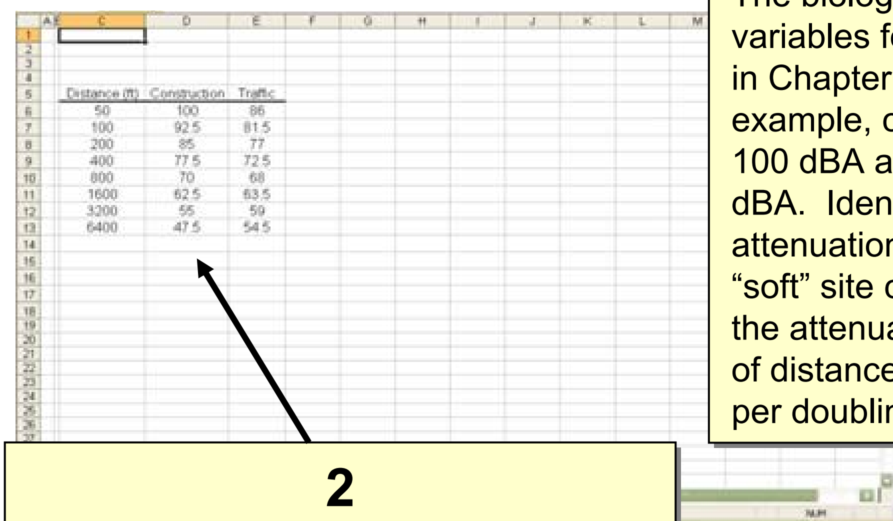
Noise Assessment Tutorial

The following guidance provides step-by-step instructions for obtaining and using the equations associated with conducting a noise assessment for WSDOT projects. This is companion guidance to Chapter 7 of the *WSDOT Biological Assessment Preparation for Transportation Projects* (BA Manual, available at http://www.wsdot.wa.gov/Environment/Biology/BA/default.htm#BATrainingManual). Both terrestrial and underwater noise examples are provided.

Terrestrial Noise – Trend Equations and Their Use

1

The biologist should first estimate the noise variables for the project using the guidance in Chapter 7 of the BA Manual. For this example, construction noise is estimated at 100 dBA and traffic noise is estimated at 86 dBA. Identify site conditions to determine the attenuation rates for noise – in this case, "soft" site conditions are assumed; therefore the attenuation rates are 7.5 dB per doubling of distance for construction noise and 4.5 dB per doubling of distance for traffic noise.

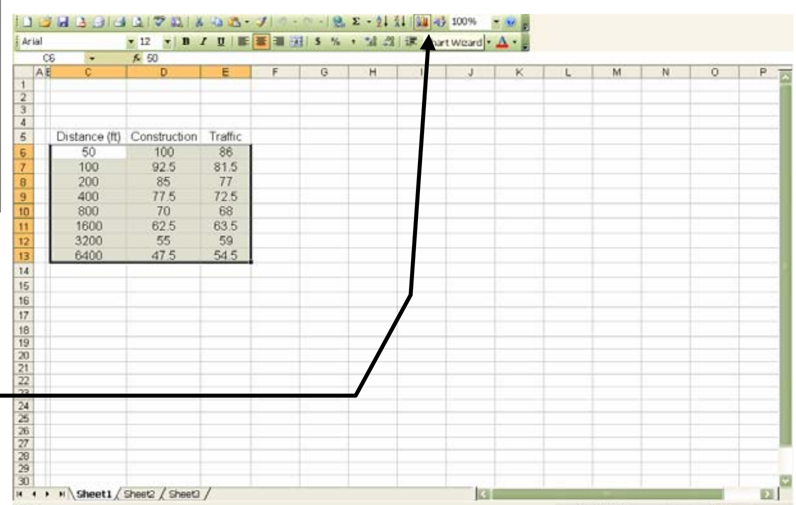


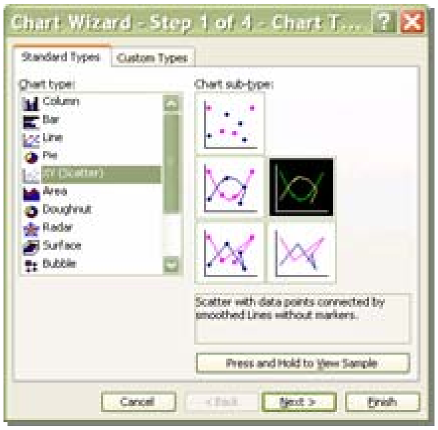
2

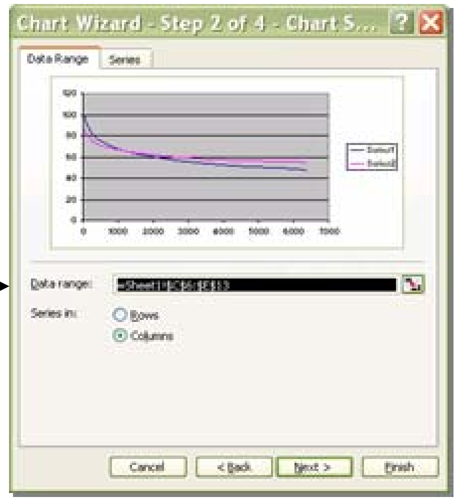
Once you have identified the estimated construction noise and traffic noise, use a spreadsheet program to build an attenuation table. Note the columns from left to right are distance, construction noise, and traffic noise. The distance should double every row, and the sound levels for construction and traffic will decrease by the attenuation rates identified in Step 1.

3

Select the data cells as shown (selection is highlighted) and click on a Chart Wizard button or select Insert Chart.

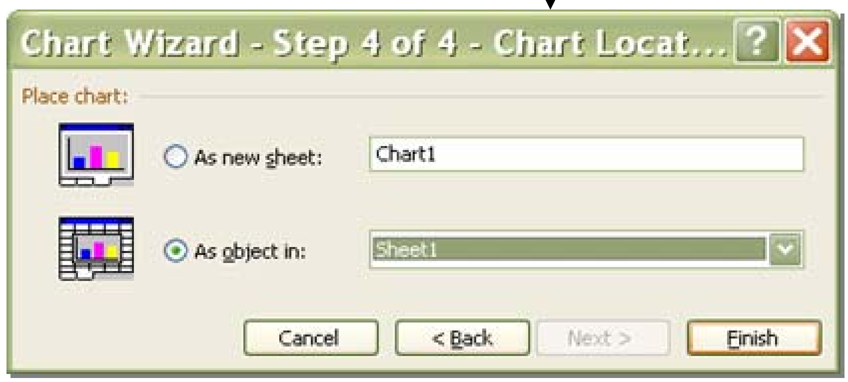


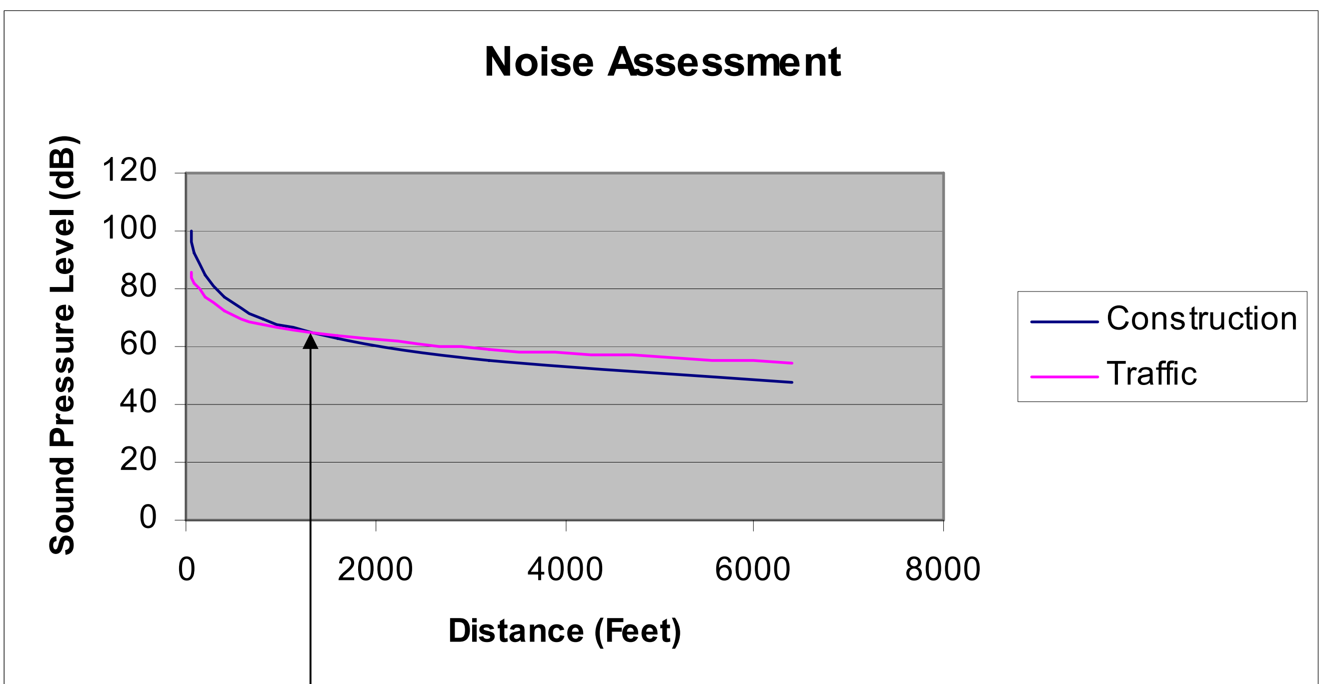




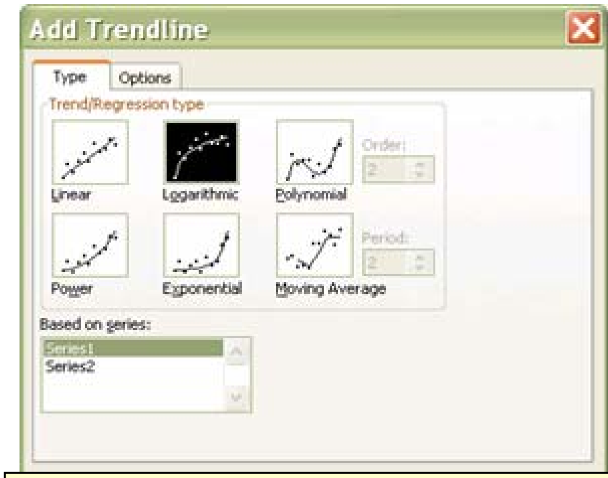
4

Select XY Scatter as the chart type. Label the chart if necessary. Finish the chart to display it on the spreadsheet.



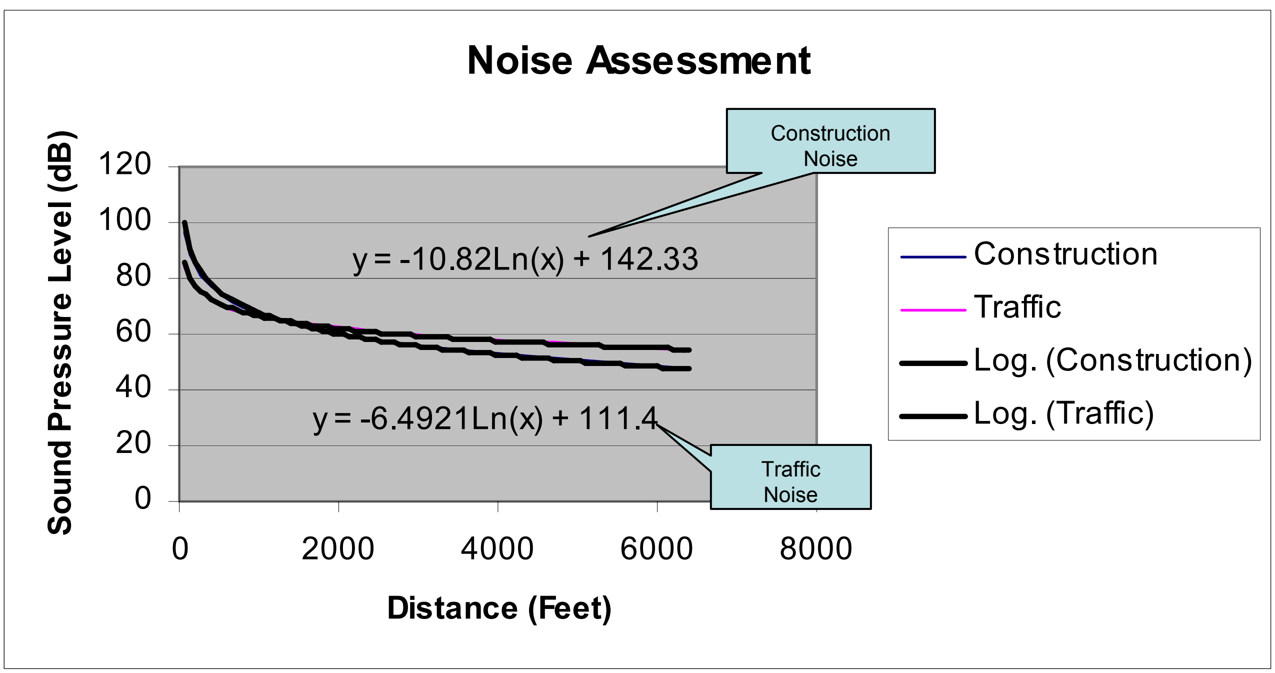


A chart is now displayed, showing two attenuation lines (construction and traffic). The location on the x-axis where the two lines cross is the limit of project-related noise. After this point, the baseline traffic noise is louder than construction noise.



5

The next step is to add a trendline for construction and traffic noise. Either select Add Trendline from the Chart menu, or right-click on the construction line in the chart and select Add Trendline. Make sure the trendline is logarithmic, and click the Options tab to display the equation on the chart. Add the trendline and the equation to the chart. Complete step 5 for each line to get trendlines and equations for construction and traffic noise.



Now that the equations have been identified, solve for either variable to determine the noise level at a given distance, or the distance from the source of a given noise level. The next page walks through examples using the trendline equations.

Example Construction Noise Trendline

$y = -10.82 \bullet Ln(x) + 142.33$

(Ln = natural log)

Example Traffic Noise Trendline

$y = -6.4921 \bullet Ln(x) + 111.4$

(Ln = natural log)

Solving for ***y*** will provide the decibel level at a known distance. Solving for ***x*** will yield the distance from the source a known decibel level will occur.

Note - These equations are not constant. You must graph the construction and traffic noise estimates for each specific project to get the correct equations.

Example – A spotted owl nest site is located 650 feet from the project. What is the expected construction noise level at the nest site? Solve the equation for y, which from the chart above is decibel level.

•Substitute 650 for x in the construction trendline equation

$y = -10.82 \bullet Ln(650) + 142.33$ **LN** **650**

$y = -70.080841 + 142.33$

$\mathbf{y = 72\ dBA}$

Calculator buttons

Example – The known baseline noise level in the project vicinity is 55 dBA. At what distance will construction noise attenuate to this level? Solve the equation for x, which in the chart above is distance.

•Substitute 55 for y in the construction trendline equation

$55 = -10.82 \bullet Ln(x) + 142.33$ *subtract 142.33 to the other side*

$-87.33 = -10.82 \bullet Ln(x)$ *divide both sides by -10.82*

$8.07 = Ln(x)$ *to get x alone, take the exponent of both sides* **e^x** **8.07**

$\mathbf{x = 3{,}197\ feet}$

Underwater Noise

Practical Spreading Loss

The US Fish and Wildlife Service and National Marine Fisheries Service currently recognize the Practical Spreading Loss equation as the best method to determine underwater noise attenuation rates. WSDOT recommends using Practical Spreading Loss equation in the project noise assessment, and then defining a more realistic impact zone based on site-specific factors. The following steps will guide the biologist through the Practical Spreading Loss equation.

Practical Spreading Loss

$$\mathbf{TL = 15 \bullet Log(R_1/R_2)}$$

Where TL is the transmission loss in dB, R_1 is range in meters of the sound pressure level, and R_2 is the distance from the source of the initial measurement.

Solving for **TL** will provide the underwater sound pressure level at a given distance. To determine at what distance or range a known sound pressure level will occur, the equation must be solved for R_1:

$$\mathbf{R_1 = (10^{(TL/15)}) \bullet R_2}$$

Example – A project is impact pile driving 30-inch hollow steel piles, which are expected to produce sound pressure levels of 196 dBrms 10 meters from the pile. What is the underwater sound pressure level 1,500 meters from the pile? Solve the equation for Transmission Loss, and subtract the TL from the initial sound pressure level.

$TL = 15 \bullet Log (R_1/R_2)$ **LOG** **150**

$TL = 15 \bullet Log (1500m/10m)$

$TL = 15 \bullet 2.176$

$TL = 33$ dBrms

Subtract 33 dBrms from the initial sound pressure level of 196 dBrms to get the sound pressure level at 1,500 meters **= 163 dBrms.**

Example – A project is impact pile driving 30-inch hollow steel piles, which have been documented to produce sound pressure levels of 196 dBrms 10 meters from the pile. The underwater baseline noise level in the area is 135 dBrms. At what distance will pile driving noise attenuate to baseline levels? Solve the equation for distance using the known transmission loss.

$\mathbf{R_1 = (10^{(TL/15)}) \bullet R_2}$ *TL = 196 – 135 = 61* | 10^X | 4.07 |

$R_1 = (10^{(61/15)}) \bullet R_2$

R1 = 11,749 ● 10m

R1 = 117,490 meters

For this example project, the extent of project-related noise would be estimated at 117,490 meters from project activity.

For more information, see Chapter 7 of the BA Manual at http://www.wsdot.wa.gov/Environment/Biology/BA/default.htm#BATrainingManual.