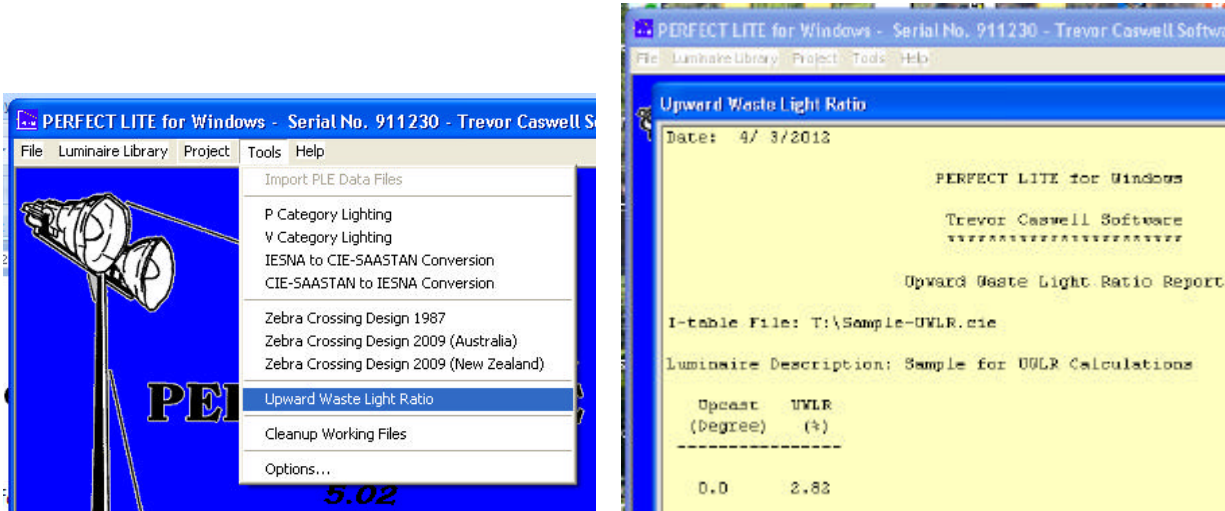


Upward Waste Light Ratio

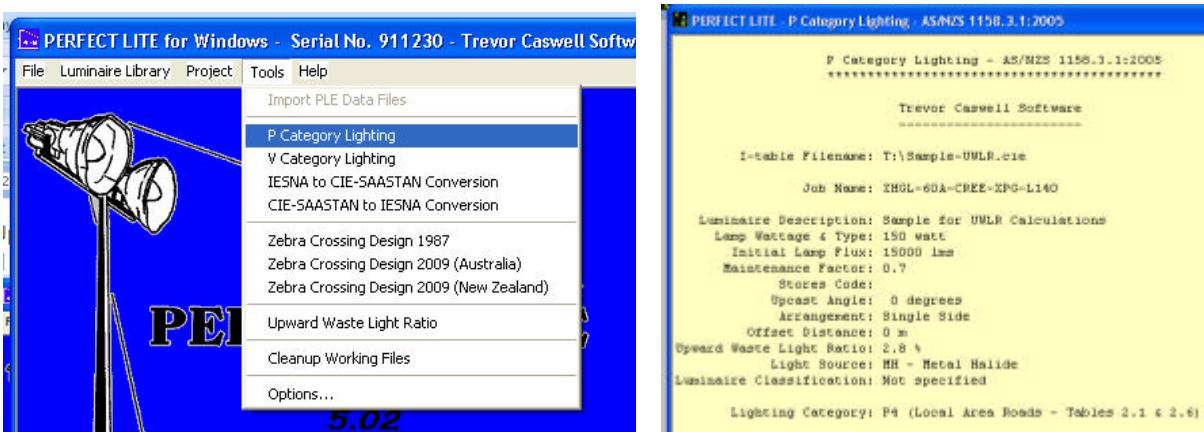
Results differ between Perfect Lite & Photometric Toolbox

Perfect Lite for Windows can calculate the Upward Waste Light Ratio (UWLR) in several modules, namely:-

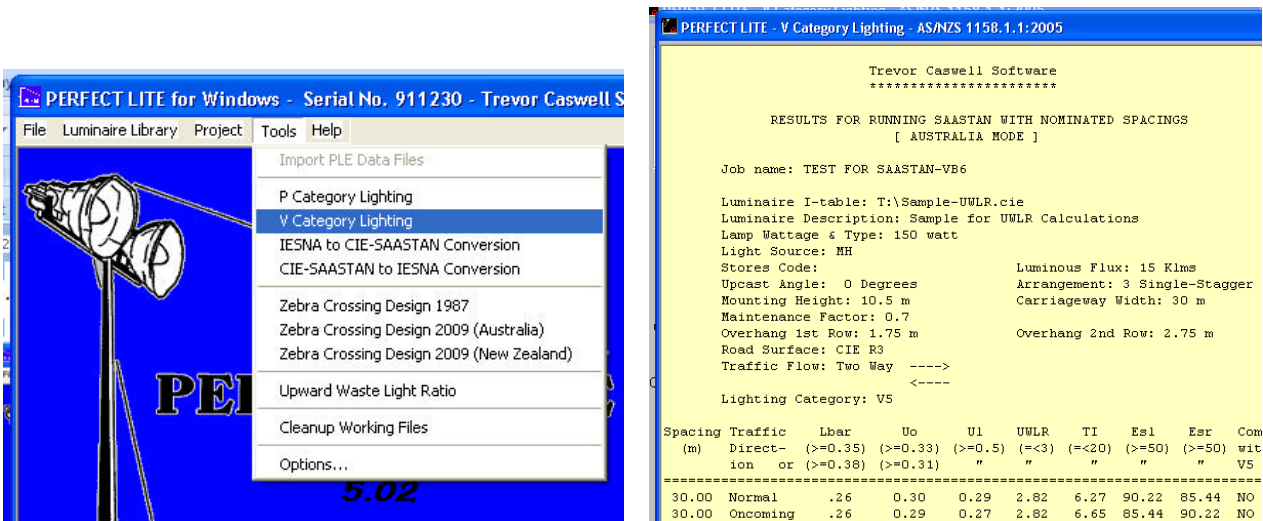
1. Upward Waste Light Ratio



2. P Category



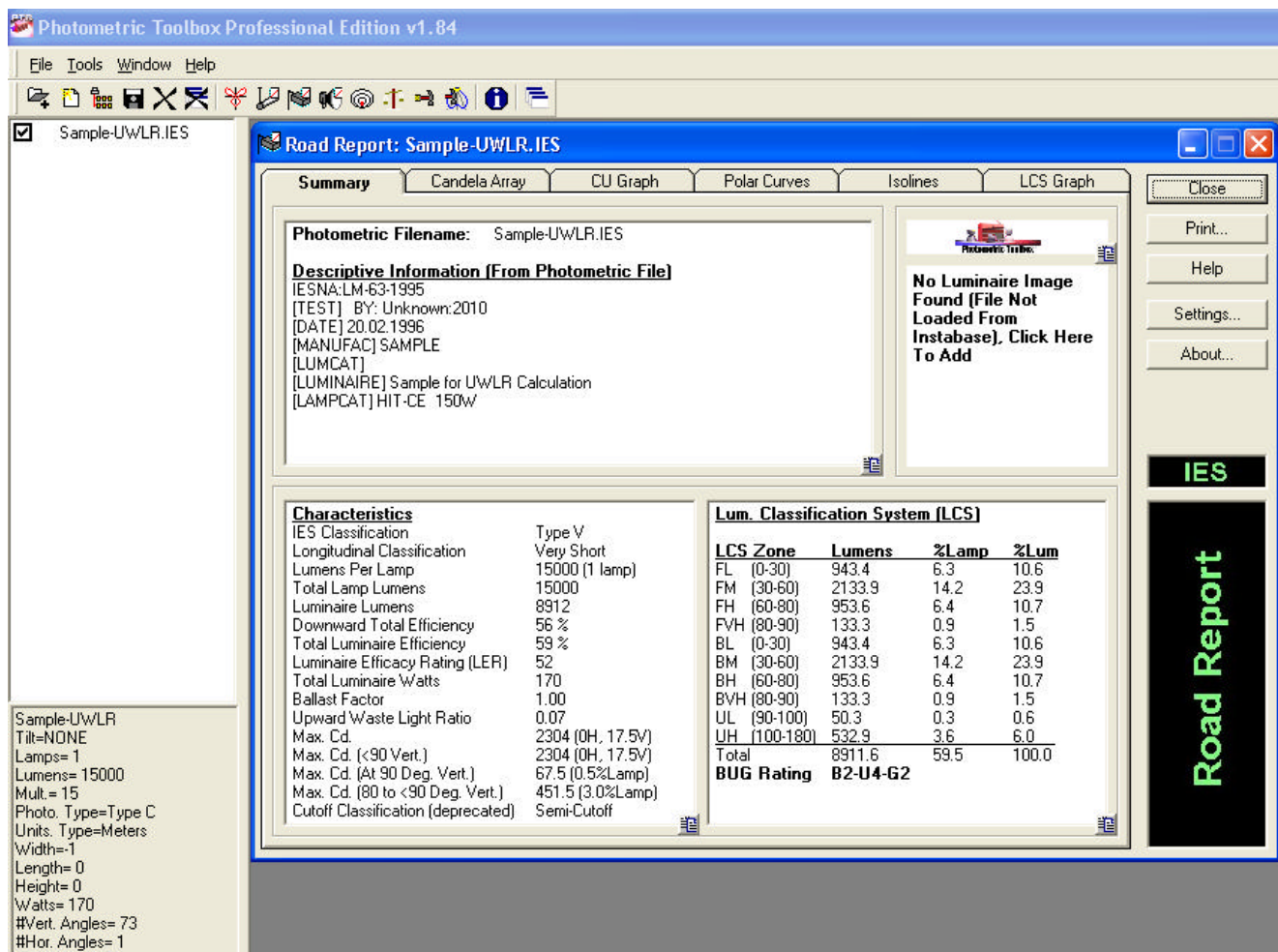
3. V Category



As can be seen, the UWLR result from all these modules is essentially the same (except for the number of decimal places) as they are all based on the CIE/SAASTAN photometric i-table format.

The **Photometric Toolbox** program, by Lighting Analysts Inc., can use several different photometric i-table formats (eg. IESNA, Elumdat, CIBSE etc.) to calculate UWLR but NOT the CIE/SAASTAN photometric i-table format.

In Photometric Toolbox, using a sample IESNA photometric i-table file from which the CIE/SAASTAN file used above is derived gives the following results. For convenience, a totally symmetrical luminaire (Horizontal plane) has been used.



As can be seen the UWLR is '0.07' which when multiplied by '100' gives '7%'.

Why are the results different?

Why does the CIE/SAASTAN i-table format calculate UWLR as 2.8% and Photometric Toolbox as 7%. The reason lies in the extent of data included in the i-table file themselves. Below is the sample IESNA i-table:-

```

IESNA:LM-63-1995
[TEST] BY: Unknown:2010
[DATE] 20.02.1996
[MANUFAC] SAMPLE
[LUMCAT]
[LUMINAIRE] Sample for UWLR Calculation
[LAMP CAT] HIT-CE 150W
TILT=NONE
1 15000 15 73 1 1 2 -1 0 0
1.00 1.00 170
0 2.5 5 7.5 10 12.5 15 17.5 20 22.5 25 27.5 30 32.5 35 37.5 40 42.5 45 47.5
50 52.5 55 57.5 60 62.5 65 67.5 70 72.5 75 77.5 80 82.5 85 87.5 90 92.5 95
97.5 100 102.5 105 107.5 110 112.5 115 117.5 120 122.5 125 127.5 130 132.5
  
```

135 137.5 140 142.5 145 147.5 150 152.5 155 157.5 160 162.5 165 167.5 170
172.5 175 177.5 180

0
139.4 139.9 138.4 139.4 143.7 148.7 152.2 153.6 153.5 152.2 150.6 148.8 146.6
144.2 141.7 138.8 135.7 132.1 128.3 124.2 119.6 114.3 108.5 102.3 95.0 87.5
79.5 71.3 62.6 54.3 45.9 37.9 30.1 22.6 15.8 9.6 4.5 2.5 2.6 3.0 3.9 5.3 7.8
12.0 18.9 29.3 41.3 16.2 2.1 0.8 0.7 0.5 0.4 0.3 0.3 0.3 0.3 0.3 0.3 0.3
0.4 0.4 0.5 0.5 0.6 0.7 0.8 0.9 0.9 0.9 1.0 1.0

Basically, the red lines are the vertical angles and green lines intensity data at these angles in Candelas (coincidentally these values equate to Candelas per 1000 lamp lumens). As can be seen the angles range from 0° to 180° in 2.5° increments. The actual intensity data is to 1 decimal place.

Below is the sample CIE/SAASTAN i-table (converted from the above IESNA i-table):-

1	1	0	Sample for UWLR Calculations															
139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	
139	139	139	139	139	139	139	139	139	139	139	144	144	144	144	144	144	144	
144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	
144	144	144	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154	
154	154	154	154	154	154	154	154	154	154	154	154	154	154	147	147	147	147	
147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	
147	147	147	147	147	147	142	142	142	142	142	142	142	142	142	142	142	142	
142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	136	
136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	136	
136	136	136	136	136	136	136	136	136	136	128	128	128	128	128	128	128	128	
128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	
128	128	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124	
124	124	124	124	124	124	124	124	124	124	124	124	124	120	120	120	120	120	
120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	
120	120	120	120	120	114	114	114	114	114	114	114	114	114	114	114	114	114	
114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	109	109	
109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	109	
109	109	109	109	109	109	109	109	109	102	102	102	102	102	102	102	102	102	
102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	
102	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	
95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	
88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	
88	88	88	88	80	80	80	80	80	80	80	80	80	80	80	80	80	80	
80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	71	71	
71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	71	
63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	
54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	
54	54	54	54	54	54	54	54	54	54	54	46	46	46	46	46	46	46	
46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	
46	46	46	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	
38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	
30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
30	30	30	30	30	30	23	23	23	23	23	23	23	23	23	23	23	23	
23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	16	
16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	
16	16	16	16	16	16	16	16	16	16	10	10	10	10	10	10	10	10	
10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
10	10	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	3	3	
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	8	8	8	8	
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
8	8	8	8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

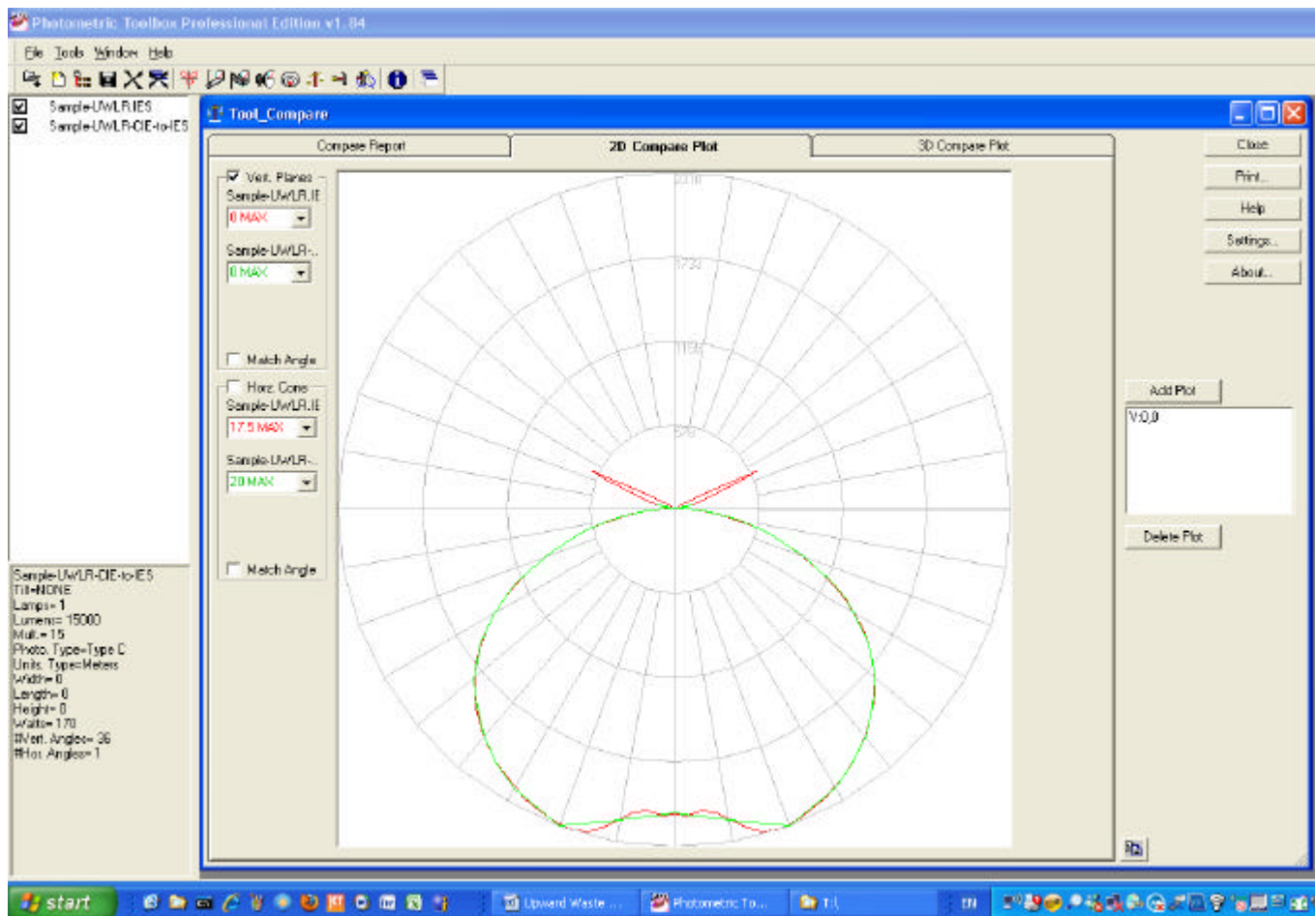
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1	1	1													

The look of this i-table is quite different to the IESNA one. Except for the first line of the file, all the numbers are intensity values in Candelas per 1000 lamp lumens at pre-defined horizontal and vertical angles. The intensity data values are to zero decimal places. The pre-defined angles in the vertical plane are:

0° to 30° (in 10° steps); 30° to 45° (in 5° steps); 45° to 105° (in 2.5° steps); 105° to 180° (in 15° steps);

This is quite different to the IESNA angle increment of a consistent 2.5°.

Below is a part 2D intensity comparison plot from Photometric Toolbox showing the IESNA (red line) and CIE/SAASTAN (green line) i-tables.



As can be seen there is a marked 'spike' on the IESNA plot above the horizontal at approx. 125° in the vertical plane. This spike in intensity is not picked up in the CIE/SAASTAN i-table as its angles are only at105°, 120°, 135°, 150°....

Hence, the differing UWLR values from the two programs. In this example, Photometric Toolbox gives a higher value of UWLR than Perfect Lite. *It should be noted that the distribution of light from different manufacturers/makes/models of luminaires can vary significantly and there will be cases where there are no such spikes or spikes DO coincide with CIE/SAASTAN angles. In these cases, the variation between UWLR results would be much less or insignificant.*

Which result should be used in your lighting design?

The AS/NZS 1158 series of road lighting Standards requires (for compliance) the use of photometric data i-tables in the CIE 132 format, see Clause 4.3.3 of AS/NZS 1158.2:2005. This is the format used in Perfect Lite.

Therefore, in my opinion, for any road lighting calculations in Australia & New Zealand the results from the CIE/SAASTAN i-table must be used.

I would like to acknowledge the assistance given by Robert Rich (Sylvania Lighting Australasia) and Andrew Gale (Brisbane City Council) in arriving at this explanation.

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