Ocean Park Master Redevelopment Project

EP-249/2006/A – Condition 2.25

Glare Impact Assessment Report

May 2010

Certified by _____ **on 9 June 2010**

Lindsay Pickles (ETL)

Verified by Independent Environmental Checker on 8 June 2010
IEC Certificate attached in the submission? Yes

Ocean Park Master Redevelopment Project

Environmental Permit No. EP-249/2006/A - Condition 2.25

Glare Impact Assessment Report

Submitted by ERM-Hong Kong, Limited dated 31-05-2010

This is to verify that

Glare Impact Assessment Report

Submitted by ERM-Hong Kong, Limited

dated 31-05-2010

Has been verified by the undersigned.

Signed

Dr Anne F Kerr
Independent Environmental Checker (IEC)
Retained by Ocean Park Corporation
pursuant to Environmental Permit No. EP-249/2006/A

Date 8 June 2010

FINAL REPORT

Ocean Park Corporation, Hong Kong

Ocean Park Symbio Show:
Glare Impact Assessment

May 2010

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FINAL REPORT

Ocean Park Corporation, Hong Kong

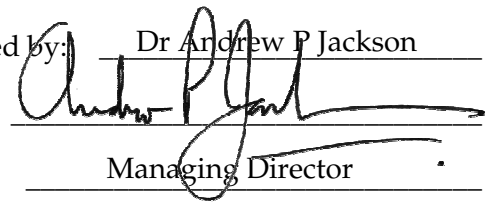
Ocean Park Symbio Show:
Glare Impact Assessment

May 2010

Reference 0108721

For and on behalf of
ERM-Hong Kong, Limited

Approved by: Dr Andrew P Jackson

Signed: 

Position: Managing Director

Date: 31 May 2010

CONTENTS

LIST OF ANNEXES

1 INTRODUCTION

1.1 BACKGROUND

Ocean Park Corporation, Hong Kong (OPC) is in the process of redeveloping its educational and recreational attractions as part of the Ocean Park Master Redevelopment Plan (MRP).

An open-air lagoon night show will be hosted at the Aqua City as one of the new attractions of the Ocean Park. The most up-to-date layout plan of the lagoon and design drawings of the audio poles and audio speakers are presented in *Annex A*. Detailed description of the show and updated design details are presented in *Section 1.3*.

The potential environmental impacts of the MRP have been assessed and presented in the Environmental Impact Assessment Report for "*Repositioning and Long Term Operation Plan of Ocean Park*" (Register No. AEIAR-101/2006) (the approved EIA Report), and an Environmental Permit (EP-249/2006) for the MRP was granted on 28 July 2006. EP-249/2006 was replaced by EP-249/2006/A (EP) on 23 October 2006. Under the requirements of Condition 2.25 of the EP, a detailed design of night-time functional and thematic lighting is required. The design shall take into account the possible light pollution and night-time glare.

1.2 PURPOSE OF THE REPORT

This report presents the Glare Impact Assessment (GIA) undertaken by ERM-Hong Kong, Ltd (ERM) and its sub-consultant, CSA (M&E) Ltd, of the lagoon night show at the Ocean Park, Hong Kong. This report is to outline the study approach of the impact assessment for the night-time functional and thematic lighting of the show. Potential impacts of light pollution and negative glare impact to the nearby sensitive receivers have been assessed and compared with relevant guidelines.

1.3 THE LAGOON NIGHT SHOW

The lagoon night show, *Symbio*, is an open-air entertainment event to be hosted at the Aqua City featuring a combination of audio and visual effects.

The show will be held in an exterior area of about 4,000 m^2, and a medium level of pollution has been assumed. A light loss factor of 0.75 has been employed in the assessment.

The duration of the show will be around 10 to 20 minutes. There will only be one show every night, and it will end before 22:00 hours, ie before Ocean Park closes daily.

The show comprises six scenes and is based on the theme of an ancient tale about dragons.

With respect to the latest layout plan of the show (see *Annex A*), the light sources that have the potential to cause adverse glare impact to the nearby sensitive receivers are:

- Lighting poles with 3 rotating spot lights each around the lagoon;
- Underwater LED up lights mounted on the water screen pumps, water jet pumps, and water cannons;
- Theatrical flame effect jet up to 10 m within the lagoon;
- Theatrical flame on water effect around the centre circular water wall screen;
- Projector lights on the circular water wall screen; and
- Pyrotechnic Special Effects Material (PSEM) [(1)] within the lagoon.

The potential glare impact was assessed using a computer simulation based on the following assumptions.

- All spot lights with an output of 17,800 lumen and a 70 degree vertical beam angle directly pointing outward along the show area;
- Underwater LED up lights with an output of 810 lumen and no shielding by the water wall screen, to simulate the worst-case scenario;
- Theatrical flame jet effects assumed as upward light fixtures with an output of 50,000 lumen;
- The light impact of the theatrical flame on water effect will be at low level and blocked by the adjacent building. It is expected that the potential glare impact will be insignificant and therefore has not been included in the computer simulation;
- The projector lights with an output of 17800 lumen, a vertical beam angle of 45 degree upward and pointing outward from the show. The potential shading by the water projection screen has been neglected to simulate the worst-case scenario; and
- PSEM assumed as upward light fixtures with an output of 10,000 lumen.

A lighting schedule, including power, number and types of lighting is given in *Table 2.1*.

[(1)] The show proposes to use close proximity theatrical pyrotechnics, produced by Pyrotechnic Special Effects Material (PSEM), that have been developed for indoor use for stage shows and concerts.

Table 2.1 Lighting Schedule

Luminaire Type		Power	Mounting Height	Beaming Direction	Nos.	Type	Lumen Output
1	Lighting pole with 3 head rotating spot light	3x1200W	6 m[Note]	70 degree	17	MSI metal halide	17800
2	Under water LED light	18x4.5W	Under water	90 degree upward	84	LED	810 (assumed)
3	Projector light on water wall screen	300W	Level to water surface	45 degree upward	5	NSH	17800 (assumed)
4	Theatrical flame effect	-	Level to water surface	90 degree upward	14	-	50000 (assumed)
5	PSEM	-	Level to water surface	90 degree upward	12	-	10000 (assumed)

Note:
Each lighting pole will hold 3 intelligent lighting fixtures, each housed within its own enclosure. All lighting enclosures will be located at the same elevation around the lagoon. The top of all lighting enclosures will be at +23.5 mPD (*Annex A*). All lighting poles are assumed at 6 m above ground, ie about the same level as the 1st floor of the nearest sensitive receiver, to represent the worst-case scenario.

Details of the representative sensitive receivers are presented in *Table 3.1* and their locations are shown in *Annex B.*

Table 3.1 Rrepresentative Sensitive Receivers

Sensitive Receiver		Type of Sensitive Receiver	Approximate Distance from the Show	Type of View
1	Mini Range Complex and Petrol Station	Commercial / Municipal	87 m	Obstructed view toward site, blocked by building inside Ocean Park
2	Wong Chuk Hang Road Garden	Municipal	290 m	Clear view, no significant obstruction
3	Buildings near Shouson Hill Road	Residential	270 m	Clear view, no significant obstruction
4	Country Villa	Residential	225 m	Clear view, no significant obstruction

The potential glare impacts were assessed using the *Dialux 4.6* computer simulation programme.

Rectangular 'solid objects' have been used to simulate the representative sensitive receivers (see *Annex B*).

The assessment parameters, including glare, source intensity and light entry through windows are defined as follows:

- glare, occurs when a bright light source enters the visual field;
- source intensity, the luminance intensity extending beyond the area being lit from any single source in the potentially obstructive direction; and
- light entry through windows, (Ev), represents the vertical illuminance in Lux perpendicular to the window glazing.

The degrees of impacts on the representative sensitive receivers have been simulated as follows:

- Glare: the observer calculation points for the assessment of veil luminance have been included at the same strategic locations as the source intensity calculation points at the sensitive receivers;
- Source intensity: a luminous intensity calculation point has been included at 6m above ground level, pointing toward the show, at each of the sensitive receivers. The calculation points have been levelled to the light poles to represent the worst-case scenario; and
- Light entry through window: a calculation surface is created at the surface of each of the 'solid objects' that are facing the show.

5 ASSESSMENT CRITERIA

There is no legislative criterion for glare impact assessment in the *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*). References have been made to relevant guidelines issued by the Highways Department (HyD) and The Chartered Institution of Building Services Engineers (CIBSE).

5.1 MAXIMUM ESTIMATED ALLOWABLE VEIL LUMINANCE

With reference to the *Public Lighting Design Manual* issued by the HyD, it is proposed to use the threshold increment for the assessment of the disability glare caused by the show. The threshold increment (% T.I.) will depend on both the background luminance and the veil luminance observed by the sensitive receivers. The maximum allowable veil luminance caused by the show is 3.64 candela (cd)/m^2, assuming an interior lighting arrangement of 200 Lux, a relative wall illuminance of 0.5, a wall reflectance of 0.5 and a maintenance factor of 0.8. Details of the calculation of maximum allowable veil luminance are presented in *Annex D*.

5.2 SOURCE INTENSITY

In accordance with the *Environment Consideration for Exterior Lighting* issued by the CIBSE, the source luminance shall be limited to 30 kilocandela (kcd) for Environmental Zone E3, Medium district brightness areas.

5.3 LIGHT ENTRY THROUGH WINDOW

In accordance with the *Environment Consideration for Exterior Lighting* issued by the CIBSE, the suggested maximum Lux level entering the window shall be less than 10 Lux for Environmental Zone E3, Medium district brightness areas.

6 ASSESSMENT RESULTS

The predicted glare, source intensity and light entry through window are presented below.

6.1 DISCOMFORT AND DISABILITY GLARE

The veil luminance will be caused by the show to the representative sensitive receivers. The veil luminance will reduce the contrast between the interior illuminance and the objects observed by the receivers, which may cause distraction and discomfort to the sensitive receivers.

The predicted maximum veil luminance is 3.15 cd/m² at the Mini Range Complex, which is lower than the maximum allowable veil luminance of 3.64 cd/m² as stated in *Section 5.1*. The predicted veil luminance was lower than 0.91 cd/m² at other sensitive receivers, ie far lower than the maximum allowable veil luminance. Details of the supporting calculations are given in *Annex C*.

6.2 SOURCE INTENSITY

The predicted maximum source intensity of each light source at the calculation points (1 to 4) is 3.72kcd, which is well within the CIBSE 's requirement, as stated in *Section 5.2*. Results indicate that only Luminaire Type 1 (lighting poles) will have potential to impact the sensitive receivers, other Luminaire Types 2 to 5 will not have any impact on the sensitive receivers as they are either beaming upward or have insignificant lighting power. The predictions are summarised in *Table 6.2*.

Table 6.2 Summary of Predicted Source Intensity

Luminaire Type [1]	Luminous Intensity [cd] [2]
Sensitive Receiver 1: Mini range complex and petrol station	
Type 1	76
Type 1	75
Type 1	73
Type 1	37
Type 1	36
Type 1	36
Type 1	3652
Type 1	3656
Type 1	3670
Type 1	3075
Type 1	3090
Type 1	3104
Sensitive Receiver 2: Wong Chuk Hang Road Garden	
Type 1	3621
Type 1	3623
Type 1	3625
Type 1	10
Type 1	10

Luminaire Type [1]	Luminous Intensity [cd] [2]
Type 1	10
Type 1	3692
Type 1	3692
Type 1	3691
Type 1	3690
Type 1	3691
Type 1	3691
Type 1	3643
Type 1	3645
Type 1	3646
Type 1	3691
Type 1	3692
Type 1	3693
Type 1	3478
Type 1	3482
Type 1	3486
Type 1	3331
Type 1	3333
Type 1	3337
Type 1	1868
Type 1	918
Sensitive Receiver 3: Building near Shouson Hill Road	
Type 1	3660
Type 1	3661
Type 1	3662
Type 1	187
Type 1	186
Type 1	185
Type 1	3290
Type 1	3295
Type 1	3300
Type 1	3718
Type 1	3719
Type 1	3721
Type 1	2937
Type 1	2944
Type 1	2952
Type 1	3716
Type 1	3718
Type 1	3719
Type 1	2453
Type 1	2460
Type 1	2469
Type 1	2183
Type 1	2193
Type 1	2204
Type 1	2366
Type 1	290
Sensitive Receiver 4: Country Villa	
Type 1	3160
Type 1	3169
Type 1	3178
Type 1	1844
Type 1	1835
Type 1	1826
Type 1	1040
Type 1	1046
Type 1	1053
Type 1	3350

Luminaire Type [1]	Luminous Intensity [cd] [2]
Type 1	3353
Type 1	3361
Type 1	568
Type 1	573
Type 1	577
Type 1	3349
Type 1	3352
Type 1	3355
Type 1	274
Type 1	277
Type 1	279
Type 1	222
Type 1	223
Type 1	224
Type 1	34
Type 1	2460

Notes:

[1] In accordance with *Table 2.1*, Luminaire Type 1 refers to lighting pole with 3 head rotating spot light, ie a total of 51 nos. of Type 1 sources with 17 nos. of lighting poles.

[2] Only luminaries with source intensity exceeded 1 cd have been shown.

6.3 LIGHT ENTRY THROUGH WINDOW

The predicted maximum Lux level is 1.30 at the Mini Range Complex, which is much lower than the CIBSE's requirement of 10 Lux, as stated in *Section 5.3*. Details of the calculations are given in *Annex C*.

In accordance with the EP Condition 2.26, a specialist with training and practical experience in outdoor sport lighting and illumination had been employed to design, manage and oversee the implementation and maintenance of the illumination requirements and system for the proposed nightly Ocean Park show.

Although the assessment results indicate no significant glare impact at the representative sensitive receivers, it is still recommended to undertake at least two rounds of monitoring prior to the nightly show tests and the performance. During each monitoring event, the Lux levels should be measured with a Lux Meter or Light Meter at one of the most affected sensitive receivers before and during the show. The increase in the Lux level with the show should be compared with that before the show. The Lux level measured during the show should also be compared with the recommended CIBSE's requirement of 10 Lux.

In case the monitoring results indicate measured Lux level higher than 10 Lux, an investigation of the exceedance is required to be conducted by the specialist. Recommendations should be given for any necessary adjustments to the lighting schedule of the show.

The specialist is also required to conduct regular checks, at least once a month, on the lights for the show to ensure that all lights are fixed at not more than 70 degree vertical beam angle and all lights being used are under the lighting schedule.

The predicted maximum veil luminance (ie 3.15 cd/m^2) at all representative sensitive receivers is lower than the maximum allowable veil luminance of 3.64 cd/m^2.

The predicted source intensities of all lighting used for the show at the representative sensitive receivers are well below the criterion of 30kcd recommended by the CIBSE.

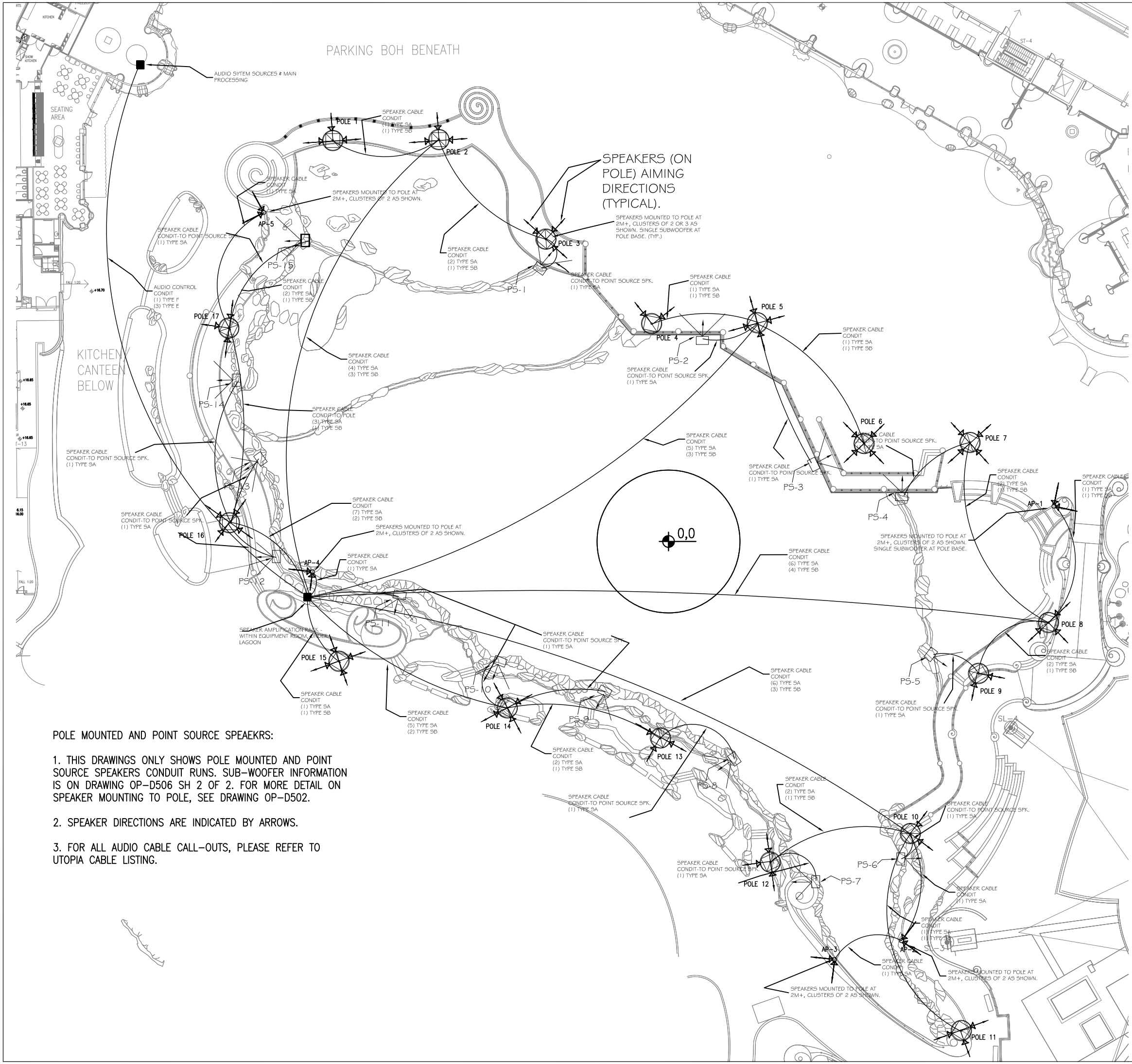
For light entry through window, the predicted Lux levels at all representative sensitive receivers are well below the CIBSE's recommendation of 10 Lux.

The potential glare impacts of the spot lights, underwater LED lights, theatrical flame effects, projectors, lights and PSEM effects of the lagoon night show to the representative sensitive receivers are considered insignificant.

The potential night-time glare impacts are expected to be further mitigated by its absorption into the overall operational lighting of the Ocean Park.

Annex A

Updated Design Layout Plans and Drawings



POLE MOUNTED AND POINT SOURCE SPEAEKRS:

1. THIS DRAWINGS ONLY SHOWS POLE MOUNTED AND POINT SOURCE SPEAKERS CONDUIT RUNS. SUB-WOOFER INFORMATION IS ON DRAWING OP-D506 SH 2 OF 2. FOR MORE DETAIL ON SPEAKER MOUNTING TO POLE, SEE DRAWING OP-D502.

2. SPEAKER DIRECTIONS ARE INDICATED BY ARROWS.

3. FOR ALL AUDIO CABLE CALL-OUTS, PLEASE REFER TO UTOPIA CABLE LISTING.

LEGEND

- SPEAKERS MOUNTED TO POLE, NUMBER OF SPEAKERS VARIES AS INDICATED PER PLAN
- POINT SOURCE SPEAKER MOUNTING HEIGHT – 1M AFF
- AUDIO CONTROL

SPEAKER QTY.

All light poles and AP-1 have 1 subwoofer plus these quantities on the pole:

Pole 1 = 3
Pole 2 = 3
Pole 3 = 3
Pole 4 = 2
Pole 5 = 4
Pole 6 = 4
Pole 7 = 4
Pole 8 = 3
Pole 9 = 2
Pole 10 = 2
Pole 11 = 3
Pole 12 = 3
Pole 13 = 3
Pole 14 = 4
Pole 15 = 4
Pole 16 = 4
pole 17 = 3
AP-1 = 3
AP-2 = 2
AP-3 = 2
AP-4 = 2
AP-5 = 2

WIRETYPES

TYPE SA = Belden 5000FE speaker
TYPE SB = Belden 5T00UP speaker
TYPE D = Belden 3074F DMX
TYPE F = Belden B9B510T fiber
TYPE E = Belden 7923A ethernet

GENERAL NOTES

1. All field conduit stub ups into base of lighting pole.
2. All equipment room conduit stub ladder tray above equipment racks.
3. All field cabling to have 3 meter tails after reaching it's destination equipment.
4. All equipment room cabling to have 6 meter tails above end of conduit.
5. All cabling to have unique numeric labeling and as-installed drawing corresponding to cable numbers.
6. All conduit to be sized according to local Hong Kong electrical code for the type, quantity and size of conduit fill as indicated on this drawing.
7. No cable splices permitted within conduit or on cable tails. Only continuous run cable from end to end.
8. Maintain minimum bend radious as specified in specification documents for all lighting cables, fiber optic cables and ethernet cables.
9. Use only specified cable manufacturer and model unless otherwise approved in writing by the technical representative from Utopia Entertainment.
10. Poles 1 through 17 and AP-1 through AP-5 have JBL Control 30 speakers on them. Poles 1 through 17 have 1 JBL SB-210 subwoofer near the base. AP-1 has 1 JBL SB-210 subwoofer near the base.

GRAPHIC SCALE: 1:200

0 1M 5M 10M

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S	SHOW FACILITY INPUT DRAWING	-	DEC 2019
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OCEAN PARK REDEVELOPMENT

CONTRACT NO. S00202
AQUA CITY – SYMBIO LAGOON SHOW

SITE PLAN
SPEAKER CONDUIT

SCALE	DATE
1:200	22 JULY 2019
DRAWN BY: S.P.	CHECKED BY: B.K.

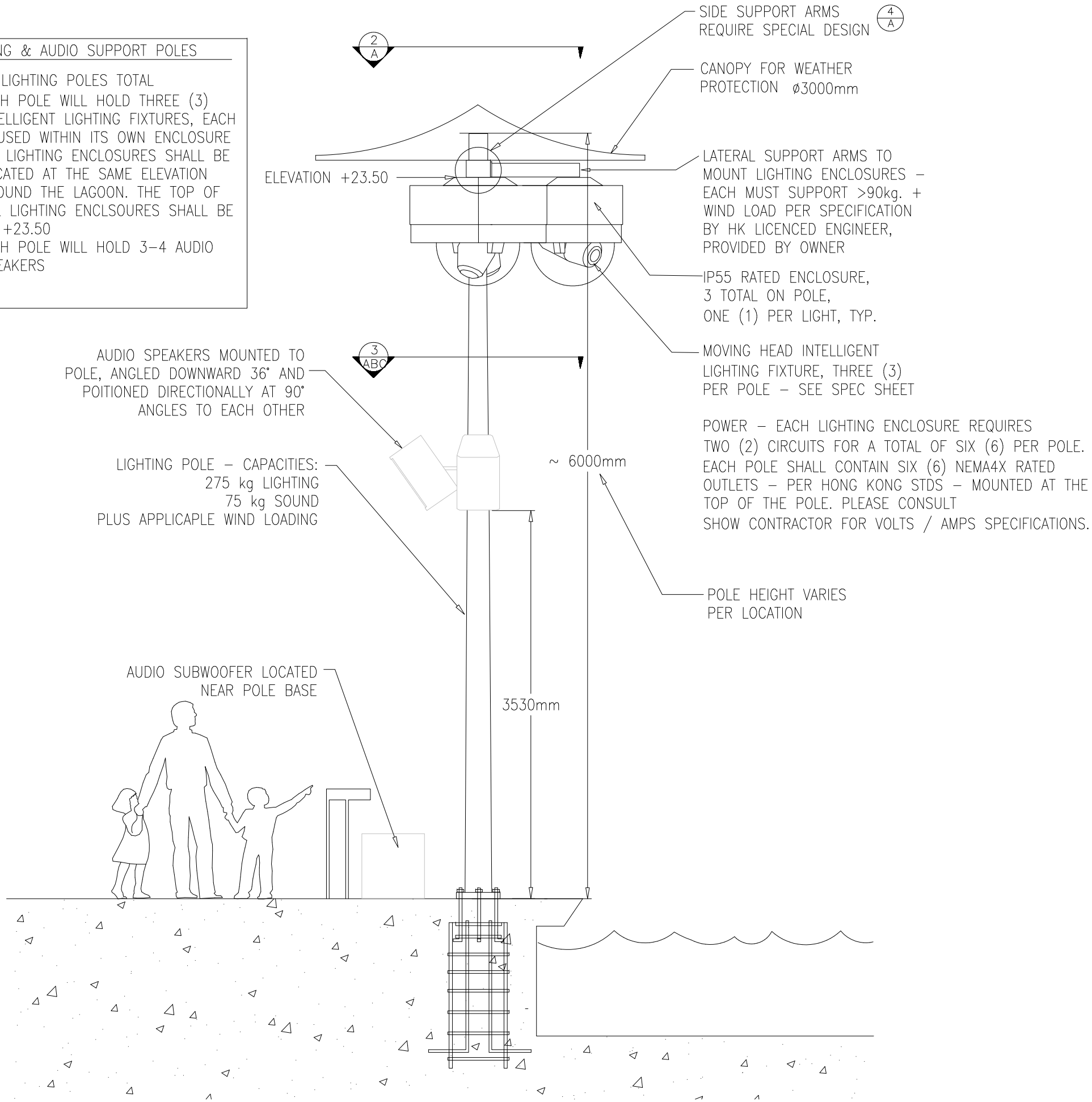
PREPARED BY
RAW MEDIA TEKNOLOGIES

CONSULTANT
UTOPIA ENTERTAINMENT, INC.
23638 LYONS AVE., SUITE 437
NEWHALL, CA 91321 USA
"JUST IMAGINE!"

DRG. NO.	REV.
OP-D506 - SH 1 OF 2	5

LIGHTING & AUDIO SUPPORT POLES

- 17 LIGHTING POLES TOTAL
- EACH POLE WILL HOLD THREE (3) INTELLIGENT LIGHTING FIXTURES, EACH HOUSED WITHIN ITS OWN ENCLOSURE
- ALL LIGHTING ENCLOSURES SHALL BE LOCATED AT THE SAME ELEVATION AROUND THE LAGOON. THE TOP OF ALL LIGHTING ENCLSOURES SHALL BE AT +23.50
- EACH POLE WILL HOLD 3–4 AUDIO SPEAKERS



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LIGHTING AND AUDIO FUNCTIONAL REQUIEMENT

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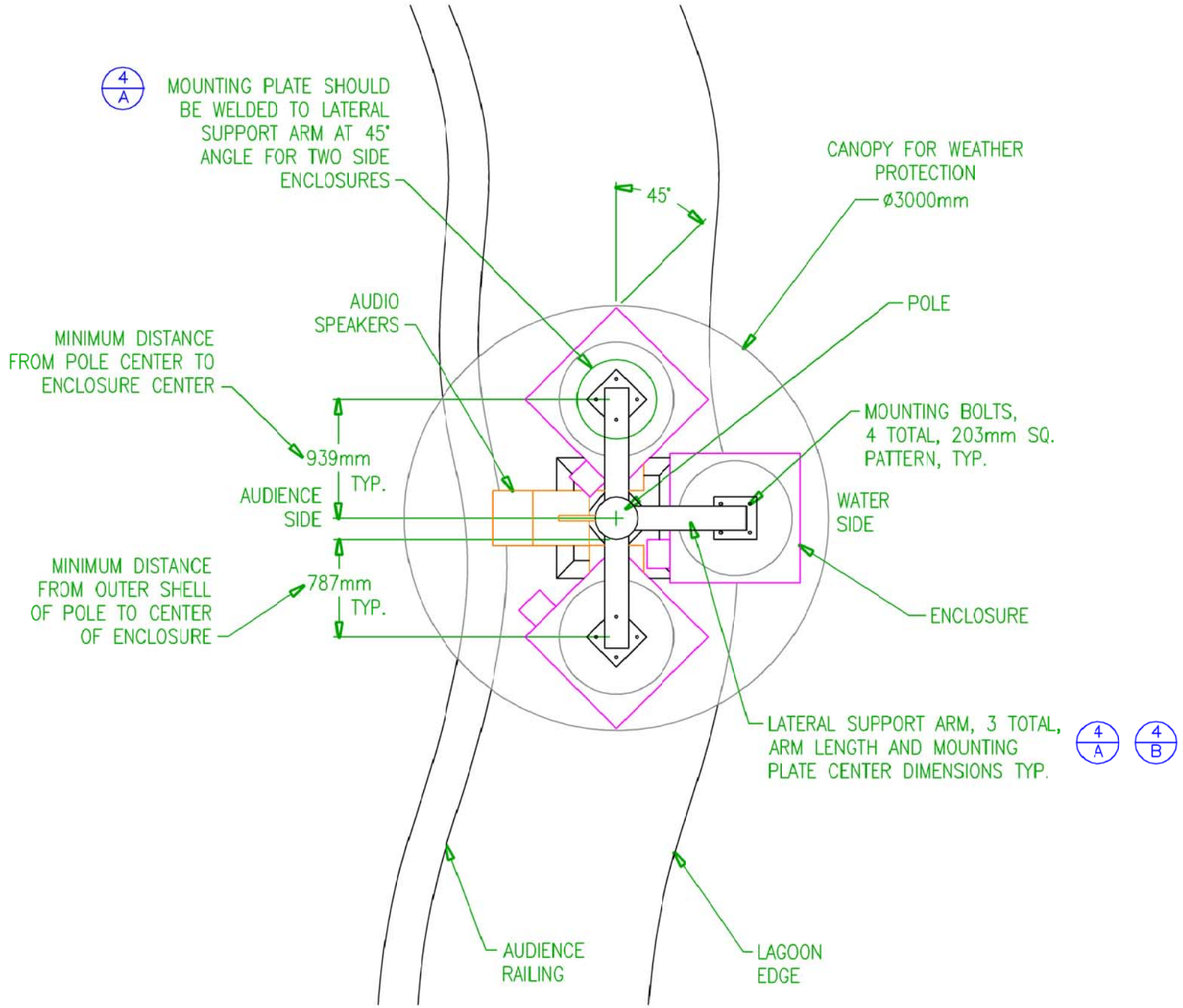

LIGHT ENCLOSURE ORIENTATION - PLAN VIEW 2/A

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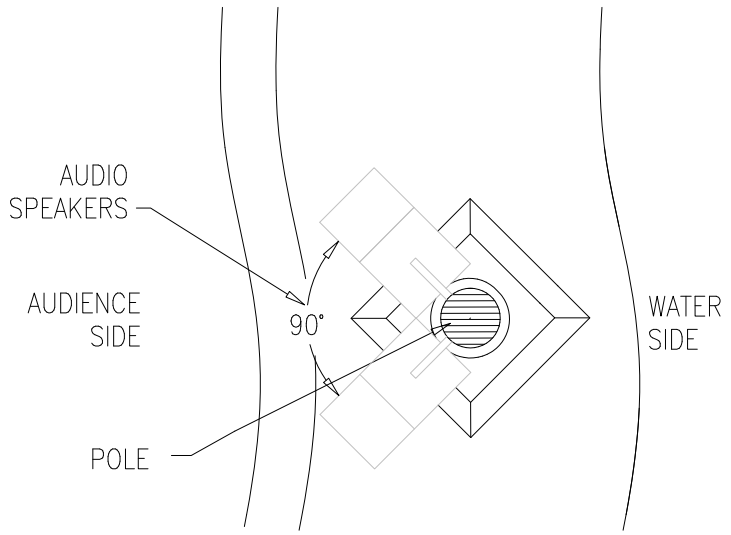
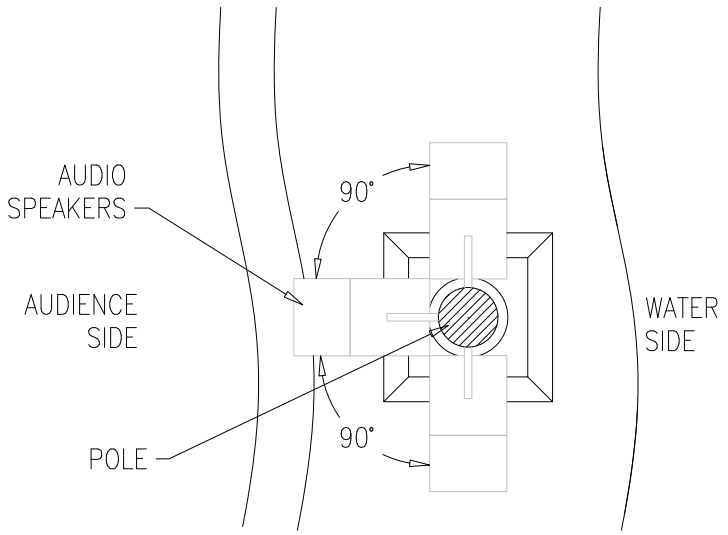
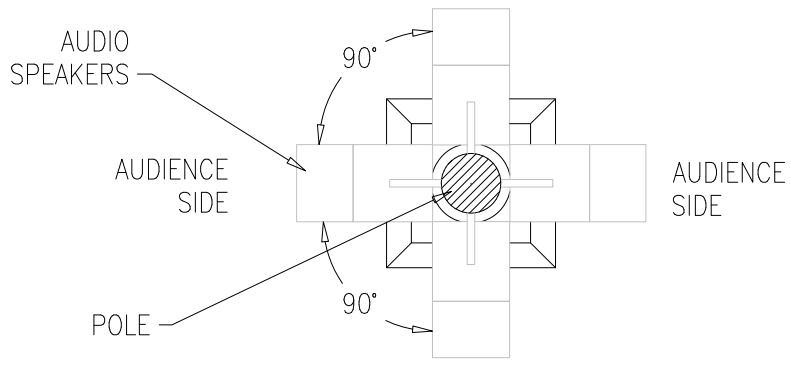


2 SPEAKER ORIENTATION - PLAN VIEW 3/A



3 SPEAKER ORIENTATION - PLAN VIEW 3/B



4 SPEAKER ORIENTATION - PLAN VIEW 3/C

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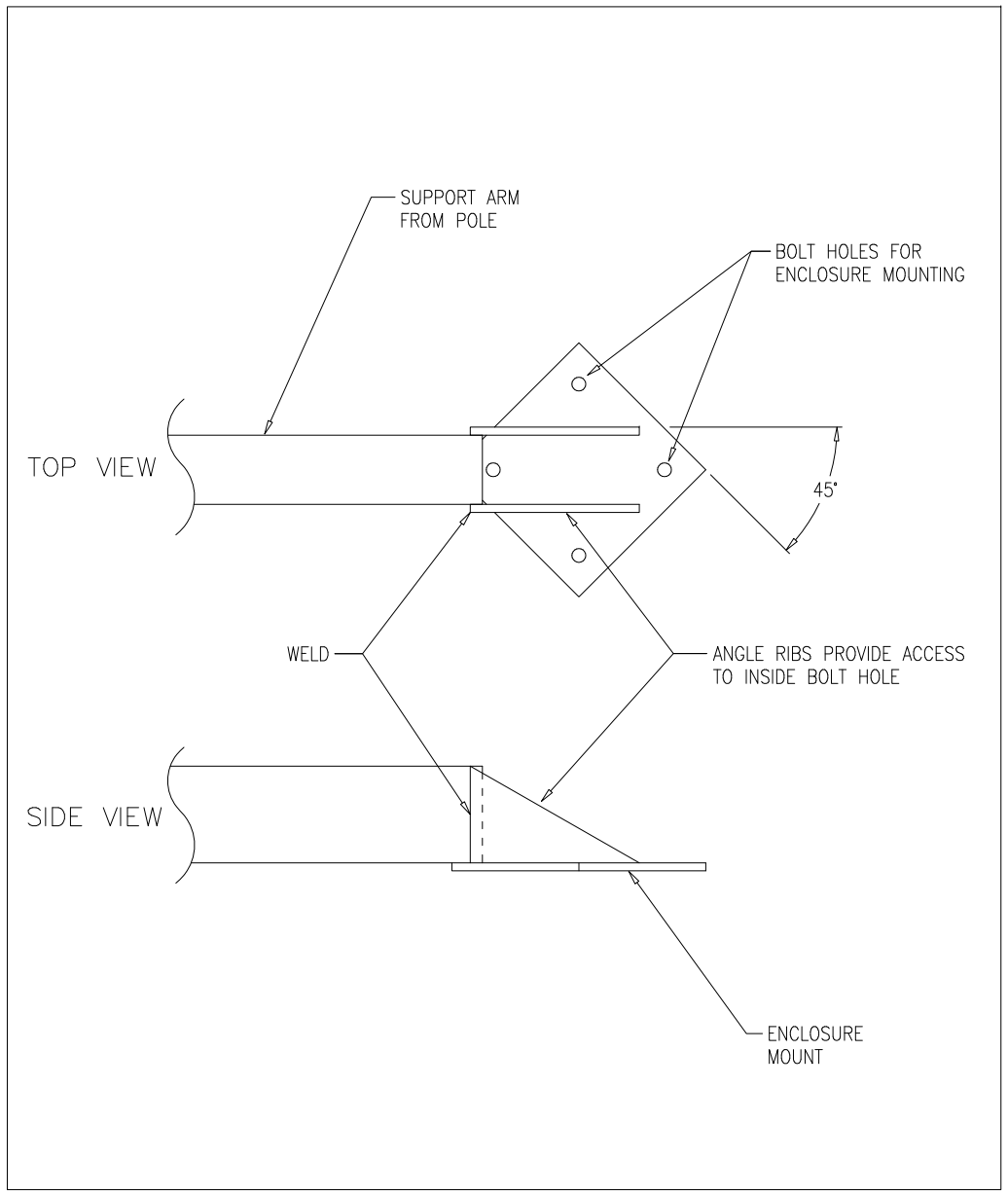

TWO SIDE ENCLOSURE SUPPORT ARMS - TWO PER POLE

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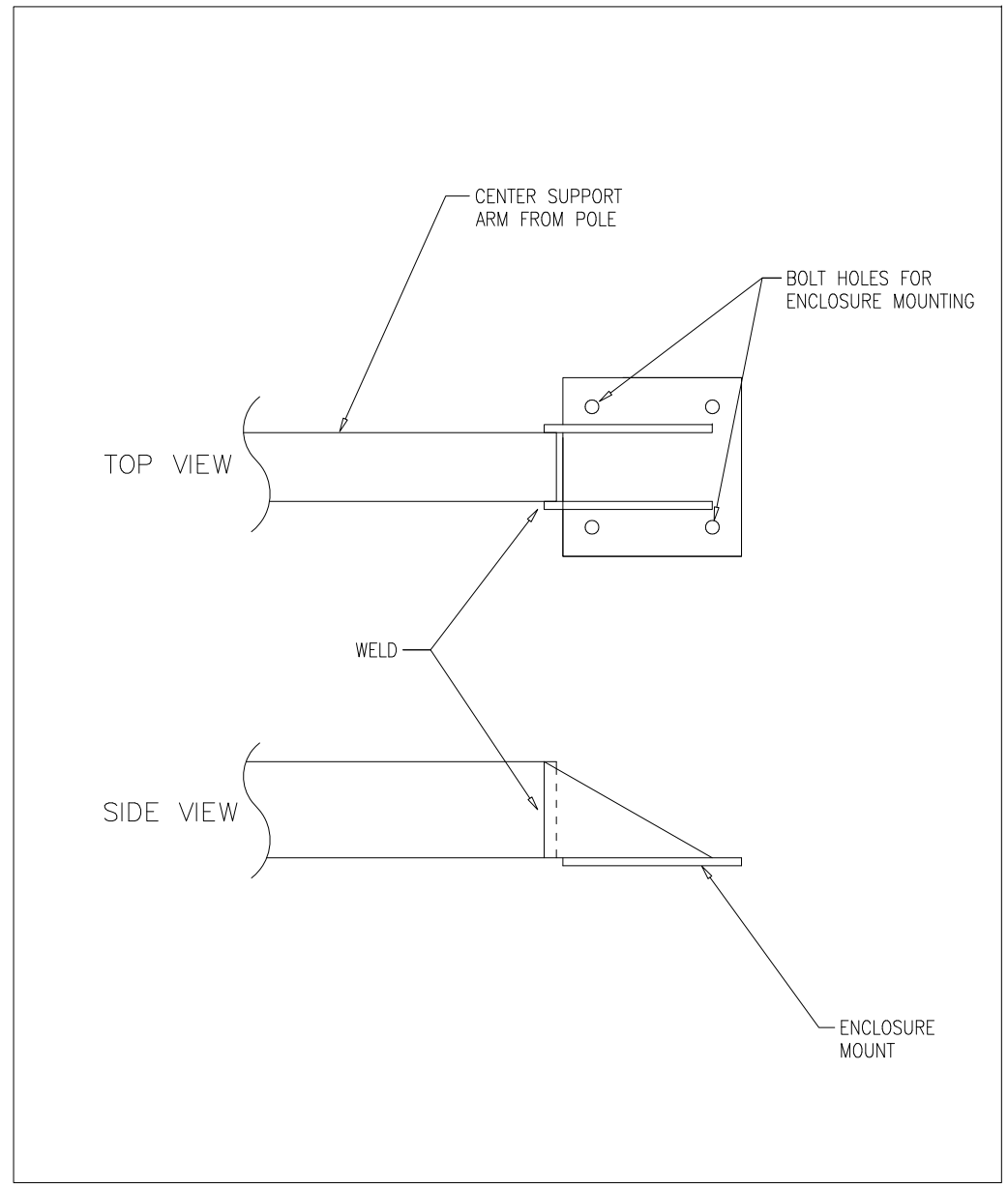
SUGGESTED ANGLED SUPPORT ARM DESIGN 4/A



CENTER ENCLOSURE SUPPORT ARM - ONE PER POLE

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SUGGESTED CENTRAL SUPPORT ARM DESIGN 4/B

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LIGHTING AND AUDIO
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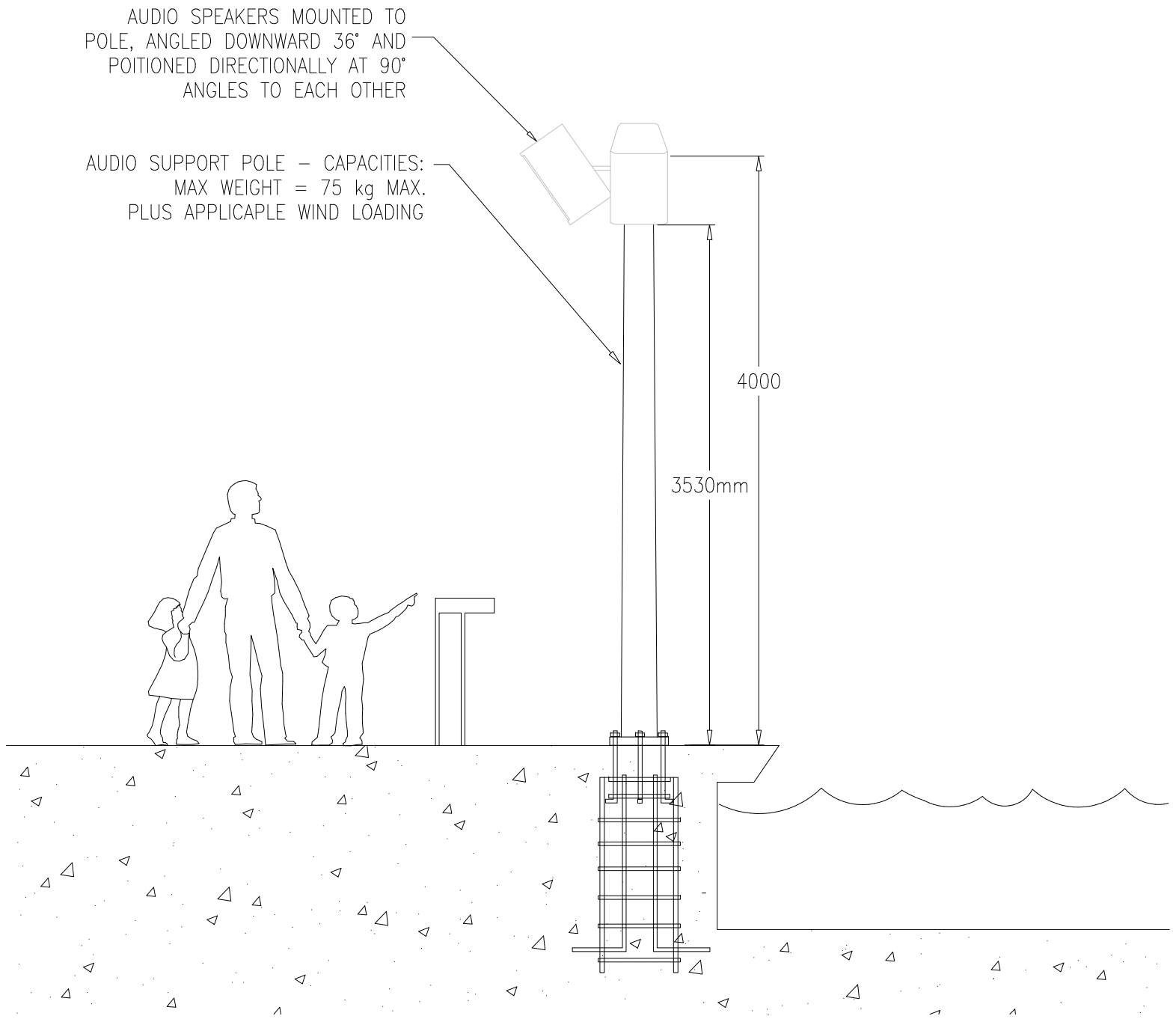
AUDIO SUPPORT POLES

- 5 AUDIO ONLY POLES TOTAL
- EACH POLE WILL HOLD 2-3 AUDIO SPEAKERS



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AUDIO SUPPORT POLE - "AUDIO ONLY"
FUNCTIONAL REQUIEMENT

SCALE	DATE
1:20	23 JULY 2009
DRAWN BY	CHECKED BY
S.P.	B.K.

PREPARED BY
RAW MEDIA TEKNOLOGIES

CONSULTANT
UTOPIA ENTERTAINMENT, INC.
23638 LYONS AVE., SUITE 437
NEWHALL, CA 91321 USA
"JUST IMAGINE!"

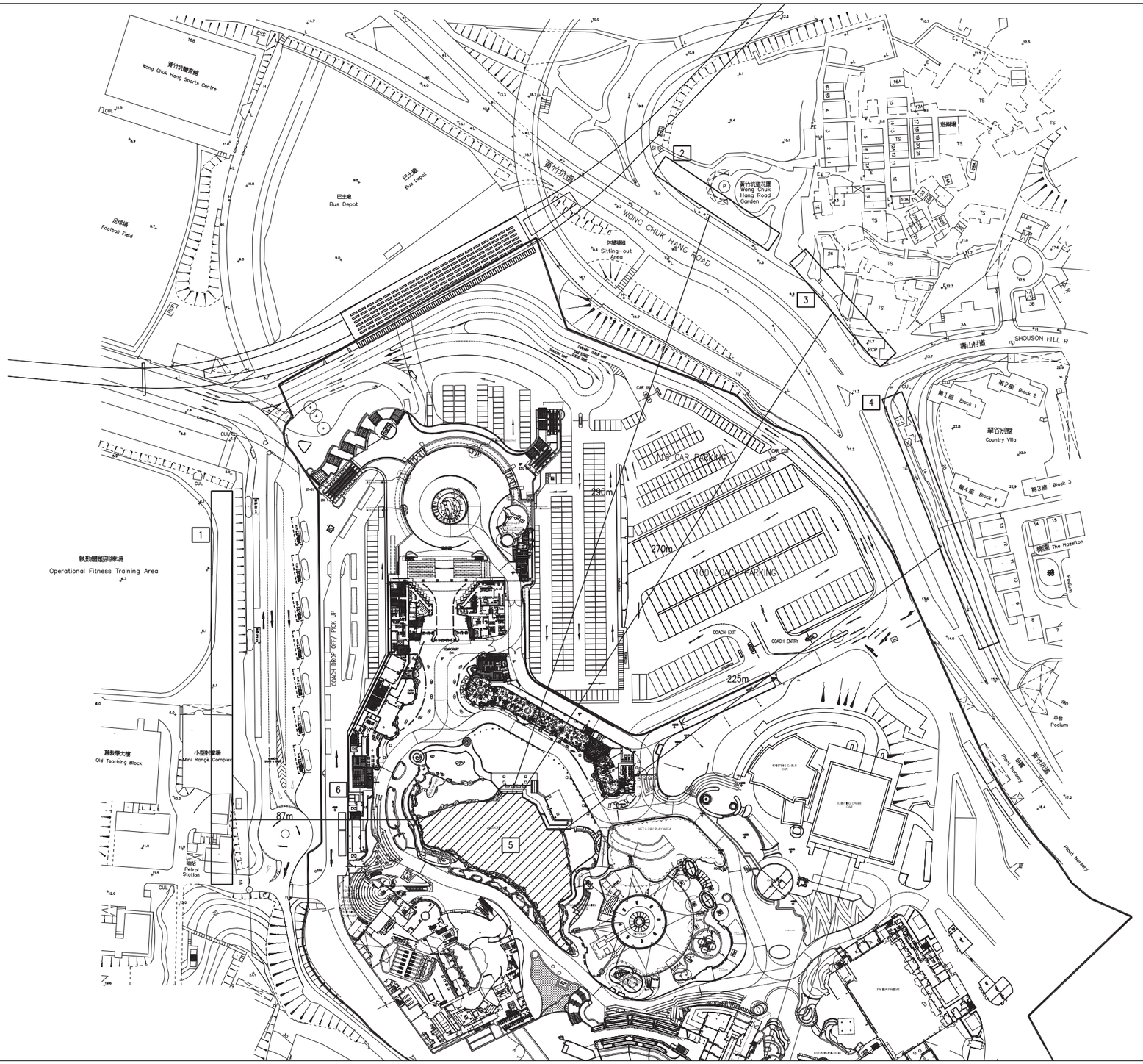
DRG. NO. OP-D502 - SH 5 OF 5

REV. 6

\\SERVER\Users\BKIvlen\OceanPark_S002 - Symbio\Schematic Drawing Package\AUDIO Redesign\OP-D506\OP-D502r6.dwg

Annex B

Locations of Representative Sensitive Receivers and the Lagoon Night Show



Annex B

Locations of Representative Sensitive Receivers and the Lagoon Night Show

FILE: 0108721a
DATE: 11/02/2010

Environmental Resources Management

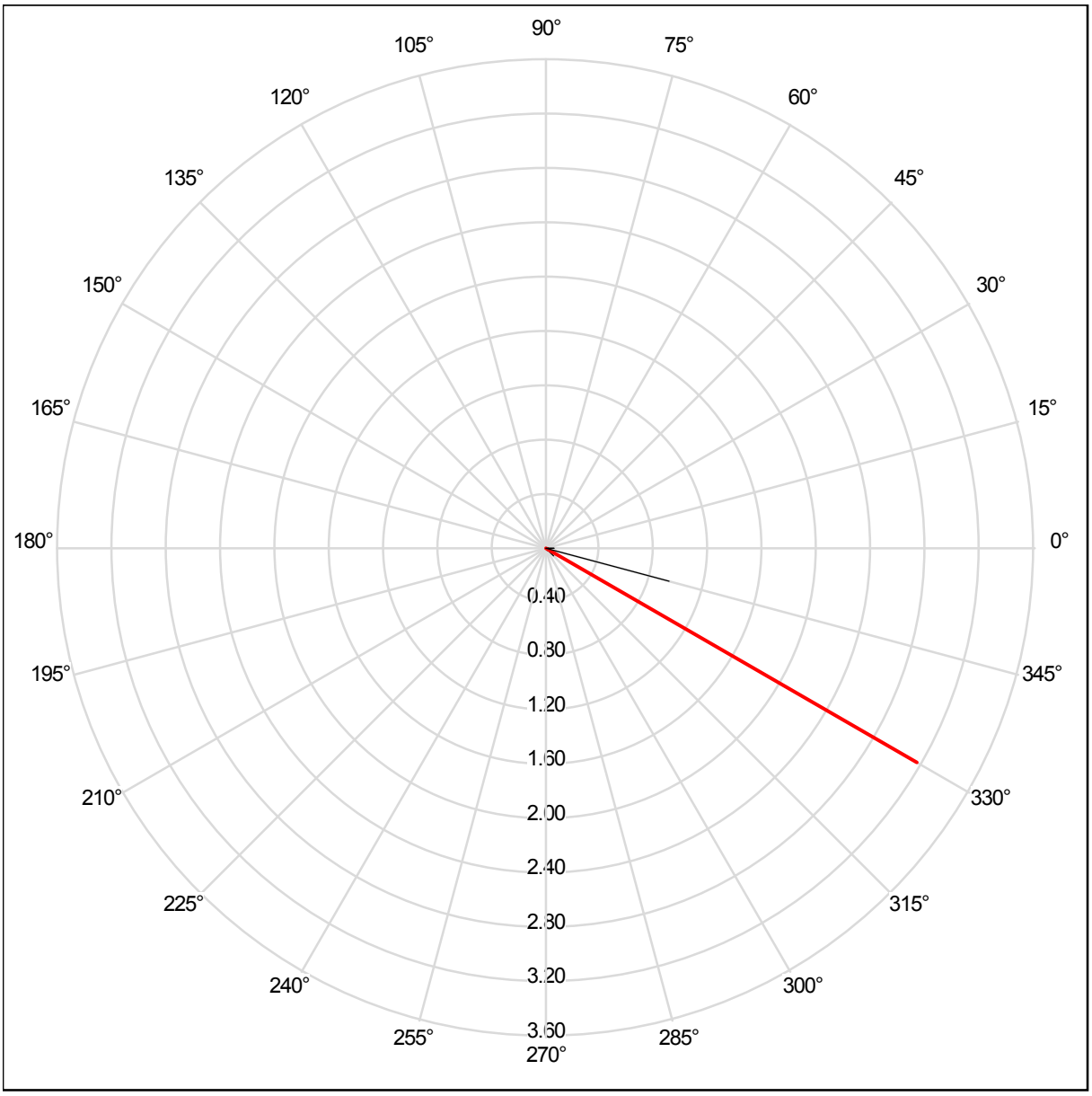
ERM

Annex C

Dialux Study Simulation

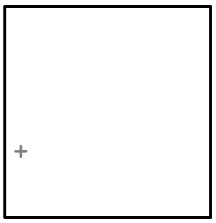
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / GR Observer at Mini Range / Veil Luminances



Values in Candela/m²

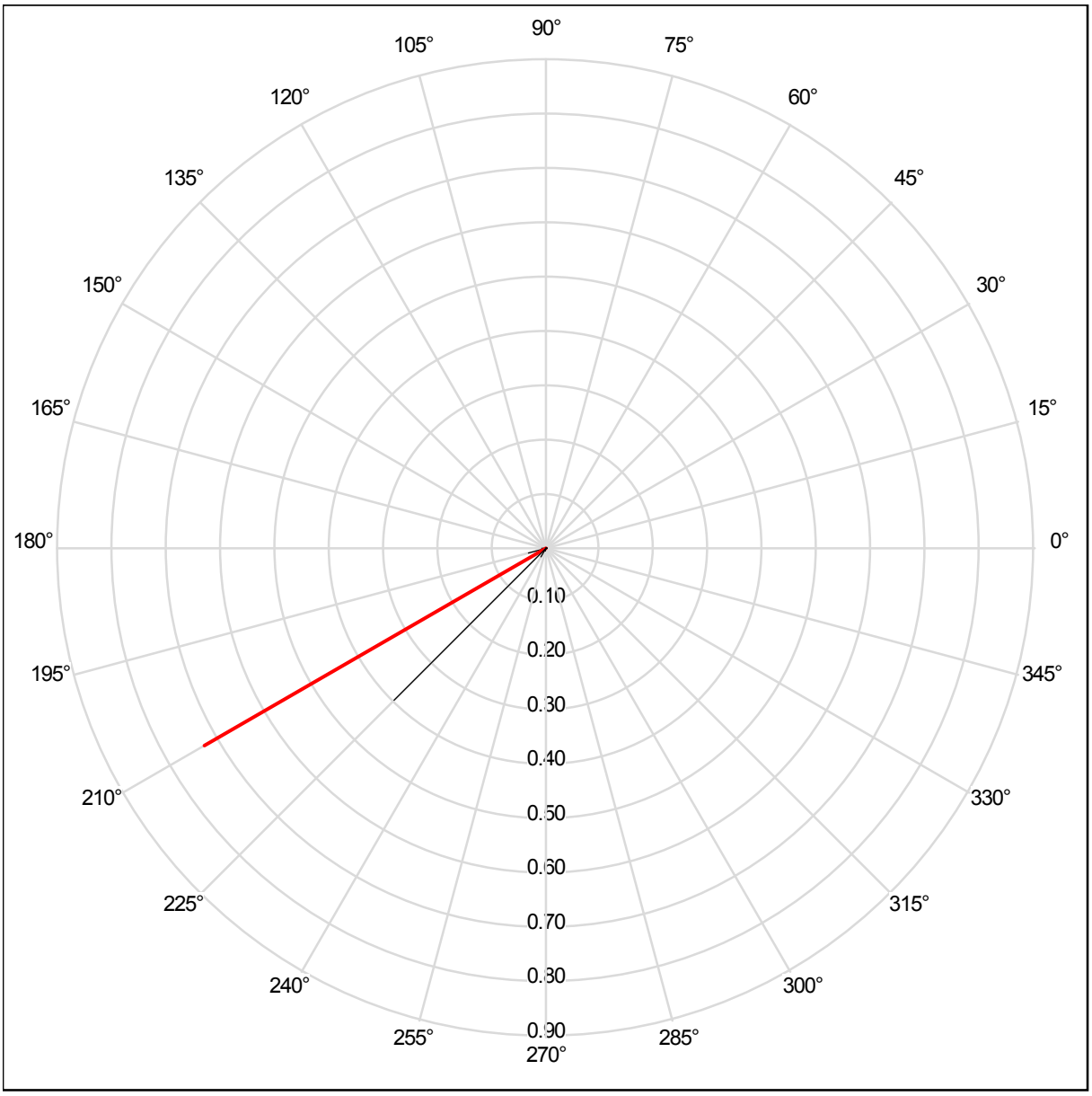
Position of observer in external scene:



Position: (-35.117 m, 156.252 m, 6.000 m)
Viewing sector: 0.0 ° - 360.0 °, Increment: 15.0 °, Angle of inclination: -2.0 °
Veil Luminance: Min: 0.00 cd/m², Max: 3.15 cd/m²
The equivalent veil luminance of the environment has been calculated precisely.

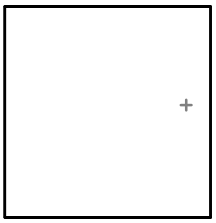
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / GR Observer at Coutry Villa / Veil Luminances



Values in Candela/m²

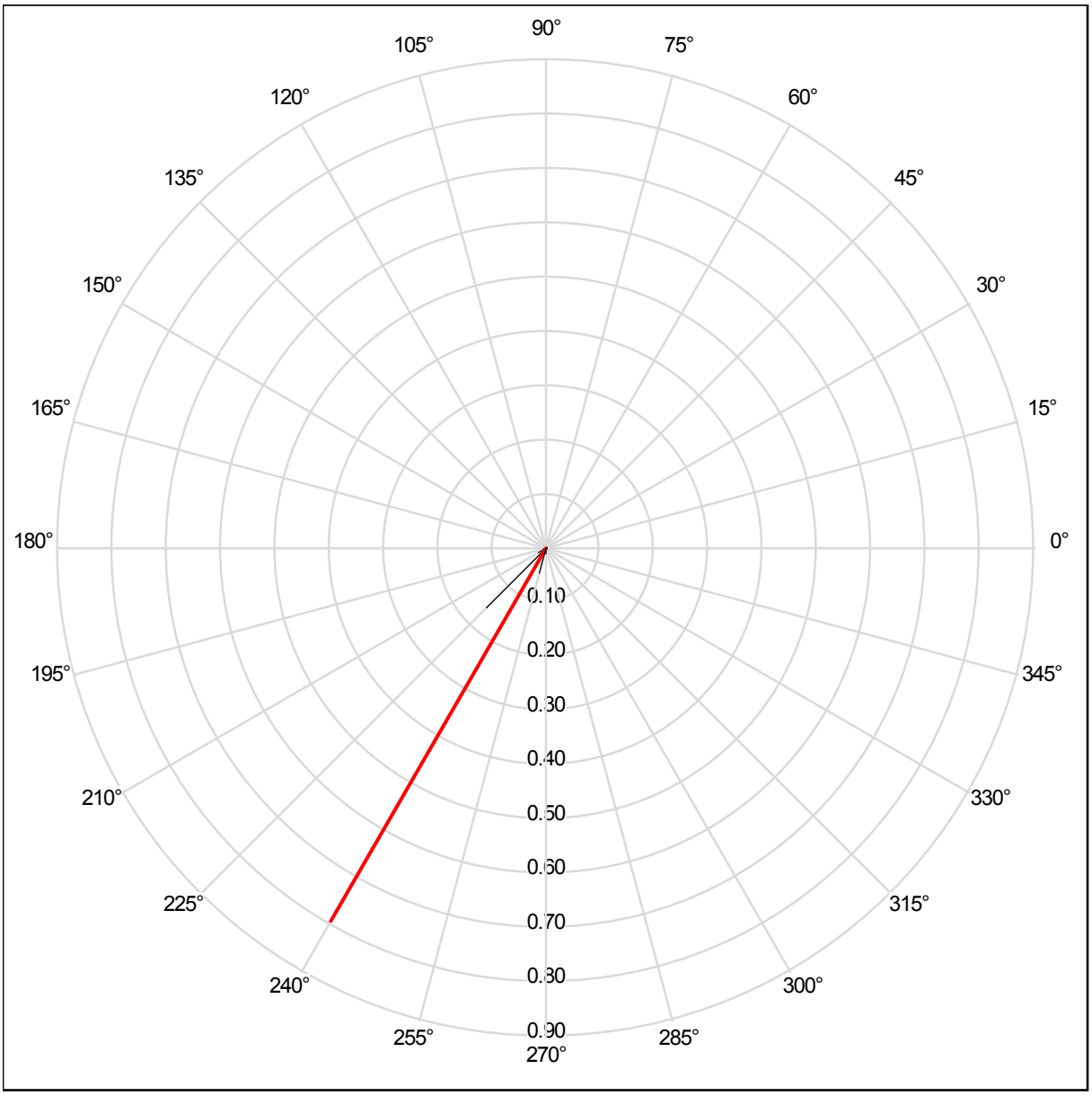
Position of observer in external scene:



Position: (297.223 m, 249.424 m, 6.000 m)
Viewing sector: 0.0 ° - 360.0 °, Increment: 15.0 °, Angle of inclination: -2.0 °
Veil Luminance: Min: 0.00 cd/m², Max: 0.73 cd/m²
The calculated equivalent veil luminance of the environment is based on the assumption of a complete diffuse reflection behavior of the environment (acc. EN 12464-2).

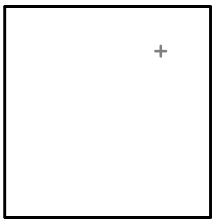
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / GR Observer at Building / Veil Luminances



Values in Candela/m²

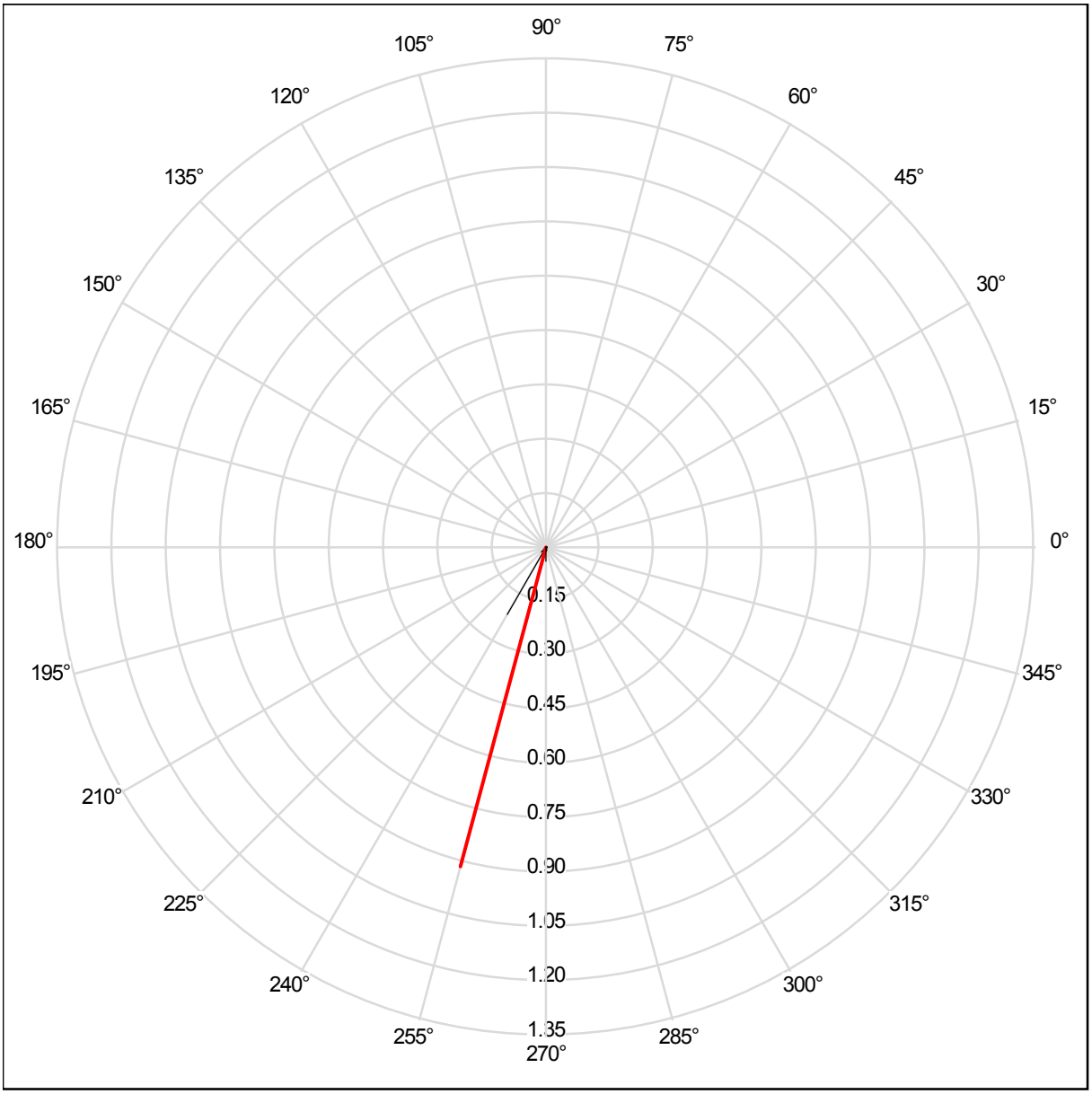
Position of observer in external scene:



Position: (245.863 m, 357.780 m, 6.000 m)
Viewing sector: 0.0 ° - 360.0 °, Increment: 15.0 °, Angle of inclination: -2.0 °
Veil Luminance: Min: 0.00 cd/m², Max: 0.79 cd/m²
The calculated equivalent veil luminance of the environment is based on the assumption of a complete diffuse reflection behavior of the environment (acc. EN 12464-2).

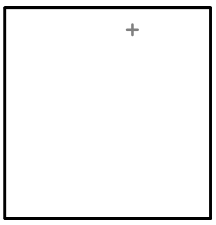
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / GR Observer at Wong Chuk Hang Road Garden / Veil Luminances



Values in Candela/m²

Position of observer in external scene:



Position: (189.089 m, 403.264 m, 6.000 m)
Viewing sector: 0.0 ° - 360.0 °, Increment: 15.0 °, Angle of inclination: -2.0 °
Veil Luminance: Min: 0.00 cd/m², Max: 0.91 cd/m²
The calculated equivalent veil luminance of the environment is based on the assumption of a complete diffuse reflection behavior of the environment (acc. EN 12464-2).

Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / Mini Range and Traning Area / face to Ocean Park / Value Chart (E)

1.86	1.95	1.99	1.96	1.87	1.79	1.61	1.50	1.30	1.17	1.01	0.90	0.77	0.67	0.57	0.49
1.83	1.92	1.98	1.96	1.88	1.78	1.61	1.49	1.31	1.18	1.04	0.90	0.78	0.66	0.57	0.48
1.83	1.94	2.01	1.98	1.90	1.83	1.67	1.53	1.35	1.23	1.05	0.91	0.77	0.66	0.55	0.47
1.69	1.56	1.84	1.82	1.77	1.70	1.60	1.49	1.36	1.19	1.06	0.90	0.79	0.67	0.57	0.49
1.67	1.75	1.79	1.78	1.75	1.71	1.62	1.51	1.35	1.18	1.03	0.88	0.75	0.64	0.55	0.48
1.61	1.70	1.74	1.72	1.74	1.69	1.61	1.47	1.31	1.14	0.97	0.82	0.70	0.60	0.53	0.47
1.56	1.64	1.69	1.70	1.69	1.64	1.55	1.42	1.26	1.08	0.92	0.77	0.66	0.56	0.51	0.45
1.57	1.63	1.64	1.66	1.66	1.61	1.53	1.37	1.23	1.05	0.90	0.77	0.68	0.61	0.54	0.50
1.70	1.79	1.82	1.84	1.82	1.73	1.56	1.34	1.18	0.96	0.83	0.72	0.64	0.57	0.53	0.50
1.79	1.91	1.94	1.95	1.92	1.78	1.59	1.32	1.14	0.93	0.82	0.71	0.64	0.59	0.54	0.52
2.05	2.23	2.27	2.29	2.23	2.02	1.79	1.48	1.18	0.95	0.78	0.68	0.62	0.58	0.54	0.52
2.17	2.30	2.33	2.35	2.26	2.03	1.78	1.42	1.17	0.94	0.77	0.70	0.64	0.61	0.59	0.56
2.48	2.60	2.60	2.61	2.54	2.26	1.99	1.62	1.29	0.99	0.81	0.69	0.65	0.61	0.59	0.56
2.65	2.67	2.67	2.67	2.52	2.22	1.94	1.51	1.20	0.92	0.76	0.64	0.61	0.57	0.55	0.54
2.88	2.85	2.86	2.88	2.73	2.43	2.07	1.50	1.17	0.68	0.56	0.54	0.51	0.47	0.49	0.45

100.00 m

0.00

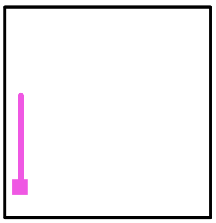
0.00

186.00 m

Values in Lux, Scale 1 : 1330

Not all calculated values could be displayed.

Position of surface in external scene:
Marked point:
(-35.117 m, 83.516 m, 0.000 m)

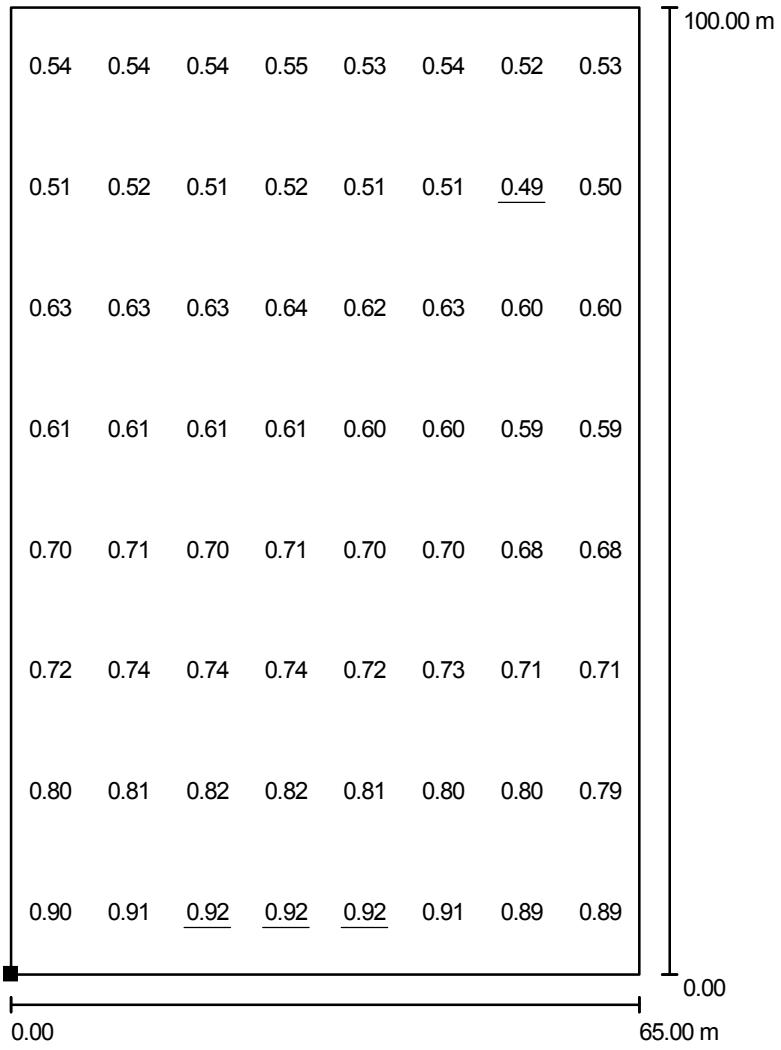


Grid: 64 x 32 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
1.30	0.26	3.07	0.197	0.083

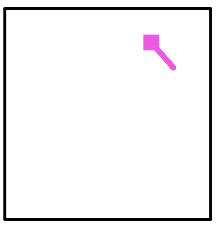
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / Building / face to Ocean Park / Value Chart (E)



Values in Lux, Scale 1 : 782

Position of surface in external scene:
Marked point:
(228.636 m, 377.528 m, 0.000 m)

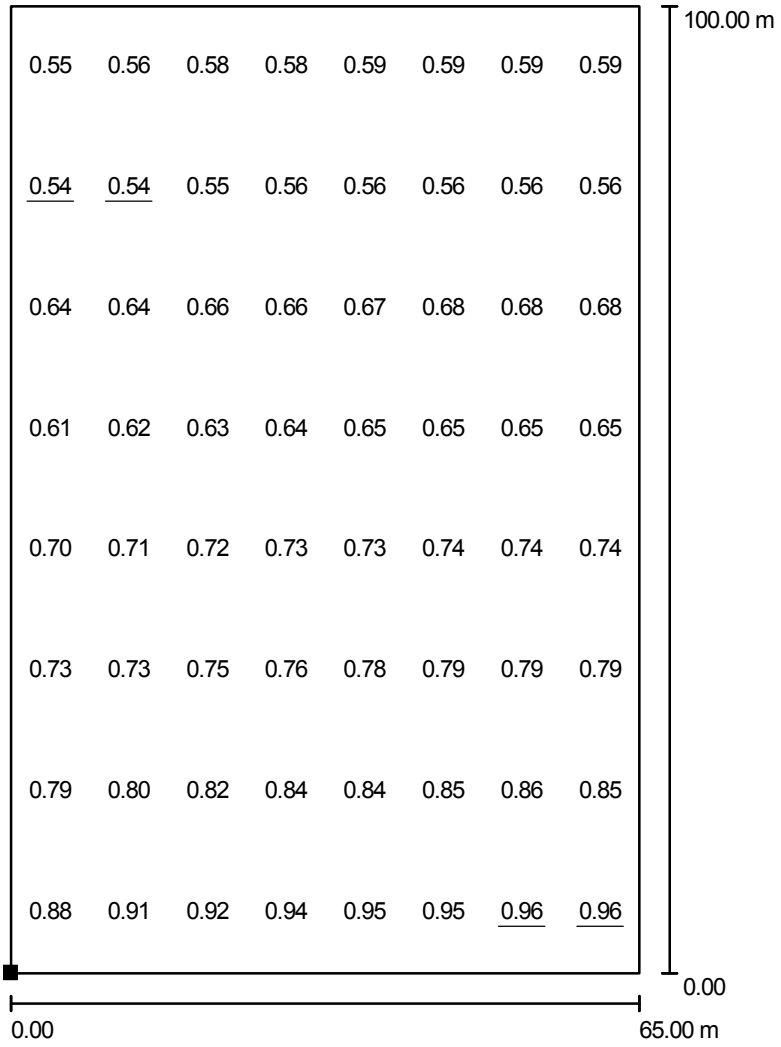


Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.68	0.49	0.92	0.730	0.534

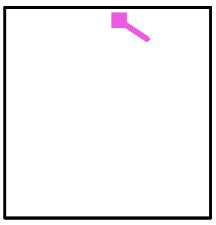
Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / Wong Chuk Hang Garden / face to Ocean Park / Value Chart (E)



Values in Lux, Scale 1 : 782

Position of surface in external scene:
Marked point:
(164.243 m, 419.709 m, 0.000 m)



Grid: 8 x 8 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.71	0.54	0.96	0.757	0.560

Operator
Telephone
Fax
e-Mail

Lagoon Show / Normal / Country Villa / face to Ocean Park / Value Chart (E)

0.47	0.49	0.50	0.51	0.50	0.51	0.52	0.53	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53
0.46	0.47	0.48	0.49	0.48	0.50	0.50	0.51	0.50	0.51	0.51	0.51	0.50	0.51	0.51	0.51
0.49	0.50	0.52	0.53	0.52	0.53	0.53	0.54	0.53	0.54	0.53	0.54	0.53	0.54	0.54	0.54
0.48	0.49	0.50	0.51	0.50	0.51	0.51	0.52	0.51	0.52	0.51	0.51	0.51	0.51	0.51	0.52
0.56	0.57	0.58	0.59	0.58	0.59	0.59	0.60	0.57	0.58	0.57	0.58	0.55	0.56	0.55	0.56
0.54	0.55	0.56	0.57	0.56	0.57	0.57	0.58	0.55	0.56	0.55	0.55	0.53	0.53	0.53	0.53
0.58	0.58	0.60	0.61	0.60	0.61	0.61	0.62	0.60	0.61	0.60	0.61	0.58	0.58	0.57	0.57
0.57	0.57	0.59	0.60	0.58	0.59	0.59	0.60	0.58	0.59	0.58	0.58	0.56	0.56	0.55	0.55
0.64	0.65	0.65	0.66	0.66	0.66	0.66	0.67	0.65	0.66	0.65	0.65	0.62	0.62	0.60	0.60
0.63	0.64	0.64	0.65	0.64	0.65	0.65	0.65	0.63	0.64	0.63	0.63	0.60	0.60	0.57	0.57
0.69	0.69	0.70	0.71	0.71	0.71	0.71	0.71	0.69	0.69	0.69	0.69	0.65	0.65	0.62	0.62
0.68	0.68	0.69	0.69	0.69	0.69	0.70	0.70	0.68	0.68	0.67	0.67	0.63	0.63	0.60	0.60
0.76	0.77	0.78	0.78	0.78	0.79	0.78	0.78	0.77	0.77	0.75	0.74	0.71	0.71	0.67	0.67
0.75	0.75	0.77	0.77	0.77	0.77	0.77	0.77	0.75	0.75	0.75	0.74	0.69	0.69	0.65	0.65
0.85	0.87	0.86	0.88	0.86	0.87	0.87	0.87	0.85	0.84	0.82	0.82	0.78	0.77	0.75	0.74
0.87	0.89	0.90	0.92	0.90	0.92	0.92	0.92	0.89	0.89	0.89	0.89	0.85	0.83	0.78	0.77

100.00 m

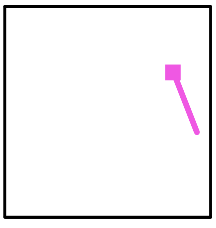
0.00

0.00

127.00 m

Values in Lux, Scale 1 : 908

Position of surface in external scene:
Marked point:
(272.471 m, 312.912 m, 0.000 m)



Grid: 16 x 16 Points

E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0	E_{min} / E_{max}
0.64	0.46	0.92	0.723	0.500

Annex D

Calculation of Maximum Allowable Veil Luminance

CSA (M&E) Limited
Calculation Sheet

Project:	Ocean Park Glare Impact Assessment			**File Ref:**	1329/Calc/Veil_Lum
Service :	Electrical	**Initial :**	TL	**Date :**	8/12/2009
Checked By :	BP	**Dated :**	09/02/2010		

To Calculate the Maximum Allowable Veil Luminance for a Limited Threshold Increment of 15% :

1. Parameters and Assumptions:

Consider a Flat located at the sensitive receivers with interior illuminance level of 200 lux
Relative illuminance at wall = 0.5 of work plane
Wall Reflectance = 0.5
Maintenance factor = 0.8

2. To calculate the wall luminance:

Illuminance Level at work plane = 200 Lux
Wall Reflectance = 0.5
Wall illuminance (Eav) = 0.5 x 200 Lux = 100 Lux

$$\text{Wall Luminance} = \frac{R \times Eav}{p} = \frac{0.5 \times 100}{3.1416} = 15.9 \quad cd/\ m^2$$

Where:
R = Reflectance of the wall
Eav = Illuminance level in Lux

3. To calculate the maximum allowable veil luminance for a limited threshold increment of 15%:

$$\text{Threshold Increment (\% T.I.)} = 15 = \frac{95 \times Lv}{(L/\ MF)^{1.05}}$$

$$15 = \frac{95 \times Lv}{(15.9/\ 0.8)^{1.05}}$$

$$Lv = 3.644 \quad cd/\ m^2$$

Where:
Lv = Veil Luminance in cd/m^2
L= Background Luminance (Wall luminance)
MF = Maintenance Factor

I.E. The veil luminance shall be limited to 3.644 cd/m^2 for 15% threshold increment with 200 Lux interior lighting arrangement at the sensitive receivers assumed.