Note! The sound files are only playable when the Measurement Period is in daily mode and not averaging mode

Comment

You can type any comment which will show in the comment line next to the logger. Make sure the Apply button is clicked to save the comment.
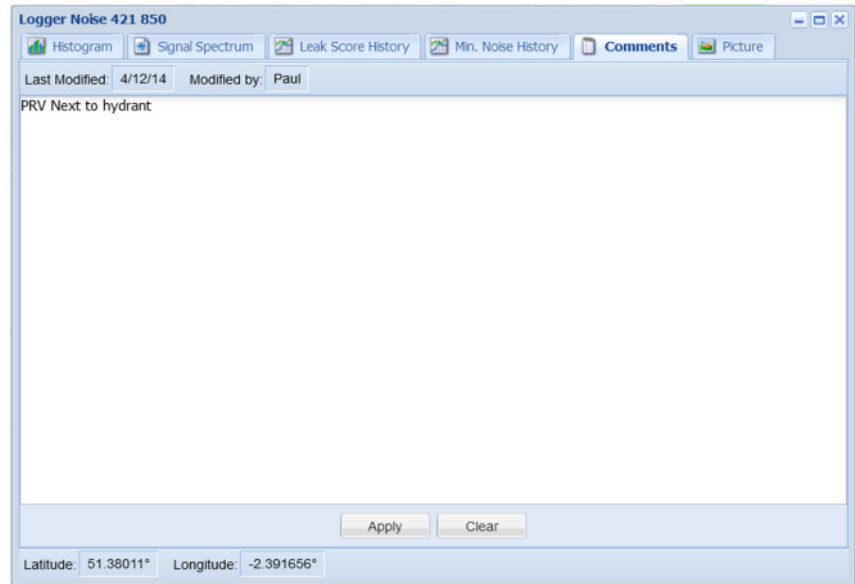

Figure 40: Comment Window

Picture

This opens up a picture of the installed logger onsite. For this facility to be fully operational a photo must be taken during the logger installation using the PDA (Personal Digital Assistant) and ZONESCAN Mobile installation tool.

Logger Noise Report

The Create a Logger Noise Report allows one to choose the options in the window below before creating a report.

• Click Open and a separate window will open which then can be sent to print
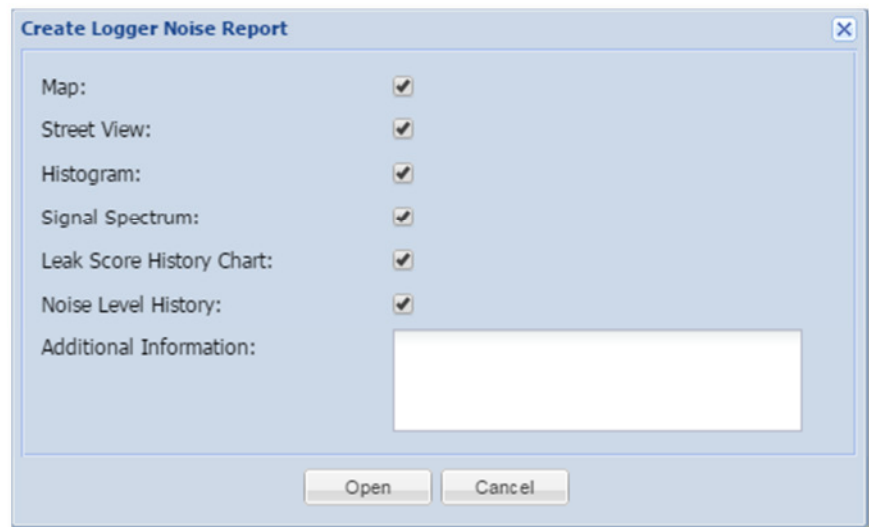
Figure 41: Create a Logger Noise Report

A separate window will open through the internet browser showing the included options chosen.

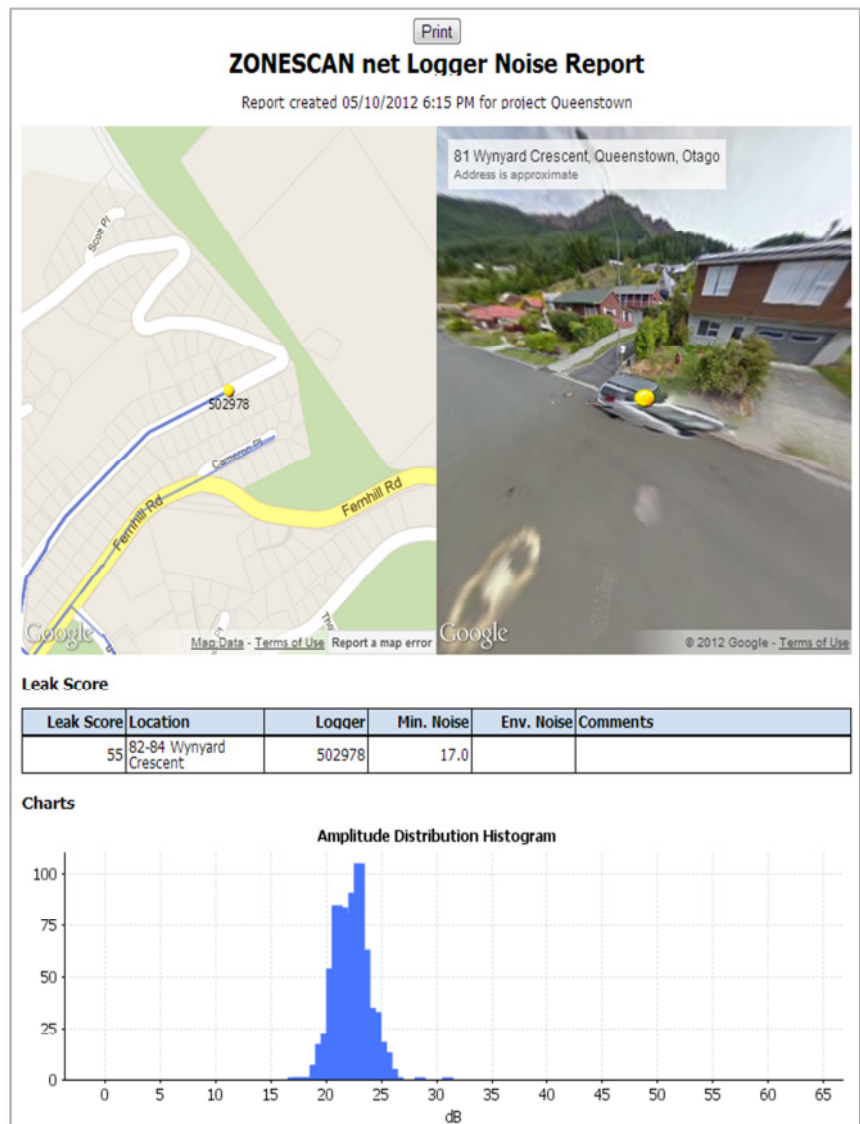- Press the print button to send the report to a printer or PDF file
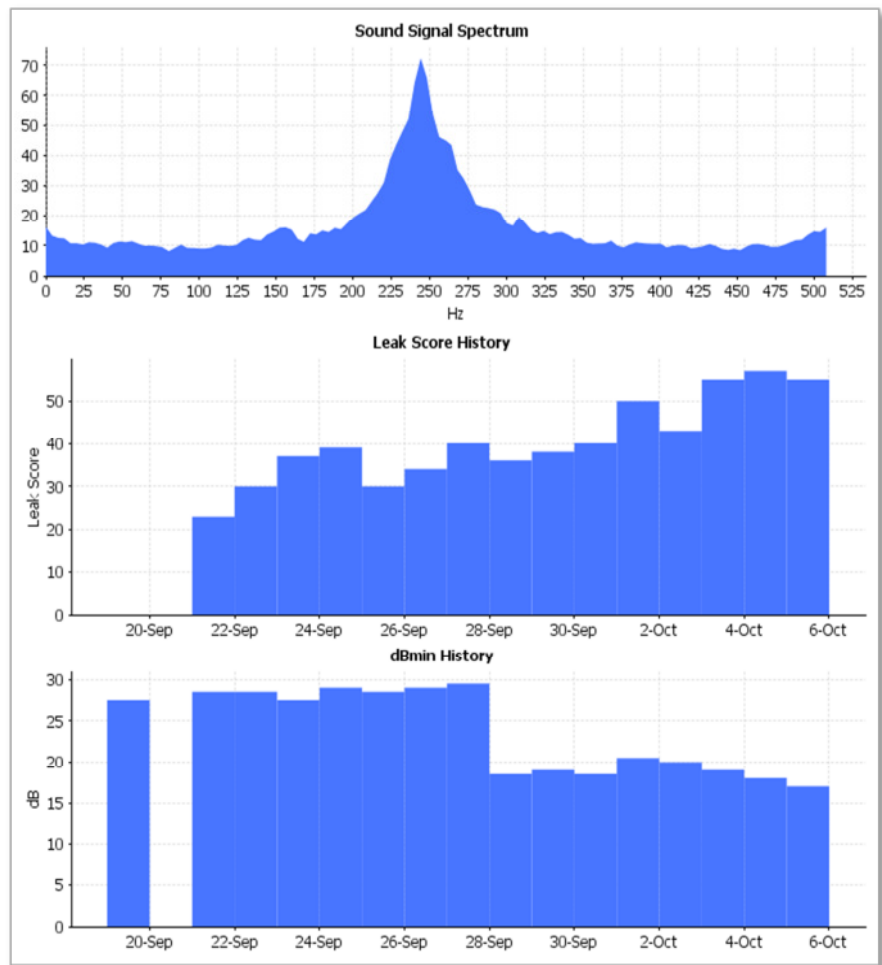
Figure 42: The Logger Noise Report

Figure 43: The Logger Noise Report – cont.

Export to CSV   The Export to CSV (Comma-separated values) will download the Loggers Leak Score into CSV file format and automatically open Excel with the data.
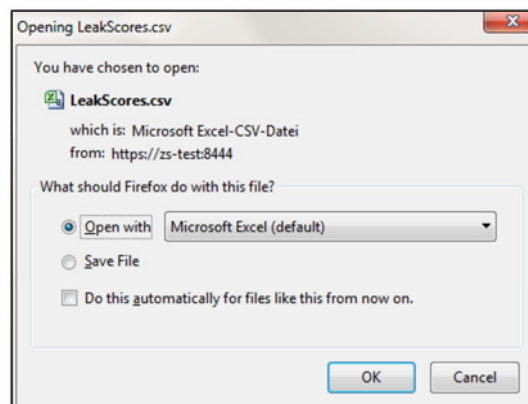

Figure 44: Create a Measurement Report

Manual Correlation

The Manual Correlation opens a separate window and allows the user to pick any two loggers in the project to correlate between.
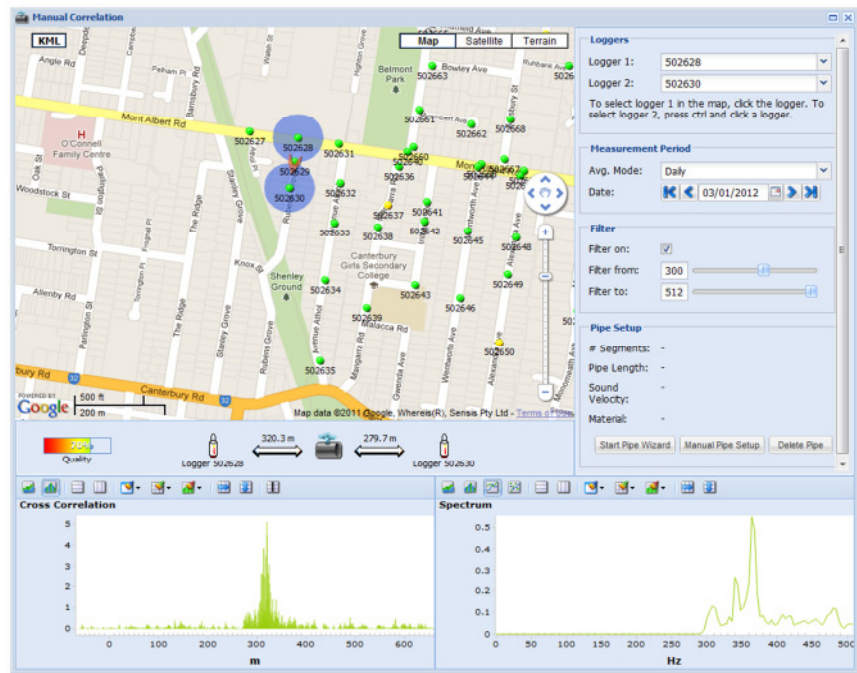

Figure 45: Manual Correlation Window

- Use the drop-down arrows in the Loggers' section to select your chosen Logger 1 and 2 or alternatively select logger 1 by clicking on the Map and Logger 2 by pressing CTRL and click on the Logger 2
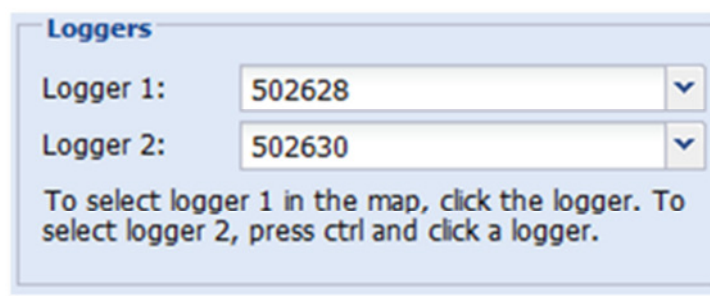

Figure 46: Selecting the Loggers

- Use the Measurement Period Average. Mode drop-down to select either daily, Last 5 days and last 30 days. Select the measurement date via the arrows or calendar
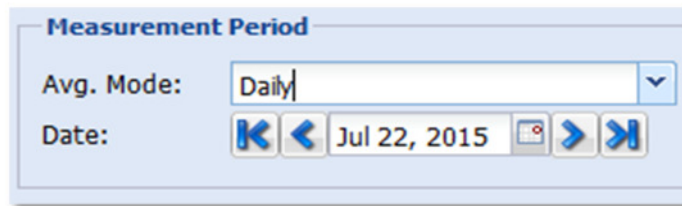
Figure 47: Selecting the Measurement Period

Note! Filters are a very important part of correlation, it's recommended that the Filter On is left ticked as it keeps the correlation clean and helps remove unwanted noise

- The Filter from: is the low filter cut off and Filter to: is the high filter cut off, click and hold either slider to increase or decrease the filter to improve the correlation quality and graph. Filter once the true pipe information has been entered as this gives a better result
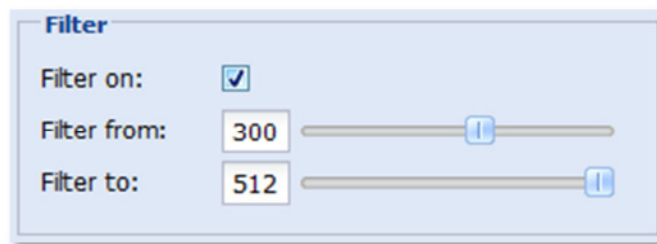
Figure 48: Selecting the Filter

Figure 51 is the section where the pipe data is entered for the correlation to give a true result. If no pipe data is entered then the correlation result will be displayed in survey mode; a distance over 600m.

- If the pipe data is known then select Manual Pipe Setup to enter the distance between the loggers, the pipe diameter and material type. If the distance between the correlated loggers is unknown then use Start Pipe Wizard to draw the pipe

Figure 49: Entering Data Pipe
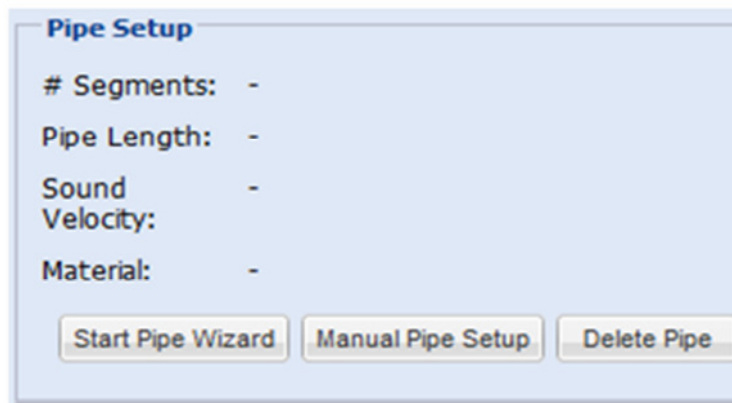
- In the Manual Pipe Setup window click Add Segment to enter the Length, Material and Diameter. When all segments are entered click Save
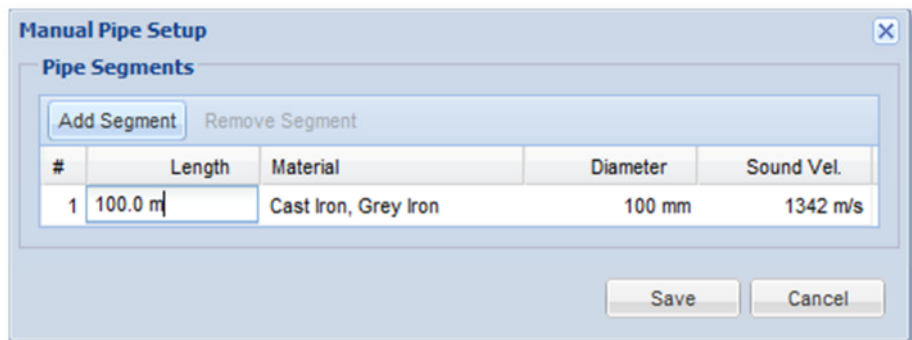
Figure 50: Manual Pipe Setup

- There is also a Pipe Wizard available, refer to 3.2.3 Entering Pipe Data with Pipe Wizard

Once the Pipe Setup and Filtering is complete the Manual Correlation Dashboard window will look similar to the screen below. In this example a 70% correlation was achieved and the leak position is depicted by an orange dot on the map and the diagram between the cross correlation graph and the map.

- Use the signal spectrum as a guide to position the filters, in the example below there is a concentration of sound between 300 and 400 Hz so this must be included
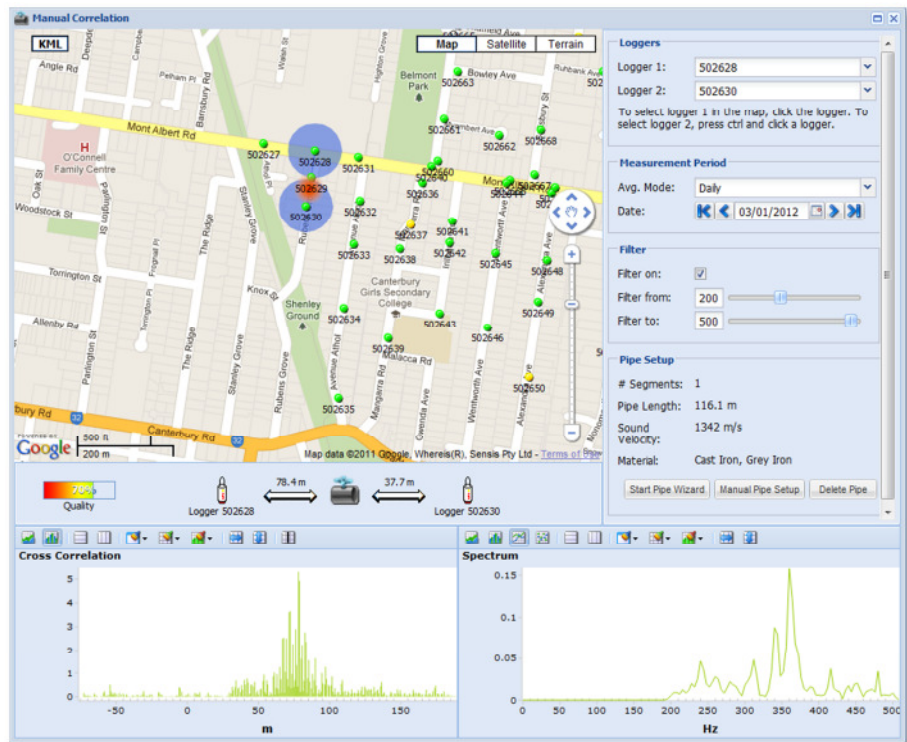
Figure 51: Manual Correlation Result

- If the Pipe information is incorrect then simply click the Delete Pipe and repeat the Manual Correlation steps

4 Print Menu
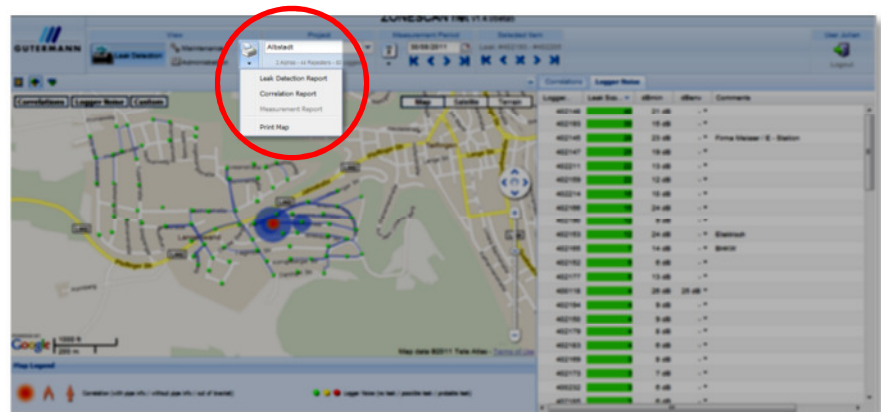
Figure 52: Print Menu

The print section has four options which include print Leak Detection Report, Correlation Report, Measurement Report and the Map.

The Leak Detection Report includes the Leak Scores, Correlations and Map for the chosen date. A window will appear which gives the user the option to remove correlations, Logger Noise or Map before printing.
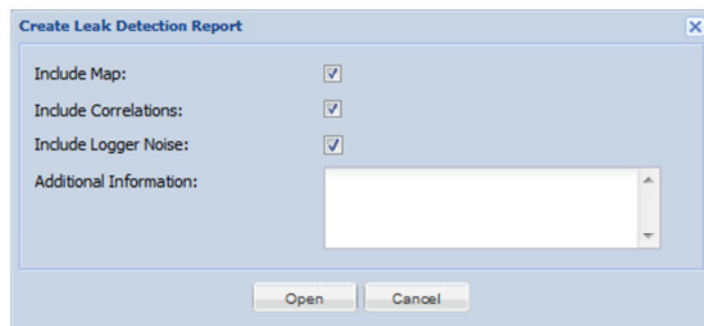
Figure 53: Print Report Window Options

- A new browser window opens with the report; use the print button on the browser

Figure 54: Print Report Page

5 Maintenance View

Figure 55: Maintenance View

Note! The following description assumes a fully activated map menu

5.1 Logger Table

In the Logger Table, all Loggers of the current project are displayed.

Figure 56: Logger Table

5.1.1 Table Fields

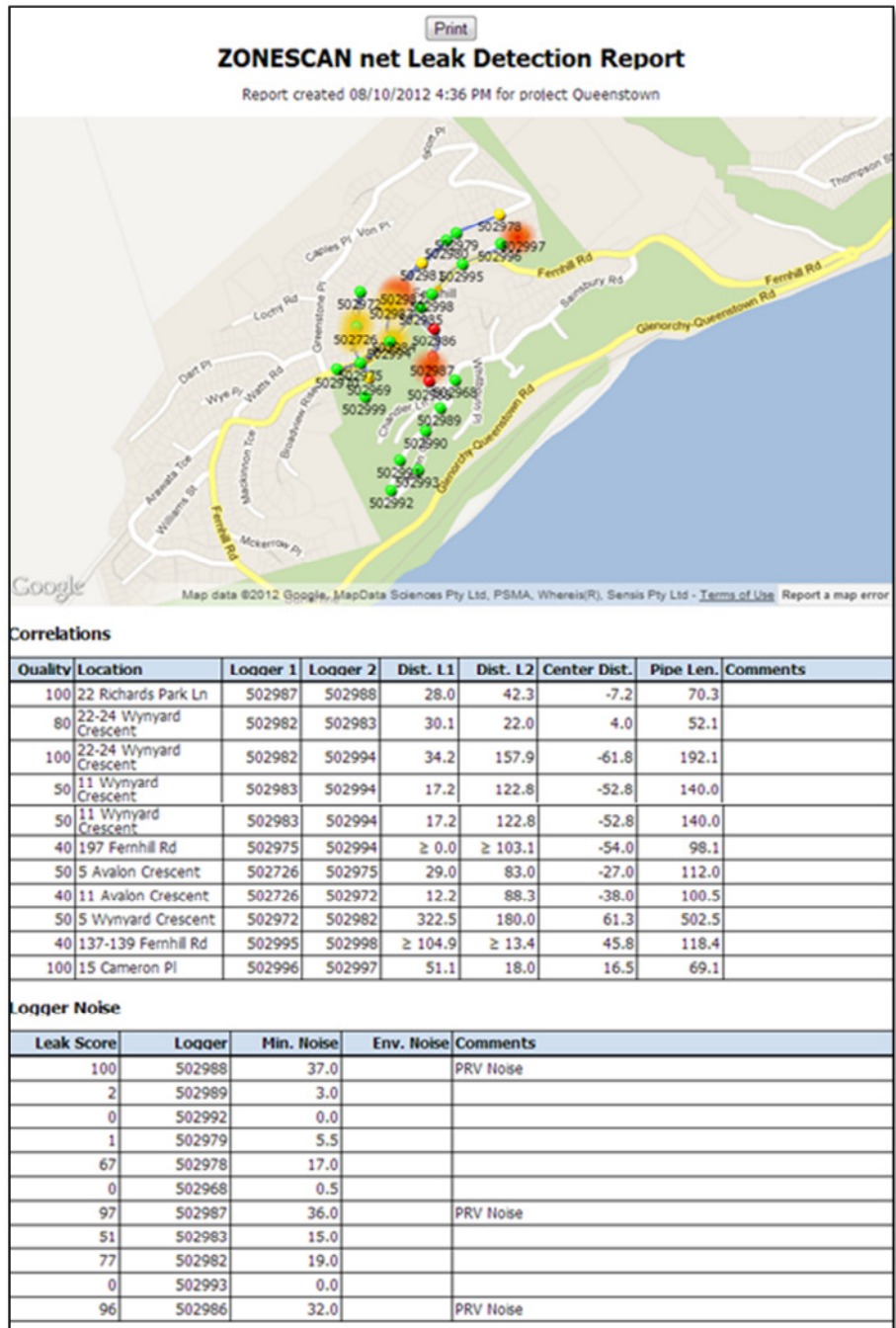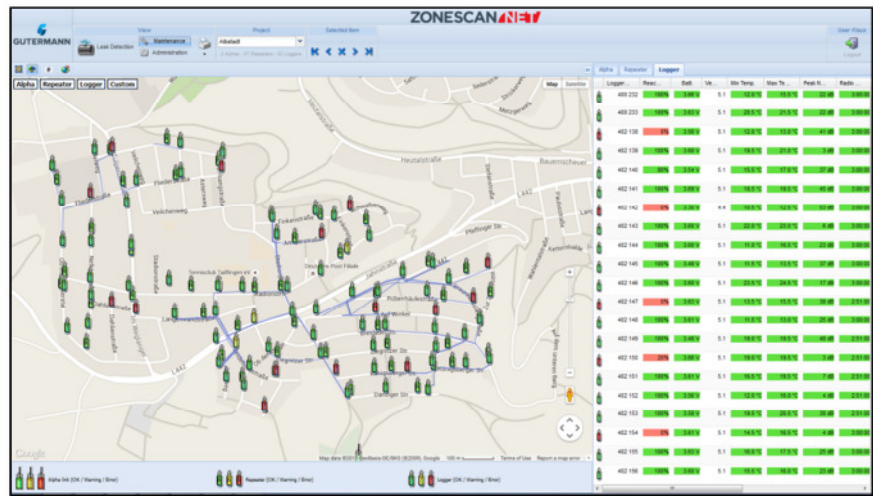|	
Logger	Reference number of the displayed Logger
Reachability	The fraction or percentage the loggers were reached in the last 5 days
Batt.	Current battery charge of the individual Loggers
Version	Version of the respective Logger
Min Temp.	The lowest temperature measured during the last measurement
Max Temp.	The highest temperature measured during the last measurement
Peak Noise	The largest dB value measured during the last measurement
Radio Operation	It's the time during which the logger can be reached for communication. Warning: 6 hours or longer radio operation times will reduce battery life
Comments	Comments is a text field with entries on, e.g. permanent noise sources

5.1.2 Context Menu

You can change the base settings of this table by right-clicking an entry in the table

Show in Street View

🔍 Reachability History

🔍 Battery History

🔍 Min Temp. History

🔍 Max Temp. History

🔍 Peak Noise History

📄 Comments

🖼 Picture

🔤 Export List as CSV

👤 Edit Logger

👤 Delete Logger

👤 Delete Logger's Measurements

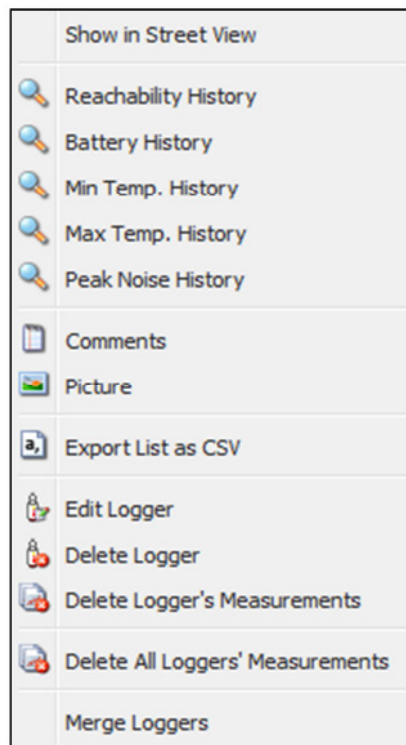👤 Delete All Loggers' Measurements

Merge Loggers

Figure 57: Logger Settings

Reachability History	To display the History of when the Logger had communication with the ZONESCAN NET
Min Temp History	To display the Minimum Temperature of the selected Logger, click the Min Temp item
Max Temp History	To display the Maximum Temperature of the selected Logger, click the Max Temp item
Battery History	To display the charge state of the selected Logger, click the Battery History item
Comments	To add a comment about a Logger, select the Comments item. Enter the desired comment in the text field that appears. Click Apply to save the entered comment. The text is displayed in the table in the Comments field
Picture	To view an available Picture of the selected Logger. The Picture should have been taken and uploaded by ZONESCAN Mobile during the installation process
Maintenance	To Print out a report for the selected Logger to include all the fields in the Table
Add Logger	Click Add Logger to add a not-yet existing Logger to the list. In the window that opens, enter the values for Logger No., Location, Latitude and Longitude. After entering all values, confirm your entries by clicking the Save button
Edit Logger	To make changes to the base settings of existing Loggers, select Edit Logger. Make the desired changes and then click Save
Delete Logger	Loggers listed in the table can be deleted with the Delete Logger item
Delete Logger's Measurements	To delete the measurement data of a Logger, click the Delete Logger's Measurements item
Delete Logger's Sound Signals	Click Delete Logger's Sound Signals to delete the recorded signals
Delete All Loggers	Use this item to delete all Loggers for the current project
Delete All Loggers' Measurements	The measurement data of all Loggers is deleted by clicking this item
Delete All Loggers' Sound Signals	Click this item to delete the sound signals of all Loggers

Furthermore you have the options with context menus to select the Alpha Link and the Last Reached

Alpha Link   Indicates which Logger is connected
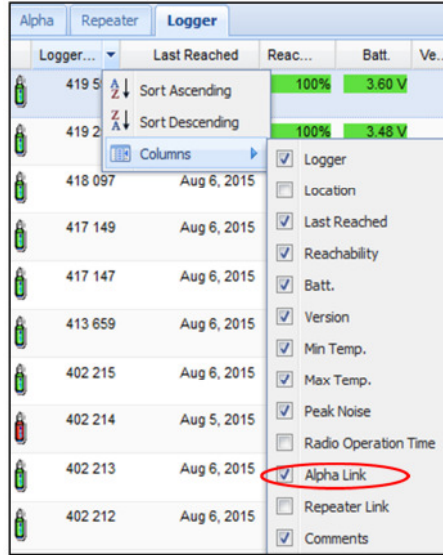
Figure 58: Alpha Link

Last Reached   Shows the date when the Logger was contacted
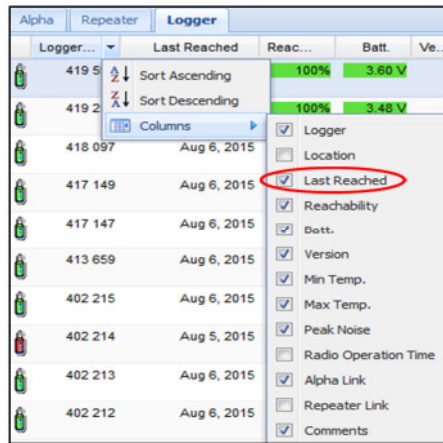
Figure 59: Logger Settings

5.2 Alpha Table

In the Alpha Table, all Alphas of the current project are displayed.

Figure 60: Alpha Table

5.2.1 Table Fields

Please refer to Tables and Settings of section Logger.

5.3 Repeater Table

In the Repeater Table, all Repeaters of the current project are displayed.

Figure 61: Repeater Table

5.3.1 Table Fields

Please refer to Tables and Settings of section Logger.

6 Administration View

Note! This section is only relevant for users with supervisor level
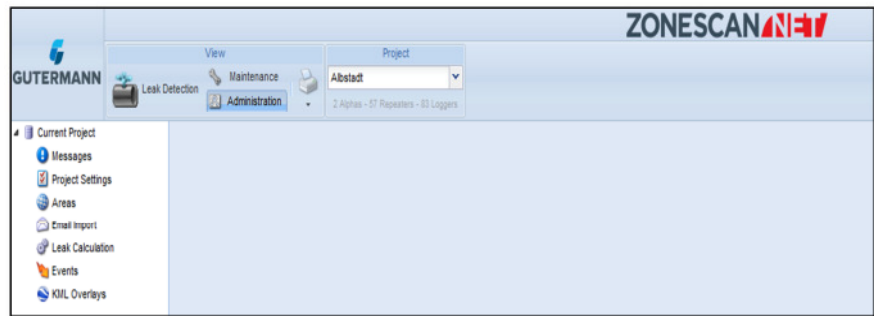
Figure 62: Administration

- To change the settings of an existing project, click Administration in the View area of the menu bar. In the Project area, select the project that is to be changed. In the navigation bar, then click the Current Project > Settings item
- To save your settings, click the Save button in the respective table

6.1 Current Project Settings

Note! The preset values are guide values and may vary

6.1.1 General Table
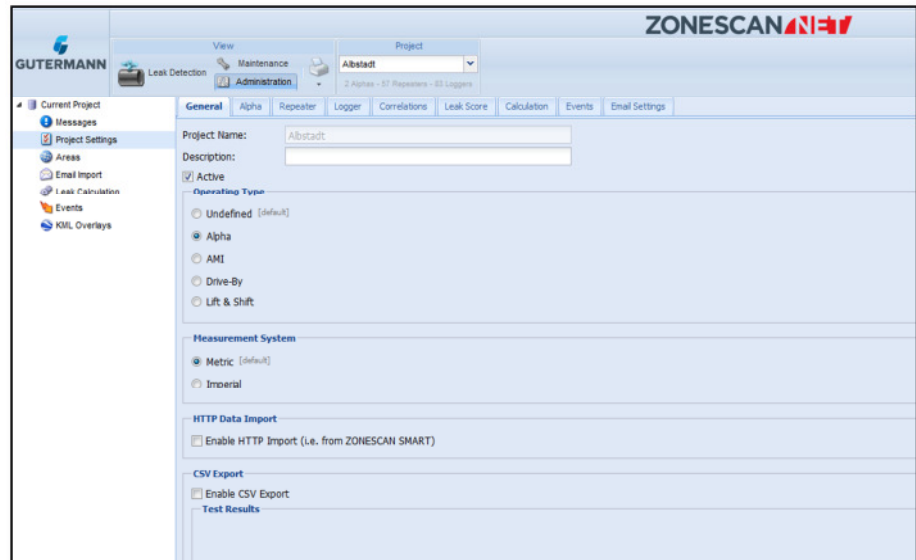
Figure 63: Settings > General

Project Name

The name of the project is automatically taken over from the menu bar

Operating Type

You can select the appropriate operating type according to operating mode. The Alpha item is preset. If you are working in a fixed network, click Fixed Network here. The data is then integrated in your network

6.1.2 Alpha Table
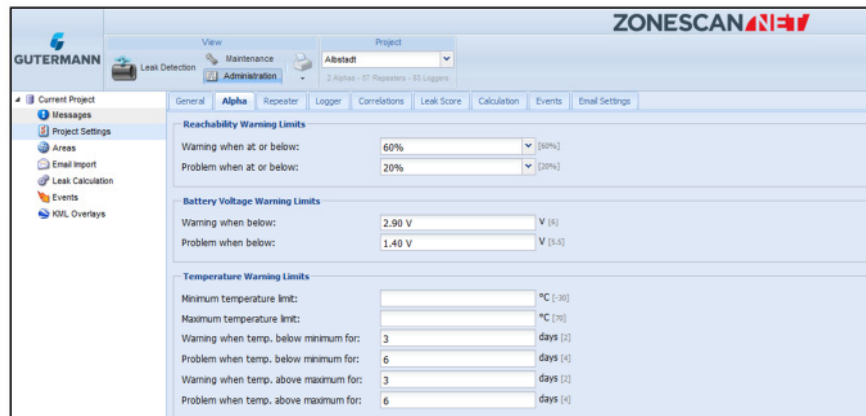
Figure 64: Settings > Alpha

Reachability Warning Limits

Warning when not reachable for: Define the number of days after which a warning is displayed if an Alpha was not reached. Preset: 2 days

Problem when not reachable for: Define the number of days after which an error is displayed if an Alpha was not reached. Preset: 4 days

Battery Voltage Warning Limits

Warning when below: Enter the charge state of the batteries of the Alphas below which a warning is displayed. Preset: 6.00 V

Problem when below: Enter the charge state of the batteries of the Alphas below which an error is displayed. Preset: 5.50 V

Temperature Warning Limits

Minimum temperature limit:
Enter the lower temperature value below which a warning or an error is displayed. Preset: -30.0°C

Maximum temperature limit:
Enter the upper temperature value above which a warning or an error is displayed. Preset: 70.0°C

Warning when temp. below minimum for: Enter the number of days after which a warning is displayed if the temperature measured at the Alpha remains below the limit value entered above. Preset: 2 days

Problem when temp. below minimum for: Enter the number of days after which an error is displayed if the temperature measured at the Alpha remains below the limit value entered above. Preset: 4 days

Warning when temp. above maximum for: Enter the number of days after which a warning is displayed if the temperature measured at the Alpha remains above the limit value entered above. Preset: 2 days

Problem when temp. above maximum for: Enter the number of days after which an error is displayed if the temperature measured at the Alpha remains above the limit value entered above. Preset: 4 days

6.1.3 Repeater Table
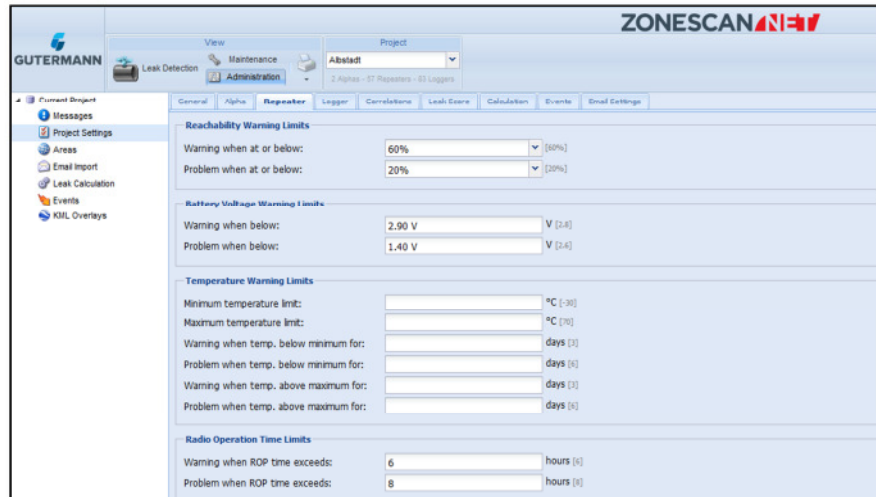
Figure 65: Settings > Repeater

Reachability Warning Limits

Warning when not reachable for: Define the number of days after which a warning is displayed if a Repeater was not reached. Preset: 3 days

Problem when not reachable for: Define the number of days after which an error is displayed if a Repeater was not reached. Preset: 6 days

Battery Voltage Warning Limits

Warning when below: Enter the charge state of the batteries of the Repeaters below which a warning is displayed. Preset: 2.80 V

Problem when below: Enter the charge state of the batteries of the Repeaters below which an error is displayed. Preset: 2.60 V

Temperature Warning Limits

Minimum temperature limit: Enter the lower temperature value below which a warning or an error is displayed. Preset: -30.0 °C

Maximum temperature limit: Enter the upper temperature value above which a warning or an error is displayed. Preset: 70.0 °C

Warning when temp. below minimum for: Enter the number of days after which a warning is displayed if the temperature measured at the Repeater remains below the limit value entered above. Preset: 3 days

Problem when temp. below minimum for: Enter the number of days after which an error is displayed if the temperature measured at

the Repeater remains below the limit value entered above. Preset: 6 days

Warning when temp. above maximum for: Enter the number of days after which a warning is displayed if the temperature measured at the Repeater remains above the limit value entered above. Preset: 3 days

Problem when temp. above maximum for: Enter the number of days after which an error is displayed if the temperature measured at the Repeater remains above the limit value entered above. Preset: 6 days

6.1.4 Logger Table
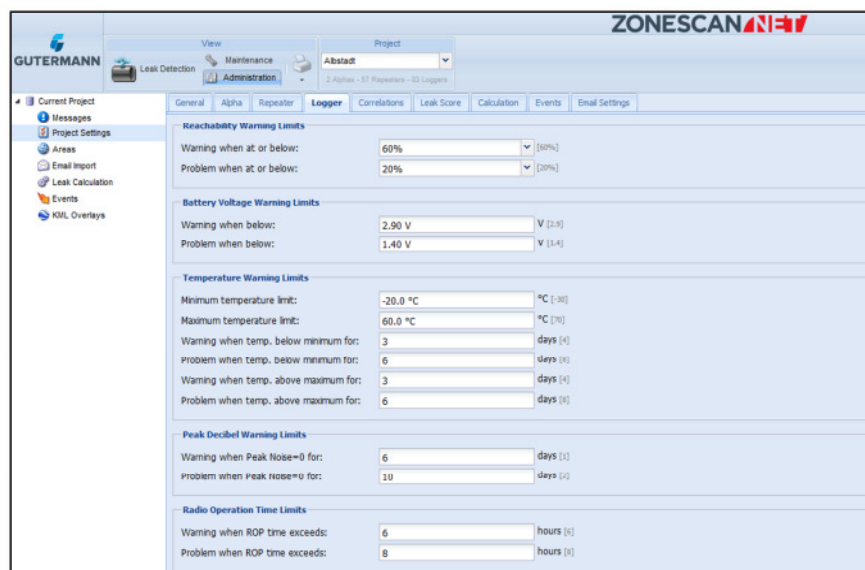
Figure 66: Settings > Logger

Leak Value Warning Limits

Possible leak: Enter the values based on experience for displaying a possible leak. Preset: 40

Probable leak: Enter the values based on experience for displaying a probable leak. Preset: 70

Reachability Warning Limits

Warning when not reachable for: Define the number of days after which a warning is displayed if a Logger was not reached. Preset: 4 days

Problem when not reachable for: Define the number of days after which an error is displayed if a Logger was not reached. Preset: 8 days

Battery Voltage Warning Limits

Warning when below: Enter the charge state of the batteries of the Loggers below which a warning is displayed. Preset: 2.90 V

Problem when below: Enter the charge state of the batteries of the Loggers below which an error is displayed. Preset: 1.40 V

Temperature Warning Limits

Minimum temperature limit: Enter the lower temperature value below which a warning or an error is to be displayed. Preset - 30.0 °C

Maximum temperature limit: Enter the upper temperature value above which a warning or an error is to be displayed. Preset: 70.0 °C

Warning when temp. below minimum for: Enter the number of days after which a warning is displayed if the temperature measured at the Logger remains below the limit value entered above. Preset: 4 days

Problem when temp. below minimum for: Enter the number of days after which an error is displayed if the temperature measured at the Logger remains below the limit value entered above. Preset: 8 days

Warning when temp. above maximum for: Enter the number of days after which a warning is displayed if the temperature measured at the Logger remains above the limit value entered above. Preset: 4 days

Problem when temp. above maximum for: Enter the number of days after which an error is displayed if the temperature measured at the Logger remains above the limit value entered above. Preset: 8 days

Peak Decibel Warning Limits

Warning when dBmax=0 for: Enter the number of days after which a warning is displayed if the highest dB value measured at the Logger is equal to 0. Preset: 1 day

Problem when dBmax=0 for: Enter the number of days after which an error is displayed if the highest dB value measured at the Logger is equal to 0. Preset: 2 days

6.1.5 Correlations Table
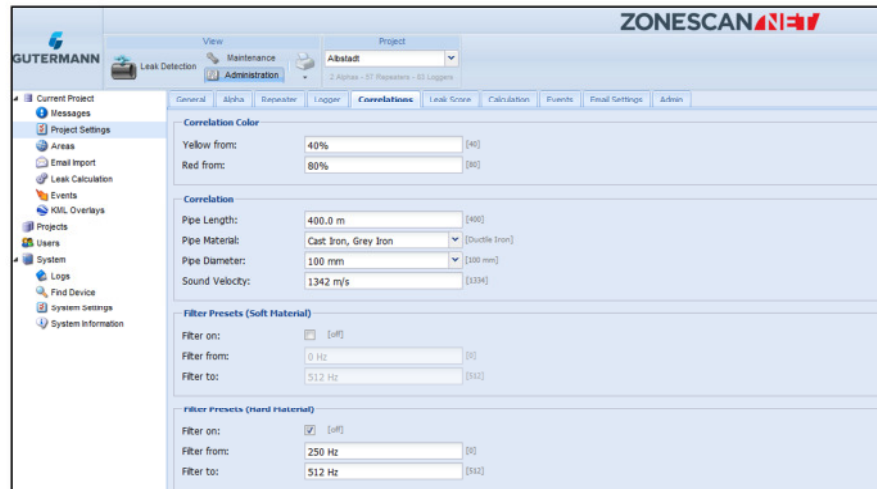
Figure 67: Settings > Correlations

Correlation Color

There are two levels of warning thresholds: yellow in the range of 40 - 79%, which indicates a possible, and red in the range of 80 - 100% indicates a probable leak. The green indicator (0 - 39%, everything is in order) is here not shown. The default values are 40% and 80%

Pipe Presets

Pipe Length: Enter the distance between two Loggers. Preset: 600m

Note! Incorrect evaluations will result if the entered length is shorter than the actual pipe length

Note! If not sure, enter a value that exceeds the actual distance between the Loggers. Example: actual pipe length: 255m, entered pipe length: 600m

Pipe - Material: Select the pipe material from the drop-down list. Preset: Ductile Iron

Pipe - Diameter: Select the pipe diameter from the drop-down list. Preset: 100mm

Sound Velocity: The sound velocity is dependent on the pipe material and is automatically set by the system upon selection of the pipe material. Preset: 1334 m/s

Filter Presets (Soft Material)

Filter on: Select the check box if your pipe is made of soft material (e.g., PVC, PE)

Filter from: Enter the lower Hz value above which filtering is to be performed. Preset: 0 Hz

Filter from: Enter the lower Hz value above which filtering is to be performed. Preset: 512 Hz

Filter Presets (Hard Material)	Filter on: Select the check box if your pipe is made of hard material

Filter from: Enter the lower Hz value above which filtering is to be performed. Preset: 120 Hz

Filter to: Enter the upper Hz value up to which filtering is to be performed. Preset: 512 Hz

6.1.6 Leak Score Table
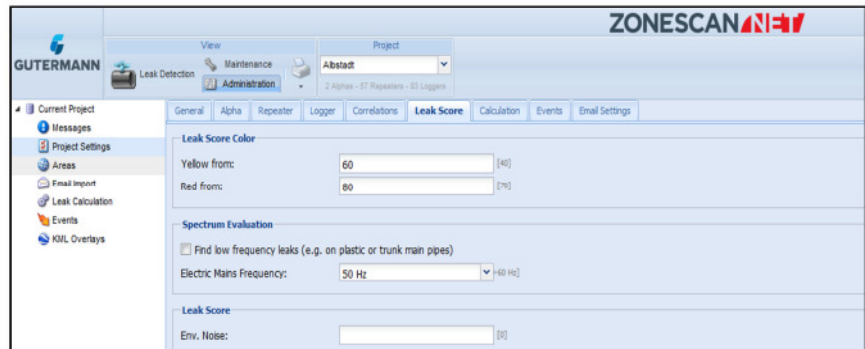
Figure 68: Settings > Leak Score

Env. Noise   In this field, the measurement sensitivity of the logger can be adjusted to the environmental sound intensity

6.1.7 Calculation Table
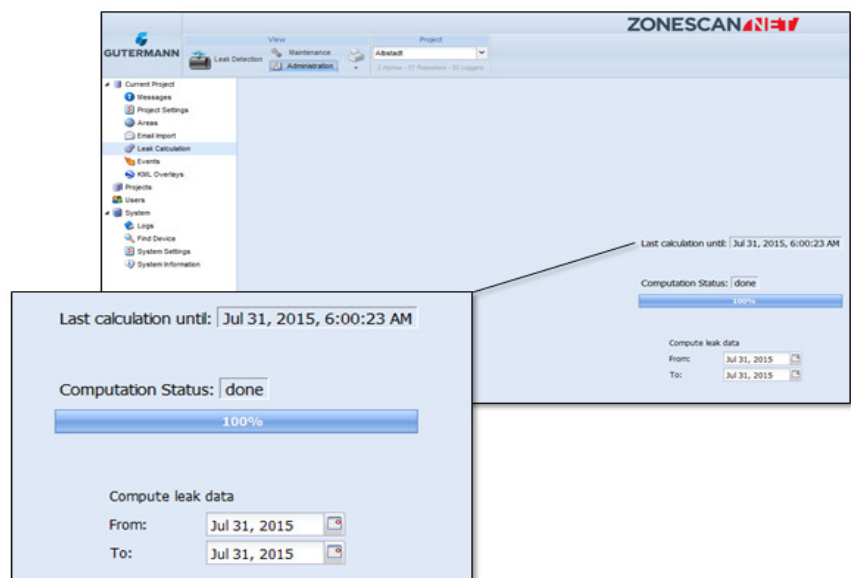
Figure 69: Settings > Calculation

Start Leak Calculation	Perform leak calculation manually
Interrupt Leak Calculation	Interrupt leak calculation
Delete Leak Scores	Delete all leak scores
Refresh Data	Check e-mail

6.1.8 Events Table
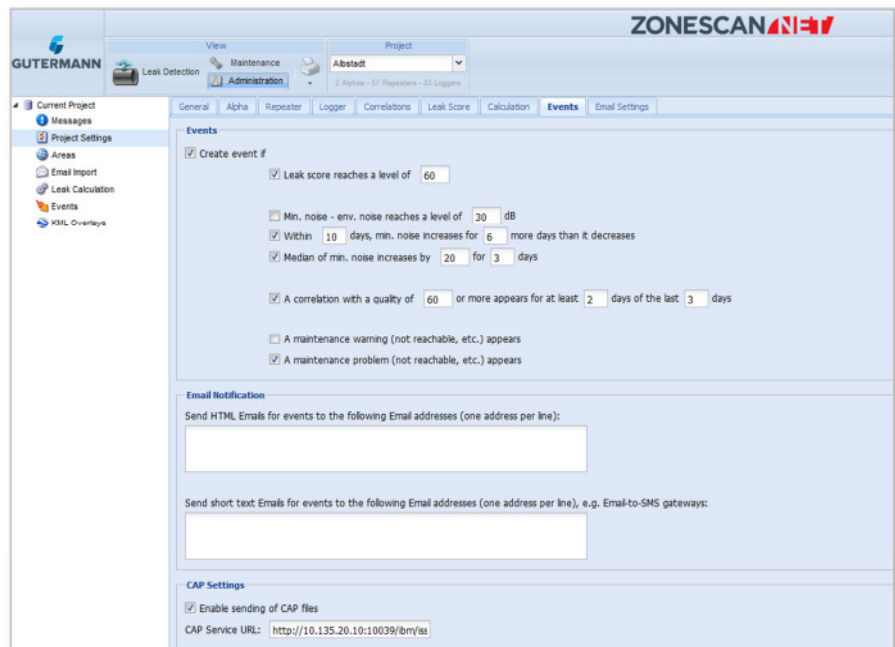
Figure 70: Settings > Events

One of the essential additions to version 1.5.0 is the Events Table where e-mail alarms can be set for the project. Within this table the project administrators can setup the e-mail alarm parameters including the e-mail addresses of the recipients. The settings are designed to alert on a genuine leak rather than a false positive.

6.1.9 E-mail Settings Table
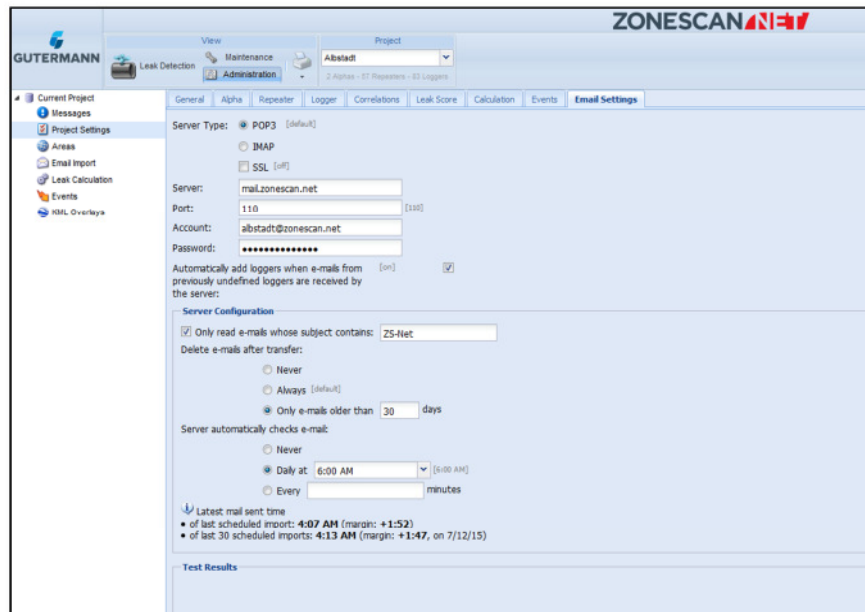
Figure 71: Settings > E-mail

Server Type: Click to define your server type. Select the SSL (Secure Sockets Layer) check box if necessary. Preset: POP3

Server: Enter your server's name. Example: pop.1and1.com

Port: Enter the port enabled for e-mail reception. Preset: Port 110

Account: Enter the e-mail account that receives the data for the project. Example: albstadt@zonescan.eu

Password: Enter the password for the e-mail account entered above

Check the "Automatically add Loggers when e-mails from previously undefined Loggers are received by the server" to avoid having to manually set up new Loggers
Preset: check box is selected

Server Configuration   "Only read e-mails whose subject contains:" Select the check box and enter ZS-Net in the text field

Delete e-mails after transfer: Select whether and when the transferred e-mails are deleted:

- Never

- Always

- Only e-mails older than N days
  Enter the number of days after which e-mails are deleted
Preset: Always

"Server automatically checks e-mail:" Select whether and when the server checks for new e-mail.

- Never

- Daily at
  Select the desired time from the drop-down menu

- Every N minutes
  Enter the number of minutes after which the server checks for new e-mail.
Preset: Daily at 5:00 AM

Note! When entering the time, note that the calculation is useful only after e-mail has been checked. The time of the correlation calculation can be defined in the Server Configuration table

Test Results

If you test the e-mail settings with the Test e-mail settings button, the test results appear here

Use the Test e-mail settings button to test whether your settings are correct and e-mails can be received. The results of the test appear in the Test Results field

6.1.10 Administration Table
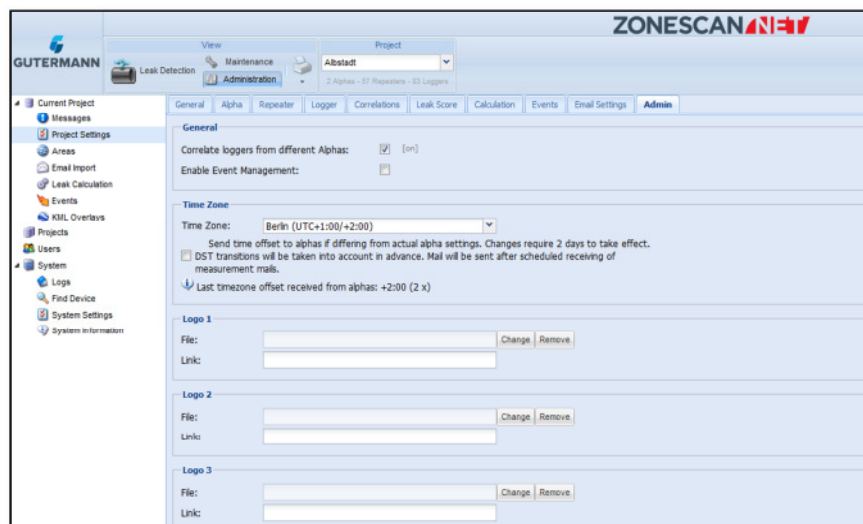
Figure 72: Settings > Administration

6.2 KML Overlays

The uploaded KML (Keyhole Markup Language) overlay files are displayed here in a list:

Figure 73: List of the KML files

Import	Click Import to upload the KML files stored on the PC
Delete	Click to delete a selected KML file from the list
Delete All	Delete all KML files in the list

6.3 Projects

All currently running projects are displayed in a list:
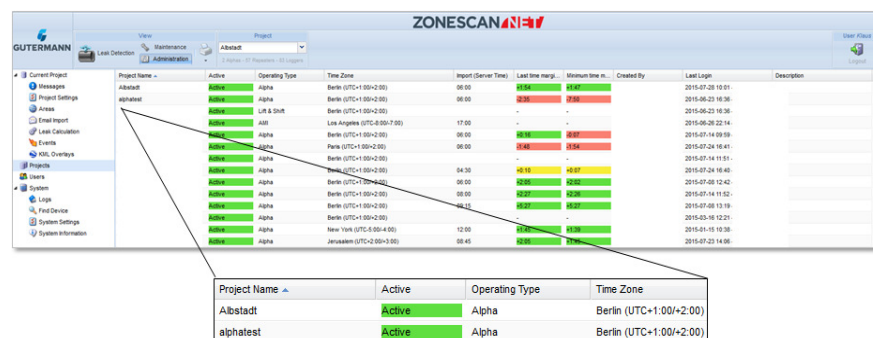
Figure 74: Project List

Add	Create a new project
Edit	Edit a project selected in the list
Delete	Delete a selected project from the list
Import Project	An existing project stored on the PC is imported
Merge Project	To merge two projects, you need an (exported) project file that is then imported into an already existing project. In the project list, select the project into which the file is to be imported. Then click Merge Project
Export Project	All projects are exported

Import Loggers	Selected Loggers are imported
Export Loggers	All Loggers contained in the project are exported

6.4 Users

All users and their assigned projects are displayed in this table:

Figure 75: Users

Add	Click Add to create a new user. In the window that opens, enter user name, password, user type as well as the first and last name. Click to assign the user individual projects. Once all data has been entered, click Save to activate the profile
Edit	Click the Edit button to edit an existing profile
Delete	Click Delete to remove an existing profile

6.5 System

The system category lists all information related to the ZONESCAN NET server. This category is only available for Administrators.

Figure 76: System Messages

6.5.1 Messages

There are two types of messages:

Info
This is a simple status message about system activities and background processes

Warning
Please contact support if a message is displayed with the warning status

7 Appendices

7.1 Correction explained in detail
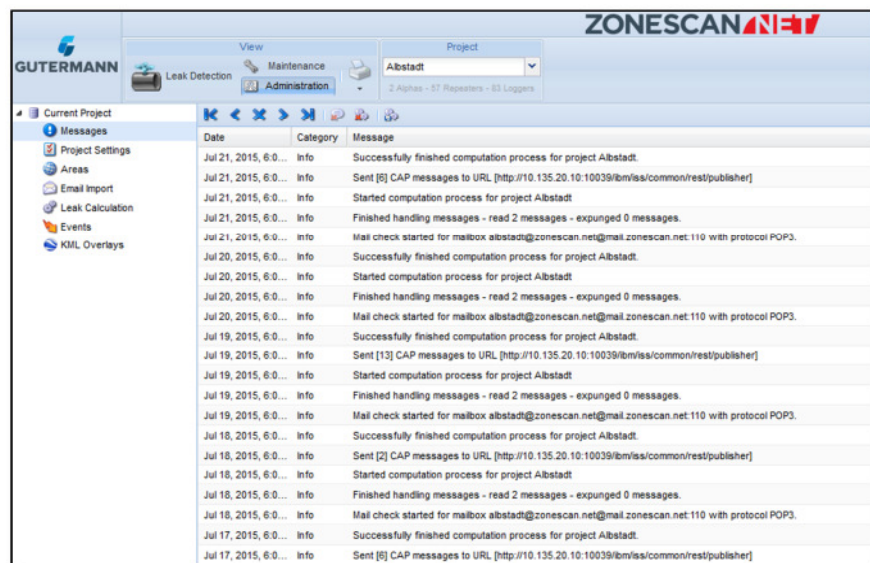
Leakage noise is generally a wild mixture of tones, each of which can be associated with individual frequencies (tone pitches, oscillations). The distribution of this frequency content is referred to as a spectrum.

First, the time series signal is recorded. These time series values can undergo a mathematical transformation, Fourier analysis.

A particularly efficient computational technique of Fourier analysis is the FFT (Fast Fourier Transform). This is used to calculate the frequency content and, in particular, identify the presence of dominant individual frequencies. Using this information, it is possible, for example, to draw conclusions on disturbances (e.g., electrical machines).

Frequencies are specified in units of Hz (Hertz) as the number of oscillations per second. For leakage noises, one usually finds a uniform mixture of frequencies, primarily located in the range from 50 to 1000 Hz.

The knowledge of the spectrum, i.e., of the frequency response, is particularly helpful for the computational use of filters, by means of which one can separate the useful and the interfering portions of the noise measurement spectra.

Correlation is a mathematical method for comparing two time series signals with one another.

A leakage noise is simultaneously recorded by two sensors at different locations. The sound emitted by the leak spreads in the water pipe at a defined sound velocity. If the acoustic event were to be brief and occur only once, e.g., a blow with hammer, it would be simple to measure the arrival at both receivers. In this case, one would only need to compare the arrival times at the two receivers with one another. If these are the same, the sound has traveled the same distance to the receivers, i.e., the sound source lies in the middle of the pipe between the receivers.

If the arrival times are different, it is possible to calculate the distance to the two receivers from the measured time difference. The sound arrives at the closer sensor before the more distant sensor.

Leakage noise, however, is not a one-time acoustic event, but it is also not completely monotonous. Small, irregular changes in sound intensity and frequency occur. These changing signatures travel to the two receivers in the same way as a hammer blow and may arrive at the sensors at different times.

Because the identification and comparison of an individual signature is not as simple as in the case of a hammer blow, the two time series signals are first recorded for a period of time; the time series includes many individually measured signal values.

The two time series signals are mathematically compared with one another, i.e., correlated with one another. If the leakage sound arrived at the sensors simultaneously, the same signatures are compared and the signals are then similar and the correlation is high.

In general, however, the respective signatures arrive at the sensors at different times and simultaneously recorded signals do not correlate with one another. Because the signals were digitally recorded and stored, it is possible to retroactively shift the signals with respect to one another and re-correlate them with one another.

This is performed systematically. From the results, one obtains a correlation curve that includes the individual correlation values over the respective computationally performed time shift.

If, during this process, one reaches precisely the time shift that corresponds to the propagation time difference from the sound source to the two receivers, the signal signatures match and one obtains a correlation maximum at this point.

Because this is the comparison of two different signals, it is also called a cross correlation.

In the context of leakage noises, the goal of the correlation measurement is primarily to determine the propagation time difference of two signals.

Because the correlation curve also includes spectral information, it is often of interest to define the character of the leakage noise, particularly for distinguishing noises that are not related to the leak, provided this can be detected by means of a frequency analysis (e.g., electrical noise). The correlation curve can also be mathematically filtered for the purpose of retroactively separating such interfering noise to better identify the correlation maximum caused by the leak.

7.2 Center Correction explained in detail

With correlation we measure the time delay between the leak noise reaching both sensors:
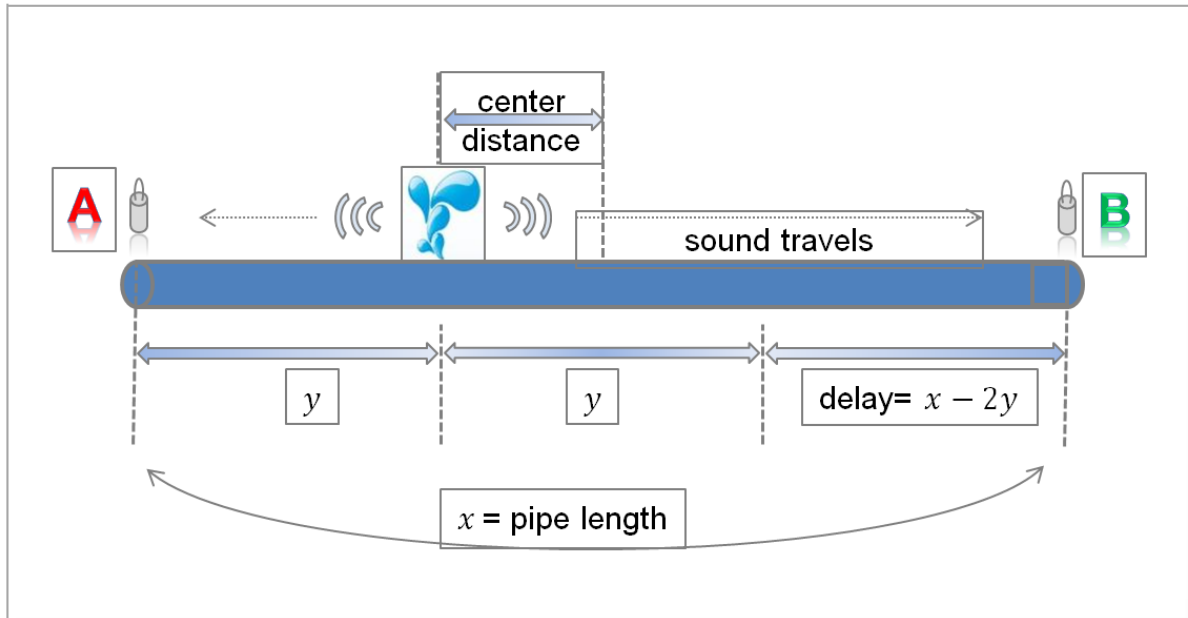
Figure 77: Center Correlation

From this we can calculate the leak distance from both sensors, but only if we know the pipe length between the sensors x. In practice, in ZONESCAN NET we often don't know the pipe length because it was not entered using the pipe wizard of manual pipe entry.

Even if we don't know the pipe length however, we can always calculate the offset of the leak from the center between the sensors using the default sound velocity. This is called center distance.

7.2.1 Example

The selected correlation between sensors 402179 and 402193 in project "Albstadt" below seems to be left of sensor 402193.
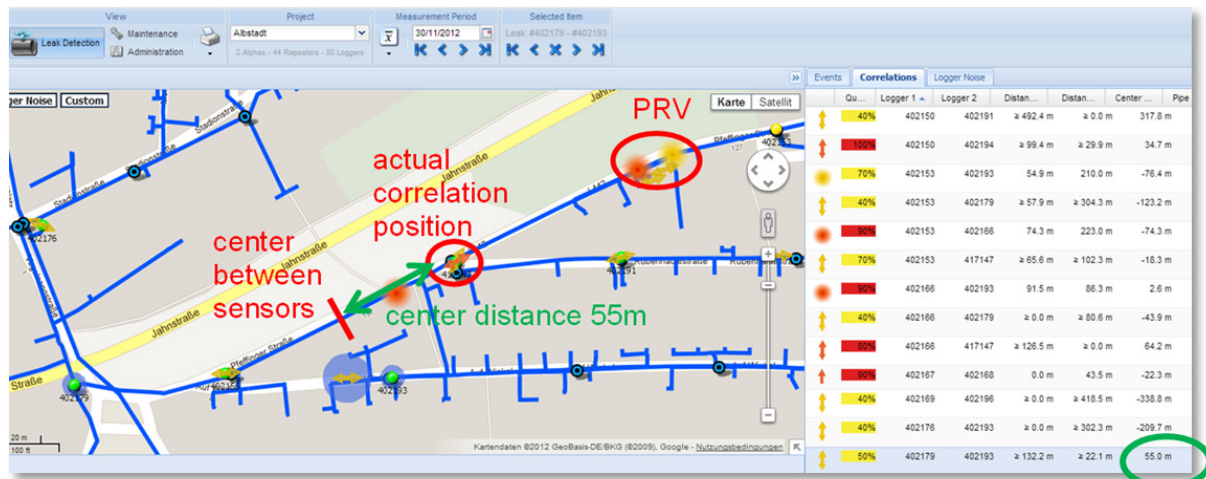
Figure 78: Center Correlation – cont.

As we can see from the KML (Keyhole Markup Language) overlay this is not possible because there is no direct pipe connection between the sensors. However, the center distance of 55m tells us that the noise source is 55m from the center between the sensors towards logger 402193 (if it was towards the first sensor, the center distance would be negative). From this we can see that the correlation position is the junction with the pipe coming from the PRV (Pressure Reduction Volve), which is also the cause for the correlation.

8 Hardware Description

8.1 Overview

As shown in Figure 1, the ZONESCAN system consists of the devices

- ZONESCAN 820 Logger
  - Model 4-1-C1 (EU, internal antenna),
  - Model 4-2-C1 (EU, external antenna),
  - Model 5-1-C1 (North America, internal antenna)
  - Model 5-2-C1 (North America, external antenna)

- ZONESCAN 820 Repeater
  - Model 4-1-C1 (EU)
  - Model 5-1-C1 (North America)

- ZONESCAN Alpha communication unit
  - Model S-ALPHA-4-0-A1 (EU)
  - Model S-ALPHA-5-0-A1 (North America)

External Antenna types

- ZONESCAN 820 Logger
  Impedance   50Ω
  Antenna gain: 0dBi max.
  Polarisation: linear; vertical

  Example: C02+MT07-1+174U+SMA M from CHIN MORE

- Model S-ALPHA
  Impedance   50Ω
  Antenna gain: 12dBi max.
  Polarisation: linear; vertical

  Example: YA9-11 from LAIRD TECHNOLOGY

8.2 Installation

The initial setup of the ZONESCAN system and/or specific training for the setup is provided by a qualified Gutermann representative.

8.3 Conformity

This device complies with part 15 of the FCC Rules and with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

9 Disposal

Never put electrical appliances, accumulators, and batteries in household waste bin. Always collected separately and perform an environmentally friendly recycling. When disposing of electrical appliances, accumulators, and batteries always comply with national and regional waste disposal regulations. If an orderly disposal of our products is not possible, send the unit to us. We dispose our products environmentally friendly. Address see imprint.

10 Imprint

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Subject to alterations I Software Version 2.1 – Document 03/2017

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