

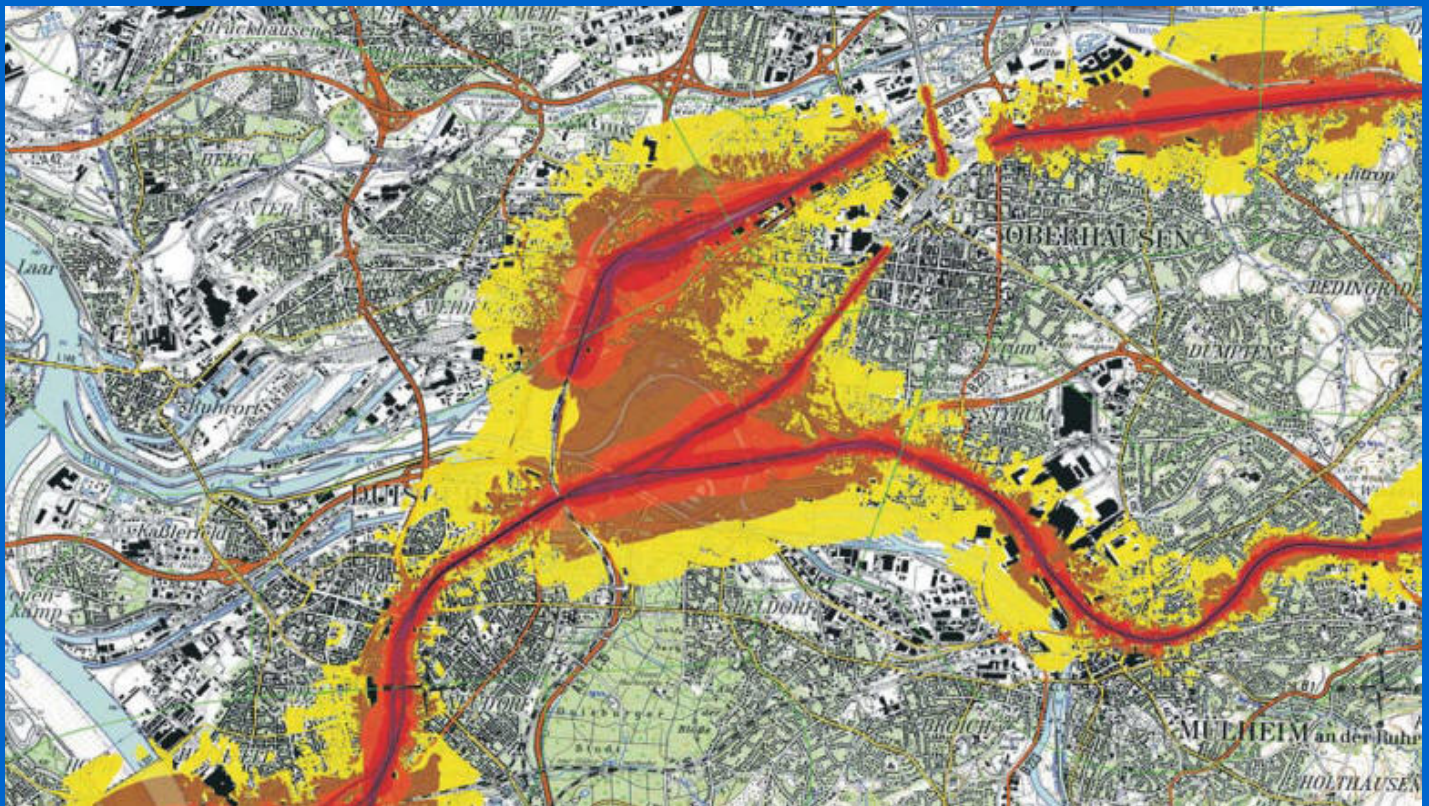


**Sound
PLAN**

SoundPLAN Info #1

February 2012

If you are not a SoundPLAN user and want to experiment with the noise maps, please feel free to download the demo version from our server, ([download SoundPLAN](#)). If you want to use a real version, ask the SoundPLAN rep from your area (the links are located on the right border of this page). If you are already a SoundPLAN user and want to test a module, send us an e-mail and we will supply the setup file for one month.



Noise Map from the END train noise map of the German Eisenbahn-Bundesamt

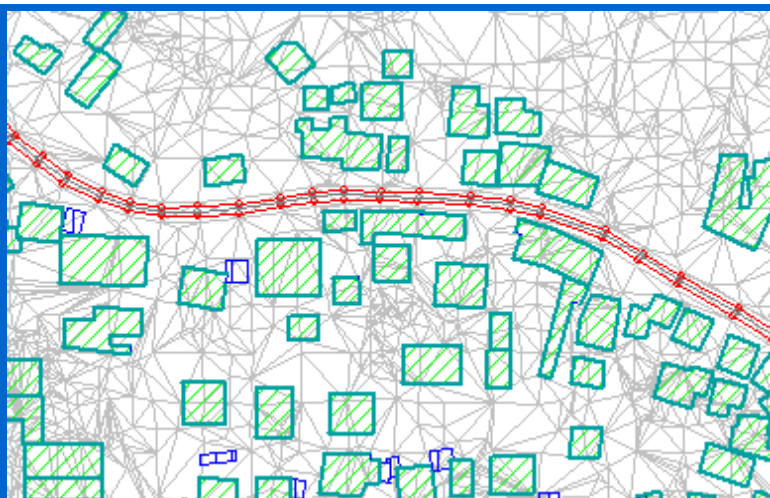


Grid and triangle based noise maps

All noise mapping simulation software packages have facilities to produce noise maps where receivers are arranged in a grid pattern following the terrain in a set height. Most programs also allow to create vertical noise maps. In addition to the grid based noise maps, SoundPLAN offers a noise map based on a triangulation of receivers. As receivers can be freely arranged on the left and right side of noise barriers and along roads and train lines, the quality of the contour lines is superior to the grid based approach.

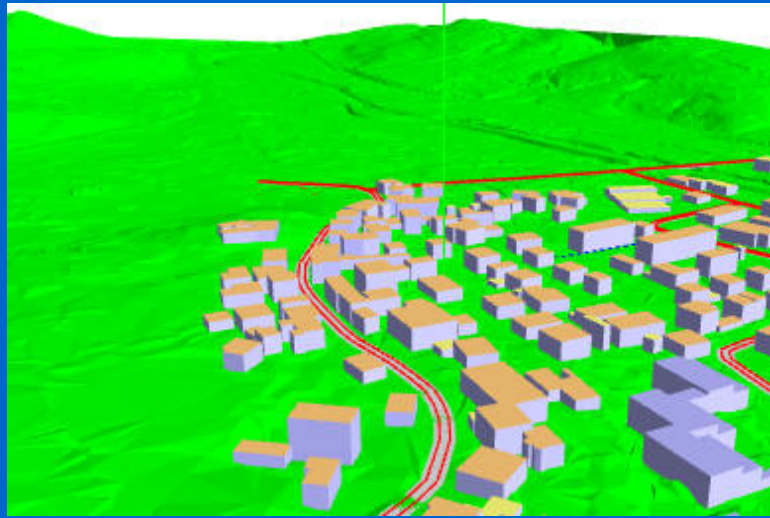
In the picture to the left, the noise map is produced in a 3D solid model which greatly enhances the ability to recognize your city. Facade Noise Maps and Cross-sectional Noise Maps can also be incorporated into the solid model if desired so.

The rest of this overview will show the features of the noise maps and the ways to format them.



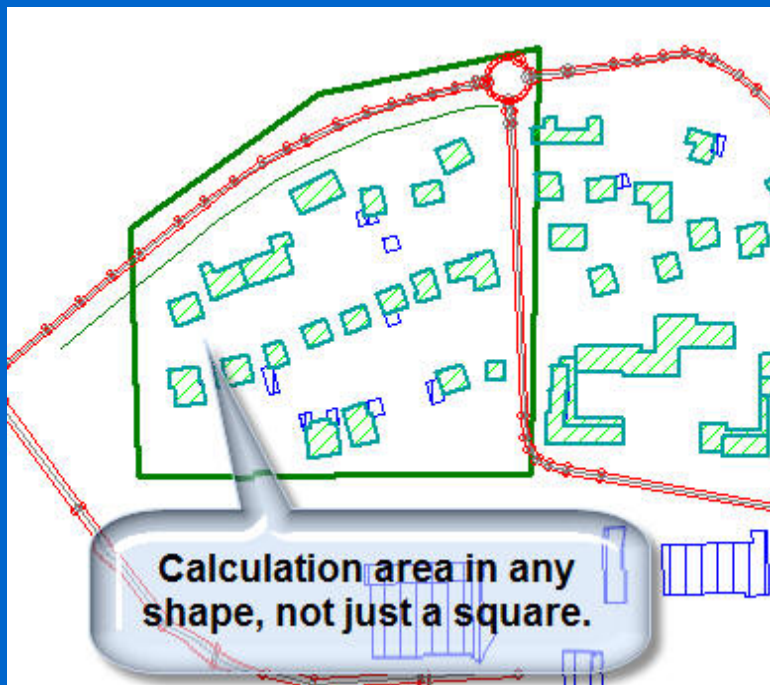
Transparent triangulation to set the height of receivers

Noise maps show the simulated noise at a given height above the terrain, often at 2 meters. The noise maps are based on a fixed grid of receivers with a customary spacing of either 2, 5 or 10 meters (any spacing is possible in SoundPLAN). To set the elevation of all receivers of a Grid Noise Map, a triangulation of all relevant objects is made (spot elevations, elevation lines, roads, buildings...). The triangulation is the same that is used for the elevation



supply in the calculations. These triangulations are part of the "Situation" that is made of relevant objects.

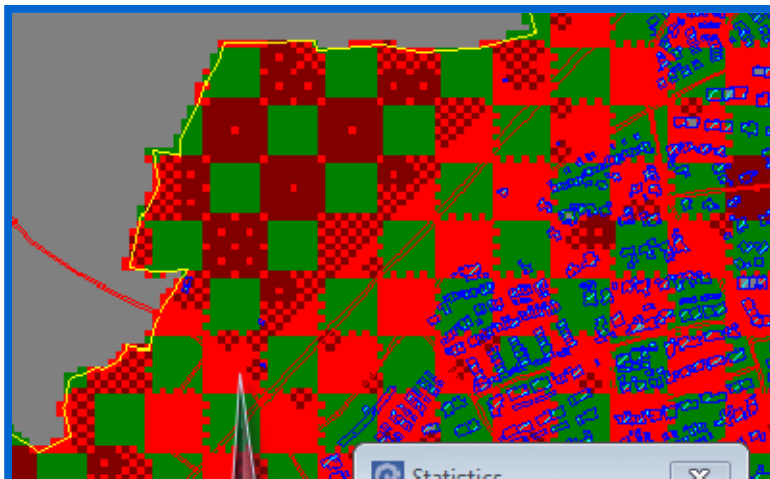
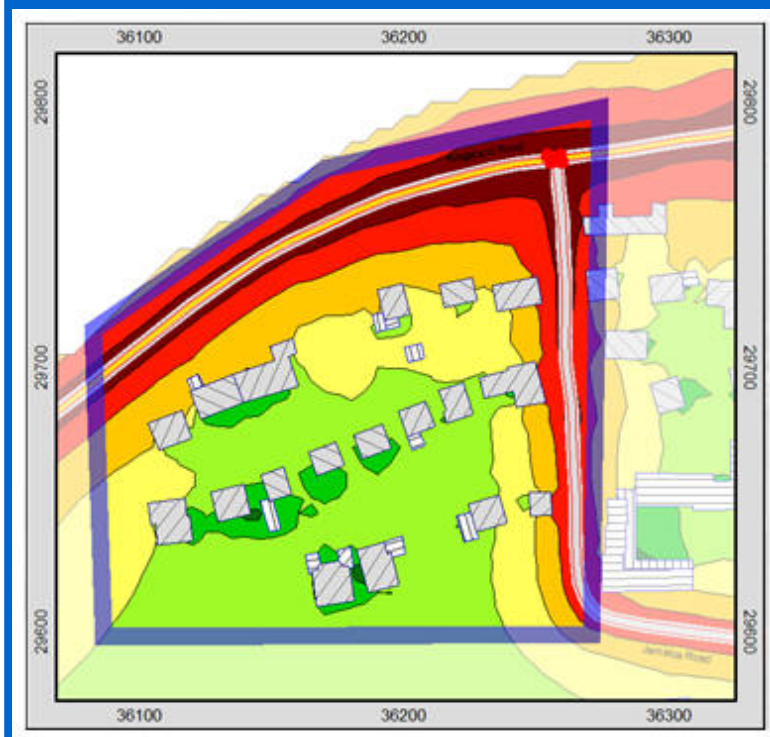
In the Geo-Database and in the Graphics, these triangulations can be checked in 2D and in 3D. If the triangulation doesn't represent the terrain correctly, insert elevation lines or spot elevations to further define the surface. The triangulation follows certain rules, elevation lines, roads, railways and line sources are never intersected by the triangulation to ensure these objects are always on the surface.



Grid versus Calculation Area

Grid Noise Maps have an internal structure of a fixed grid. Multiple Grid Noise Maps share the same origin so it is possible to combine multiple maps to form a single noise map. Receivers for the maps are only calculated when the receiver falls within the selected calculation area. These calculation areas can be shaped at will.

The lower picture depicts an option in the Graphics where it is possible to highlight the calculation area and dampen the rest of the map.



Calculations are organized in squares of 9x9 receivers that are either calculated or interpolated.

Statistics	
<u>Number of points</u>	
Total:	23134
Calculated:	7270
interpolated:	4435
<u>Calculation time about</u>	
Total:	01:43:49 [h:m:s]
So far:	00:52:31 [h:m:s]
remaining:	00:51:17 [h:m:s]

Calculations and Interpolations

Fixed grids with a 5 meter spacing might be appropriate for noise maps in the city; for parts of the noise map away from buildings, sources and obstacles the required density of calculated receivers is much less than a 5 meter spacing would deliver. Therefore SoundPLAN employs a scheme of interpolations within a noise map.

To the left, the squares with green backgrounds are awaiting the calculations and the red squares have already been calculated. Dark red indicates receivers are interpolated, and light red indicates the receiver was calculated.

As a user, you can control the process of interpolation by defining the maximum "spread" in dB that is permitted within a

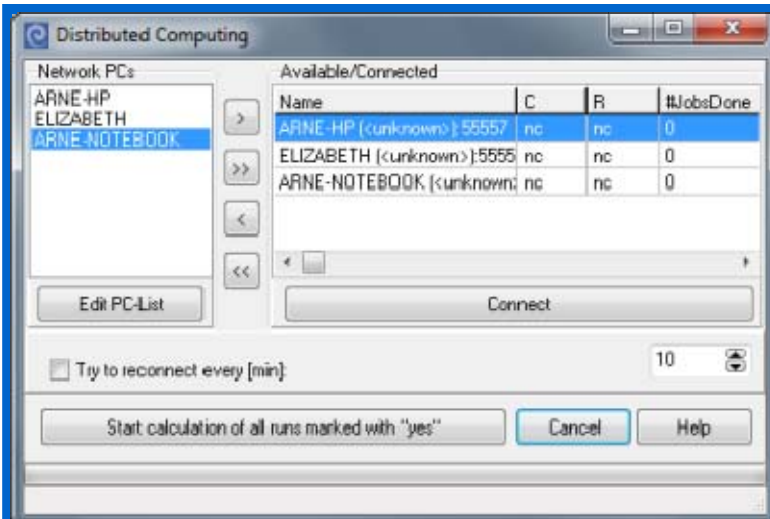
square of 9x9 receivers. You can also define how accurate the middle of a square must be calculated and interpolated in order for the program to interpolate the rest of the receiver points.

The picture to the left indicates 23,134 receivers are present and that 7270 have been calculated and 4435 have been interpolated saving roughly 1/3 of the calculation time without compromising the accuracy of the results. For critical calculations, it is possible to completely de-activate the interpolations.

Distributed Grid Noise Calculations

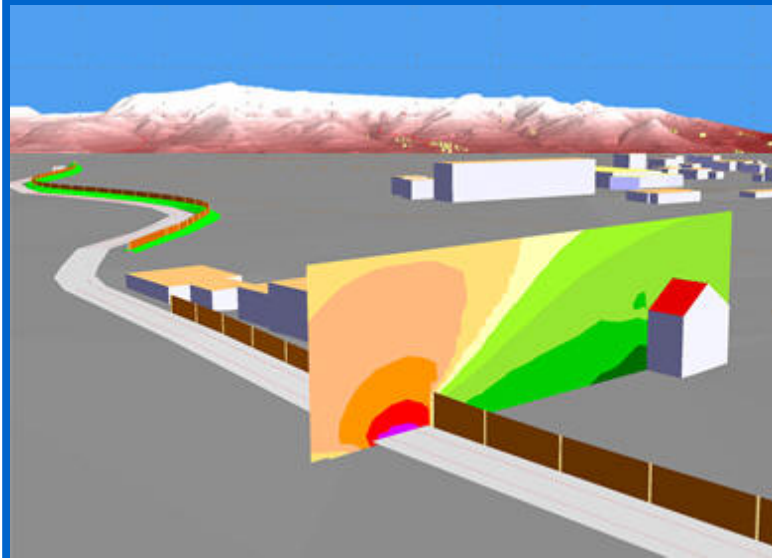
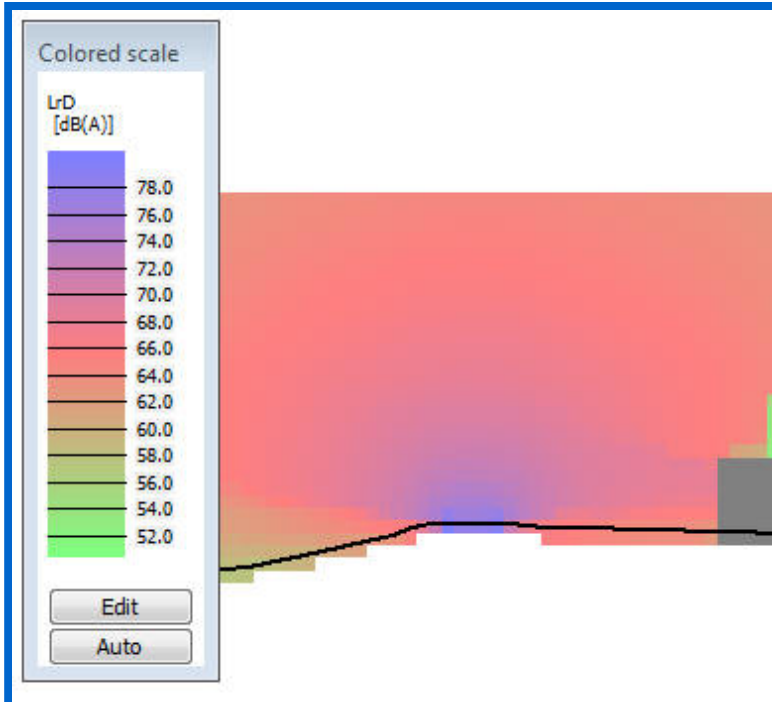
Grid noise maps are time consuming, even for the latest generation of processors. Especially for very big noise maps with hundreds of road and railway sources, it is a big help to share the calculation load among multiple computers. For this reason SoundPLAN offers the Distributed Computing module where only the main program needs to be licensed and an unlimited number of calculation engines can be harnessed into the calculations. As there is virtually no overhead, 10 PCs will deliver the results in about 10% of the time.

Just select the PCs and click on the start button. It's that simple.



Grid Cross-Sectional Noise Map

Aside from the "normal" terrain following noise map, SoundPLAN offers a mapping option where a vertical noise map is calculated on top of a calculation line. SoundPLAN calls this the Grid Cross-Sectional Noise Map. These noise maps are perfectly suited to document the effectiveness of a noise barrier like in the lower picture. One or multiple Grid Cross-Sectional Noise maps can be combined with other maps and displayed in a 3D solid model.





General Settings Standards Assessment Grid Noise Map Statistics Desc

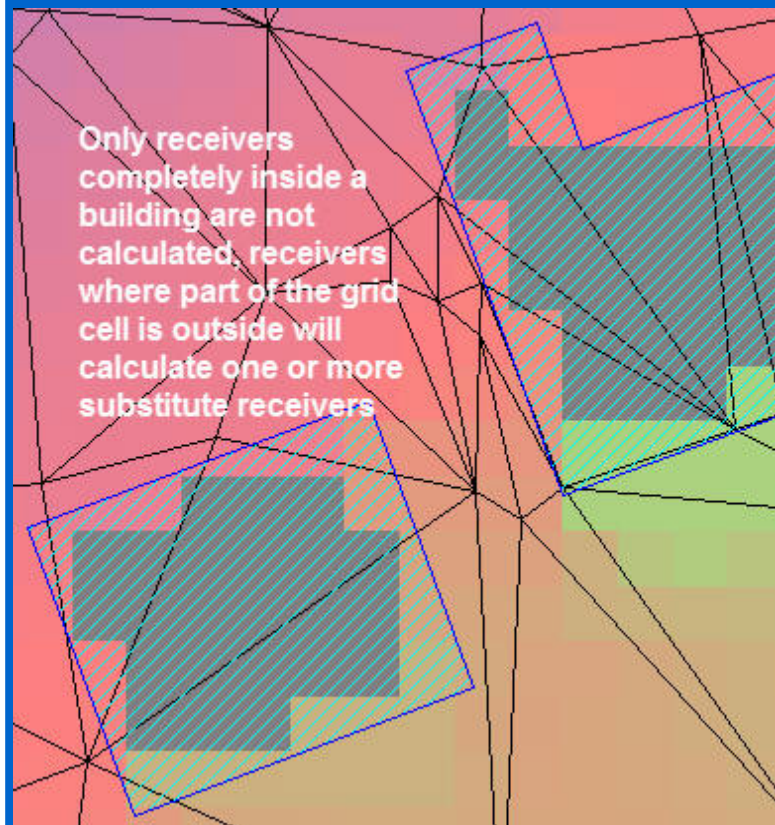
☒ Calculate new Grid Noise Map

Grid space [m] Height above ground [m]

☐ Recalculate Grid Noise Map

Calculation area for recalculation: >>

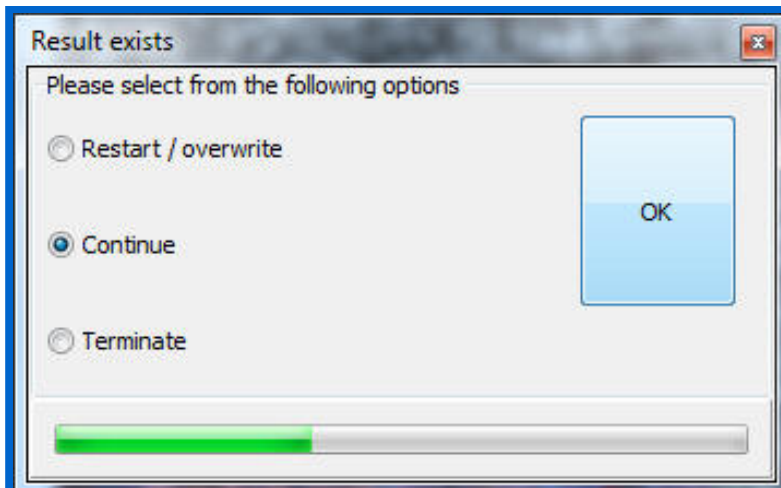
Max # of substitute points (if grid point inside building)  



Receivers in buildings / calculation of substitute points / contours and buildings

In a Grid Noise Map, receivers representing a grid cell can be located inside a building and therefore be excluded from calculations. It is entirely possible in densely built over areas to have all centers of all grid cells inside buildings. This isn't much of a problem for SoundPLAN because we calculate substitute receivers on the perimeter of the buildings. You, the user, define how many substitute points you want to allow and the software will then calculate one or multiple substitute points and will average the results. The more substitute points you calculate, the longer the calculation time.

Other software products simply leave empty spots for grid cells where the center of the cell is inside the building.



Calculate - Stop and Resume

Sometimes work gets interrupted, so what happens when there is an interruption during the calculation of a large noise map? With SoundPLAN, no problem! You can stop the calculation at any given time and resume where you stopped. A calculation that has not finished can be re-started, and if the button "continue" was checked, calculations resume where they were when they were interrupted.

With every license of SoundPLAN, it is possible to calculate noise maps while editing graphics or completing other tasks while the noise map is prepared. Multi-tasking is built-in!

Calc.	Name	Calc. Type	Percent Data	Last Edit	Last Run
0	---Höhenmodell---		0	8/17/2008 5:26:40 P	
Yes	Umriss-DGM Stadtgebiet	Digital Ground Model	1. "008_Höhen Stadtgebiet.geo"	1/2/2012 12:25:02 P	9/19/2008 7:19:14 P
Yes	Höhenlinien zur Überhöhung	Elevation Lines	2. "HDGM0001.dgn"	1/2/2012 12:25:03 P	
	DGM mit Erhöhungen	Digital Ground Model	3. "008_Höhenlinien aus Erhöhungen.geo"	1/2/2012 12:25:06 P	9/23/2008 9:38:58 P
	DGM Freizeitanlagen	Digital Ground Model	4. "008_Höhen Freizeitgelände.geo"	1/2/2012 12:25:09 P	6/18/2008 7:55:18 P
	---Beschleunigung Bestand---		100	3/17/2008 6:14:29 P	
Yes	101_RU_Schallan-Bestand	Grid Noise Map	101. "01_Schallan-Bestand.nfl"	1/2/2012 12:25:10 P	9/23/2008 9:43:38 P
Yes	102_GU_Schallan-Bestand	Facade Noise Map	102. "01_Schallan-Bestand.nfl"	1/2/2012 12:25:10 P	9/23/2008 9:59:30 P
	111_RU_Schallan-Bestand 5m-Raster	Grid Noise Map	111. "01_Schallan-Bestand.nfl"	10/29/2008 9:46:32	10/29/2008 11:49:2
	112_GU_Schallan-Bestand stockwerkweise	Facade Noise Map	112. "01_Schallan-Bestand.nfl"	4/6/2009 4:05:08 PM	4/6/2009 3:08:16 PM
	121_Schnittstellen aus Matrikvielfalt	Cross Section Map	121. "01_Schallan-Bestand.nfl"	7/7/2008 9:50:22 AM	7/9/2008 7:48:16 AM
	201_RU_Schallan-Bestand	Grid Noise Map	201. "02_Schallan-Bestand.nfl"	10/29/2008 9:50:24	10/16/2008 9:38:24
	202_GU_Schallan-Bestand	Facade Noise Map	202. "02_Schallan-Bestand.nfl"	10/29/2008 9:50:24	10/29/2008 10:57:4
	211_RU_Schallan-Bestand 5m-Raster	Grid Noise Map	211. "02_Schallan-Bestand.nfl"	10/29/2008 9:50:37	10/19/2008 2:19:08
	212_GU_Schallan-Bestand stockwerkweise	Facade Noise Map	212. "02_Schallan-Bestand.nfl"	10/29/2008 9:50:49	10/16/2008 9:33:46 P
	---Auswertung---		1000	8/26/2008 5:01:14 P	
	1101_Hotspots Schallan-Bestand	Grid noise hotspots	1101. "01_Schallan-Bestand.nfl"	10/9/2008 10:59:35	10/24/2008 10:40:1
	1201_Hotspots Schallan-Bestand	Grid noise hotspots	1201. "02_Schallan-Bestand.nfl"	10/9/2008 10:59:37	10/23/2008 2:30:34
	---Textberechnungen---		9999	3/17/2008 5:26:40 P	
	Temporäre für Schallan	Single Point Sound	9999. "Auswertung.nfl"	9/26/2008 2:22:48 P	9/26/2008 1:23:02 P

Maximize calculation efficiency

To maximize the throughput of your calculation engine, multiple calculations are placed in a table so SoundPLAN can work on calculating one noise map after another without sitting idle until the user can feed it more jobs.

Hosting multiple calculations in a table also means you will have a record of what you did. Everything is documented and repeatable!

Calculations in SoundPLAN are multi threaded so they will make use of PCs with multiple CPU, and PCs with CPUs that have more than 1 core. If you have a 64 bit PC, SoundPLAN allows you to use 4 gigabyte for the program and data, which is plenty for normal noise maps. If this is still not enough, tiling is another option.

Number of threads

CPU =Intel(R) Core(TM) i7 CPU X 990 @ 3.47GHz (GenuineIntel, type 0, family 6, model C, stepping 2), 3458.1 MHz, 12 logical CPUs, 0 physical CPUs:

This PC has 12 logical CPU(s), we advise to use exactly this value as number of threads to utilize max. calculation speed. Reduce this number in order to allow to do something else with this PC during calculation.

Number of threads

11

To maximize the throughput of the entire system, it is possible to edit one set of data while a noise map of other data is calculated. You do not need 2 or more licenses of SoundPLAN to edit data and at the same time, do calculations or produce graphics.

Re-calculate parts of the Grid Noise Map

Nobody is perfect! If you did a big calculation and then discovered you had a mistake inside the elevation supply or a source that is only locally important had a mistake in it, you can re-calculate just a part of a noise map. You do not need to re-calculate the entire noise map. Simply define a calculation area for the "patch" and run the calculation in the re-calc mode to fix the problem. No wasted time for a full re-calculation.

☐ Calculate new Grid Noise Map

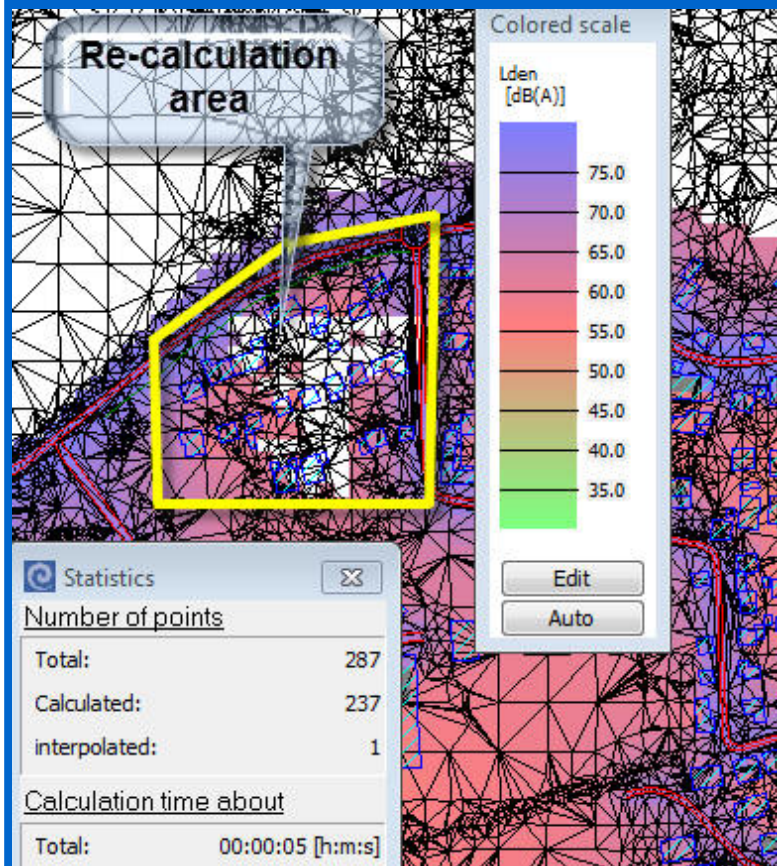
Grid space [m] Height above ground [m]

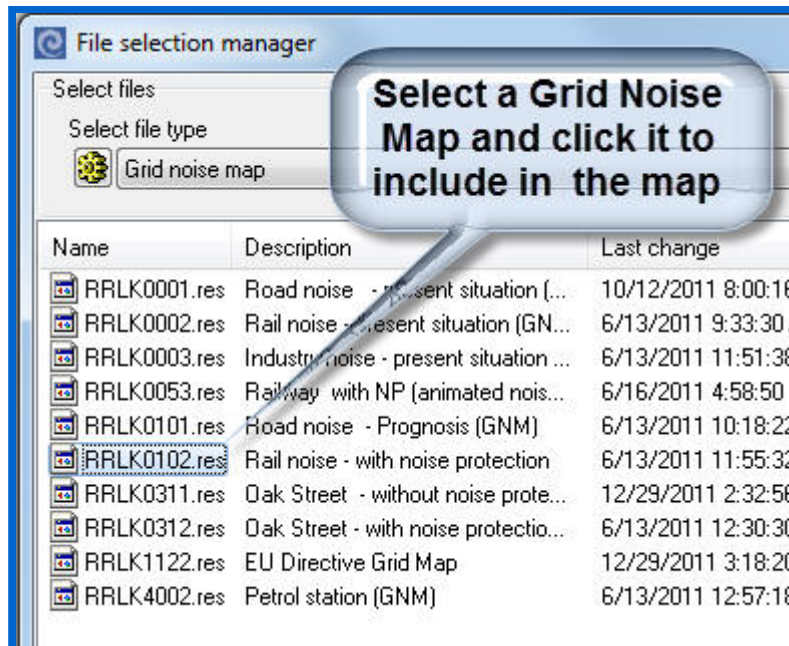
☒ Recalculate Grid Noise Map

Calculation area for recalculation:

>>

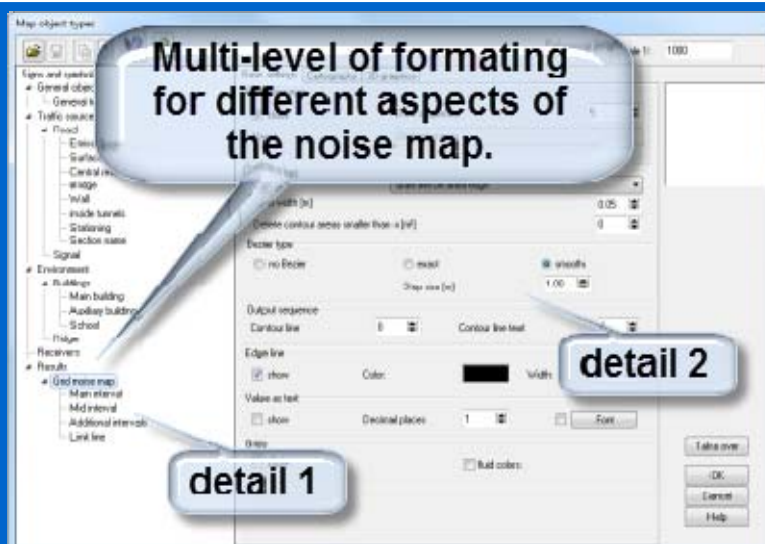
Max# of substitute points (if grid point inside building)





The object concept of noise maps

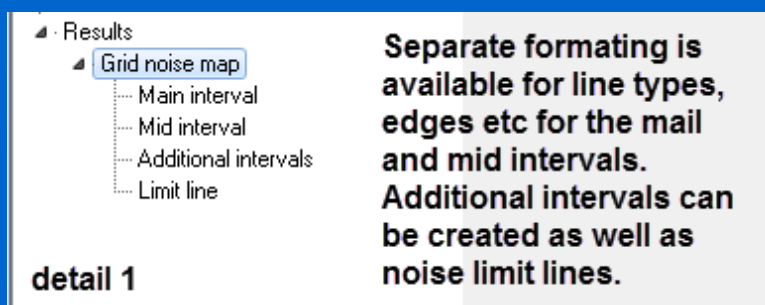
SoundPLAN is capable of calculating and managing a virtually unlimited number of noise maps. In the Graphics you can activate multiple Grid Noise Maps to be displayed at the same time, and it is also possible to view multiple noise maps in 3D along with multiple Grid Cross-Sectional Noise Maps. Just like the Situations and Geo-Files, these objects are the building blocks that can be assembled into the SoundPLAN graphics. Just drag and drop!



Formatting capabilities I

In SoundPLAN, noise maps are objects and can be formatted the same way as all other objects. Objects can have multiple sub-objects. In the case of the Grid Noise Map, the main object has sub-objects of the "Main interval" the "Mid interval", "additional intervals" and the Noise Limit Line.

For each of the sub-objects, the contour lines can be drawn or omitted, fill can be chosen or omitted, or the entire map can be presented in the grid pattern either in the scale intervals or as a fluid scale. Formatting capabilities III will show details.



Bezier type
☐ no Bezier ☐ exact ☒ smooth

detail 2 Step size [m] 1.00

Choose the scale parameters

Scaling

Interval: Minimum value: 42.594 Maximum value: 84.212

Data: 45.000 80.000

Colored scale: 5.000 ☒ ascending

No. of intervals: 9

Unit of measurement

Measure: Noise [dB(A)] Decimal places: 0

Unit: dB(A)

Colors

☒ set From color:

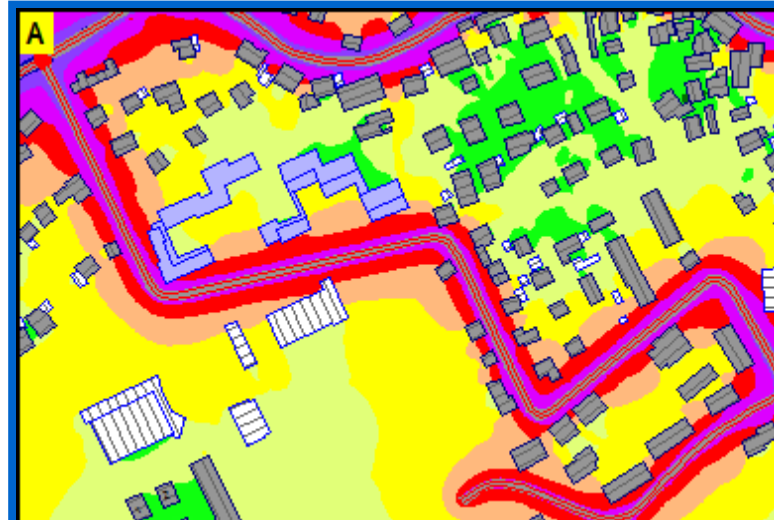
☒ ascending ☐ keep color sequence

OK Cancel Help

Pick a color sequence

Formatting capabilities II

For the display of noise maps, the color scale is of prominent importance. A user defined progression of colors can be assigned either use the "standard" noise modeling progression or as one of your own making. For example, where the areas below the noise limit are displayed in green shades, the noise limit is left white and the areas with noise levels exceeding the limit are shown in red tones. Be creative with SoundPLAN!



Formatting capabilities III

Different appearances of the same noise map depend on the choices in the object setup.

A) is the regular contour map with fills for the main interval but no noise contour lines.

B) is a grid noise map with a fluid scale where the value of the grid cell is used to interpolate the colors within the color scale.

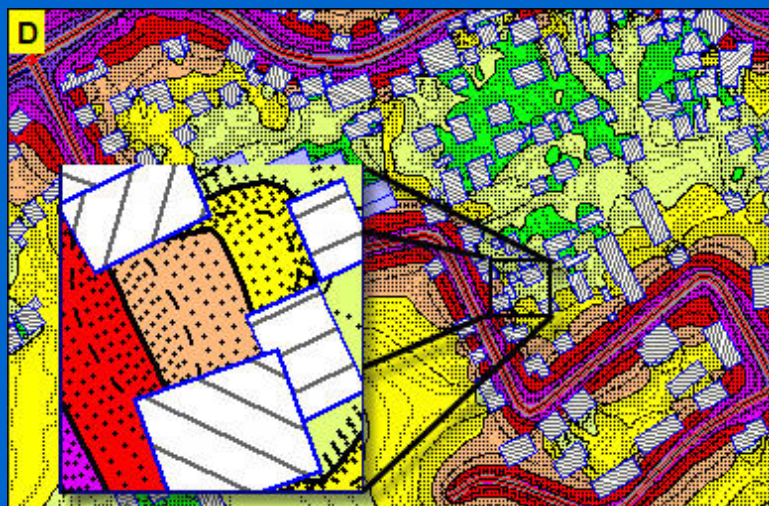
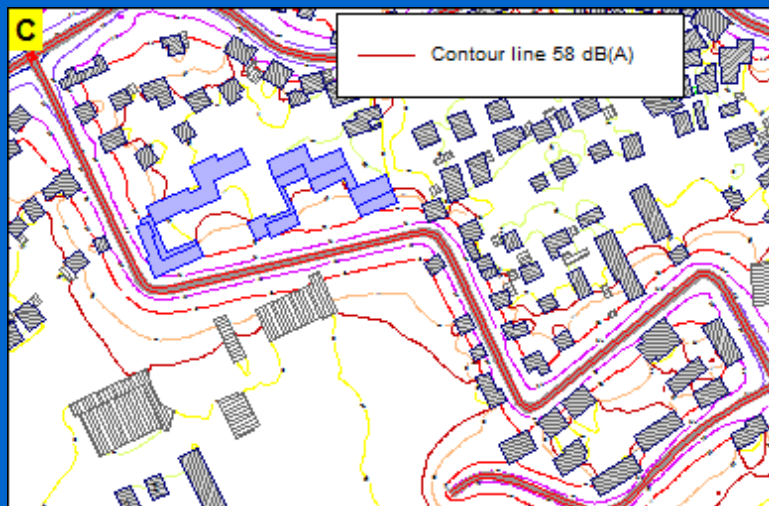
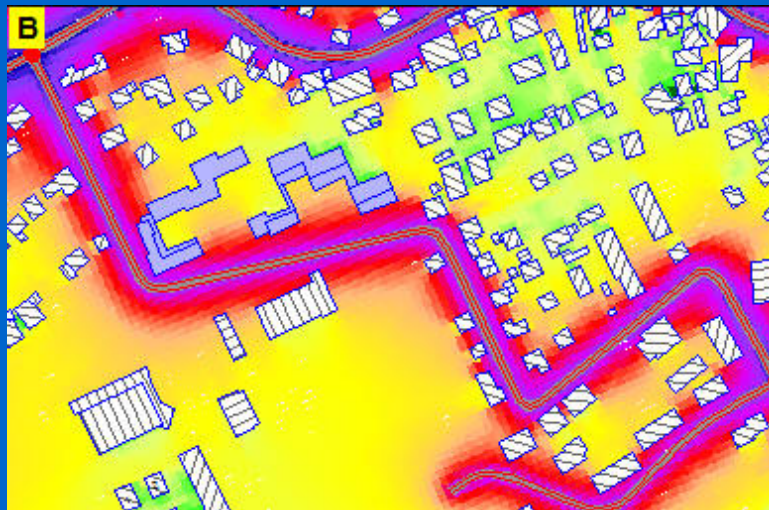
C) has no fill but the contour lines drawn in scale color.

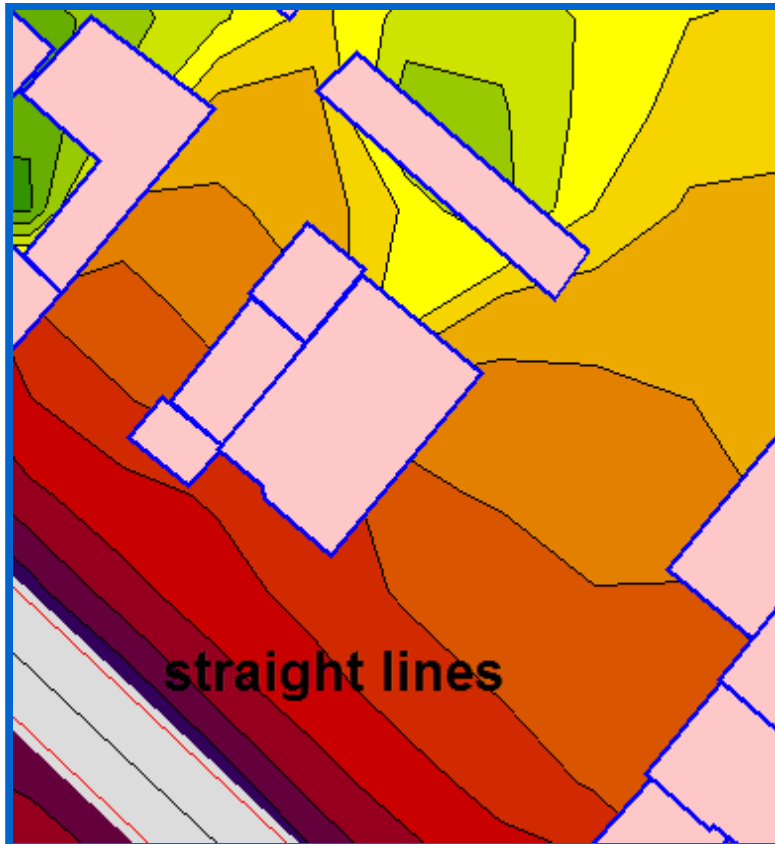
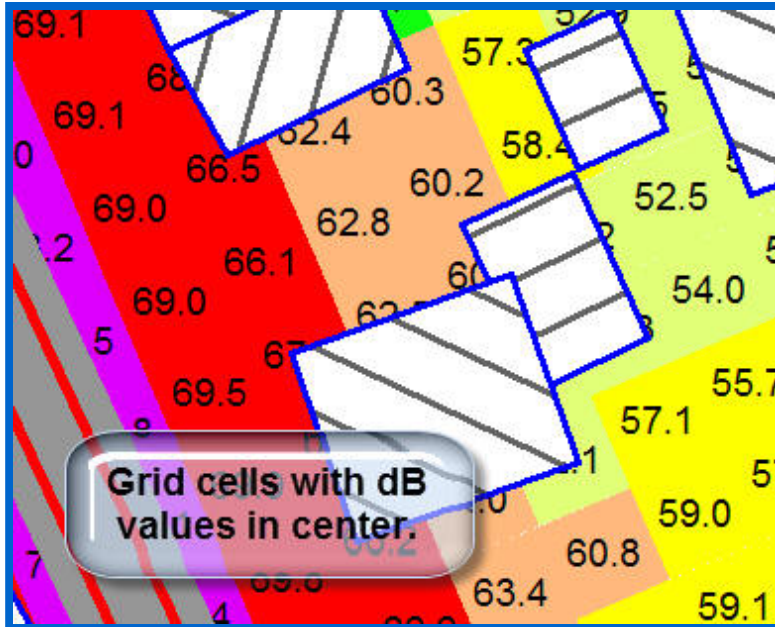
D) not only has the contour lines for the main and middle of the scale interval drawn, but also shows a contour line every dB step. As with the present resolution, because these lines are difficult to see, a screen capture detail was inserted in the

graphics.

E) shows the grid cells with the dB values in the middle of each cell.

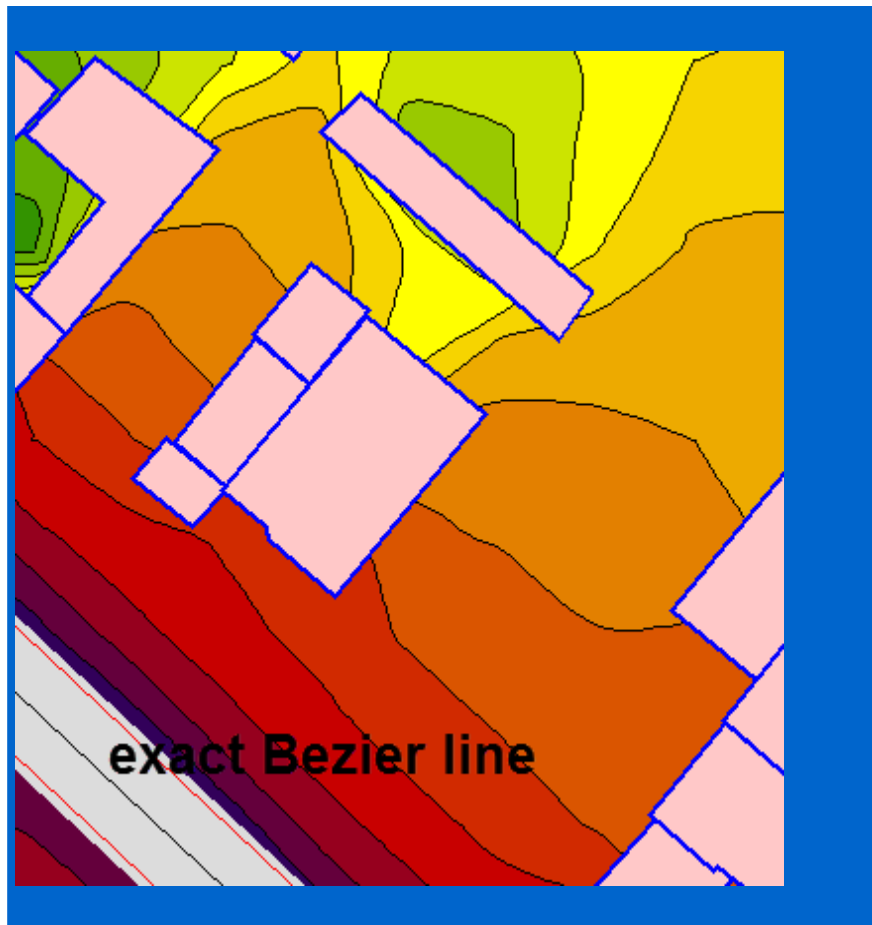
These are only a small portion of the formatting options available in the SoundPLAN graphics.

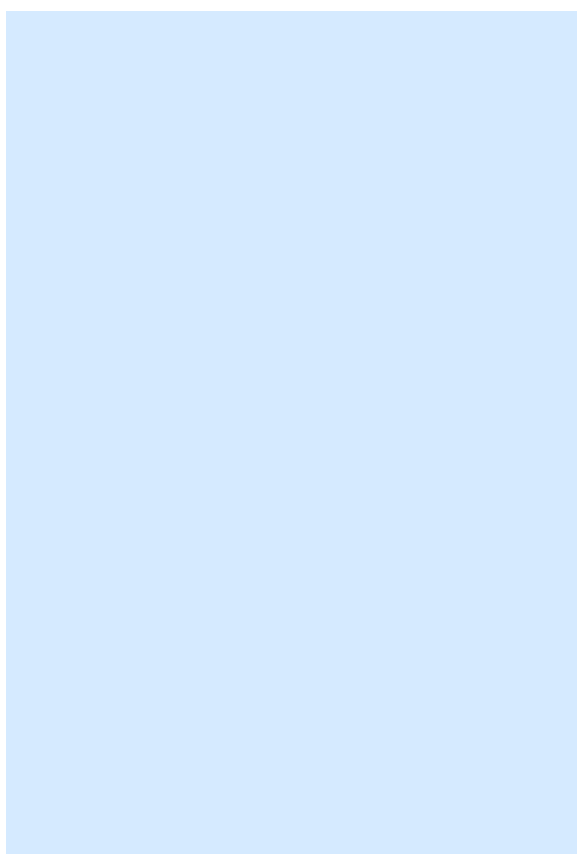
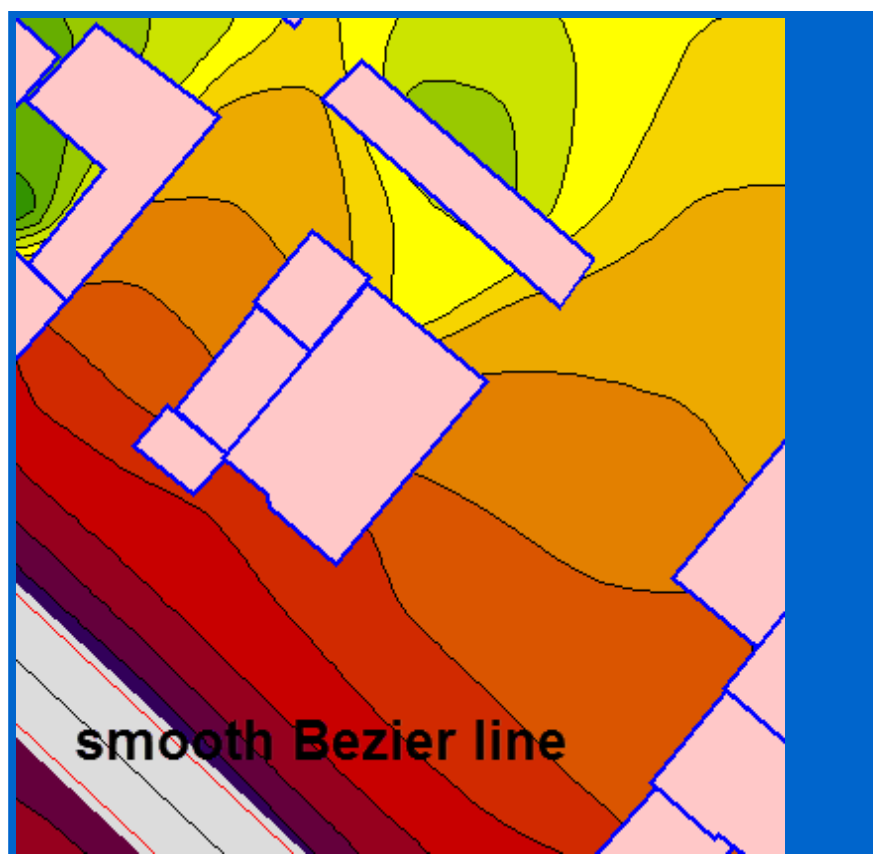


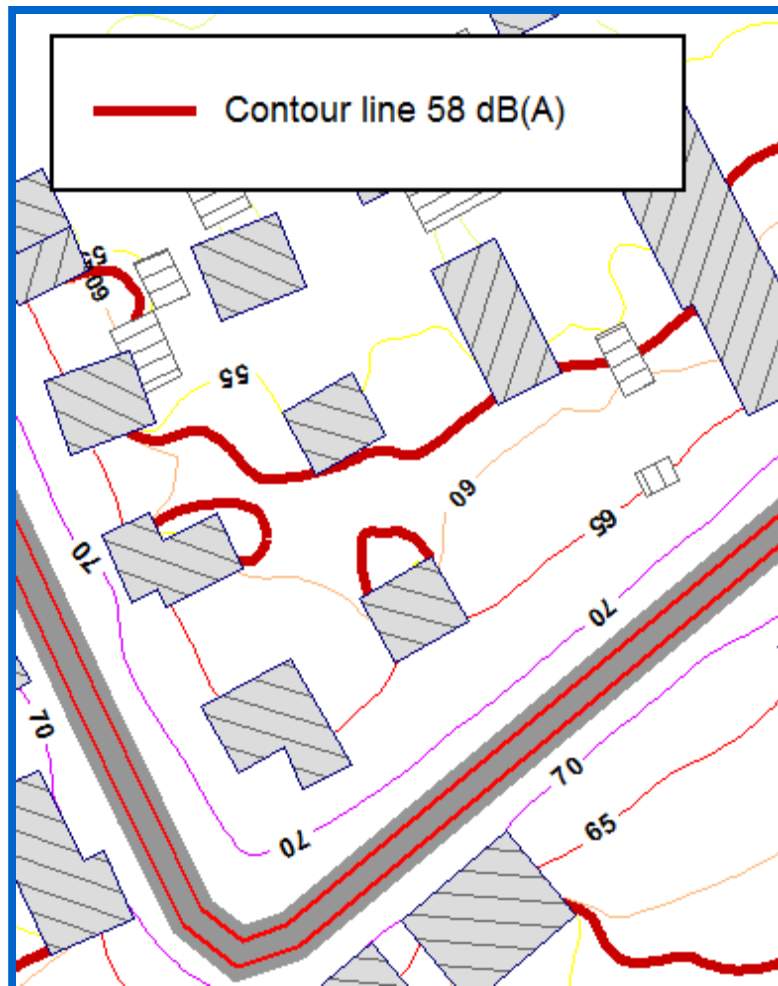


Formatting capabilities IV

Contour lines can be straight lines or exact Bezier curves through the interpolated points of the contour lines or curves with further smoothing of user defined tension. (No drop-outs as seen in other software)

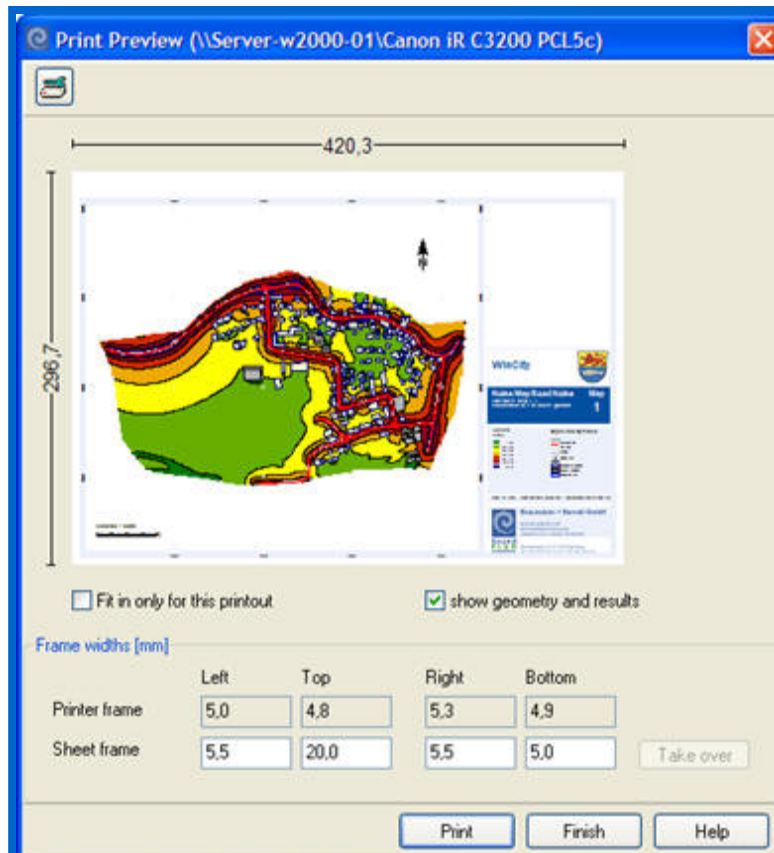






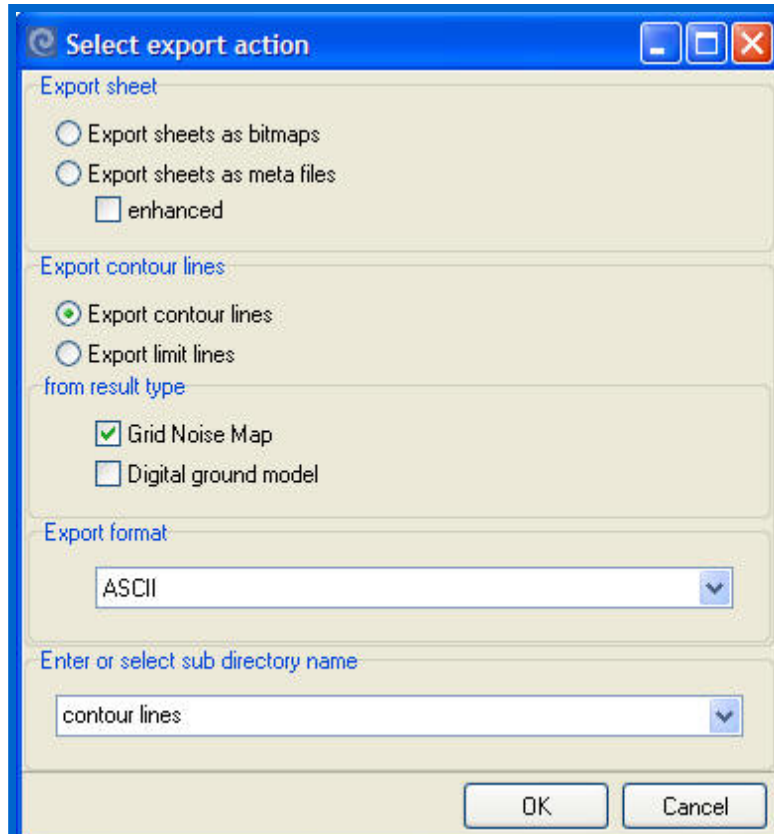
Inserting specific contour lines

Often it is important to insert a specific contour line into the graphics. SoundPLAN allows you to insert any number of discrete contour lines and format them the way you want (color, line width, dB value, etc.). As these sub-objects are independent of all other objects, the noise limit contour lines can be used in conjunction with any other formatting option.



Print Preview

Before you print a noise map, make sure the dimensions are correct. Check this with a print-preview.



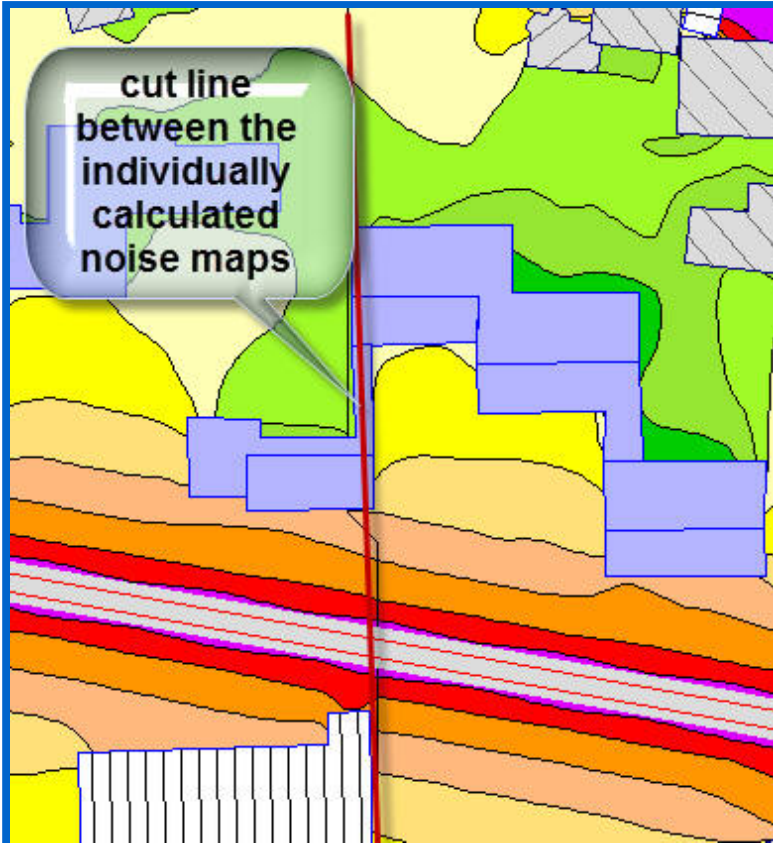
Export capabilities for Grid Noise Maps

Sometimes it is desired to incorporate noise maps in different software packages. SoundPLAN offers the options to export contour lines or the grid values.



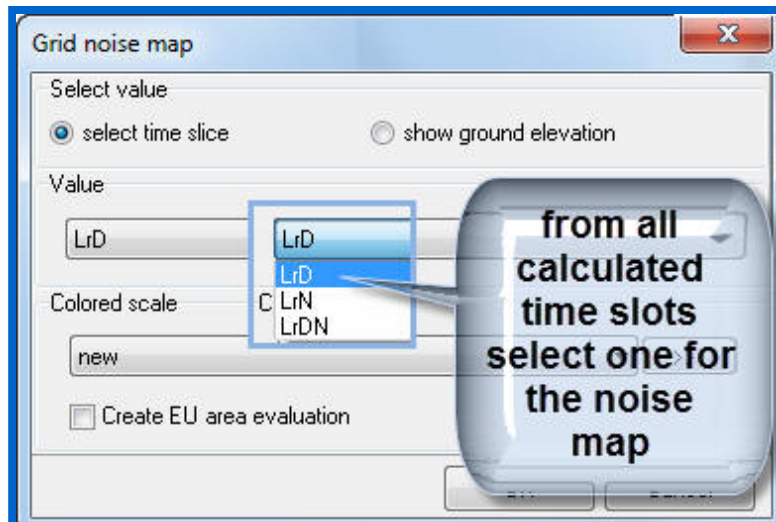
Grid Noise Maps in 3D

Grid Noise Maps can be displayed in 3D either as the grid map or as a contoured noise map. Fluid scale grid maps are not possible. In order to display the grid map (which was calculated 2 meters above the ground) and not have it cover the road, the grid map was artificially lowered 10 cm below the road surface.



Capability to seamlessly join multiple Grid Noise Maps

For noise maps in agglomerations or even country wide noise maps, it is paramount the software allows the area to be covered by multiple noise maps. In SoundPLAN, there is no limit in the number of noise maps. When noise are presented where multiple map files are loaded, it is an absolute requirement that the noise contour lines continue from one noise map to another one without a break. In SoundPLAN this is assured. Multiple noise maps have the same resolution dependant origin, meaning that the grid pattern continues without an interruption from one noise map file to the next.



Noise Maps for day/evening/night or day/night of Leq24/Lmax

SoundPLAN users can define as many time slots as they wish. In the graphics to the left, three time slots were calculated. For the noise map, the level at day time was chosen.



Hot Spots

In cities, it can be difficult to point out where noise problems are located. Roads are narrow, and it may be difficult to see on the narrow band along the road where the high noise levels occur. Furthermore, the normal Gris Noise Map does not take affected population numbers into account. The Hot Spot analysis finds how many residents in a radius of 20 or 50 or 100 meters are affected by high noise levels for every grid cell. The radius and the threshold value are user defined. With one glimpse it is possible to see in the entire city where the problem zones are.

This is a great presentation tool!

Calculations with noise maps

Some noise modeling jobs not only require to present the noise levels as they will be for the planned change in the road infrastructure, but also show changes in the noise level before and after the changes. For this, SoundPLAN offers the possibility to do calculations with noise maps. Use one noise map as the basis, then request the program to subtract the values of a second noise map from it, and the resulting noise map is the difference map between both noise maps. As the formula is accessible, there is no limit to the complexity of possible arithmetic operations with noise maps.

Examples:

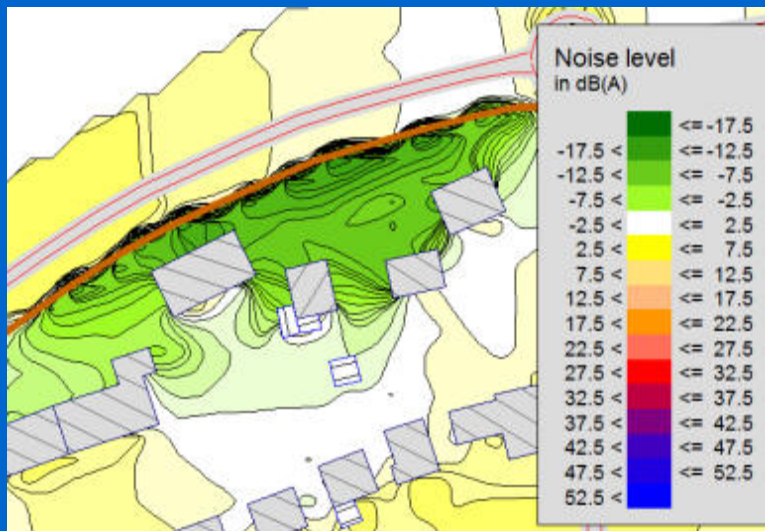
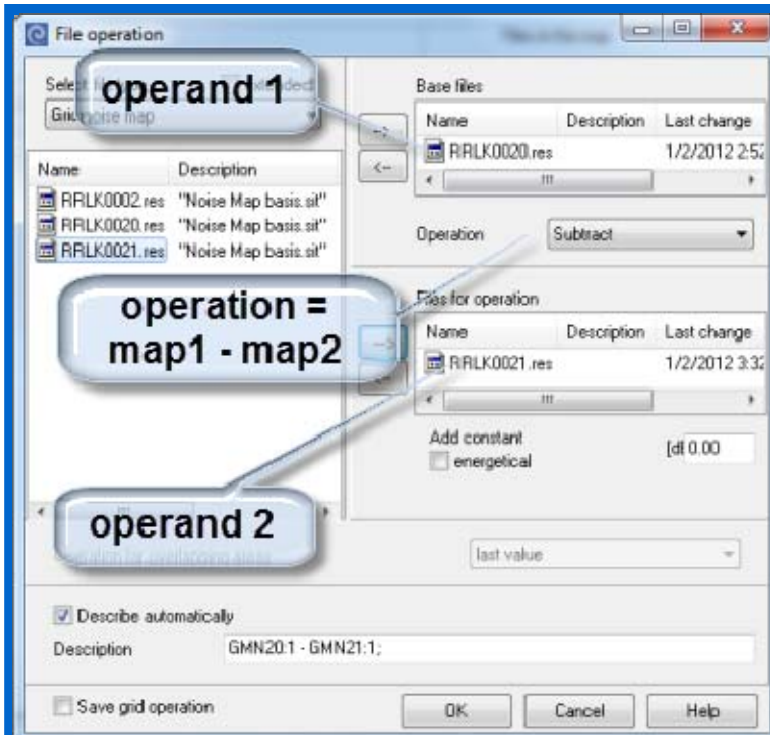
Calculate the increase of noise due to a new road => use the noise map for the new status as the base and subtract the old status from it. The result is the increase of noise level.

Show how effective a noise barrier is by subtracting the noise maps of before and after. (This is the case in the graphic to the left.)

Energetically add the noise maps of the road noise and the noise map of train noise and the result is the total noise level. This way you can display the road noise, the train noise and the comprehensive noise level without any extra noise map calculations.

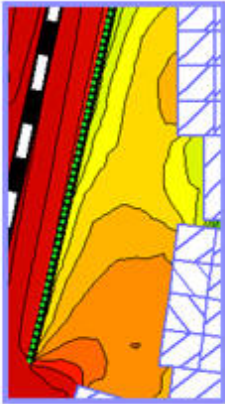
Use only one noise map, but "Add a constant" energetically to accommodate for the background noise level of x dB.

If you check the box, "Save Grid

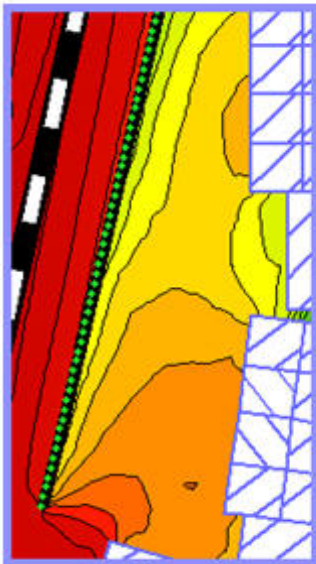


Operation", you can use the resulting map as the basis for further operations.

Meshed Noise Map
with ~ 1500 receivers



Grid Noise Map
with ~ 1500 receivers



Grid Noise Map versus Meshed Map

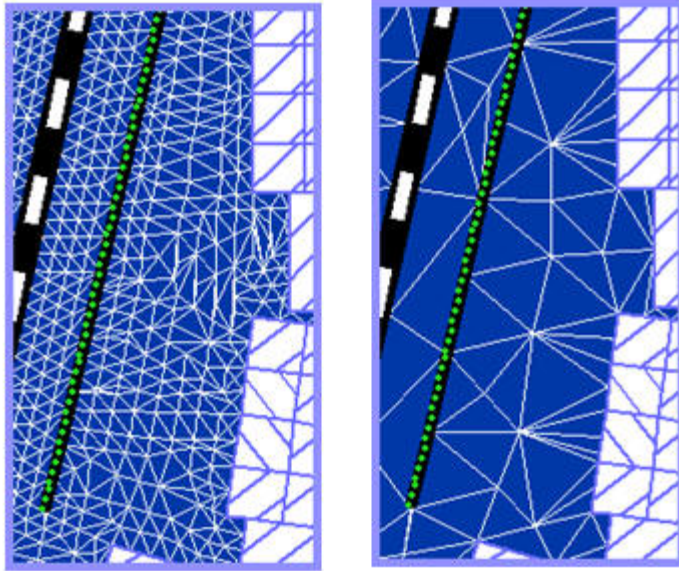
With Grid Noise Maps, all receivers are located in a rigid grid pattern. That means receivers close to a source experience much higher noise levels than receivers where the center of a grid cell is farther away. There is no way to avoid that the contouring algorithm will create unwanted "bubbles" along the road alignment.

Similar problems can be seen with noise barriers as in the picture to the left. Some grid cell centers are slightly to the left of the barrier and some are to the right of the barrier. As the contouring algorithm does not know anything about the barrier, the contours around barriers have waves in them and bubbles.

With the Meshed Noise Map, the receivers are not located in a strict grid pattern, but rather where they are needed. Therefore, receivers are on both sides of the noise barrier and along the road and also around buildings. In the graphics, the receivers of the Meshed Noise Map are triangulated, and the contour lines are calculated from these triangulations.

As can be seen in the lowest set of screenshots, the density of receivers can be influenced, but receivers always will line the source line and the noise barrier, assuring the quality of contours in the Meshed Noise Map will always surpass the quality of contours in the Grid Noise Map.

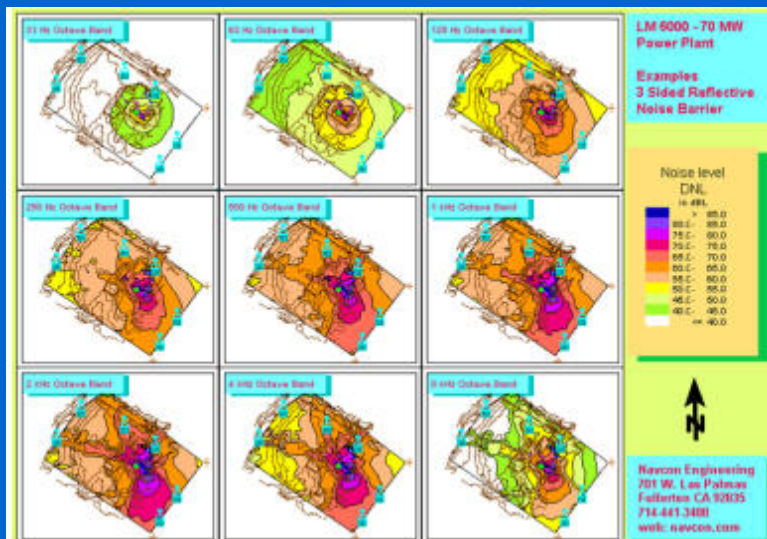
The Meshed Noise Map is especially useful in urban areas where the streets are very narrow. In order to get good contour lines with a Grid Noise Map, the receiver



spacing would have to be 2 or 5 meters, which would result in a very large grid file and a high calculation time. The Meshed Map can dramatically reduce the number of receivers needed and will produce very good contour lines without "bubbles" and "wobbles."

So, why not switch completely from the Grid Noise Map to the Meshed Map? The Meshed Noise Map functions beautifully under normal circumstances, but has limits when Noise Map operations are required. For the Grid Noise Map, the receivers are the same for a map with and a map without a noise barrier. This is not the case for the Meshed Noise Map. The Meshed Noise Map needs to interpolate receivers and insert them in the resulting noise map, introducing some uncertainty. And, the Grid Noise Map has a by far compacter file format making it more suited for very large noise maps.

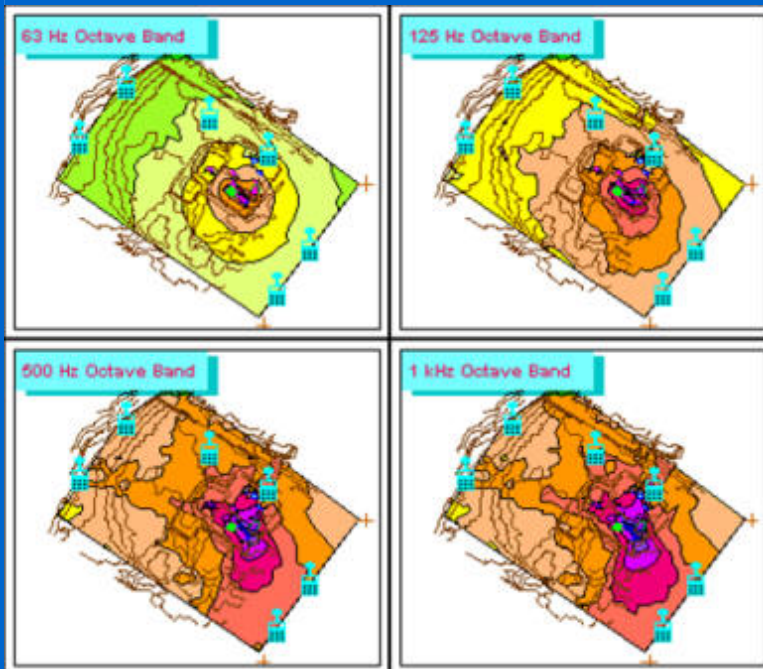
For customers who have a license for the Grid Noise Map and the Facade Noise Map, the Meshed Noise Map is available free of charge!



Noise maps frequency by frequency

For small to medium projects, the Meshed Noise Map not only delivers a high quality alternative to the Grid Noise Map, but also delivers something absolutely unique to SoundPLAN. When a noise map with industrial, frequency dependant sources is calculated using the Meshed Noise Map, it is possible at loading time (in the Graphics when the noise map is selected and loaded into memory) to select which of the frequencies or partial frequency bands the noise map shall display.

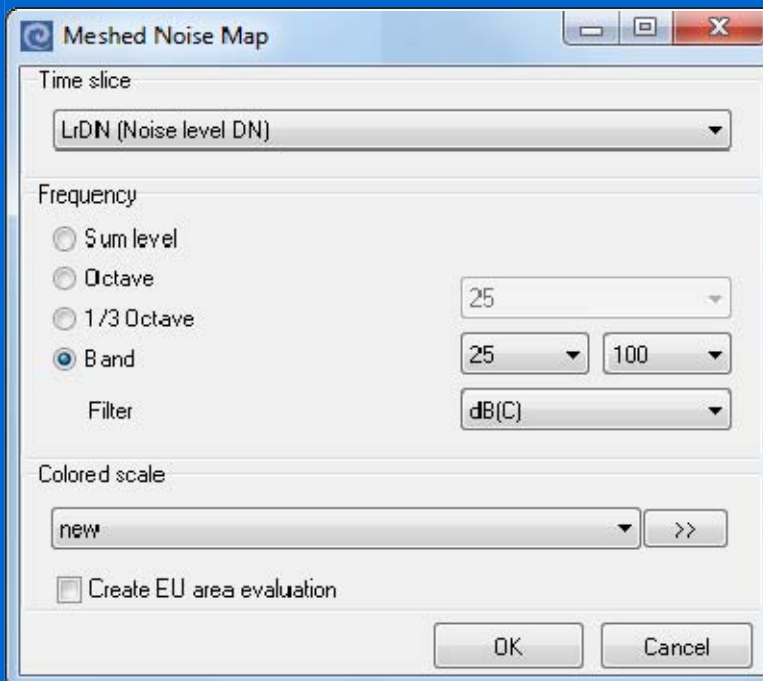
Detail:



As it is possible in SoundPLAN to have multiple noise maps in a single graphics sheet, you can display the same noise map multiple times, one for the low frequencies, one for 500 Hz, one for 1000 Hz and one for all higher frequencies. In the picture to the left, the same noise map was displayed for 31 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz and 8 kHz.

The middle picture is an enlargement of a section of the picture above. The picture below shows the selection options for the frequencies and frequency filters.

Selection of frequency ranges:





Animated Noise Map

SoundPLAN contains a powerful animated noise map for train noise. The calculation that results in this noise map is the basis for finding the maximum noise level, but it can also be presented stand alone.

Please click on the noise map to the left to start the animated noise map, which was produced by AAC in Spain.

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