mobile Plant and Vehicle Lighting

Throughout the port, various items of mobile plant are equipped with lighting to assist with night-time operations. The extent and nature of such lighting is determined by the specific tasks being performed and the associated safety considerations.

Much of the plant and equipment is common to general industrial and commercial facilities, i.e. forklifts, cars, trucks, mobile cranes, etc. The lighting from such vehicles and equipment is normally task specific and of duration limited to the activity at hand. Any effects are not normally addressed as a part of Plan Rules.

The following light carrying sources are unique to a port environment.

Ships:

The type, location, and intensity of lighting provided on each ship varies with the type of ship but is driven primarily by task and safety requirements. Whilst the port has little or no control over such lighting (and hence any consequential effects) the duration of the lighting is limited to the time that the ship is berthed and in the main the backdrop for such lighting is the illuminated port environment. See image 1 above showing a ship berthed at the container terminal.

Container Cranes:

Lighting is provided on the access platforms to the cranes to enable safe access to the crane operator cabins. Task lighting is also provided to illuminate the containers. The light sources vary in colour and intensity and, whilst visible from a distance, are small sources in the context of the overall port lighting.

Container Straddle Carriers:

Containers are transported around the port using “straddle carriers”. These are provided with task lighting to assist them in locating and transporting containers. The lighting is task specific, predominantly low intensity and of minimal effect in the context of the overall port lighting.

8. Lighting Changes for the Long Term Vision of the Port

The nature and extent of the lighting associated with the proposed changes are described as follows:

8.1 Proposed Lamp Types for New Lighting Arrangements

The recommended methodology to light developments in Dampier Bay and the expanded container terminal will be to utilise new technology LED luminaires where practicable.

The goal for the general pole mounted lighting installation would be to have “flat glass” luminaires that will provide:

- Uniform illumination levels
- Minimal direct glare
- Compliant over boundary spill light

Present lighting technology enables these objectives to be achieved in areas for general circulation and light vehicle movements with pole heights up to 25 metres. In areas such as the container terminal with high vehicle movements, a more hazardous environment and where greater pole heights are required, it is not currently technically practical to achieve the required illumination levels without raising the aiming angles of the luminaires. This results in an increase in spill light and glare.

LED technology is continually improving such that it is reasonable to expect that high output luminaires with good optical control and suitable for mounting at heights greater than 30 metres will become available in the not too distant future (5 to 10 years).

Until this technology is available, lighting solutions for the container terminal areas may require the use of high pressure sodium (HPS), metal halide (MH), and fluorescent technology lamps and luminaires (generally as used at present) to achieve safe and effective lighting installations. These may require raised luminaire aiming angles resulting in increased glare and light spill within the harbour environment. Note that these effects are likely to occur irrespective of the mounting heights of the luminaires (i.e. 30 or 40 metres).

An additional benefit of LED luminaires is the energy saving that can be achieved. These savings result from:

- Greater luminous efficacy (greater lumens per watt output) compared to HPS lamps).
- Less wastage of light (light spill) due to more precise and efficient optical control.
- Greater ability to control the LED compared to HPS lamps. LED lamps start instantly and thus can be turned ‘on’ only when needed (without a start-up delay) and ‘off’ when not needed. The output of LED lamps can also be easily reduced (dimmed down). Examples of energy control schemes are turning lights ‘off’ when an area is not in use or dimming to low levels with time schedules or occupancy detectors switching the lights to full output only when needed.

LED lamps provide a number of other advantages compare to HPS lamps:

- The white light from LED lamps and the higher colour rendering index makes colours viewed under light from LED lamps appear closer to the true colour (as viewed in day-light).
- LED lamps provide longer lamps life and reduced maintenance costs.

8.2 Dampier Bay

Low height poles shall be utilised in the Dampier Bay redevelopment. Typically pole heights will be in the 6 to 10 metre range. In addition, low level and building mounted amenity/feature/architectural lighting may be utilised where appropriate.

8.3 Container Terminal at Te Awaparahi Bay

The ideal methodology to light the expansion of the Port onto the reclamation area will be to utilise “flat glass” type LED luminaires mounted on lighting poles up to 40 metres high. This option will significantly reduce the visible glare and upward light spill in the harbour environment.

It is envisaged that with the current rapid rate of development of LED technology, suitable luminaires will be available with the 5 to 10 year period anticipated for the operations in the expanded reclamation area.

Any lighting required in the interim will be of a similar form to the existing lighting; i.e. high pressure sodium lamps with flood luminaires.

LED luminaires are currently available that are suitable for mounting at 30 metres height for less demanding situations. When assessed for the recent expansion of the container storage area on Cashin Quay, LED luminaires were not yet available with sufficiently high output to meet the illumination levels necessary for the area.

8.4 Other Areas

Changes of use in other areas may necessitate changes to the present lighting solutions. This may be applicable to roadways, parking areas, pedestrian crossings, building changes, etc.

Changes and improvements may be made to the existing lighting in these areas by installation of new light fittings (luminaires) using new technology lamps; for example LED (light emitting diodes).

9. Assessment of Environmental Effects

The effect of the proposed exterior lighting on the surrounding environment is assessed as follows:

9.1 Dampier Bay and Inner Harbour

VISUAL AMENITY

The lighting shall be provided to enhance the night time environment and encourage the public to move freely and safely in accessible areas. The lighting shall facilitate the public access to the new ferry terminal and provide a connection to the main commercial area of Lyttelton. The effect of the proposed lighting will be a reduction over the glare and sky glow affects of the existing lighting.

GLARE

The form and orientation of the future lighting shall utilize 'flat glass' luminaires with LED luminaires and precise lighting control optics, is such that no significant increase in glare effect is anticipated.

LIGHT SPILL

The proposed lighting installation will be designed so that that light spill will be insignificant and comply with the current District Plan lighting Rule for the Lyttelton Port Zone (Rule 2.3).

SKY GLOW

The use of 'flat glass' luminaires with LED lamp technology and with constrained directional light output will eliminate any significant direct emission to the night sky in the inner harbour environment. Any indirect effect from illuminated areas will also be negligible because of the relatively small area and low illumination level involved.

9.2 Container Terminal at Te Awaparahi Bay

VISUAL AMENITY

The proposed expansion of the container terminal on reclaimed land in Te Awaparahi Bay will significantly increase the width and viewing angle of the flood lit area to an observer in Diamond Harbour. The proposed expansion will also have increased depth (distance from the sea wall to the existing coal terminal) and therefore the lighting poles will appear more dense in comparison to the existing terminal areas.

The new areas will be closer to some observers in Diamond Harbour and this will increase the intensity of the lighting effects.

At present only the coal terminal areas, with relatively low level lighting and a small number of lighting poles (as indicated on the right side of Image 2), are visible from Purau.

The expansion of the container terminal to the east will become visible to observers in Purau. At a distance of approximately 3 kilometres, the lighting effects will be noticeable but minimal. Refer to the satellite image in Appendix B showing the viewing angle from Purau. There may be a perception by an observer that the remoteness and tranquillity of Purau are compromised by these lighting effects.

The proposed expansion of the container terminal on reclaimed land in Te Awaparahi Bay will almost double the width and viewing angle of the flood lit area to an observer in Governors Bay. The distance of the proposed reclamation is over 6 kilometres away from Governors Bay and therefore will have minimal adverse effects to an observer.

The use of “flat glass” luminaires, when available, will significantly reduce / minimise the direct glare from the light source and will reduce most of the negative visual aspects of the lighting (direct glare and sky glow).

Visiting ships berthed at the terminal may not have lighting sources that meet the above criteria.

GLARE

The form and orientation of the proposed new lighting will be to reduce the intensity of the direct glare from the luminaires in comparison to those in the existing container terminal areas.

The proposed 40 metre pole height will have only a minor effect in increasing the viewing angle to the light source from across the harbour when viewed from sea level.

The majority of the residential areas in Diamond Harbour are elevated and 20 metres or more above sea level. This effectively reduces the viewing angle to the “flat glass” luminaires and minimise the effects of glare.

LIGHT SPILL

The proposed design of additional lighting, in combination with the remote location with respect to the residential boundaries, is such that light spill will be insignificant, and comply with the current District Plan lighting Rule for the Lyttelton Port Zone (Rule 2.3).

There may be a small increase in illumination of the hill side behind and above the coal terminal as a result of reflected light. With the separation distance provided by the coal terminal and “flat glass” luminaires, this lighting effect will be minimal.

SKY GLOW

The output of the proposed “flat glass” floodlights is constrained to downward directional beams. These will have minimal contribution to sky glow compared to the existing luminaires in the container terminal. This contribution will predominantly be from reflective surfaces.

In conjunction with the steep hillside backdrop, this will eliminate any significant direct emission to the night sky above the hill tops.

Any lighting required in the interim (prior to availability of suitable LED luminaires) will be of a similar form to the existing lighting; i.e. high pressure sodium lamps with flood luminaires.

Furthermore the background night sky to the north is influenced by light emission from Christchurch city which reduces the contrast potential.

10. Conclusion

Lyttelton Port of Christchurch endeavours to adopt best practice techniques to reduce environmental impacts.

The Port Lyttelton Plan shows the long term vision of the Lyttelton Port of Christchurch for the rebuilding and enhancement of the Port.

This plan shows changes to Dampier Bay, the inner harbour and expansion on reclaimed land in Te Awaparahi Bay to the east of the port.

Current lighting in the port generally uses conventional high pressure sodium lamps and conventional luminaires mounted on poles up to 30 metres in height.

While the existing lighting installation complies with the District Plan for lighting performance for spill light on site boundaries, the visual effects of sky glow and glare are not well controlled.

The recommended methodology to light developments in Dampier Bay will be to utilise pole mounted new technology LED luminaires supplemented with low level and building mounted amenity/feature/architectural luminaires. The main pole mounted luminaires will provided significant benefits compared to conventional luminaires including: improved visual amenity, reduced glare, compliant light spill, and minimal sky glow effects.

The expanded container terminal may require the use, in the first instance, of similar lighting solutions to those presently employed with similar effects to existing. In the longer term (5 to 10 years) it is expected that developments in LED technology will enable “flat glass” luminaires to be used resulting in reductions to visible glare and upward light spill.

Pole heights up to 40 metres are proposed for the expansion on the reclaimed land in Te Awaparahi Bay.

11. Appendix A – Glossary of Lighting Terms

The following simple definitions apply to terms used in this report:

- Illuminance

  The measure of illumination level, which is the amount of light or luminous flux (i.e. Lumens) incident on a surface, per unit area, measured in Lux (1 Lux = 1 Lumen /m²).

- Luminance

  The measure of brightness, which is a function of concentration or density of luminous intensity (i.e. Candelas) in a given direction per unit area, measured in Candela/m² (Cd/m²).

- Luminaire

  The international term for a lighting fitting, which is the assembly that contains a light source and distributes the light output.

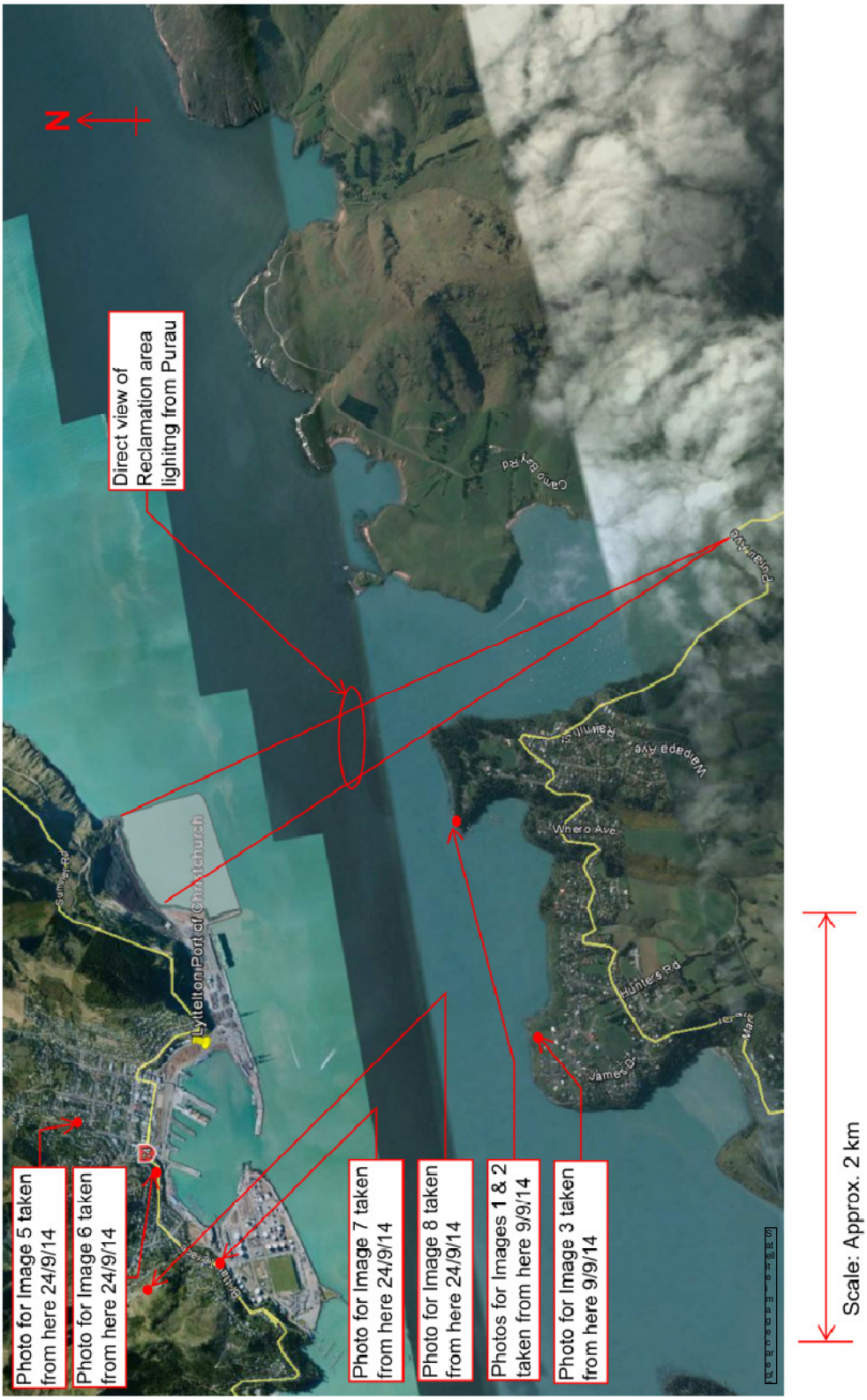
- Uniformity of illuminance – outdoor lighting

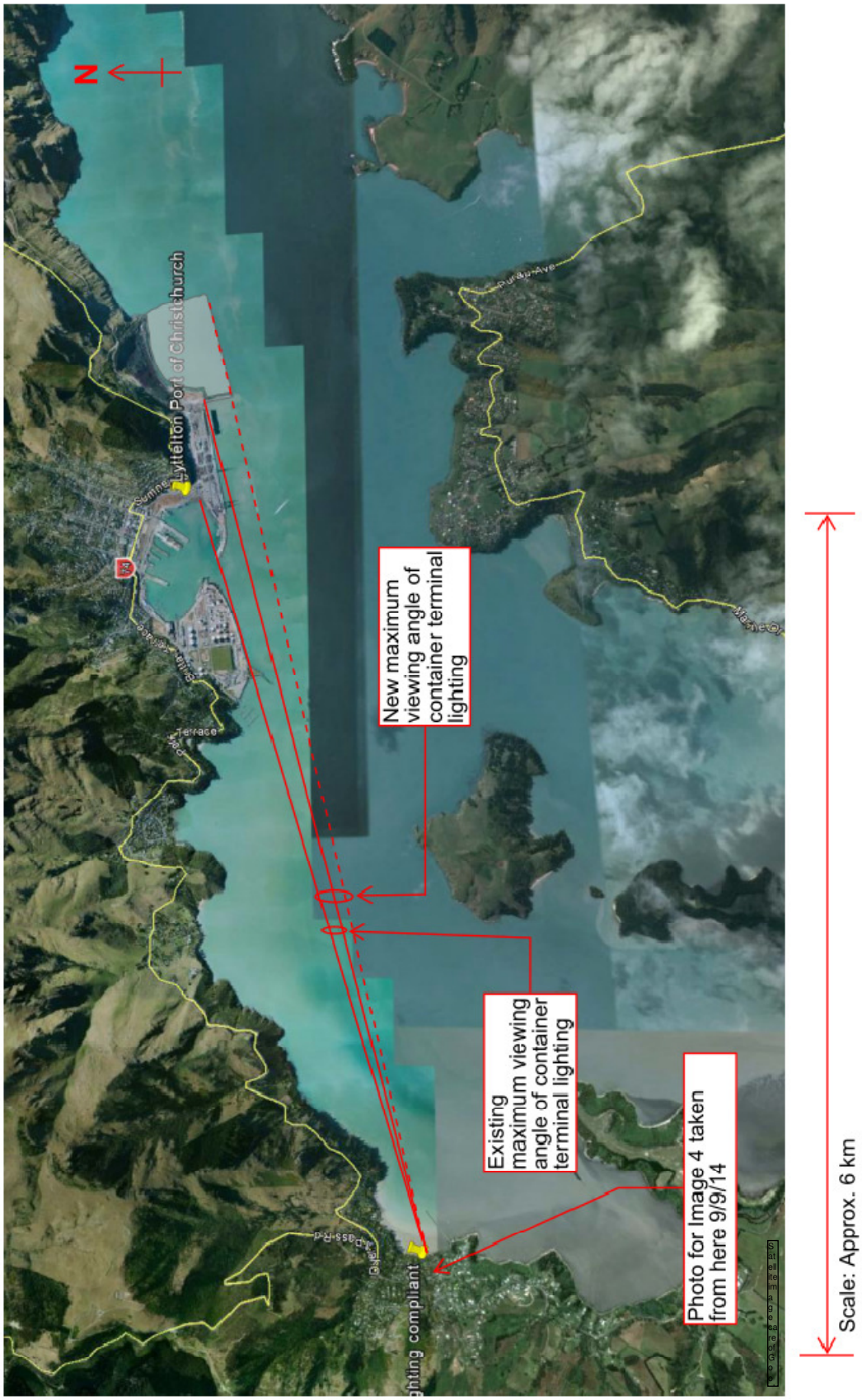
  The ratio of the maximum illuminance to the average illuminance on a given plane within the calculation or measurement area.

- Lux

  The international system (SI) unit of illuminance and luminous emittance, measuring luminous flux per unit area. It is equal to one lumen per square metre.

12. Appendix B – Harbour Satellite Images




N
Lyttelton Port of Christchurch
New maximum viewing angle of container terminal lighting
Existing maximum viewing angle of container terminal lighting
Photo for Image 4 taken from here 9/9/14
Scale: Approx. 6 km