

Essential products for the professional firework display and explosives industry

We have developed products to allow the professional display industry to make sensible and scientifically based estimations of several major issues currently affecting the fireworks display industry and more generally, the explosives industry. The products are designed to assist in planning and legal compliance issues, and to help provide objective decision making criteria, in particular in terms of contingency planning for displays and environmental issues. These tools have been developed alongside our work on some of the major firework displays around the world and are now available to the wider firework community. All are available for purchase on a time limited or perpetual subscription.

Each of these products is based on Microsoft Excel – for simplicity of use and flexibility in developing new additions

- **ShellCalc®** - a trajectory and fallout modelling tool for firework displays
- **EnvCalc®** - for determining the environmental impact of a display
- **SoundCalc®** - for determining sound levels at distances from ground or aerial fireworks
- **PlumeCalc®** – for smoke plume modelling of explosives sites – particularly for CoMAH safety reports
- **LicenceCalc®** – for initial plotting of “Separation distances” for UK Local Authority of HSE licences

CarnDu Ltd also offer bespoke calculations for events or venues – please contact us for further details

For more information please contact

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w: www.carndu.com

www.facebook.com/shellcalc

www.facebook.com/envcalc

www.facebook.com/plumecalc

www.facebook.com/licencecalc

www.facebook.com/soundcalc

And for more details on the courses we offer

www.pyroworkshops.com



ShellCalc© Pro - a trajectory and fallout modelling tool

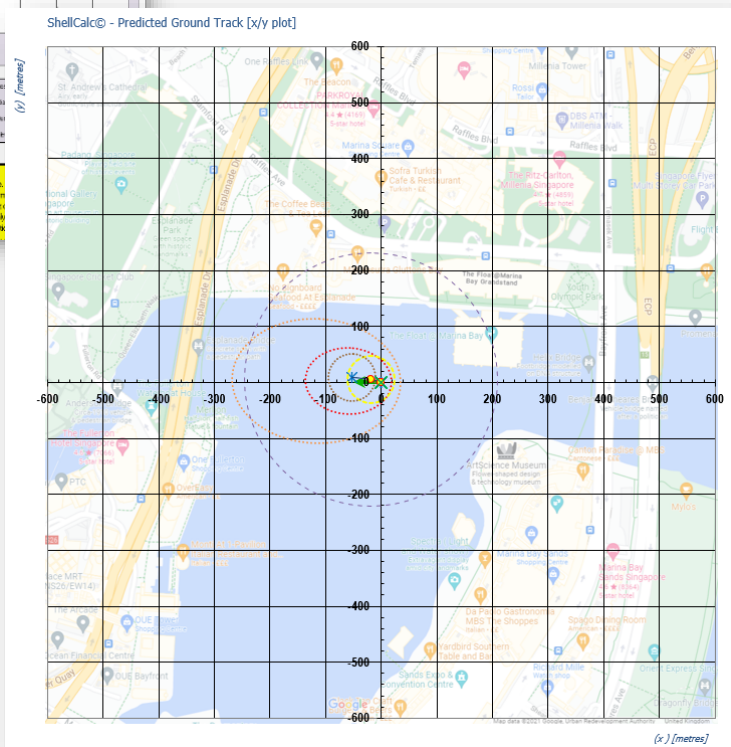
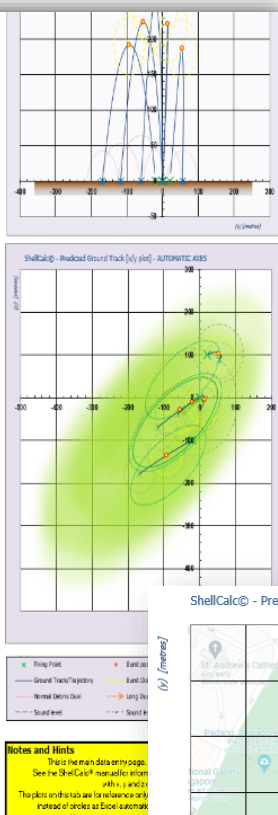
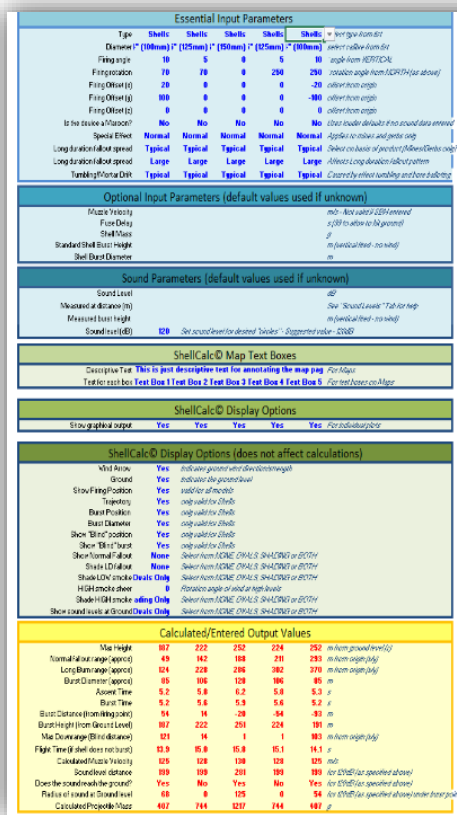
ShellCalc® Pro allows realistic modelling of both the trajectories of a variety of fireworks and their fallout/debris patterns depending on firing angles, wind strength and direction.

- Model 5 launch sites or angles simultaneously
- The effect of wind on fallout/debris and in particular contingency planning
- New “Tablet friendly” page for small screens – particularly useful on site
- Demonstrating Low Hazard/High Frequency and High Hazard/Low Frequency risks and the importance of considering both
- Help determining what is a “Safety” distance
- A new feature to show noise impact at ground level
- Optional display of smoke at Low or High levels



A free version – ShellCalc© Standard – is available but the functionality is limited and we do not recommend it for professional display companies. The Standard version will not be developed further.

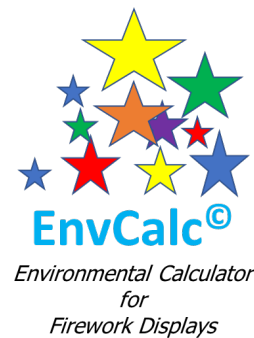
See <https://www.dropbox.com/s/uibfehbbwdezxyr/ShellCalc.mp4?dl=0>



Environmental calculator – EnvCalc© - the Environmental calculator - an environmental impact tool

EnvCalc© has been developed to quantify the environmental impact of displays following several very high profile events when the anti-firework lobby has been vocal in condemning firework displays as highly polluting. The calculator considers:

- The chemical by-products of combustion and their environmental impact
- The use of the tool to calculate the amount of combustion by-products released
- Comparison with other event aspects such as travel of the crowd to the display, Importation and transport of fireworks, Display equivalence in terms of power generation, use of drones etc
- Plotting of simple smoke plume



See <https://www.dropbox.com/s/x4fqhmfdbfwu211/EnvCalc.mp4?dl=0>

EnvCalc© is now available in several languages for the basic Input/Output page – including Spanish, French, Italian, German and Dutch.

Environmental Calculator for firework displays v2.0h

Mandatory Inputs (enter values in BLUE cells)

Display Name **ADME Manufacturing**

Display Date **12/08/2020**

Display NEC **6621g**

Distance driven to display **100** km

Length of display **5** minutes

No of people expected **5000**

Average travel distance for spectators **50** km

Optional Inputs (enter values in BLUE cells)

Distance from port to magazine (km) **100**

Distance from factory to port (km) **100**

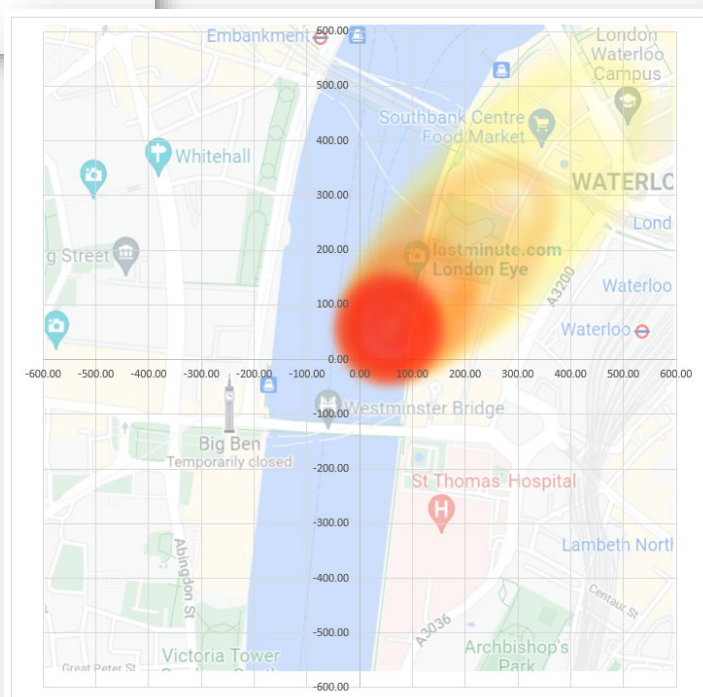
Distance by sea to UK (km) **10000**

Licensed - CamDu (Test)

For more information please visit following websites:
<http://www.camdu.com>
<http://www.shifukub.com>
<http://www.firework.com/india>

Outputs

	Gases			Solids		
	CO2 + CO	NO2	SO2	total	PM10 (Note 1)	PM2.5 (Note 1)
Total produced from factory to UK (import) (kg)	456.02	388.80	288.34	273.13	5.3483	2.6903
Total produced for transport to/from display (kg)	46.81	81.73	58.68	285.18	0.2028	0.1008
Total produced in display itself (kg)	350.48	11.57	25.7	348.25	22.4999	9.7246
Total produced by spectators travel (kg)	444.75	36.38	26.54	487.27	34.7369	2.8550
TOTAL FOR EVENT	2987.54	387.89	329.88	856.77	58.3888	15.6697
% import	6.46%	14.93%	25.21%	52.08%	6.59%	17.40%
% transport to display	0.66%	15.47%	15.83%	3.45%	0.35%	0.67%
% display	2.12%	2.89%	0.79%	58.82%	32.88%	8.14%
% spectators	50.78%	6.79%	8.17%	5.68%	57.84%	38.97%
TOTAL FOR EXPORT	186.09%	186.09%	186.09%	186.09%	186.09%	186.09%
% display for export only	2.20%	26.34%	0.84%	38.13%	26.42%	9.89%
% spectators for export only	67.31%	68.43%	81.15%	8.67%	61.77%	21.17%
TOTAL FOR EXPORT ONLY	188.06%	188.06%	188.06%	188.06%	188.06%	188.06%
Fraction of display itself compared to spectators	3/42.75	3/72.77	3/10.52	3/10.69	3/7.79	3/7.5
Number of km driven by a car to equate to the display	1185	42887	6526	38812	460399	460399
Concentration in display area (ug/m3)	41023	11348	2572	108232	1841	9722
EU air quality limits (ug/m3)	10000	300	150	30	30	75
(CO only - 2 hours)	(2 hours)	(2 hours)	(2 hours)	(24 hours)	(24 hours)	(24 hours)
Generation rate (g/s)	113.66	28.13	5.9	196.69	40.57	20.26
Carbon equivalent (minuting) to 800Gt generation	231.40	For display only	For overall event	10401.40		
No of trees to plant for display itself (carbon offset)	0.5					
No of trees to plant for overall event (carbon offset)	25.4					



PlumeCalc© - the smoke plume modelling tool for explosives sites

PlumeCalc© is a smoke plume model tailored specifically for explosives sites.

Most smoke plume modelling has been done for chemical sites or similar where the emissions are effectively 24 hours a day, 365 days a year. As a result these models plot the output of smoke for a variety of meteorological conditions and reflect the constant emission of pollutants, both gaseous and solid.

Thankfully, explosives events at manufacturing and storage sites are very rare – and although it is useful to model, perhaps, both the “most likely” and “worst case” scenarios at a particular site (given the prevailing wind and the proximity and location of offsite areas that could be affected by an explosive event) what is more important in many ways is the ability to quickly plot those areas that would be affected immediately affected by any such event in order to react appropriately both in the short term immediately following the event, and in terms of clean up afterwards.

PlumeCalc© has been specifically designed for both planning (eg in a CoMAH safety report) and immediately post event to inform emergency services and other Government authorities (eg the Environment Agency).

We are still working on input parameters but at present these include:

- Storage types – eg Mixed explosives, High explosives (with or without heavy metals), AN based, Mixed fireworks or Manually entered
- Total NEC involved
- Wind speed and direction as well as Precipitation – to calculate deposition of soluble materials



PlumeCalc©

*Smoke Plume Calculator
for
Explosives Sites*

Smoke plume calculator for explosives sites v2022c

Licensed - CarnDu (Test)

Mandatory Inputs (enter values in BLUE cells)

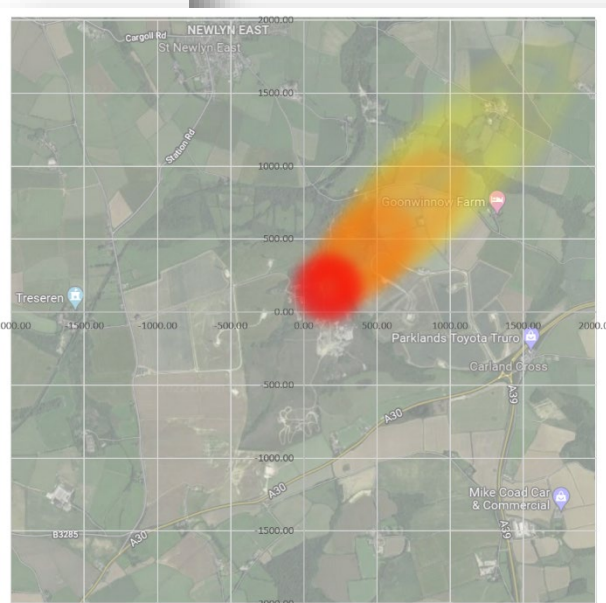
Site Name	Newlyn Downs (Redcliffe)	for reports etc
Model Date	20/02/2022	enter in dd/mm/yyyy format
NEC	25000 kg	
Storage Type	Mixed Storage (typical)	Explosives held

Notes
This is for a single magazine assuming any communication between magazines does not occur

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PlumeCalc©
*Smoke Plume Calculator
for
Explosives Sites*



PlumeCalc© will then calculate the approximate breakdown of combustion byproducts and also plot a smoke plume on an imported map or satellite image to display areas that are likely to be affected.

LicenceCalc© - applying UK Q/D relationships to explosives sites

Explosive site licencing at Local Authority (LA) or HSE licenced sites is based on maintaining "Separation Distances". These separation distances depend on a variety of factors including:-

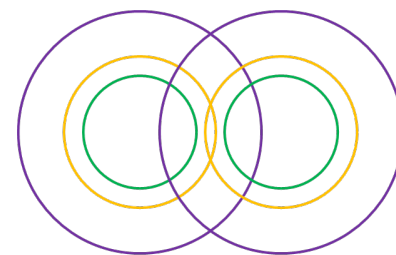
- Quantity of explosive held
- Hazard Type (HT) of the explosives
- Building construction

It is often a daunting and complicated task for the operator of a site to visualise these separation distances, and to be able to manipulate the quantities and types held in order to maximise (or at least optimise) the quantity of explosives held.

The Explosive Regulations 2014 (ER2014) require certain distances to be maintained both onsite (eg between buildings on site – whether they also hold explosives or not) and offsite (eg to roads, inhabited buildings etc).

When a licence needs to be updated (a "variation") these same factors have to be taken into consideration.

LicenceCalc© allows you to enter these values and plots "circles" on maps or satellite images to assist in planning or making alterations to a site. It plots both "outside" and "inside" separation distances and assists in the process of applying for a new licence or a variation.



LicenceCalc©
Explosive Licencing Tool

Explosives Licence Calculator v103

Enter data in BLUE cells only

Building No	Building Ref	Type	UK2014 Table used	Calculated Distances from ER2014				Building Position from Origin		Calculated "Circles"			
				Quantity	Class B	Class D	Class E	X (m)	Y (m)	Class B	Class D	Class E	Show
1	M1	M11 Brick Build Mounted	Table 1	2000	114	281	434	0	0	17	126	293	470
2	M2	M11 Brick Build Unmounted	Table 2	3000	223	444	708	0	0	17	239	454	584
3	M3	M113 Lany design	Table 10	20000	86	172	258	-150	30	18	106	150	250
4	M4	M114 Lany design	Table 11	30000	90	180	270	-100	20	20	90	180	270
5	M5	M115 Mounted (c.c. rig)	Table 5	400	112	224	336	-200	-200	20	112	224	336
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Show Class B "circles" - Green ☐

Show Class D "circles" - Yellow ☐

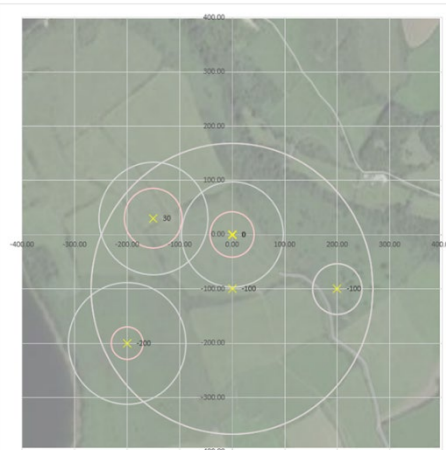
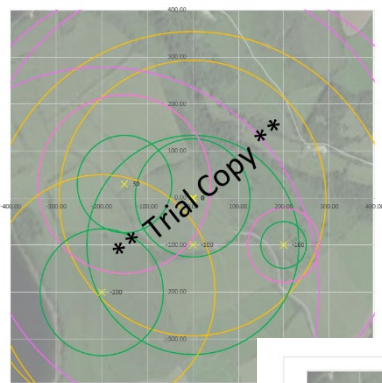
Show Class E "circles" - Purple ☐

Notes

1. Select Hazard Type and building type from dropdown
2. Enter quantities and building position (metres from origin)
3. Enter maximum distance from centre of building to outermost wall - this is used to calculate "circles" for plotting
4. The relevant ER2014 Table number is displayed

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SoundCalc© Pro – noise planning for ground or aerial fireworks

As noise production is becoming an increasing concern, and the ability to demonstrate that systems are in place (but choice of materials etc) to minimise sound impact and properly calculate what sound level impacts the ground (and audience and wildlife). SoundCalc© Pro also will find application for indoor venues and stage effects.

The program also outputs numerically and allows calculation of distances required to achieve a particular sound level. This new calculator was designed to show sound levels super-imposed onto a map but is equally useful for other noise generators such as:-

- Theatrical devices
- Other indoor sound generation
- War gaming sound levels



Sound Level Calculator for firework displays v104

Company Name: Trial (limited functions)
Venue: Helston
Date: 21/02/2022

Aerial noise

Enter the measured (or provided) noise levels and the measured distance along the Horizontal axis (see HELP)
Then enter the new distance to get the calculated sound level at that distance
Also calculated is the Horizontal Distance needed to achieve various sound levels from 88dB to 134dB

Given level (db)
at distance measured at ground level (H_g) (m)
at height of burst (H_b) (m)
Effective distance from measurement to source (H_e) (m)
New distance (m)
Sound level at that distance

Desired sound level	88	90	92	94	96	98	100	102	104	106	108	110
Distance needed to achieve that level (H _g) (m)	1176	934	742	589	468	372	295	235	186	148	118	93
Distance along ground to achieve level (H _g) (m) (Note 5)	1172	930	736	582	459	361	281	217	163	118	76	25

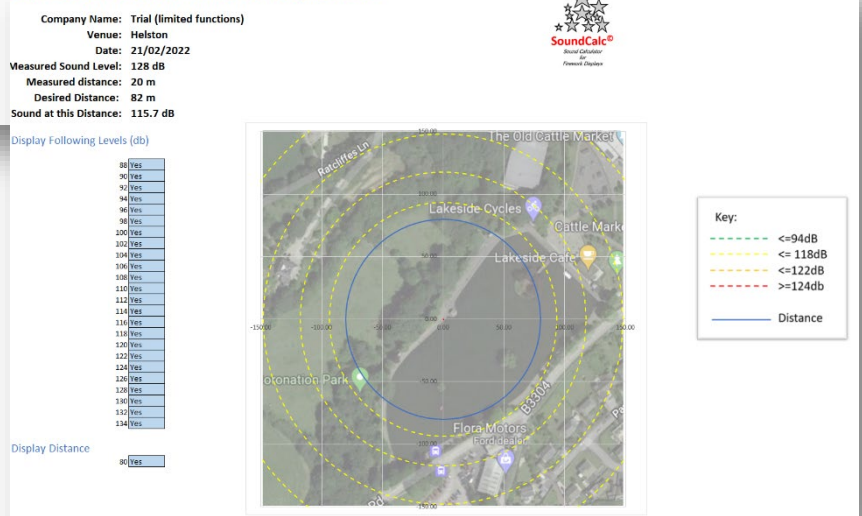
Desired sound level	112	114	116	118	120	122	124	126	128	130	132	134
Distance needed to achieve that level (H _g) (m)	74	59	47	37	30	23	19	15	12	9	7	6
Distance along ground to achieve level (H _g) (m) (Note 5)	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!	#NUM!

Notes:

1. The calculations presume no local effects
2. The calculations assume only one firework is producing noise at any one instant
3. The calculations could be used to provide "Safety" areas where the noise level does not exceed, say, 120dB
4. Sound levels and distances can be obtained from measurements and/or the data provided by the manufacturer
5. If #NUM! shows then the height needed is less than the burst height

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Sound Level Calculator for firework displays v104



SoundCalc© Pro allows plotting of simple sound level “circles” on maps in a manner akin to the ShellCalc© sound plotting but applicable to a wide variety of situations.

It can be used for “ground” or “aerial” noise and has user selected “cut-off” line to be displayed on the map.

2022 price list (GBP)

ShellCalc© and EnvCalc© are available as 1 year, 3 year or perpetual licences. As long as the licence is valid software upgrades during the licence period are free. For most companies all you need to pay is the INDIVIDUAL price.

Licence Type	Individual Price (ex VAT) (Note 1)	Individual Price (inc VAT) (Note 1)	Association Deal (ex VAT)	Event/Venue or Enforcer (ex VAT)	Comments
			(Note 2)	(Note 3/4)	
ShellCalc© 1 year	£262.50	£315.00	£210.00	£525.00	
ShellCalc© 3 year	£525.00	£630.00	£420.00	£1,050.00	
ShellCalc© Perpetual	£1,050.00	£1,260.00	£840.00	£2,100.00	
ShellCalc© 1 year Extension	£210.00	£252.00		£420.00	
ShellCalc© 3 year Extension	£420.00	£504.00		£840.00	
ShellCalc© Perpetual extension	£840.00	£1,008.00		£1,680.00	
EnvCalc© 1 year	£131.25	£157.50	£105.00	£262.50	
EnvCalc© 3 year	£262.50	£315.00	£210.00	£525.00	
EnvCalc© Perptual	£525.00	£630.00	£420.00	£1,050.00	
EnvCalc© 1 year Extension	£105.00	£126.00		£210.00	
EnvCalc© 3 year Extension	£210.00	£252.00		£420.00	
EnvCalc© Perpetual Extension	£420.00	£504.00		£840.00	
SoundCalc© Pro 1 year	£131.25	£157.50	£105.00	£262.50	
SoundCalc© Pro 3 year	£262.50	£315.00	£210.00	£525.00	
SoundCalc© Pro Perpetual	£525.00	£630.00	£420.00	£1,050.00	
SoundCalc© Pro 1 year Extension	£105.00	£126.00		£210.00	
SoundCalc© Pro 3 year Extension	£210.00	£252.00		£420.00	
SoundCalc© Pro Perpetual Extension	£420.00	£504.00		£840.00	
PlumeCalc© 1 year	£262.50	£315.00	£210.00	£525.00	
PlumeCalc© 3 year	£525.00	£630.00	£420.00	£1,050.00	
PlumeCalc© Perpetual	£1,050.00	£1,260.00	£840.00	£2,100.00	
PlumeCalc© 1 year Extension	£210.00	£252.00		£420.00	
PlumeCalc© 3 year Extension	£420.00	£504.00		£840.00	
PlumeCalc© Perpetual Extension	£840.00	£1,008.00		£1,680.00	
PlumeCalc© Emergency Access	£600.00	£720.00			Note 5
LicenceCalc© 1 year	£131.25	£157.50	£105.00	£262.50	
LicenceCalc© 3 year	£262.50	£315.00	£210.00	£525.00	
LicenceCalc© Perpetual	£525.00	£630.00	£420.00	£1,050.00	
LicenceCalc© 1 year Extension	£105.00	£126.00		£210.00	
LicenceCalc© 3 year Extension	£210.00	£252.00		£420.00	
LicenceCalc© Perpetual extension	£420.00	£504.00		£840.00	
Software Bundle A 1 year	£367.50	£441.00	£294.00	£735.00	Note 6
Software Bundle A 3 year	£735.00	£882.00	£588.00	£1,470.00	
Software Bundle A Perpetual	£1,470.00	£1,764.00	£1,176.00	£2,940.00	
Software Bundle B 1 Year	£472.50	£567.00	£378.00	£945.00	Note 7
Software Bundle B 3 Year	£945.00	£1,134.00	£756.00	£1,890.00	
Software Bundle B Perpetual	£1,890.00	£2,268.00	£1,512.00	£3,780.00	

Prices valid February 2022 and exclude VAT except where shown

Note 1: You may make copies for different events or different users WITHIN your company. Distribution of software or licence keys to other companies is strictly prohibited. Extension prices are only valid if extension is taken BEFORE existing licence expiry

Note 2: Discounted price only applies if a minimum 10 association members purchase the product at the same time. If there are more than 30 association members purchasing at the same time please consult us for pricing details. Renewals are at the standard rate.

Note 3: This ONLY applies to enforcing authorities, venues or events. Maximum of 10 events or 3 contractors per annum – additional events or contractors charged at individual prices. You DO NOT need to add event costs to individual prices if you are a company

Note 4: We presume enforcers may use the products for a variety of reasons – hence the additional costs. These include: Research, To check against what people submit, To do calculations for a variety of events at a variety of venues, or by a variety of companies at the same venue, Potentially for tendering purposes, Potentially for enforcement purposes

Note 5: We will hold a copy of your PlumeCalc© files in case of incident and run the model at your request

Note 6: Special discounted price for purchasing ShellCalc© and EnvCalc© OR SoundCalc© at the same time. Note renewals are at standard renewal prices

Note 7: Special discounted price for purchasing ShellCalc© AND EnvCalc© AND SoundCalc© at the same time. Note renewals are at standard renewal price

Extensions can only be claimed during the lifetime of your existing licence

Support

We will, of course, assist any user in getting the most from the software.

- In the first month after purchase we will help users with installation or use problems
- We will always welcome requests for enhancements or additional features. We can't always implement them – but we will always consider them
- If, after 1 month, you need additional support we offer the following:-
 - Email queries will be answered as soon as possible – simple queries will be free, if additional work is needed this will be chargeable
 - General queries may also be posted on the relevant Facebook page – so that others can benefit if we identify problems or can show you the best way to get the most from the software (like the ShellCalc© videos we have posted)
 - We can offer telephone support (chargeable)
 - We can offer remote login to your computer to assist (chargeable)
 - We can offer a Teams session where we demonstrate how to overcome a particular issue (chargeable)
- Charges – we will charge you for our time for the items shown as “chargeable” above. At present we charge £50 per hour (ex VAT) in 30 minute slots for any of these functions – minimum £25 (ex VAT)
- If you want us to setup your software using a map and display details and return it to you we will do so on a specific consultancy basis at our normal rates
- If you want us to run all the models for you using information supplied by you we will do so on a specific consultancy basis at our normal rates. We can also prepare contingency tables and reports as needed.

Help with mapping is the most requested issue – we have expanded the user manuals to help with this, and have a video available as well.