Appendix A

Predicted Ground Borne Vibration arising from Sheet Piling

- **Glengad**
- **Aghoos**
- **Bay (Surface Intervention)**

CORRIB ONSHIRE PIPELINE

Glengad compound

Assessment of piling vibration

3 September 2010

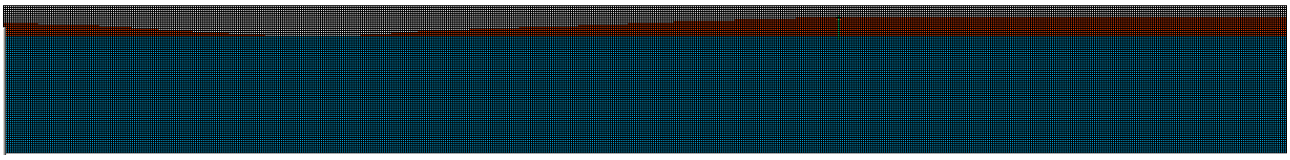
In order to construct the reception chamber for the tunnel at the Glengad compound it will be necessary to insert sheet piles using a vibratory piling rig. This would cause vibration to be propagated to the surrounding area, and an assessment has been made of the likely vibration.

Some data on vibration from vibratory pile drivers are given in BS 5228-2:2009, namely:

C44 4m to 5m soft saturated sand over soft to firm clay 2.6mm/s ppv at 6m at 27.5Hz
C51 unknown soil conditions, 11mm/s ppv at 10m at 25Hz
C53 Gravel over London Clay (55-79 kW), 4.3mm/s ppv at 5m at 25Hz
C55 Glacial till/gravelly sandy silt mixture with occasional cobbles (130 kW) 2.4mm/s ppv at 10m 26.6Hz
C56 Gravel 42mm/s ppv at 3m variable up to 23.3 Hz.

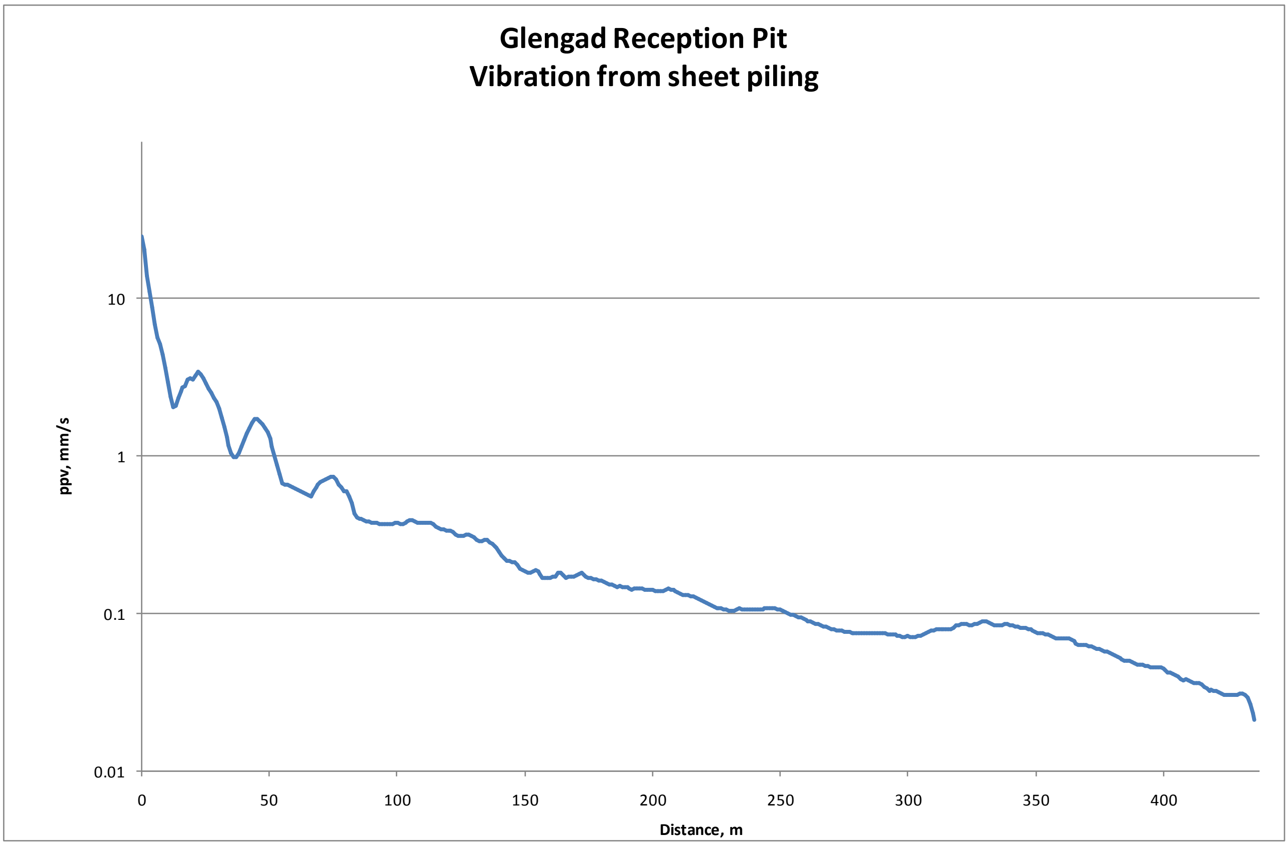
For this study it is assumed that a piling rig of 130kW will be used, operating at a frequency of 33.3 Hz. It is assumed that each pile will be driven to refusal as the toe reaches the top of the rockhead, and this has been modelled as the worst case. At this point, little energy is absorbed by the friction of inserting the pile, and it is assumed that for a short time almost all the energy of the vibration is radiated as vibration. This can be expected to cause higher vibration than the 2.4mm/s at 10m of C55.

A prediction exercise has been carried out using the finite difference time domain model Findwave. The following section through the model shows the geology assumption:



From the bottom up, the layers are schist, and sandy gravel.

An oscillating force of was applied to the top of a line of sheet piles in the model, at a frequency of 38Hz. The ppv at the top of the schist was as follows:



The distance from the piling site to the nearest house is approximately 230m. At this distance the ppv is predicted to be approximately 0.1mm/s, below the threshold of human perception. The minimum distance to Dooncarton mountain is approximately 1000m at which the ppv will be signifantly lower than 0.02mm/s.

Aghoos compound

Assessment of piling vibration

3 September 2010

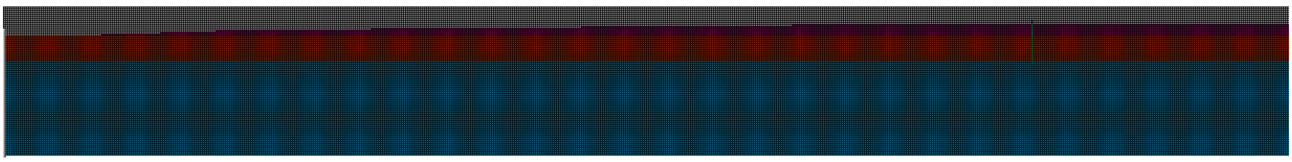
In order to construct the launch chamber for the tunnel at the Aghoos compound it will be necessary to insert sheet piles using a vibratory piling rig. This would cause vibration to be propagated to the surrounding area, and an assessment has been made of the likely vibration.

Some data on vibration from vibratory pile drivers are given in BS 5228-2:2009, namely:

C44 4m to 5m soft saturated sand over soft to firm clay 2.6mm/s ppv at 6m at 27.5Hz
C51 unknown soil conditions, 11mm/s ppv at 10m at 25Hz
C53 Gravel over London Clay (55-79 kW), 4.3mm/s ppv at 5m at 25Hz
C55 Glacial till/gravelly sandy silt mixture with occasional cobbles (130 kW) 2.4mm/s ppv at 10m 26.6Hz
C56 Gravel 42mm/s ppv at 3m variable up to 23.3 Hz.

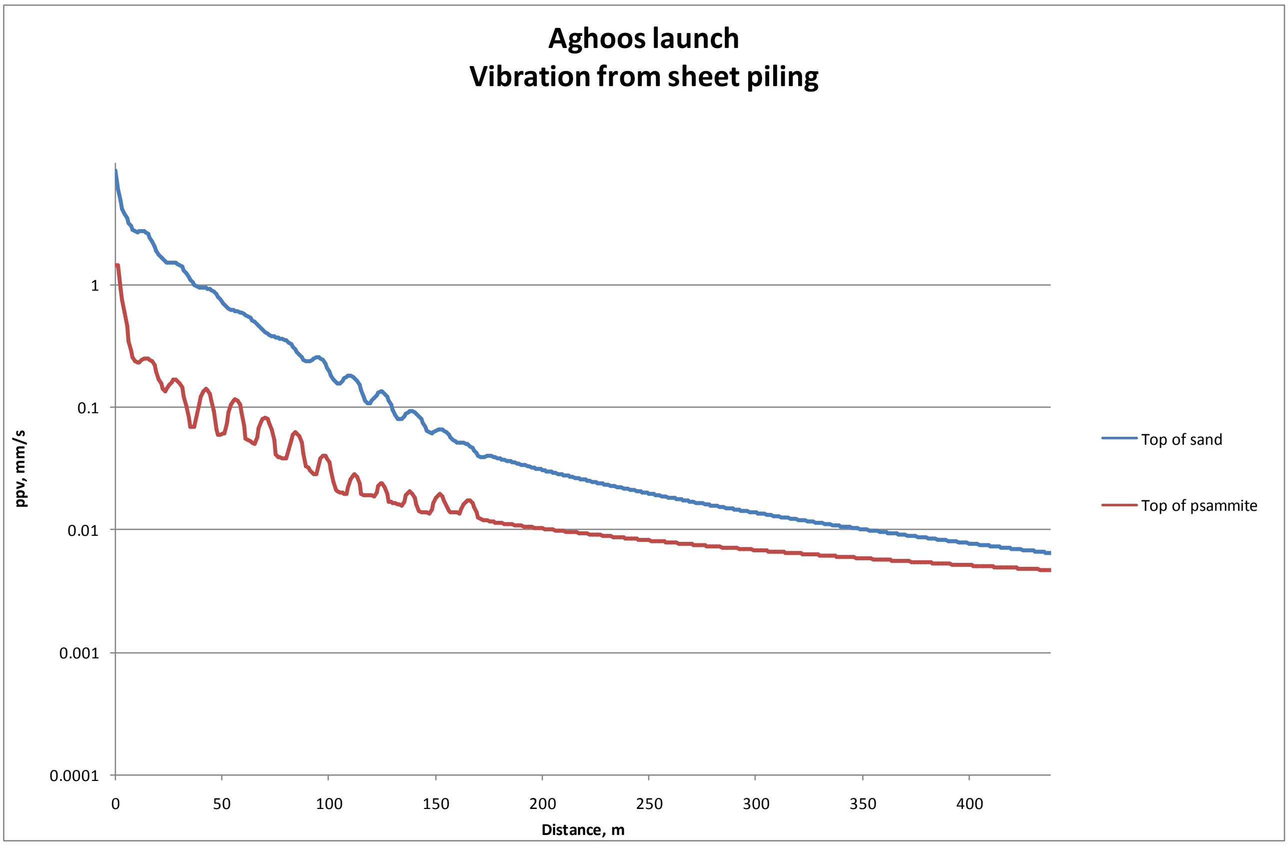
For this study it is assumed that a piling rig of 130kW will be used, operating at a frequency of 33.3 Hz. It is assumed that each pile will be driven to refusal as the toe reaches the top of the rockhead, and this has been modelled as the worst case. At this point, little energy is absorbed by the friction of inserting the pile, and it is assumed that for a short time almost all the energy of the vibration is radiated as vibration. This can be expected to cause higher vibration than the 2.4mm/s at 10m of C55.

A prediction exercise has been carried out using the finite difference time domain model Findwave. The following section through the model shows the geology assumption:



From the bottom up, the layers are Psammite, sand and peat.

An oscillating force of was applied to the top of a line of sheet piles in the model, at a frequency of 38Hz. The ppv at (i) a level equivalent to the top of the sand, and (ii) a level equivalent to the top of the psammite, as a function of distance from the model, was as follows:



The distance from the piling location to the nearest house is approximately 300m. At this distance the ppv is predicted to be less than 0.02mm/s. The minimum distance to Dooncarton mountain is approximately 4000m at which the ppv will have been reduced to below 0.005 mm/s.

CORRIB ONSHIRE PIPELINE

Intervention pit

Vibration assessment

2 September 2010

In the unlikely event of an intervention pit being required, its construction would involve the insertion of sheet piles using a vibratory pile driver. This would cause vibration to be propagated to the surrounding area, and an assessment has been made of the likely vibration as well as underwater sound level.

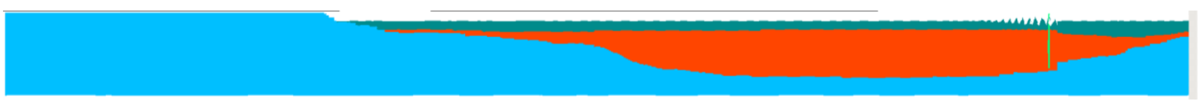
The piling rig which would be used is a Bauer RTG 21 T rig or similar. This would be fitted with a hydraulic vibrator such as a MR 105 V. This vibration has a power of 380 kW, and operates at a frequency of 2300 rpm (38.3 Hz) with a maximum centrifugal force of 1050 kN. It is assumed that it will take 6 minutes to insert a pile 1 metre in length. Since only a part of the energy of the piling rig is radiated as vibration, the remaining part is absorbed by overcoming friction acting against the insertion of the pile and does not contribute to the vibration. This effect is accounted for by determining the distance the pile is inserted on each stroke of the vibrator, and reducing the peak particle displacement by this amount. It should be noted that in some soil conditions the rate of pile insertion may be much greater, as much as one metre per minute, in which case the vibration and underwater sound level will be substantially reduced.

Some data on vibration from vibratory pile drivers are given in BS 5228-2:2009, namely:

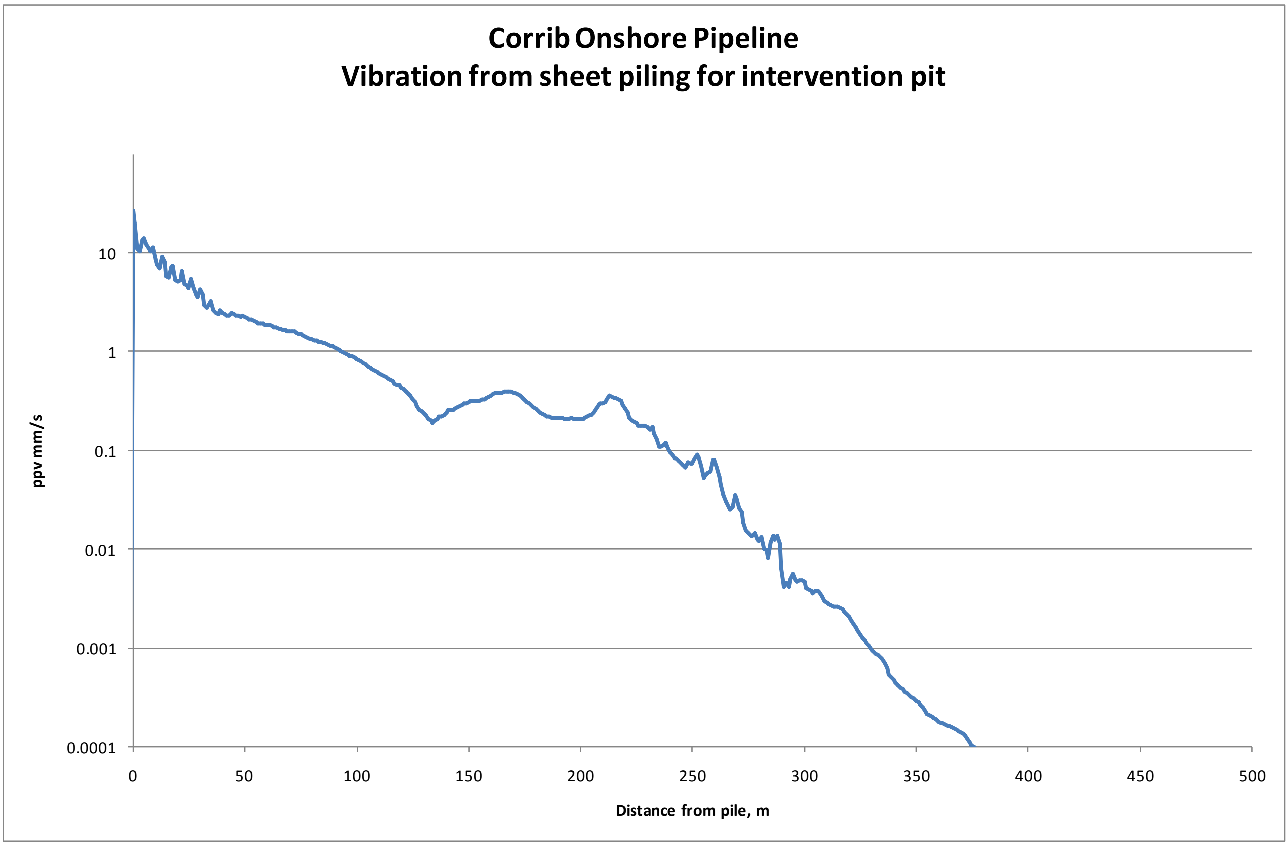
C44 4m to 5m soft saturated sand over soft to firm clay 2.6mm/s ppv at 6m at 27.5Hz
C51 unknown soil conditions, 11mm/s ppv at 10m at 25Hz
C53 Gravel over London Clay (55-79 kW), 4.3mm/s ppv at 5m at 25Hz
C55 Glacial till/gravelly sandy silt mixture with occasional cobbles (130 kW) 2.4mm/s ppv at 10m 26.6Hz
C56 Gravel 42mm/s ppv at 3m variable up to 23.3 Hz.

Although the power of three of these five items is not available, it appears that the MR 105V may be more powerful than the example given in BS 5228.

A prediction exercise has been carried out using the finite difference time domain model Findwave. This was based on section 2 as used in the modelling exercise for vibration from the TBM, as follows:



An oscillating force of 1050kN was applied to the top of a line of sheet piles in the model, at a frequency of 38Hz. The ppv at a level equivalent to the top of the sand, as a function of distance from the model, was as follows:



The distance from the tunnel alignment (on which any intervention pit would be located) to the nearest house is 234m. At this distance the ppv is predicted to be less than 0.1mm/s. The minimum distance to Dooncarton mountain is approximately 1000m, which is a distance beyond the extent of the model. The results show that vibration at 1000m will be below 0.001mm/s.