6.1 CALCULATION OF CONSTRUCTION VIBRATION IMPACTS

At the time of preparation of this document it is not possible to define fully the plant and methods that will be used during construction, these being the responsibility of the construction contractor. Consequently, it is not possible to prepare detailed inventories of plant and their intensity of use for undertaking noise and vibration predictions. Indicative noise and vibration from construction works has therefore been predicted on the basis of current best assumptions, as presented in Section 6.2 below.

On the basis of the assumed plant and their anticipated locations of use, vibration levels have been predicted using a combination of published empirical predictors, published data and Arup Acoustics' experience and professional engineering judgement.

Published prediction methods provide a means of estimating vibration levels only in terms of the peak particle velocity (PPV). The predictions have been based on the latest available information, principally that given in TRL Report 429 *Groundborne vibration caused by mechanised construction works*. These predictions enable assessment to be made of the risk of damage to structures and provide an indication of the extent of the area around the works at which vibration may be perceptible. However, assessment of the potential for perceptible vibration to cause disturbance according to *BS 6472: 1992 Evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)* requires calculation of the vibration dose value (VDV). None of the published literature includes such predictors. It has therefore been necessary to adopt the following procedure:

- the PPV was predicted as described;
- the root mean square acceleration (a_{rms}) was calculated from the PPV assuming sinusoidal vibration and approximate dominant frequency. This approach is particularly suited to sources such as vibratory piling and vibratory compaction, but is less reliable for impulsive vibration such as percussive piling;
- the period estimated vibration does value eVDV was calculated from the a_{rms} and assumed duration of the various construction activities. The uncertainties in the plant, operating methods and duration of the works has necessitated significant engineering judgement to be used in this stage of the calculation process;
- the predicted eVDV data were compared against the criteria given in this Environmental Statement.

6.2 CONSTRUCTION ACTIVITIES AND EQUIPMENT

In order to undertake calculations of noise and vibration from construction it was necessary to make assumptions, based on professional experience from similar schemes, of the number of events that would occur within the assessment period, the noise and vibration levels and the duration of the events. The activities and plant that it was assumed would be used and that generate noise and/or vibration sufficient to require consideration are as follows:

1. Demolition work

- pneumatic breakers – hand held and excavator mounted;
- disc cutter;
- excavator;
- compressor;
- spoil lorry.

2. Cut and cover work

The sections listed below are discussed in Scheme Description Report (Appendix 3).

Diaphragm walling

The following cranes would be required for the cut and cover work on the south side of the river:

Section 1	4 cranes
Section 2	6 cranes
Section 3	4 cranes
Section 4	4 cranes

To the north of the river the following cranes would be required:

Section 5	2 cranes
Section 6	2 cranes

It was assumed that 2 teams would operate together, each team requiring a crane and other plant as follows:

Diaphragm wall excavation team:

- crane;
- grab or hydrofraise;
- bentonite pump;
- bentonite conditioning plant;
- excavator;
- spoil truck.

Concrete team:

- crane (for re-bar installation);
- concrete pump;
- bentonite pump;
- bentonite conditioning plant;
- concrete truck;
- compaction – pokers;
- batching plant (remote from pour locations).

Earthworks / excavation and landscaping

It was assumed that top down construction would be used and consequently that the first stage of excavation would produce the highest level of noise. As the excavation progresses, noise sources would be screened by the retaining walls. The following plant was assumed:

- excavator;
- spoil lorries;
- dumpers;
- scrapers;
- dozers;
- compaction plant (vibratory).

Concreting

Construction of the top slab was assumed to require:

- formwork construction – hand tools, power saw, etc;
- crane (for re-bar installation);
- concrete pump;
- concrete truck;
- compaction – pokers;
- batching plant (remote from pour locations).

3. Retaining walls outside tunnel portals

The plant required for the retaining walls was assumed to be similar to that for the diaphragm walling.

4. Contractor's Compound

- Cranes;
- Batching plant;
- Support services:
  - generator;
  - compressor;
  - wood working – circular saw, etc;
  - metal working – bar bending, welding;
  - traffic – HGV and personnel.

5. Dredging

Noise levels for the plant cannot be determined at this stage. However, it is understood that a combination of backhoe and grab dredging is likely to be used to excavate the trench. Arisings are expected to be transported by barge to storage areas.

6. Temporary Storage and Re-use of Dredged Materials

It was assumed that temporary storage of the dredged materials would be on the site of the RMC works to the south of the river and east of the tunnel. Plant required in this area were assumed to include:

- dozers;
- excavators;
- dumpers;
- generator;

- compressor;
- traffic – HGV and personnel;
- pumps;
- batching / mixing plant;
- screening machinery.

7. Casting Basin

The casting basin was assumed to be located within Howdon Yard, in the industrial area immediately to the north of the river. The following plant may be required:

- piling rig: driven steel and hard-hard secant piles;
- excavator;
- concrete mixer lorry;
- concrete pump.

8. Construction of New Road Junctions and Structures

The following plant was assumed to be required for construction of road junctions and structures.

Bridge construction

- excavator;
- compressor;
- crane;
- concrete mixer lorry;
- piling for bridge pier foundations.

Road works

- pneumatic breaker;
- lorry (spoil removal / deliveries);
- compaction plant – vibrating roller;
- tarmac team.

Earthworks

- excavator;
- spoil lorries;
- dumpers;
- compaction plant – vibrating roller.

6.3 AMBIENT NOISE SURVEY

The following table shows the results of the ambient noise surveys.

TABLE 6.3.1: RESULTS OF AMBIENT NOISE SURVEY

Measurement Location	$L_{A10\ (18hour)}$ (dB)	Ambient Noise Level: $L_{Aeq\ (15\ minutes)}$ (dB)		
		Day	Evening	Night
25 Salcombe Ave	-	61	-	-
51 Salcombe Ave	72[1]	70	-	-
30 Brixham Cresc	-	57	-	-
19 Bilton Hall Rd	67	65	63	60
8 Newlyn Drive	-	63	-	-
28 Newlyn Drive	-	67	-	-
39 Newlyn Drive	65[1]	63	-	-
5 Regent Rd	-	67	-	-
11 Regent Rd	64	64	61	57
25 Regent Rd	65[1]	65	-	-
9 Stephen Ct	-	60[2]	-	-
46 Epinay Walk (north-west façade)	68[1]	65	-	-
46 Epinay Walk (south-east façade)	68[1]	67[3]	-	-
42 Epinay Walk (south-east façade)	63[1]	62[3]	-	-
67 Stothard St	63	62	58	56
106 St Paul's Rd	-	65[3]	-	-
178 St Paul's Rd	63	63	56	60
St Bede's RC Junior School, Harold St	68	68	61	56
Harold St	-	73[4]	-	-
13 Salem St	-	62[4]	-	-
St Mark's Church	-	56[4]	-	-
Minster Parade	-	57[4]	-	-
Grange Nursing Home, Staple Rd	54	53	49	47

TABLE 6.3.1: RESULTS OF AMBIENT NOISE SURVEY

Measurement Location	$L_{A10\ (18hour)}$ (dB)	Ambient Noise Level: $L_{Aeq\ (15\ minutes)}$ (dB)		
		Day	Evening	Night
Dunn Street Primary School	-	55	-	-
59 Commercial Rd	-	58	-	-
Pearson Place	-	68	-	-
St. Paul's Vicarage, 47 Norman Terrace	52	53	50	47
49 Brinkburn St	65	64	60	56
25 Henley Gardens	59	59	56	49
63 Melrose Gardens	71	69	65	61

Notes:
Levels presented are for 1m from façade
[1] $L_{A10(18\ hour)}$ calculated from 3 hourly measurements, in accordance with the Shortened Measurement Method from *CRTN*
[2] $L_{Aeq(30\ minute)}$ measurement
[3] $L_{Aeq\ (15\ minute)}$ measurement
[4] $L_{Aeq\ (1\ hour)}$ measurement

6.4 ASSESSMENT RESULTS

TABLE 6.4.1: NUMBERS OF PROPERTIES WITHIN 600 M OF ALIGNMENT AFFECTED BY CHANGES IN TRAFFIC NOISE LEVELS

North of Tyne

Noise band dB(A)	Beneficial change, dB(A)					Adverse change, dB(A)				
	1 < 3	3 < 5	5 < 10	10 <15	15 and above	1 < 3	3 < 5	5 < 10	10 <15	15 and above
< 50	0	0	0	0	0	68	0	0	0	0
50 < 60	28	0	0	0	0	276	0	0	0	0
60 < 70	60	0	0	0	0	76	0	0	0	0
≥70	0	0	0	0	0	33	0	0	0	0
Significance	Negligible	Low	Medium	High	Very high	Negligible	Low	Medium	High	Very high

South of Tyne

Noise band dB(A)	Beneficial change, dB(A)					Adverse change, dB(A)				
	1 < 3	3 < 5	5 < 10	10 <15	15 and above	1 < 3	3 < 5	5 < 10	10 <15	15 and above
< 50	83	6	0	0	0	0	0	0	0	0
50 < 60	270	0	0	0	0	24	0	0	0	0
60 < 70	56	0	0	0	0	44	0	0	0	0
≥70	0	0	0	0	0	0	0	0	0	0
Significance	Negligible	Low	Medium	High	Very high	Negligible	Low	Medium	High	Very high