

## 4 NOISE

### 4.1 INTRODUCTION

4.1.1 This section provides an evaluation of the potential noise impacts associated with the construction and operational phases of the Theme Park and associated developments, the Project. Supplementary information for the noise assessment is provided in *Annex C*.

4.1.2 During the construction phase of the Project, powered mechanical equipment (PME) employed in the construction of the Theme Park and associated developments will be the primary source of noise reaching the surrounding environment. The major activities will include:

- site reclamation works and seawall construction;
- earth berm construction;
- construction of access and internal distribution roads and parking lots;
- construction of the Penny's Bay Rail Link;
- construction of the proposed Theme Park development including its associated hotels;
- construction of a water recreation centre with a lake for irrigation and water sport recreation activities; and
- construction of utilities and support facilities.

4.1.3 During the operation of the Theme Park, the principal sources of noise included in this Study are (not all Project-related):

- associated road works comprising:
  - a section of CKWLR from the existing Yam O Interchange to the valley behind the existing power station of CLP;
  - Road P2 together with an access road through Yam O to connect the proposed Yam O station to the Theme Park;
  - resort roads, namely Road D1 and Road D2, around the proposed Theme Park; and
  - a central pedestrian walkway between the two theme parks in centre of the Retail, Dining and Entertainment;
- rail traffic (Penny's Bay Rail Link);
- Penny's Bay Public Transport Interchange (PTI) and the temporary PTI at Yam O rail station;
- Theme Park operation including rides and evening fireworks displays;
- sewage pumping station;
- occasional operation of the existing CLP power station in Penny's Bay;
- potential exposure of Theme Park resort hotels to noise from the future container terminal development to the south-east of the site; and
- water recreation centre

4.1.4 HKITPL has indicated that, based on the land uses associated with their other operational theme parks, none of the types of potential noise sensitive receivers identified in *Annex 13* of the EIAO-TM will be located within either phase of the Theme Park.

4.1.5 *Figure 4.1a* shows the principle noise sources covered under the Project.

4.1.6 Where, according to the applicable noise guidelines or regulations, potential Project-related noise impacts are identified during either the construction or operational phases, appropriate mitigation measures are recommended and Environmental Monitoring and Audit requirements identified.

## 4.2 STATUTORY REQUIREMENTS AND EVALUATION CRITERIA

### CONSTRUCTION NOISE

#### ***General***

4.2.1 The principal legislation addressing the control of construction noise is the *Noise Control Ordinance, Cap. 400* (NCO). Various Technical Memoranda (TMs) stipulating control approaches and criteria during the restricted hours have been issued under the NCO. The following TMs are applicable to the control of noise from construction activities:

- Technical Memorandum on Noise from Percussive Piling (PP-TM); and
- Technical Memorandum on Noise from Construction Work other than Percussive Piling (GW-TM).

4.2.2 The EIAO and the EIAO-TM also provide guidelines for the assessment of noise impacts associated with construction activities.

4.2.3 Regardless of any noise impact description or assessment made in this EIA Report, the Noise Control Authority will be guided by the relevant TMs issued under the NCO in assessing any application, once filed, for a Construction Noise Permit (CNP) for works planned during restricted hours (i.e. 1900 to 0700 hours and any time on a general holiday including Sundays). The Authority will consider all the factors affecting its decision taking the then prevailing situations and conditions into account. Nothing in this EIA Report shall bind the Authority in making its decision and further, there is no guarantee that a CNP will be issued. If a permit is to be issued, the Authority may include any conditions it considers appropriate and such conditions must be followed during the execution of the works covered by the permit. Failing to do so may lead to cancellation of the permit and prosecution action under the NCO.

#### ***Percussive Piling***

4.2.4 Under the PP-TM, percussive piling is prohibited at any time on Sundays and public holidays and during evening and night-time hours (1900-0700 hours), Monday through Saturday. A CNP is required in order to carry out such work during daytime hours (0700-1900 hours), Monday through Saturday. As the issuance of a CNP by the Noise Control Authority would depend on the submission of an application by the Contractor, and therefore on the Contractor's compliance with the percussive piling noise limits set out within the PP-TM, the assessment of this type of noise has not been included in this EIA. However, for completeness, the process that would be followed in assessing a CNP application for percussive piling is described below.

4.2.5 In evaluating a CNP application for percussive piling, the Noise Control Authority would be guided by the PP-TM. In assessing the potential noise impact, the EPD would consider the difference between the Acceptable Noise Levels (ANLs), as specified in the PP-TM, and the Corrected Noise Levels (CNLs) predicted to result from the proposed percussive

piling activities. Depending on the projected noise impacts at nearby Noise Sensitive Receivers (NSRs), the Noise Control Authority would determine the allowable time periods for percussive piling operations, as indicated in *Table 4.2a*.

**Table 4.2a - Permitted Hours of Operation for Percussive Piling (Note: the Use of Diesel, Pneumatic and/or Steam Hammers is prohibited)**

Amount by which CNL exceeds ANL	Permitted hours of operation on any day not being a holiday
More than 10 dB(A)	0800 to 0900 and 1230 to 1330 and 1700 to 1800
Between 0 dB(A) and 10 dB(A)	0800 to 0930 and 1200 to 1400 and 1630 to 1800
No Exceedance	0700 to 1900

### ***General Construction Works During Restricted Hours***

- 4.2.6 The NCO provides statutory controls on general construction works during restricted hours (i.e. 1900-0700 hours Monday to Saturday and at any time on Sundays and public holidays). The use of powered mechanical equipment (PME) for the carrying out of construction works during these restricted hours would require a CNP. The Noise Control Authority will assess all CNP applications on a case by case basis and, in doing so, it will be guided by the GW-TM.
- 4.2.7 When assessing an application for the use of PME, the Noise Control Authority will compare the ANLs specified in the GW-TM with the CNLs (adjusted for any barrier and reflection effects) associated with the proposed PME operations. The NCO requires that noise levels from construction at affected NSRs be less than a specified ANL. The ANLs are related to the inherent noise sensitivity of the noise receiver areas in question, which in turn relate to the background noise characteristics of these areas. Each noise receiver area is then assigned an Area Sensitivity Rating based on its predominant land use and the presence, if any, of Influencing Factors such as nearby industrial areas, major roads or airports. The relevant ANLs for evenings and holidays and for night-time are provided in *Table 4.2b*.

**Table 4.2b - Acceptable Noise Levels (ANLs,  $L_{Aeq, 5min}$  dB) for General Construction Works to be Carried out During Restricted Hours**

Time Period	Area Sensitivity Rating		
	A	B	C
All days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours)	60	65	70
All days during the night-time (2300-0700 hours)	45	50	55

- 4.2.8 Factors influencing the outcome of a CNP application, such as the assigning of ANLs, would be determined by the Noise Control Authority at the time of the application review based on the then prevailing site conditions. It should be noted that conditions around the site(s) may change from time to time.

### **General Construction Works During Normal Working Hours**

- 4.2.9 Although the NCO does not provide for the control of noise from construction activities during normal working hours (0700 to 1900 hours, Monday to Saturday), Annex 5 of the EIAO-TM specifies a limit of  $L_{eq, 30 \text{ min}}$  75 dB(A) for residential NSRs. Annex 5 also provides construction noise limits for schools of  $L_{eq, 30 \text{ min}}$  70 dB(A) and 65 dB(A) during normal teaching periods and examination periods respectively.
- 4.2.10 Both the GW-TM and the EIAO-TM acknowledge the potential noise sensitivity of areas designated as Country Parks. However, the GW-TM does not identify Country Parks themselves as NSRs. Furthermore, while the EIAO-TM provides general construction noise limits at residences and schools during normal working hours, it provides no such limit for Country Parks. Therefore, in this EIA construction noise levels at Country Parks have generally been estimated in relative terms only.

### **RAILWAY NOISE**

- 4.2.11 Railway noise is controlled under the NCO and the subsidiary *Technical Memorandum for the Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites* (IND-TM). The IND-TM provides the appropriate noise principles and assessment procedures and establishes ANLs for various areas depending on their Area Sensitivity Ratings as well as time of the day. Again Area Sensitivity Ratings for all areas containing NSRs are based on the predominant land use and the presence of any influencing factors such as industrial areas, major roads and airports.
- 4.2.12 The relevant criteria are presented in Table 4.2c below and are to be met at a position 1 m from the exposed facade of the NSR.

**Table 4.2c - NCO Railway Noise Assessment Criteria (ANLs,  $L_{Aeq,30min}$  dB)**

Time Period	Area Sensitivity Rating		
	A	B	C
Daytime & Evening (0700 to 2300)	60	65	70
Night-time (2300 to 0700)	50	55	60

- 4.2.13 The EIAO-TM provides additional criterion for assessing railway noise at identified NSRs. The criterion, which appear in Table 4.2d, are expressed in terms of the A-weighted maximum noise level ( $L_{Amax}$ ) due to individual railway noise events during the night-time (2300-0700 hours).

**Table 4.2d - EIAO-TM Railway Noise Criterion**

Parameter	Criterion Level in dB
Maximum A-weighted sound pressure level during 2300-0700 hours, $L_{Amax}$	85

- 4.2.14 Country Parks are not specifically identified as NSRs in the IND-TM and are assigned no quantitative railway noise limit under the EIAO-TM. Therefore, within this EIA, railway noise impact is assessed at the existing Lantau North Country Park and the Proposed Country Park Extension Area and is addressed qualitatively.

## **FIXED PLANT NOISE**

### ***Fixed Plant Inventory***

4.2.15 Noise levels from fixed plant sources within the Study Area are required to comply with the EIAO-TM. The fixed plant noise sources assessed in this EIA include:

- the Penny's Bay PTI and the temporary PTI at Yam O rail station;
- the Theme Park amusement operations (Phases I and II);
- the sewage pumping station at Penny's Bay;
- the parking lots proposed at Penny's Bay;
- CLP's gas turbine power station in Penny's Bay; and
- the future Container Terminal development (previous Container Terminals 12 and 13) planned to the south-east of the Theme Park.

### ***Fixed Plant Noise Criteria***

4.2.16 The EIAO-TM requires that all fixed noise sources be located and/or designed such that:

- the total fixed source noise level at the facade of the nearest NSR is at least 5 dB(A) lower than the appropriate ANL as specified in the IND-TM (note, these are the same ANLs as shown in *Table 4.2c* for railway noise); or
- where the prevailing pre-Project noise level in the area is 5 dB(A) or more below the appropriate ANL, the total fixed source noise level must not exceed this pre-Project noise level.

4.2.17 The Corrected Noise Levels or CNLs (corrected for the presence of tonality, impulsiveness and intermittency) at the various NSRs due to fixed noise sources are normally developed in accordance with the IND-TM. The noise impacts of the various fixed plant sources are considered to be cumulative. Therefore, in assessing the overall noise impact of fixed plant sources, the individual fixed source noise levels at each NSR are combined.

4.2.18 Once again, while assigning Area Sensitivity Ratings to the various types of areas which could contain NSRs, the IND-TM groups Country Parks together with rural areas and villages as having the highest inherent sensitivity to intrusive noise. However, Country Parks themselves are not considered identical to other NSRs and furthermore, the EIAO-TM does not provide a specific noise limit for Country Parks. Therefore, this EIA evaluates fixed plant noise levels at Country Parks qualitatively.

### ***Public Transport Interchanges (PTIs)***

4.2.19 Under the NCO, PTIs are regarded as "public places" and as such, there is no statutory noise standards that may be applied to these facilities. Although the predominant sources of noise associated with PTIs are road vehicles, road traffic noise standards are not the most appropriate criteria since road vehicle movements within PTIs represent a relatively fixed noise source compared with the free-flowing traffic on a normal road or highway. As such, due to the nature of the noise source represented by PTIs and the characteristics of their noise emissions, the appropriate noise limits specified in the IND-TM, as reference, has been adopted for such facilities.

## **ROAD TRAFFIC NOISE**

### **Traffic Noise Criteria**

4.2.20 The EIAO-TM requires that road traffic noise levels outside the facades of any sensitive buildings which rely upon openable windows for ventilation should not exceed the criteria given in *Table 4.2e*. Any measured or predicted road traffic noise levels which exceed these criteria will be considered to be an adverse environmental impact requiring mitigation consideration.

**Table 4.2e - EIAO-TM Road Traffic Noise Criteria**

<b>Sensitive Uses</b>	<b>Road Traffic Noise L<sub>10, (1hr)</sub> (dB(A))<sup>(1)</sup></b>
Domestic Premises	70
Offices	70
Educational Institutions	65

Note: (1) Maximum permissible noise level assessed at 1 m from the external facade.

4.2.21 Though the EIAO-TM does not specify a limit for traffic noise levels received at a Country Park, road traffic noise impact assessment at the existing Lantau North Country Park and the Proposed Country Park Extension Area is provided and interpreted qualitatively.

### **Criteria for Indirect Technical Remedies to Road Traffic Noise Impacts**

4.2.22 Where feasible, direct technical remedies are to be recommended to reduce identified noise impacts where predicted traffic noise levels exceeds the criteria presented in *Table 4.2e*. These measures include, but are not limited to, the following:

- noise barrier walls located along roadside and/or in central reserve area;
- noise enclosures or semi-enclosures;
- earth berms;
- noise reducing road surfaces (quiet pavements); and
- road decking or underpass construction.

4.2.23 Where direct technical remedies cannot be applied due to traffic or engineering constraints, or where such measures would not be wholly effective in eliminating noise impacts, the potential benefit of indirect technical remedies (i.e. improvement in noise insulation of windows and provision of air conditioning) will be assessed. Such indirect technical remedies to traffic noise impacts would be provided by the Project Proponent to qualified NSRs only as a last resort and in accordance with the Executive Council Directive, *Equitable Redress for Persons Exposed to Increased Noise Resulting From The Use of New Roads*. For affected NSRs to be eligible for indirect technical remedies, the following three criteria from the Executive Council Directive must be satisfied:

- the predicted noise level from the “new” road, together with any other traffic in the vicinity, exceeds a specified noise level (i.e. 70 dB(A) L<sub>10, (1 hr)</sub> for domestic premises and 65 dB(A) L<sub>10, (1 hr)</sub> for educational institutions);
- the predicted overall noise level must be at least 1.0 dB(A) greater than the prevailing traffic noise level, i.e. the total traffic noise level which existed prior to the start of construction on the new or improved road; and
- the contribution to the increase in the predicted overall noise level from the “new” road must be at least 1.0 dB(A).

4.2.24 Here “new” roads are considered to include those which, within the scope of the Project, are proposed to be constructed along totally new alignments, as well as those existing

roadway sections which are to undergo major modifications. Major modifications are considered to be those resulting in at least a 25% increase in the number of lanes, a substantial alteration in an existing alignment or a significant change in a relevant traffic parameter such as an increase in posted speed. Roads that will remain either completely unchanged or that will undergo only minor modifications not satisfying the above conditions, will be classified as “unaltered”.

## **FIREWORKS NOISE**

### ***A Fireworks Noise Limit for Residential NSRs***

- 4.2.25 Evening fireworks displays are uniquely characteristic of commercial theme parks and other major tourist attractions. Similarly the noise which may reach the surrounding community from such displays is unique in terms of its character (almost entirely impulsive) and duration (about 15-20 minutes for low level shows and likely 5 minutes for mid-level shows). Neither the EIAO-TM nor any of the other relevant technical memoranda address fireworks noise specifically. It has therefore been necessary to adopt an appropriate limit for fireworks noise, which, if met, would prevent any significant noise impacts from occurring at the nearest NSRs.
- 4.2.26 *Section 13(1)* of the NCO is applicable to the control of fireworks noise originated from the Theme Park. While the usual approach is to employ *Section 13(1)(c)*, i.e. via the IND-TM, it is not considered appropriate as the characteristics of noise from fireworks (almost entirely impulsive) differ from those associated with other more general types of industrial (or similar) noise. It is therefore proposed that *Section 13(1)(a)* should be employed and with an assessment criteria of 55 dB(A), having regard to the duration of the planned fireworks displays, and the background noise of the receivers.
- 4.2.27 It should be noted that daytime and evening pre-Project background noise levels on the north-west shore of Peng Chau have been measured (see *Section 4.3.3*) at  $L_{Aeq}$  49 to 50 dB, so that the proposed fireworks noise limit would typically exceed the natural background noise by about 5 dB(A). Given the brevity of the planned fireworks displays, background noise exceedances of this magnitude are considered to have very little potential for community noise impact.
- 4.2.28 As the fireworks displays at the Theme Park would take place during the evening - likely commencing at 2100 and 2130 hours, the proposed criterion would be applicable primarily in the evenings. The proposed 55 dB(A) criterion is 5 dB more stringent than the corresponding daytime and evening limit as stipulated in the IND-TM for the most sensitive areas, i.e. Peng Chau and Discovery Bay.
- 4.2.29 The usual approach under the IND-TM is to use the A-weighted  $L_{eq}$  made over any 30 minute period, i.e.  $L_{Aeq, 30min}$  as the unit. However, for evaluating fireworks noise, a shorter period would be more appropriate. This is due to the following two reasons:
- The residents in the potentially affected areas would warrant more protection because of the uniquely tranquil nature of their current pre-Project ambient; and
  - Fireworks shows, in general, would be shorter than half an hour in duration and as such a shorter assessment period is therefore more appropriate.

- 4.2.30 As a result, a limit of  $L_{Aeq,15min}$  55 dB at residential NSRs has been adopted for the noise created by evening fireworks displays at the Theme Park.

### ***Fireworks Noise at Country Parks***

- 4.2.31 Fireworks displays will only occur during evening, and since the Proposed Country Park Extension Area adjacent to Penny's Bay would not normally be expected to have visitors after dark, there would be no potential for fireworks noise impact at this location. There would, therefore, appear to be no need to establish a fireworks noise criterion or limit for this area.

## **4.3 NOISE SENSITIVE RECEIVERS**

### **EXISTING NOISE SENSITIVE RECEIVERS / AREA**

- 4.3.1 After inspection of the Study Area and discussion of existing and planned land uses with the EPD and other concerned government agencies, it was agreed that only four locations within the Study Area should be considered Noise Sensitive Receivers/Area (NSRs) from the perspective of their potential exposure to Theme Park and associated developments construction and operational noise. The locations of these NSRs (N1, N2, N3 and N4) are indicated in *Figure 4.3a*. The characteristics of each of these NSRs are described below.
- 4.3.2 It is noted that in certain areas there are no inhabitable structures or only scattered abandoned structures and ruins, such as those in Pa Tau Kwu and Fa Peng, and these are not considered as NSRs.

### ***Peng Chau (N1)***

- 4.3.3 Peng Chau is a sparsely populated island (largely village-type development) lying due south of the Penny's Bay site. Most of the village residences are located within the central portions of the island and will be shielded from noise originating in the Penny's Bay area by the ridge line that runs along the northern end of the island. However some relatively new low-rise apartment buildings are located on the north western tip of the island near Tai Lei where they will be directly exposed to noise from the construction and operation of the Theme Park. Peng Chau has no conventional road system and is free from any other significant noise sources (i.e. no Influencing Factors). This NSR is therefore assigned an Area Sensitivity Rating of "A".
- 4.3.4 The location of the assessment point is shown in *Figure 4.3b*.

### ***Discovery Bay (N2)***

- 4.3.5 Discovery Bay is a large, but isolated, residential development on Lantau Island located south-west of the Penny's Bay site. It is accessible only by ferry and is presently free from any other significant noise sources. This NSR is also assigned an Area Sensitivity Rating of "A". Bearing in mind that a road tunnel linking Discovery Bay and Siu Ho Wan is under construction, it is anticipated that the future background noise at Discovery Bay would increase due to the presence of more road vehicles in the area.
- 4.3.6 The location of the assessment point is shown in *Figure 4.3c*.

***Luk Keng Tseun (N3)***

- 4.3.7 Luk Keng Tsuen is a small village on the north shore of Lantau Island containing only 19 occupied residences. This NSR is located adjacent to an Ecological Park proposed under NLDFS but is also separated by only about 400 m of water from the rail line to the Hong Kong International Airport and the North Lantau Highway. This village-type NSR is considered to be “directly affected” by the noise from this expressway and therefore has been assigned an Area Sensitivity Rating of “B”.
- 4.3.8 The location of the assessment point is shown in *Figure 4.3d*.

***Lantau North Country Park (N4)***

- 4.3.9 The other potentially noise-sensitive land use will be the Lantau North Country Park lying at around 7 km to the southwest of the Penny’s Bay area.
- 4.3.10 The location of the assessment point (N4-a) is shown in *Figure 4.3e*.
- 4.3.11 Owing to the large separation distance (more than 7 km from the existing Lantau North Country Park to the Study Area) and the substantial multi-layers of terrain screening the potential noise source in this Project, it is envisaged that the Lantau North Country Park is unlikely to be subjected to construction and operational noise impact.

**PLANNED NOISE SENSITIVE AREA*****Proposed Country Park Extension Area (N4')***

- 4.3.12 The planned noise-sensitive land use in the vicinity of the Theme Park and associated developments site will be the Proposed Country Park Extension Area on Lantau Island directly west of Penny’s Bay. This land use, which is in essentially its natural state and contains only a few footpaths, overlooks the Theme Park site from the hillside above the western shore of Penny’s Bay. It is currently exposed only to noise from natural sources, aircraft, ferries and, to a limited degree, the existing shipyard and CLP power station at Penny’s Bay.
- 4.3.13 As mentioned, Country Parks are not themselves considered to be NSRs under the IND-TM and no specific noise limits are provided for Country Parks in the EIAO-TM. Therefore, it is not appropriate to assign it specific noise limits in terms of Acceptable Noise Levels, or ANLs. However, for the purposes of describing the potential project-related noise environments (particularly from the operational phase) over the existing Country Park and the Proposed Country Park Extension Area, four evaluation sites (N4-a, N4'-b, N4'-c and N4'-d) have been selected. Their locations are indicated in *Figure 4.3e*.
- 4.3.14 Representative assessment points were identified for the above NSRs and they are shown in *Table 4.3a* below.

**Table 4.3a - The Location of Assessment Points**

Noise Sensitive Receiver/Area	Assessment Point	Location	Area Sensitivity Rating	Ground Level mPD	Number of Storey	Sensitive Uses
Peng Chau	N1-a	Sea Crest Villa	A	6	3	Residential
Discovery Bay	N2-a	Crestmont Villa	A	15	2	Residential
Luk Keng Tsuen	N3-a (construction)	Village House at the northeastern tip of Luk Keng Tsuen	B	6	2	Residential
	N3-b (operation)	Village House at the southeast of Luk Keng Tsuen	B	6	2	Residential
Lantau North Country Park	N4-a	North of Mui Wo	n/a	200	n/a	Country Park
Proposed North Lantau Country Park Extension	N4'-b*	South of Yam O Interchange near Tin Shui Tau	n/a	120	n/a	Country Park
	N4'-c*	West of the proposed power station at Penny's Bay	n/a	140	n/a	Country Park
	N4'-d*	West of Theme Park Phase 1 near Sze Pak	n/a	120	n/a	Country Park

(\*) The designation of these assessment points (b, c and d) are consistent with the Penny's Bay Rail Link EIA Report which is presented in *Annex M*.

4.3.15 The Cheoy Lee Shipyard has been operational since 1960's, but will be displaced by the Theme Park and associated developments. The CLP power station serves both as an emergency standby facility and a peak load station and will continue to do so in future. Therefore, while historically this power station has seen only occasional, limited use, in the event of a serious failure in other parts of Hong Kong's power system, it could be required to operate continuously until any such problem is resolved.

4.3.16 Based on the latest RODP as shown in *Figure 2.4f*, other NSRs, including existing and planned ones under the NLDFS, are located in North Lantau area. These include Tso Wan, Tso Wan Village Expansion Area, the Proposed Housing Development at Siu Ho Wan, Tai Ho Housing Development and the planned residential development above Siu Ho Wan MTRC Depot. However as these NSRs will not be affected by the construction and operation of the Theme Park and associated developments, they will not be included in this EIA Study. For other developments proposed under the NLDFS, such as the reclamation area east of Tsing Chau Tsai and the developments at Northshore area, it is noted that there will be no noise sensitive uses proposed in these areas.

## EXISTING NOISE ENVIRONMENTS AT NSRS

### ***Peng Chau (N1)***

- 4.3.17 As was shown in *Section 4.2.3*, the EIAO-TM limits planning noise levels from fixed plant sources to either 5 dB(A) less than the ANL or the pre-Project background noise level, whichever is lower. It is therefore necessary to establish typical pre-Project noise levels at key NSRs, particularly where there is reason to expect they may be lower than the ANL - 5 dB(A).
- 4.3.18 Given the isolated and predominately rural nature as well as the natural topography of Peng Chau, it was suspected that, during the daytime and evening, pre-Project noise levels at Peng Chau would be less than the appropriate ANL-5 dB(A), i.e.  $60 - 5 = 55$  dB(A). Therefore, continuous noise monitoring was carried out as part of this EIA Study over three periods totalling 28 hours at the Sea Crest Villa near Tai Lei on the north-west shore of Peng Chau facing Penny's Bay. The monitoring location is shown in *Figure 4.3b*. This monitoring took place in mid November to early December 1999, and for comprehensiveness, covered both daytime and evening periods in weekday and weekend. A Bruel & Kjaer Type 2236 integrating sound level meter (Type 1 standard) was used. The meter was calibrated before and after each noise monitoring period using a Bruel & Kjaer Type 4231 acoustic calibrator.
- 4.3.19 Pre-Project noise levels on the north-west shore of Peng Chau were controlled by natural sources (wind and waves) and were found to be quite consistent during both the daytime and evening. Over the Saturday evening and Thursday daytime and evening monitoring periods, the average noise levels obtained were respectively  $L_{Aeq}$  49.9 and 49.0 dB(A). The detailed results of these noise measurements are contained in *Annex C1, Tables C1.1a and C1.1b* herein. Being slightly more than 5 dB(A) below the daytime and evening planning ANL for this NSR (i.e.  $L_{Aeq, 30min}$  60 dB), these pre-Project noise levels then establish a limit of approximately 50 dB(A) for noise received at Peng Chau during the daytime and evening due to fixed plant sources at the Theme Park and associated developments.
- 4.3.20 Since pre-Project noise levels at Peng Chau are controlled largely by natural sources (wind and waves), it is expected that these levels would be quite consistent from day to day. On the two monitoring days, winds were quite light so that wave noise is not expected to have been unusually high. Similarly, this noise would not typically be expected to decrease significantly during the night-time hours. It is therefore considered that the fixed plant noise limit for Theme Park and associated developments between 2300 hours (the beginning of "night-time") and 0200 hours (the planned closing of the Theme Park) should be the appropriate ANL - 5 dB(A), that is  $50 - 5 = 45$  dB(A).

### ***Discovery Bay (N2)***

- 4.3.21 It has been conservatively assumed that the background noise levels at waterfront residential locations at Discovery Bay would be the same as measured at Peng Chau. The Theme Park fixed plant noise limits would then also be the same as for Peng Chau, namely  $L_{Aeq, 30min}$  50 dB during the daytime and evening and 45 dB during the night-time.

- 4.3.22 Given that the nature of development in Discovery Bay is similar but slightly more intensive to that in Peng Chau, it was predicted that the pre-Project noise levels at Discovery Bay would be less than the appropriate ANL-5 dB(A), i.e. 55 dB(A). Therefore, continuous noise monitoring was also carried out with the same monitoring specifications and procedures adopted in the Peng Chau monitoring. The monitoring location is shown in *Figure 4.3c*. This monitoring took place in December 1999 and January 2000, again covering both daytime and evening periods in weekday and weekend.
- 4.3.23 Pre-Project noise levels at Discovery Bay were found to be quite consistent during both the daytime and evening. The average noise levels obtained for the daytime and evening monitoring periods were around 53 dB(A) and 52 dB(A) respectively. It could be seen that the ambient noise levels at Discovery Bay are generally 2 or 3 dB higher than those of Peng Chau. The higher population density, and thereby more community activities, at Discovery Bay is the likely contributing element to this difference. The detailed results of these noise measurements are contained in *Annex C1, Tables C1.2a - C1.2b*.
- 4.3.24 Being approximately 3 dB(A) below the daytime and evening planning ANL for this NSR (ie.  $L_{Aeq, 30min} 60-5 = 55$  dB), these pre-Project noise levels then establish a limit of approximately 52 dB(A) for noise received at Discovery Bay during the daytime and evening due to fixed plant sources at the Theme Park. It is therefore considered that the limit for Theme Park fixed plant noise levels between 2300 hours and 0200 hours should be the appropriate ANL - 5 dB(A), that is  $50 - 5 = 45$  dB(A).
- 4.3.25 As pointed out in *Section 4.3.1*, it is anticipated that the future background noise at Discovery Bay would increase due to the presence of more vehicles in the area, following the opening of the road tunnel linking Discovery Bay with Siu Ho Wan.

### ***Luk Keng Tseun (N3)***

- 4.3.26 Due to the proximity of this village to two major noise sources represented by the North Lantau Highway and the adjacent Lantau and Airport Rail Link, it is considered that the planning noise limit for fixed noise sources associated with Theme Park operation will, as required by the EIAO-TM, be established by the appropriate ANL - 5 dB(A). Given that this NSR has been assigned an Area Sensitivity Rating of "B", the appropriate limits are  $L_{Aeq, 30min} 60$  dB during the daytime and evening and 50 dB during the night-time.
- 4.3.27 Given the current rural nature of the area, an Area Sensitivity Rating of "B" has been assigned for construction noise assessment purposes.
- 4.3.28 Pre-Project noise levels at a village house closest to North Lantau Highway was found to be of  $L_{Aeq, 30min} 62$  dB measured by MTRC in November 1999.

### ***Lantau North Country Park (N4) and Proposed Country Park Extension Area (N4')***

- 4.3.29 This land use is in essentially its natural state and contains only a few footpaths. It is currently exposed only to the noise from natural sources and aircraft.
- 4.3.30 No noise monitoring was done at both the existing Country Park and the Proposed Country Park Extension Area to the west of Penny's Bay. However, since neither the EIAO-TM nor the other technical memoranda on noise specify noise limits for Country

Parks, the establishment of pre-Project background noise levels was not considered necessary at these locations. However, it is expected that the pre-Project noise levels over this undeveloped land will be similar to, or somewhat lower than, those measured on the north-west shore of Peng Chau.

#### **NOISE SENSITIVITY OF THE THEME PARK**

- 4.3.31 HKITP has indicated that, based on the land uses associated with their other operational theme parks, none of the types of potential noise sensitive receivers identified in *Annex 13* of the EIAO-TM will be located within either phase of the Theme Park. Furthermore, it has been agreed with HKITP that Theme Park visitors, should not be considered to represent noise sensitive receivers from the perspective of exposure to noise created by Theme Park operations, including fireworks, or internal site traffic.
- 4.3.32 No operational noise (including fixed plant, road and rail traffic, helicopter and aircraft) assessment has therefore been conducted for the Theme Park itself.

### **4.4 ASSESSMENT METHODOLOGY**

#### **CONSTRUCTION NOISE**

##### ***Construction During Unrestricted Hours***

- 4.4.1 The assessment of the potential noise impacts due to Theme Park and associated developments construction works to be carried out during unrestricted hours (0700 to 1900 hours Monday to Saturday) has been undertaken in accordance with the GW-TM and Annex 13 of the EIAO-TM. The general methodology is as follows:
- locate all representative NSRs that may be affected by construction noise from each major construction site/zone;
  - determine plant team (groups of active PMEs) that will be required for each major construction activity based on proposed plant inventories;
  - assign a sound power level (SWL) to each PME based on the GW-TM or other appropriate sources;
  - locate the “notional source position” of each major construction site;
  - calculate distance correction factors based on the distance between the notional noise source position of each work site and each NSR;
  - apply corrections as appropriate for such factors as noise screening (shielding) and reflection, and
  - calculate construction noise levels at NSRs in the absence of any mitigation measures.
- 4.4.2 For construction sites of large sizes, the notional source position has been taken to be a point 50 m from that point on the site boundary measured along the line between the approximate geographical centre of the site and the point on the site boundary nearest to the NSR.
- 4.4.3 Based on the proposed construction programme (schedule) and PME teams (*Annex A, Table A1 and Annex C2, Table C2.1*) for each major construction activity, spreadsheets have been developed to facilitate the calculation of construction noise levels at the three residential NSRs. Moreover, in view of the large distance between the construction sites and the NSRs the effect of atmospheric absorption has been included in the calculation.

Using these spreadsheets, the cumulative construction noise levels from all concurrent Theme Park and associated developments construction activities which are considered to be significant at a given NSR have been calculated.

- 4.4.4 Where the line of sight between a specific construction zone and a specific NSR will be consistently and substantially interrupted by natural terrain features, construction noise created within that zone has not been included in the calculation of overall construction noise levels at that NSR. These overall noise levels would tend to be controlled by other major construction activities, which do not benefit from terrain shielding and are to proceed concurrently with the shielded activity.
- 4.4.5 The spreadsheets summarising the plant teams and schedules for each major construction activity related to Theme Park and associated developments construction are presented in *Annex C2, Table C2.1*. The noise levels due to individual construction activities and the resulting cumulative construction noise levels at each NSR are presented in *Annex C3a, Tables C3a.1 - C3a.3*.
- 4.4.6 Potential construction noise impacts during unrestricted hours have been quantified by comparing the predicted cumulative noise levels with the EIAO-TM daytime construction noise limits as given in *Section 4.2.1*. Here, since all three NSR's are residential in nature, the appropriate limit is  $L_{Aeq, 30 \text{ min}} 75 \text{ dB}$ .
- 4.4.7 Where projected construction noise levels at an NSR exceed the EIAO-TM limit, mitigation measures are to be considered. These measures may include the use of quiet plant, the erection of purpose-built noise barriers (where appropriate) and the limitation of the use of particularly noisy plant in a particular location or within a particularly busy construction period.

#### ***Construction During Restricted Hours***

- 4.4.8 As indicated in *Section 4.2.1*, for any construction works planned during the restricted hours, it will be the responsibility of the Contractor to ensure compliance with the NCO and the relevant technical memoranda. In such cases, the Contractor will be required to submit CNP applications to the Noise Control Authority and abide by any conditions stated in the CNP, should one be issued. Therefore the potential noise impacts of construction works proposed within restricted hours are not formally assessed within this EIA. However, in order to facilitate the efforts of the Project proponent to avoid and/or mitigate any potentially adverse project noise impacts, noise levels from construction activities planned for restricted hours have been predicted at the NSRs. The PME's proposed to be operated during the restricted hours and the predicted noise impact are shown in *Annex C2 and Annex C3a* (evening time from 1900 to 2300 hours and general holidays from 0700 to 2300 hours) and *Annex C4* (night-time from 2300 to 0700 hours) respectively.
- 4.4.9 As addressed in *Section 4.2.1*, both the GW-TM and the EIAO-TM have not provided any construction noise limit for Country Parks, therefore in this EIA, construction noise impacts at the Proposed Country Park Extension Area (N4') have generally been estimated in relative terms, making reference to the PBRL EIA, *Annex M*.

- 4.4.10 Regardless of the results of the construction noise impact assessment for restricted hours, the Noise Control Authority will process the Construction Noise Permit (CNP) application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the prevailing conditions/situations.

#### **RAILWAY NOISE**

- 4.4.11 Assessment of railway noise from the planned Penny's Bay Rail Link (PBRL) has been undertaken by the Mass Transit Railway Corporation (MTRC) under a separate study. The *Penny's Bay Rail Link: Environmental Impact Assessment (PBRL EIA) - Final Report* has been included as *Annex M* of this report. The assessment methodology for railway operation noise is contained in *Section 3.5* of the PBRL EIA Report, *Annex M*.

#### **FIXED PLANT NOISE**

##### ***General***

- 4.4.12 A variety of fixed plant noise sources will be associated with the operation of the Theme Park and associated developments such as the sewage pumping station, the public transport interchanges and vehicle parking areas. Other fixed plant sources, such as the CLP Penny's Bay GTP, will predate the Theme Park and associated developments and will continue to operate after its completion. For some of these facilities, empirical at-source noise level data are available, either from previous studies of similar installations in Hong Kong or from outside information sources. In predicting the noise levels that will result at the various NSRs due to fixed plant sources, conservative approaches have generally been taken so as to compensate for any uncertainty which may exist regarding the source noise levels created by these facilities.
- 4.4.13 In estimating the noise levels to be created at the NSRs due to the various fixed plant sources, the procedures described in the IND-TM were followed, augmented, where required, with basic acoustical principles. Since the procedures followed in evaluating the noise from each fixed source tended to be somewhat unique, they are described in turn below:

##### ***The Theme Park***

- 4.4.14 The major fixed source of noise associated with the project is expected to be the Theme Park itself. As shown in *Figure 4.1a*, the Theme Park will consist of a western section (Phase I) and an eastern section (Phase II), separated by a central Retail, Dining and Entertainment (RD&E) corridor and linked by "Main Street". While the Theme Park will then be developed in two phases, the worst-case noise impact assessment has been based on the full operation of both phases.
- 4.4.15 While HKITP has supplied the general arrangement of the attractions to be located within the Phase I Theme Park (i.e. Toontown, Fantasyland, Tomorrowland etc, described in *Section 2.7.4*) and has indicated that additional similar, but as yet unspecified, attractions will be located in Phase II, noise source data for these individual Theme Park zones are not available. It is therefore necessary, and on balance preferable, to base the noise emissions of the future Theme Park on the overall noise emissions measured at another major international theme park. Towards this end, HKITP has provided average noise levels

( $L_{Aeq}$ 's) measured over 30 minute periods at three unshielded locations around the perimeter of the Anaheim, California Disneyland. These measurements, the details of which are included in *Annex C5*, revealed that average perimeter noise levels ranged from  $L_{Aeq,30min}$  67 to 69 dB.

- 4.4.16 The Anaheim Disneyland measurement which yielded the highest average noise levels was made approximately 100 m from the “Fantasmic” show site while the show was in progress. This is a relatively new show that features loud music and special audio and visual effects. However, given the continuing trend towards higher levels of amplified music and special effects at both motion picture theatres and amusements parks, the potential exists for a new Theme Park to be somewhat noisier than the Anaheim facility. To reflect this potential, the reference noise source level for the Hong Kong Theme Park has been taken to be  $L_{Aeq, 30min}$  75 dB at the Theme Park perimeter (i.e. this is the highest average noise level expected to be measured at any unshielded position along the top of the 9 m high perimeter earth berm).
- 4.4.17 EIA support information received from HKITP has indicated that the two Theme Park phases are intended to operate until midnight while the RD&E area is planned to be open until 0200 hours. It must be assumed that Theme Park noise emissions are essentially constant throughout its hours of operation. Therefore, for planning purposes, Theme Park noise impacts must be evaluated against the night-time noise limit specified in the EIAO-TM, namely 5 dB(A) less than the night-time ANL, or  $L_{eq,30min}$  45 dB(A) for residential NSRs such as Peng Chau and Discovery Bay.
- 4.4.18 In order to assess the noise levels to be created at NSRs by operations within the Theme Park boundaries, the two major park areas (Phases I and II) were considered to be represented by circular zones, each 700 m in diameter. Theme Park noise sources were assumed to be uniformly distributed throughout these circular zones such that a noise level of  $L_{Aeq}$  75 dB was generated at all positions on the park perimeter. Given the large size of these noise source zones, an assumption that all of the sound energy was emitted from a single point at their centres would have significantly overestimated the Sound Power Level (SWL) emitted by the Theme Park. On the other hand, assuming that the “notional centre” of each Theme Park noise source zone was located 50 m inside its perimeter boundary (as done for construction noise in the GW-TM), would have significantly underestimated the total SWL in this situation. Therefore, to more realistically represent these large distributed source zones, each 700m diameter circle was sub-divided into nine parts or sectors of equal area and assumed equal sound power.
- 4.4.19 It was then possible to calculate, for each sector, the Theme Park SWL that would be required to produce  $L_{eq}$  75 dB(A) at any point on the perimeter of the 700 m diameter source zone. Applying this same SWL to each sector of each of Theme Park Phases I and II, the combined Theme Park sound level at the NSRs were calculated in the standard manner (see *Annex C6*). For the distant Peng Chau and Discovery Bay NSRs, the equivalent acoustic centres of the two Theme Park source zones are very close to their geometric centres. The computation was done in accordance with International Standard ISO 9613-2: 1996(E), *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2*.

- 4.4.20 Because of the large source-to-receiver distances involved (up to 3.2 km), the attenuation of Theme Park operational noise with distance from the acoustic centres of the two source zones was calculated taking into account both geometric spreading and atmospheric absorption. The atmospheric absorption rate was based on the International Standard ISO 9613-1: 1993(E), *Acoustics - Attenuation of Sound During Propagation Outdoors, Part 1*. Average atmospheric conditions of 20° C and 70% relative humidity were assumed in selecting atmospheric absorption rates. This resulted in overall atmospheric absorption effects of 8 to 9 dB(A) over distances of 2.5 to 3.2 km.
- 4.4.21 As shown in *Figure 4.1a*, the two phases of the Theme Park will be almost entirely surrounded by 9 m high earth berms. These berms are intended to visually screen Theme Park visitors from the outside world but will also act to shield the outside world from Theme Park noise. In addition, there will be a number of hotels constructed along the waterfront to the south of the Theme Park, thereby augmenting the screening effects of the earth berms to some degree. Since neither the heights and locations of the dominant Theme Park noise sources nor of the hotels are known, it is then not possible to accurately assess the net noise shielding effect of the earth berms and hotels. While it may be concluded that this effect would be very substantial (up to 15 dB) for source and receiver positions near the ground and close to a berm, over the large distances to NSRs at Peng Chau and Discovery Bay, turbulence and other atmospheric effects may be expected to limit the average noise reduction provided by any practical noise barrier to about 8 to 10 dB(A). This typical screening effect was therefore applied at Peng Chau and Discovery Bay.
- 4.4.22 The detailed characteristics of the many noise sources that will be associated with normal Theme Park operations and contribute to the overall character of Theme Park noise are not known. However, based on observation at similar parks and on professional judgement, it is considered that the overall noise output of such a facility should not be characterised as being tonal, impulsive nor intermittent as defined in the IND-TM. Therefore, no corrections for these undesirable noise characteristics have been applied.

#### ***Penny's Bay Gas Turbine Plant (GTP)***

- 4.4.23 CLP's auxiliary gas turbine power station at Penny's Bay has been in intermittent operation for several years and as such is not a component of the Theme Park Project and associated developments. However, the noise produced by its operation will add, to some degree, to the noise levels created at NSRs by the various Project fixed plant noise sources. As the power station is only in intermittent operation, noise monitoring data are not available.
- 4.4.24 *The EIA of Gas Turbine Plant at Penny's Bay (1990<sup>(1)</sup>)* has recommended noise control measures for achieving 75 dB(A) emission at the site boundary which have been followed by the power company. This reference noise level has thus been used to project noise levels at noise-sensitive locations at which power plant noise might reasonably be expected to be audible. These projections have been based only on the spherical spreading of sound waves with distance and on facade or hillside reflection as appropriate.

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(1) China Light and Power Company, (1990), Environmental Impact Assessment of Gas Turbine Plant at Penny's Bay, Initial Assessment Report.

### ***Utility Yard (Sewage Pumping Station)***

4.4.25 The major noise source within the Utility Yard to be constructed to the west of the vehicle parking area will be the sewage pumping station, *Figure 2.11b*. Sewage pumping stations are not uncommonly located within or near residential areas. Such situations would then see NSRs located within short distances of the pumping station. Although the sewerage pumping station is not a Designated Project under the EIAO-TM, the sewage pumping station would have to meet night-time planning noise limits of from 45 to 55 dB(A) at the nearest NSR. These levels can generally be met by enclosing the pumping facilities in a building and applying appropriate silencers to the intake and exhaust air openings.

### ***Fixed Plant of Penny's Bay Rail Link***

4.4.26 Sources of fixed plant noise associated with the Penny's Bay Rail Link has been assessed separately. These include noise from ventilation building proposed at the northern and southern tunnel portals, and the noise from train washing plant at the Penny's Bay Rail Station. See *Annex M* for details.

### ***Penny's Bay PTI and temporary PTI at Yam O rail station***

4.4.27 The noise levels to be expected at Peng Chau, Discovery Bay, Luk Keng Tsuen, the Lantau North Country Park and the Proposed Country Park Extension Area due to the noise emission from PTIs were predicted using basic acoustical principles and based on the SWL measured recently at some of Hong Kong's larger PTIs (e.g. Kwun Tong and Shing Tak Centre).

### ***Cumulative Noise Impact from all Fixed Plant Sources***

4.4.28 While noise assessment of each fixed plant source on NSRs, such as Peng Chau, Discovery Bay and Luk Keng Tsuen, where appropriate, has been evaluated, cumulative noise impacts from all fixed plant sources are also assessed.

### ***Fireworks Displays***

4.4.29 As discussed in *Section 4.2.6*, in the absence of any specific limit for fireworks noise within the various Hong Kong noise regulations, a limit of  $L_{Aeq,15min}$  55 dB has been adopted for the evening fireworks displays to be staged at the Theme Park. Information provided by HKITP indicates that, because fireworks must be restricted to mid-level displays (100 m maximum height) due to the proximity of the airport, a single display would not likely be visible from both phases of the Theme Park. It is therefore considered that it will ultimately be necessary to employ two fireworks launching sites, one at the western end of Phase I and one at the eastern end of Phase II. The shows at these two sites would be staged separately, likely one starting at 2100 and one at 2130 hours.

4.4.30 While the fireworks displays to be presented at the Theme Park have not yet been developed in any detail, source noise data for such displays has been obtained based on measurements conducted by HKITP, the EPD and the EIA Study Team in November, 1999 during a specially-staged demonstration of the range of fireworks types that could be considered for use in Hong Kong. On this occasion, the maximum noise levels related to individual fireworks items and event noise levels created by each type of fireworks were

measured at distances of 500 and 800 m from the launch site. The noise output of a combination of fireworks elements that might reasonably be expected to be used are computed. The individual noise contributions of these elements have been combined and their average sound energy level computed over the estimated 5 minute duration of the show (*Annex C7*).

## ROAD TRAFFIC NOISE

### ***Calculation of Road Traffic Noise Levels***

- 4.4.31 As specified in the Study Brief, the road traffic noise calculations carried out in this Study follow the methodology described in *Calculation of Road Traffic Noise* (CRTN), published by the UK Department of Transport in 1988. The computer software used to implement this methodology was *HFANoise*, as developed by Halcrow Fox utilising a “links and nodes” representation of the road network and noise receiving environment.
- 4.4.32 The modelling scheme for the determination of traffic noise levels is based upon a digitised representation of the existing unaltered roads within the spatial scope of the Project. Each of the existing unaltered highway networks are divided into discrete road segments having homogeneous traffic conditions and road layout characterisation. For each such segment, the key characteristics of a road link with respect to its traffic noise emissions are defined; namely its traffic volume, composition, average vehicle speed, laning and horizontal and vertical alignment. Low noise road surfacing has been assumed in the assessment.
- 4.4.33 In assessing the attenuation of traffic noise with distance from the roadways, a worst-case, hard ground attenuation rate was assumed throughout the Study Area. While this assumption may be conservative in some local areas where sound may travel over natural ground, in most situations the sound paths between roadways and NSRs lie over water and/or, due to the steep terrain, well above the ground. In these cases a hard ground assumption is appropriate. All natural or man-made features that could potentially provide noise screening or reflection have been accounted for in the *HFANoise* models.
- 4.4.34 Maximum road capacity were used in the modelling of future road traffic noise levels. The traffic flow, speed and percentage of heavy vehicles for each road link are shown in *Figure 2.9b*.
- 4.4.35 All road traffic noise levels presented in this report are expressed in  $L_{10, \text{peak hour}}$  dB(A) and have been predicted at both representative and worst-case receiving levels (elevations) at the identified NSRs.
- 4.4.36 Future traffic noise levels from roads associated with the Theme Park Project have been modelled. All roads that would be subject to significant variation and those which remain unaltered or subject to minor changes were classified in the *HFANoise* model as “new” and “unaltered” respectively with reference to the Study Brief. This has enabled the model to calculate noise levels classified by road link description according to the Study Brief and the Executive Council Directive. The roads classified as “new” in this Study are Road P1, Road P2, CKWLR, Route 10, the Resort Roads and all the associated slip roads. It should be noted that Road P1 and Route 10 are not part of the Theme Park and associated developments Project.

## 4.5 IDENTIFICATION OF POTENTIAL ENVIRONMENTAL NOISE IMPACTS

### POTENTIAL IMPACTS FROM PROJECT CONSTRUCTION NOISE

4.5.1 The potential source of noise during construction phase is the use of Powered Mechanical Equipment (PME) on site /at shoreline for each activity during different periods of time. Construction works have been divided into two phases and each phase comprise of construction activities related to the following:

- reclamation and excavation;
- transport infrastructure;
- services infrastructure;
- GIC sites development;
- water recreation centre with lake development; and
- Theme Park development.

4.5.2 Concurrent activities for the construction of the PBRL are also accounted for to assess the cumulative construction noise impacts.

4.5.3 It is assumed that construction activities, in general, will be carried out on a 16-hour day (i.e. 0700-2300) and 24 working days per month basis. There will be an exception to some of the dredging plant used during the reclamation stage for the Theme Park Phase 1 Development, namely Trailer suction (TS) dredger, Cutter suction (CS) dredger and grab dredger, (see *Section 2.6.2* and *2.6.3*) whereby they will be operating on a 24-hour day and 7 days per week basis. Hence assessment of construction noise impacts has been conducted to compare against the corresponding criteria under the different time periods. However, it should be noted that despite any description or assessment made in this EIA Report, a CNP will still be required for construction works carried out during restricted hours and the Authority would consider issuance of the CNP on the basis of information submitted at that time. Nothing in this Report shall bind the Authority in making its decision.

### ***Construction Works during Daytime and Evening Period (0700-2300)***

4.5.4 The unmitigated noise levels at each NSR for each Theme Park and associated developments construction activity and the cumulative noise levels have been predicted and the results are given in *Annex C3a, Tables C3a.1 - C3a.3*. *Figures 4.3b to 4.3e* show the location of noise assessment points during the construction phase. The assessment points have been chosen to represent the worst affected NSR.

4.5.5 From our assessment on the construction noise impact from each activity of the designated projects under this EIA Study, noise levels at the NSRs from each activity are within the daytime construction noise limit. The range of noise levels predicted at each NSR is presented in *Table 4.5a* below.

**Table 4.5a - Unmitigated Predicted Construction Noise Levels**

NSR	Range of PNL <sup>1</sup> , dB(A) <sup>2</sup>	Criteria		Critical activity causing exceedance
		Daytime	Evening	
N1 - Peng Chau	37-62	75	60	Theme Park Development Phase 1 (E) <sup>3</sup>

NSR	Range of PNL <sup>1</sup> , dB(A) <sup>2</sup>	Criteria		Critical activity causing exceedance
		75	60	
N2 - Discovery Bay	36-64	75	60	Theme Park Development Phase 1 (E) <sup>3</sup>
N3 - Luk Keng Tsuen	70-75	75	65	Cumulative impacts from construction of Services Infrastructure (C) <sup>3</sup> + PBRL (T) <sup>3</sup>

Note:

(1) PNL stands for Predicted Noise Level.

(2) The noise levels presented are the cumulative noise levels.

(3) Activity reference as shown in *Annex C3a, Tables C3a.1-C3a.3*.

- 4.5.6 As shown in *Table 4.5a*, no noise exceedance during daytime has been predicted at either Peng Chau (N1) or Discovery Bay (N2). However, exceedances in the range of 2-4 dB(A) have been predicted for evening time (i.e. 1900-2300). The critical construction stage identified to be causing the noise exceedances was related to the Theme Park Phase I Development. The construction for the Theme Park building/attraction and the hotels' superstructure were identified to be the most critical activities causing exceedances.
- 4.5.7 For Luk Keng Tsuen (N3), no noise exceedance was predicted for daytime. However, noise exceedances were predicted for evening time. The maximum noise exceedance was predicted to be 10 dB(A). From our assessment results, (details as shown in *Annex C3a*), individual construction activity does not give rise to noise exceedance except for the construction of services infrastructure, which was assumed to be built along roads alignment. Due to the close proximity of Luk Keng Tsuen to the proposed Access Road at Yam O, noise exceedance in 1 dB(A) was predicted from this activity. Moreover, cumulative noise impacts from the construction of services infrastructure and the construction for the PBRL have caused exceedance to the cumulative noise levels.
- 4.5.8 Judging from the large number of construction activities and construction equipment involved, noise impacts associated with the works would be likely. Effective mitigation measures and proper environmental control practice should be adopted in order to reduce the noise impacts from the works. Mitigation measures proposed to reduce the identified noise impacts during evening time period are discussed in *Section 4.6*.

#### ***Construction Works During Night-time (2300-0700)***

- 4.5.9 As mentioned above, the TS dredger, the CS dredger and the grab dredger will be operating on a 24-hour day and 7 days per week basis during the reclamation stage for the Theme Park Phase I Development. The construction activities involved include dredging and filling at Theme Park Phase I. The plant inventory specifically proposed for night-time activities and the associated SWLs are given in *Annex C4, Table C4.1*.
- 4.5.10 The predicted night-time noise levels at Peng Chau (N1) and Discovery Bay (N2) are presented in *Annex C4, Table C4.2*. As all the night-time construction activities are concentrated at Penny's Bay, there is no line of sight from Luk Keng Tsuen (N3) to these construction activities, hence Luk Keng Tsuen has been excluded from the night-time construction noise assessment. The range of unmitigated noise levels predicted at Peng Chau (N1) and Discovery Bay (N2) is presented in *Table 4.5b* below.

**Table 4.5b - Unmitigated Predicted Night-time Construction Noise Levels**

NSR	Range of PNL <sup>1</sup> , dB(A) <sup>2</sup>	Night-time criterion	Critical Activity causing exceedance
N1 - Peng Chau	37-43	45	
N2 - Discovery Bay	39-45	45	

Note:

(1) PNL stands for Predicted Noise Level.

(2) The noise levels presented are the cumulative noise levels.

4.5.11 As shown in *Table 4.5b*, no noise exceedance for night-time works were predicted at either Peng Chau (N1) or Discovery Bay (N2) from both individual activity and cumulative activities. No adverse noise impacts from night-time construction works are anticipated.

#### ***Construction Noise Impacts at Lantau North Country Park and the Proposed Country Park Extension Area***

4.5.12 Due to the large distance separating the existing Lantau North Country Park (N4-a) from the work sites (about 7 km), construction noise would not be perceptible. However, assessment has been done on the Proposed Country Park Extension Area (N4'b to N4'd) located at Tai Shan overlooking Penny's Bay.

4.5.13 Based on the findings from the PBRL EIA, *Annex M*, construction noise levels from the construction of the PBRL at the Proposed Country Park Extension Area (N4'-b, N4'-c and N4'-d) have been predicted to be in the range from 49 dB(A) to a maximum of 64 dB(A). With the addition of other concurrent Theme Park and associated developments construction activities, predicted noise levels will only be slightly higher as most other construction sites are located far away from the Proposed Country Park Extension Area. As there are currently no camp grounds or hiking trails in the extension area fronting Penny's Bay, it is likely that there will be very few, if any, visitors using this area. Construction noise impacts are therefore regarded as minimal.

4.5.14 Since the Proposed Country Park Extension Area adjacent to Penny's Bay would not normally be expected to have visitors after dark, night-time construction noise impacts from the Penny's Bay dredging and filling works during Phase I Theme Park Development on the Proposed Country Park Extension Area is not anticipated.

#### **POTENTIAL IMPACTS FROM RAILWAY NOISE**

4.5.15 Findings from the PBRL EIA, *Annex M*, showed that an  $L_{eq, 30min}$  of 45 dB(A) has been predicted for the nearest NSR at Luk Keng Tsuen as a result of 30 train movements per hour assuming that 8-car trains will be used as a worst case. During the initial operation (but assuming the same worst case number of movements), the predicted noise level  $L_{eq, 30min}$  will be 42 dB(A) with 4-car trains upon commencement of operations. The  $L_{eq, 24hour}$  noise level would be at least 1 dB(A) lower assuming a similar peak headway for a total of 18 hours on any one day. The calculated  $L_{max}$  level at Luk Keng Tsuen is 55 dB(A). All the predicted values comply with the NCO and EIAO-TM noise limit and adverse noise impact at Luk Keng Tsuen is not expected.

4.5.16 A cumulative  $L_{Aeq, 30min}$  level of 55 dB has been predicted for Luk Keng Tsuen, taking account of the noise from Airport Express Line (AEL), Tung Chung Line (TCL) and

PBRL. The calculated  $L_{Amax}$  level at Luk Keng Tsuen is 72 dB. Noise from the operational trains of AEL and TCL would be predominant at Luk Keng Tsuen. All the predicted values comply with the NCO and EIAO-TM requirements.

- 4.5.17 It is anticipated that due to the large distance of the existing Lantau North Country Park (N4-a) from the rail track, railway noise impact would not be perceptible. However, assessment has been done on the Proposed Country Park Extension Area (N4'-b to N4'-d) located at Tai Shan overlooking Penny's Bay.
- 4.5.18 Predicted  $L_{Aeq,30min}$  level at the Proposed Country Park Extension Areas from the operation of the PBRL is in the range of 49 to 56 dB, with  $L_{max}$  level ranges between 57 to 65 dB(A).
- 4.5.19 The PBRL EIA concludes that the rail line will not generate adverse environmental noise impacts to the NSR; *Annex M* provides further details.

#### **POTENTIAL IMPACTS FROM FIXED PLANT NOISE**

- 4.5.20 It is anticipated that due to the large distance of the existing Lantau North Country Park (N4-a) from Penny's Bay, fixed plant noise would not be perceptible. However, assessment has been done on the Proposed Country Park Extension Area N4'-b to N4'-d located at Tai Shan overlooking Penny's Bay.

#### ***Theme Park Operation***

- 4.5.21 The Theme Park operation noise levels at residential NSRs at Peng Chau and Discovery Bay and at points within the Proposed Country Park Extension Area have been estimated as described in *Section 4.4.3*.
- 4.5.22 The results of these noise predictions are summarised in *Table 4.5c* below.

**Table 4.5c - Potential Noise Impacts of Theme Park Operations (Phases I and II)**

Noise Impact Assessment Location	Theme Park Noise Levels ( $L_{Aeq, 30min}$ dB)			EIAO TM Noise Criteria ( $L_{Aeq, 30min}$ dB)	
	Phase I	Phase II	Total	Day/Evening (0700 to 2300)	Night-time (2300 to 0700)
	N1-a - Peng Chau (Tai Lei)	42	40	44	50
N2-a - Discovery Bay (Tai Pak Tsui)	43	39	44	50	45
Proposed Country Park Extension (N4'c)	62	55	62	N/A	N/A
Proposed Country Park Extension (N4'd)	67	57	67	N/A	N/A

Note: In predicting Theme Park noise levels at NSRs and the Proposed Country Park Extension Area, atmospheric absorption was accounted for, as were earth berm/hotel shielding and facade/hillside reflection, as appropriate.

4.5.23 It is seen from *Table 4.5c* that the total projected Phase I and Phase II Theme Park operation noise levels at both Peng Chau and Discovery Bay are  $L_{Aeq,30min}$  44 dB, respectively. These noise levels then comply with the daytime/evening fixed plant planning limit of  $L_{Aeq,30min}$  50 dB (established in *Section 4.3.3*) as well as the night-time limit of  $L_{Aeq,30min}$  45 dB.

4.5.24 For general information it may be useful not just to examine the statutory  $L_{eq}$  values but also look at the  $L_{max}$  levels. Based on the measured  $L_{max}$  levels as provided by HKITP on various rides and attractions of the Anaheim, California facilities, it has been predicted that the  $L_{max}$  level as perceived at Peng Chau will be around 60 dB(A). A similar  $L_{max}$  level is also anticipated at Discovery Bay due to the noisiest rides.

#### ***Penny's Bay Gas Turbine Plant (GTP)***

4.5.25 The distance from the Penny's Bay Gas Turbine Plant to the nearest point within the hotel zone is approximately 1300 m. Based on the reference source level of 75 dB(A) at the plant site boundary (see *Section 4.4.3*), the essentially steady power plant noise levels at the closest point within the hotel zone is projected to be approximately 55 dB(A). This noise level is for reference only as the hotels would not rely upon openable windows for ventilation and consequently the impact on the guests therein would be minimal.

4.5.26 In calculating these noise levels, a + 3 dB(A) facade reflection correction was applied at the hotel location. While no screening factors were included in the above predictions, it is expected that noise levels at the receiver location will be further reduced due to the screening provided by the 9 m earth berm and by structures within the Theme Park itself. Further, as rooms of the hotels will not rely upon openable windows for ventilation, noise impacts from the power station will not provide any noise constraint at this location.

4.5.27 The distance from the Penny's Bay GTP to the nearest point at the boundary of the Proposed Country Park Extension Area (N4'-c) is about 860 m. The power plant noise level predicted at this point is approximately 59 dB(A).

#### ***(Utility Yard) Sewage Pumping Station***

4.5.28 From Utility Yard, given the relatively large distances (2.8 to 3.2 km) to the NSRs in the present case, sewage pumping noise levels will not then even approach the EIAO-TM

limits. Further, Theme Park visitors will be effectively shielded from any sewage pumping station noise by the 9 m earth berm. In addition, noise emitted from the pumping facilities could further be minimised by incorporating acoustic design, such as installing silencers to the intake and exhaust air openings.

- 4.5.29 Given its large separation distances from the Proposed Country Park Extension Area and the fact that most of the equipment would be located within the station building, noise impact at the Proposed Country Park Extension Area are likely to be minimal.

#### ***Fixed Plant of Penny's Bay Rail Link***

- 4.5.30 The required plant and tunnel ventilation equipment will be designed by the PBRL operator, MTRC, to ensure that the noise levels at any NSR will be 5 dB lower than the NCO criteria. This will be easily achieved by adoption of good engineering practice, the given large distance separation between the alignment and the nearest NSRs, and the provision of 9 m earth berm next to the proposed railway.

#### ***Public Transport Interchanges***

- 4.5.31 The effective SWLs measured by the EIA Study Team at some of the larger PTIs in Hong Kong (e.g. Kwun Tong and Shing Tak Centre) during the morning peak, afternoon peak and evening were  $L_{Aeq}$  110, 109 and 105 dB(A) respectively<sup>(1)</sup>. Using these measured SWLs, PTI noise levels have been projected at the four NSRs at Peng Chau, Discovery Bay, Luk Keng Tsuen and the Proposed Country Park Extension Area and are shown in *Table 4.5d*.
- 4.5.32 When assessing the Penny's Bay PTI, the projections have included a - 5 dB(A) screening factor for the noise shielding which will be provided by the Theme Park buildings, earth berms and hotels to be located between the PTI and the NSRs at Peng Chau and Discovery Bay. Due to elevated location of the Proposed Country Park Extension Area, no such shielding factors were applied in its case. A +3 dB(A) factor has been applied for building facade reflections in the case of the two residential NSRs (Peng Chau and Discovery Bay) and for sloped ground (hillside) reflections in the case of the Proposed Country Park Extension Area.
- 4.5.33 No screening factor for the noise shielding has been included for the Yam O Temporary PTI assessment at Luk Keng Tsuen since operation of this PTI precede the construction of the Theme Park Gateway, which was proposed to be located between the PTI and Luk Keng Tsuen. Although some of the area at the Proposed Country Park Extension Area will be facing the Yam O Temporary PTI, noise impact at this NSR has not been assessed due the large separation distance between the noise source and the receiver. Luk Keng Tsuen remained as the worst affected NSR.
- 4.5.34 The results of *Table 4.5d* show that the noise from both the Penny's Bay PTI and the Yam O Temporary PTI will be far below the appropriate reference criteria at the three residential NSRs. Projected noise levels at the Proposed Country Park Extension Area are

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(1) Measurements conducted by ERM in conjunction with a study on PTI emissions in 1998/99.

expected to be similar to, or less than, the normal background noise levels due largely to natural sources.

**Table 4.5d - Projected Noise Impacts from Operation of Penny's Bay PTI and Yam O Temporary PTI**

Time Period	Predicted Noise Levels <sup>(1)</sup> (L <sub>Aeq, 30min</sub> dB)				Reference Noise Criterion <sup>(2)</sup>
	Peng Chau (N1-a)	Discovery Bay (N2-a)	Luk Keng Tsuen (N3'b)	Country Park Extension (N4'c)	
AM Peak	30	30	44	43	50/60
PM Peak	29	29	43	42	50/60
Evening	25	25	39	38	50/60

Note:

(1) A shielding factor of - 5dB(A) was applied to the PTI noise levels as projected at Peng Chau and Discovery Bay. However, atmospheric absorption was conservatively neglected.

(2) The criterion of 50 dB(A) is used for Peng Chau and Discovery Bay while 60 dB(A) is used for Luk Keng Tsuen. There is no specific criteria for country park.

### ***Vehicle Parking Areas***

4.5.35 Two vehicle parking areas are to be located immediately north of the two Theme Park areas and the Penny's Bay Rail Link. However, because of the relatively low speeds at which vehicles are required to travel in such facilities, the vehicle parking areas are not considered to represent significant sources of Project operational noise when compared, for example, with the access roads leading to and from these parking lots and the hotel areas (Roads P1, P2, D1 and D2).

### ***Future Container Terminal Development***

4.5.36 As the hotels at the Theme Park will not rely on openable windows for ventilation, potential noise impacts from the operation of the future Container Terminal development on the hotels will be minimal.

### ***Water Recreation Centre (WRC)***

4.5.37 The proposed water recreation centre will include a boating facility, changing rooms, restaurants and canteens and canteens, etc. Secondary uses may include storage, kitchens and food preparation areas, etc. In view of the proposed uses of the WRC, it is expected that noise emitted from its operation would be minimal.

### ***Cumulative Noise Levels from all Fixed Plant Sources***

4.5.38 Theoretically the noise contributions from all fixed plant sources could be summed and the cumulative impacts assessed at sensitive locations such as Peng Chau and Discovery Bay. However, as most of these sources will be located north of the Theme Park (and thereby shielded by the boundary berm and buildings within the Theme Park) and they are of much smaller scale (both physically and relative to acoustical intensity), their contributions to the overall resultant noise climate will be minimal as compared to the operational noise of the Theme Park and its associated developments.

4.5.39 To illustrate this effect, the occasional operational noise from the GTP could be taken as an example. Just accounting for distance effect, the approximate 3 km separation between the GTP and Peng Chau will offer more than 40 dB attenuation and thus it will not have any additive effects to the noise climate.

### ***Fireworks Displays***

4.5.40 As discussed in *Section 4.4.3*, fireworks displays to be presented at the Theme Park have not yet been developed in any detail. However, the EIA Study Team has obtained, during a specially-staged demonstration, representative source noise data covering the range of fireworks types that could be considered for use in Hong Kong.

4.5.41 The relevant individual source noise data obtained were used to compute the resultant noise picture of a 5-minute mid-level (approximately 100 m in height) fireworks show (see *Annex C7*). It has been demonstrated that the  $L_{Aeq, 15 \text{ min}}$  55 dB limit could be met while taking a good mixture of various fireworks items considered appropriate for the Hong Kong situation.

4.5.42 In the absence of even preliminary designs of the fireworks displays at this stage, the EIA Study Team has demonstrated and illustrated one possible scenario. In the process of deriving the detailed design of the fireworks show, it would be necessary to ensure the noise emission from the actual show would correspond and not exceed those contained in this assessment.

4.5.43 For information, to supplement the equivalent noise level, it is also anticipated that maximum levels of up to approximately 85 dB(A) would be perceived at relevant NSRs in Peng Chau and Discovery Bay. Such maximum levels are from the effects related to individual fireworks items, and would resemble to that of a diesel powered golf cart (used extensively at Discovery Bay for transportation purposes) passing at a distance of 5 m approximately.

4.5.44 It is noted that in addition to the mid-level fireworks shows, there are also ground or low level shows which are associated with regular Theme Park activities and attractions. But as these shows are of such heights that are close to the ground, the associated noise will be adequately screened by buildings and structures within the Theme Park itself. It is anticipated that noise from ground or low level fireworks shows would be merged into the general operational noise of the Theme Park and could hardly be distinguished from it.

### **ROAD TRAFFIC NOISE**

4.5.45 There are three Designated Projects under the category of roads in this EIA. These are: CKWLR, Road P2 and the Resort Roads (the road sections covered have been addressed in *Section 4.1*) and they have all been assessed accordingly.

4.5.46 Traffic noise levels have been calculated at three assessment points at the Proposed Lantau North Country Park Extension Area. For Peng Chau, Discovery Bay, Luk Keng Tsuen and the existing Lantau North Country Park, traffic noise was not assessed as no impacts were anticipated due to large separation distances (for example, around 4 km between CKWLR and Peng Chau or Discovery Bay) and the very substantial terrain screening the proposed road network from the sensitive receivers.

4.5.47 The noise levels predicted at each assessment point are presented in *Table 4.5e*.

**Table 4.5e - Predicted Road Traffic Noise Levels**

Assessment Points	Predicted Noise Levels (L <sub>10</sub> dB(A))
N4'-b	70
N4'-c	67
N4'-d	40

4.5.48 *Table 4.5e* shows that the predicted road traffic noise levels along the boundary of the Proposed Country Park Extension Area fall within the range of 40 dB(A) to 70 dB(A).

## 4.6 MITIGATION OF ADVERSE CONSTRUCTION NOISE IMPACTS

4.6.1 Noise emissions from construction activities can be minimised through good site practice, selecting quiet plant, adopting quieter working methods, erection of barriers to screen the noise source, where appropriate, and posing restriction on the use of noisy equipment. The recommended mitigation measures detailed in this section should be incorporated into the Contract Specification in order to ensure the environmental performance of construction works.

4.6.2 The Contractor may develop a different package of environmental control measures to meet the required noise standards, but the following illustrates a feasible approach to mitigate the predicted noise impacts during the construction phase:

### ***Good Site Practice***

4.6.3 The construction activities being undertaken in this Project are unlikely to give rise to adverse daytime noise impacts to the surrounding environment as concluded in the preceding section. Specific mitigation measures for daytime construction works are, therefore, not required. However, the Contractor will be required to adopt good site practice and maintain proper on-site management in order to minimise noise emissions from the works during all times. The following measures are recommended:

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction works;
- Machines and plant that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum;
- Silencers or mufflers on construction equipment should be utilised and be properly maintained during the construction works;
- Mobile plant should be sited as far away from NSRs as possible; and
- Material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

4.6.4 Although it is difficult to quantify the level of noise reduction achieved from incorporation of these elements, the environmental performance of the works would be improved with these control measures.

### ***Selecting Quieter Plant for Evening Time Works***

- 4.6.5 The use of quiet plant is identified to be a feasible solution to tackle the adverse impacts associated with the evening time construction works. The Contractor may be able to obtain particular models of plant that are quieter than standard types given in GW-TM. The benefits achievable in this way will depend on the details of the Contractors' chosen methods of working, and it is considered too restrictive to specify that a Contractor has to use specific items of plant for the construction operations. It is therefore both preferable and practical to specify an overall plant noise performance specification to apply to the total SWL of all plant to be used on site so that the Contractor is allowed some flexibility to select plant to suit his needs.
- 4.6.6 Quiet plant is defined as PME whose actual SWL is less than the value specified in GW-TM for the same piece of equipment. Examples of SWLs for specific silenced PME taken from a British Standard, namely *Noise Control on Construction and Open Sites, BS5228: Part 1: 1997*, which are known to be used are given in *Table 4.6a*.

***Table 4.6a - Sound Power Levels for Specific Silenced PME***

<b>PME</b>	<b>BS5228 Table no.</b>	<b>Ref no.</b>	<b>SWL, dB(A) max</b>
Breaker	C.2	10	110
Dozer	C.9	2	104
Mobile Crane	C.7	114	101
Concrete Pump	C.6	22	106
Dump truck	C.9	27	105
Excavator/Loader	C.3	97	105
Generator	C.7	62	100
Lorry	C.8	16	108
Concrete truck (mixer)	C.6	35	100
Grader	C.9	11	110
Road Roller	C.8	27	104
Poker Vibrator	C.6	32	100

- 4.6.7 It should be noted that various types of silenced equipment can be found in Hong Kong. However, the EPD, when processing a CNP application, will apply the noise levels contained in the GW-TM, unless the noise emission of a particular piece of equipment can be validated.
- 4.6.8 The mitigated noise levels at each NSR for each Theme Park and associated developments construction activity and the cumulative noise levels have been predicted and the details are given in *Annex C3b, Tables C3b.1 - C3b.3*. The range of noise levels predicted is presented in *Table 4.6b* below.

**Table 4.6b Predicted Evening Construction Noise Levels - with the use of quiet plant**

NSR	Range of PNL <sup>1</sup> , dB(A) <sup>2</sup>	Evening time Criterion	Critical activity causing exceedance
N1 - Peng Chau	29-59	60	
N2 - Discovery Bay	28-60	60	
N3 - Luk Keng Tsuen	62-68	65	Cumulative impacts from construction of services infrastructure (C) <sup>3</sup> + PBRL (T) <sup>3</sup>

Note:

- (1) PNL stands for Predicted Noise Levels.
- (2) The noise levels presented are the cumulative noise levels.
- (3) Activity Reference as shown in *Annex C3b, Tables C3b.1-C3b.3*.

4.6.9 As shown in *Table 4.6b*, with the use of quiet plant, the noise exceedances (2-4 dB(A) without mitigation measures) during evening time at Peng Chau (N1) and Discovery Bay (N2) have been reduced to within the 60 dB(A) criterion.

4.6.10 For Luk Keng Tsuen (N3), with the implementation of quieter plant, the maximum noise level was reduced from 75 dB(A) to 68 dB(A). The noise exceedances in the range from 1 dB(A) to 3 dB(A) were mainly due to the concurrent construction works for the services infrastructure and the PBRL.

4.6.11 In order to reduce the noise levels at Luk Keng Tsuen (N3) to comply with the evening 65 dB(A) criterion, further noise mitigation measures have been considered. The erection of noise barriers at places, where appropriate, has been considered.

#### ***Use of Temporary and Movable Noise Barriers for Evening Time Works***

4.6.12 In general, purpose-built noise barriers or screens constructed of appropriate material to be located close to operating PME could give a noise reduction of up to 5 dB(A) (estimated in accordance with the GW-TM). This level of noise reduction could also be achieved by erecting temporary noise barriers along active work sites. Certain types of PME, such as generators, can be completely screened giving a total noise reduction of 10 dB(A) or more.

4.6.13 It is anticipated that a movable noise barrier with a suitable footing and a small cantilevered upper portion can be located within a few metres of a static plant and within about 5 m of more mobile equipment such as excavator and mobile crane etc., such that the line of sight could be blocked by the barriers viewed from the NSRs. The estimated noise reduction by means of screening, provided that the barriers are carefully located, can provide at least 10 dB(A) noise attenuation for static plant and 5 dB(A) for mobile plant. The noise screening benefit for each plant considered in this assessment is listed below:

- Stationary Plant - assuming 10 dB(A) reduction: poker vibrator, concrete pump and generator; and
- Mobile Plant - assuming 5 dB(A) reduction: excavator, grader, road roller, mobile crane and concrete truck.

4.6.14 The predicted noise levels with the use of quiet plant and barriers for evening time works to reduce the identified noise impacts associated with the works are presented in *Annex C3b, Tables C3b.1 - C3b.3* and *Annex C3c, Table c3.1*. Full compliance to the evening 65 dB(A) criterion at Luk Keng Tsuen (N3) was then achieved. The noise levels predicted were in the range 58-64 dB(A).

## **4.7 MITIGATION OF ADVERSE OPERATIONAL NOISE IMPACTS**

4.7.1 The operational noise assessment did not predict any exceedance of the relevant noise criteria due to the operation of the Theme Park and associated developments. Therefore, no specific mitigation measures during operational phase are required. However for fireworks displays, a maximum duration of 5 minutes for mid-level shows and a maximum height of 100 m are recommended.

## **4.8 RESIDUAL ENVIRONMENTAL IMPACTS**

### **CONSTRUCTION PHASE**

4.8.1 In view of the large number of construction activities and equipment considered in the Project, without mitigation measures, adverse construction noise impacts to the surrounding environment are likely.

4.8.2 With the implementation of practical noise mitigation measures as recommended in *Section 4.6.1*, including the use of quiet plant and the erection of noise barriers at active work sites, noise levels at all NSRs were reduced to comply with the daytime and restricted hours criteria.

### **OPERATIONAL PHASE**

4.8.3 The operational noise assessment did not predict any exceedance of the relevant noise criteria due to the operation of the Theme Park and associated developments.

## **4.9 ENVIRONMENTAL MONITORING AND AUDIT**

4.9.1 Noise monitoring and auditing has been recommended for the construction and operational phases. The specific monitoring requirements are detailed in *Annex N* of this EIA Report which comprises the stand-alone Project EM&A Manual.

## **4.10 CONCLUSIONS**

### **CONSTRUCTION NOISE**

4.10.1 Noise from the Project's construction phases has the potential to impact on the surrounding environment. Powered Mechanical Equipment (PME) will be the primary source of noise. Noise exceedances at NSRs have been predicted only for the evening time period. Mitigation measures including the use of quiet plant and the erection of movable noise barriers have been recommended for evening construction works. With the implementation of the recommended mitigation measures, noise impacts at the identified NSRs from construction works could be mitigated to comply with the statutory Noise Control Ordinance evening criterion. Despite this finding, regular monitoring of construction noise at adjacent NSRs is recommended, in order to ensure that the NSRs are subject to no adverse construction noise.

4.10.2 There are no established construction noise criteria associated with Country Parks. The construction noise of Theme Park and associated developments should not be perceptible at the Lantau North Country Park.

4.10.3 Regardless of the results of the construction noise impact assessment for restricted hours, the Noise Control Authority will process the Construction Noise Permit (CNP) application, if necessary, based on the NCO, the relevant technical memoranda issued under the NCO, and the then prevailing conditions/situations.

#### **OPERATIONAL NOISE**

4.10.4 The operational noise assessment did not predict any exceedance of the relevant noise criteria due to the operation of the Theme Park and associated developments. Despite this finding, noise monitoring is recommended during the operational phase to ensure compliance with the applicable noise criteria. In addition, it is recommended that noise monitoring should be undertaken during the fireworks displays to ensure that the duration did not exceed the maximum limit of 5 minutes for mid-level shows and did not exceed the maximum height limit of 100 m for complying the  $L_{Aeq, 15min}$  55 dB(A) criterion at both Peng Chau and Discovery Bay.

4.10.5 For railway noise from the PBRL, predicted  $L_{Aeq, 30min}$  level at Luk Keng Tsuen was 45 dB, with  $L_{max}$  level at 55 dB(A) and the  $L_{eq, 24\text{ hour}}$  noise level would be at least 1 dB(A) lower. Cumulative impact from Airport Express Line, Tung Chung Line and PBRL was estimated to be 55 dB(A). The results indicated that the proposed PBRL will not impact upon the existing NSRs and will comply with the statutory requirements of the NCO and EIAO-TM.

4.10.6 Adverse road traffic noise impact at Peng Chau, Discovery Bay, Luk Keng Tsuen and the existing Lantau North Country Park was not anticipated due to the large separation distances and the very substantial terrain screening the proposed road network from the sensitive receivers. The predicted road traffic noise levels along the boundary of the Proposed Country Park Extension Area fall within the range of 40-70 dB(A).

4.10.7 There are no established operational noise criteria associated with Country Park. The operational noise of Theme Park and associated developments should not be perceptible at the Lantau North Country Park. However, it will be perceptible at the Proposed Country Park Extension Area.

**Table 4.10a Impact Summary**

Issue	Construction Phase	Operational Phase
Assessment Points Considered	<ul style="list-style-type: none"> <li>• N1-a (Peng Chau)</li> <li>• N2-a (Discovery Bay)</li> <li>• N3-a(Luk Keng Tsuen)</li> <li>• N4-a (Lantau North Country Park)</li> <li>• N4'-b to N4'-d (Proposed Country Park Extension Area)</li> </ul>	<ul style="list-style-type: none"> <li>• N1-a (Peng Chau)</li> <li>• N2-a (Discovery Bay)</li> <li>• N3-b to N3-c (Luk Keng Tsuen)</li> <li>• N4-a (Lantau North Country Park)</li> <li>• N4'-b to N4'-d (Proposed Country Park Extension Area)</li> </ul>
Relevant Criteria	<ul style="list-style-type: none"> <li>• Daytime (0700-1900 hours) construction noise standards stipulated in the EIAO-TM is <math>L_{Aeq,30min} 75</math> dB(A) for all domestic premises on any day not being a Sunday or general public holiday for general construction works.</li> <li>• General construction works during the restricted hours follow the criteria set in the GW-TM. These are: <ol style="list-style-type: none"> <li>1. <math>L_{Aeq, 5min}</math> 60 dB and 65 dB for area with Area Sensitivity Rating of A and B respectively for all days during the evening (1900-2300 hours) and general holidays (including Sundays) during the day and evening (0700-2300 hours); and</li> <li>2. <math>L_{Aeq, 5min}</math> 45 dB and 50 dB for area with Area Sensitivity Rating of A and B respectively for all days during the night-time (2300-0700 hours).</li> </ol> </li> <li>• There are no statutory limits or guidelines for Country Parks.</li> </ul>	<p><i>Fixed Plant Noise</i></p> <ul style="list-style-type: none"> <li>• According to the EIAO-TM and IND-TM, the daytime &amp; evening (0700-2300 hours) noise limit for Peng Chau and Discovery Bay is 50dB(A) while the night-time (2300-0700 hours) noise limit for these NSRs would be 45 dB(A).</li> <li>• According to the IND-TM, the daytime &amp; evening (0700-2300 hours) noise limit for Luk Keng Tsuen is 60 dB(A) while the night-time (2300-0700 hours) noise limit for this NSR would be 50 dB(A).</li> </ul> <p><i>Fireworks Noise</i></p> <ul style="list-style-type: none"> <li>• The criterion of <math>L_{Aeq, 15 min}</math> 55 dB(A) was used for domestic premises.</li> </ul> <p><i>Railway Noise</i></p> <ul style="list-style-type: none"> <li>• According to the IND-TM, the daytime &amp; evening (0700-2300 hours) noise limits are <math>L_{Aeq, 30min}</math> 60 dB and 65 dB for NSRs with Area Sensitivity Rating of A and B respectively.</li> <li>• According to the IND-TM, the night-time (2300-0700 hours) noise limits are <math>L_{Aeq, 30min}</math> 50 dB and 55 dB for NSRs with Area Sensitivity Rating of A and B respectively. In addition, the EIAO-TM has also recommended a criterion of <math>L_{max}</math> 85 dB(A) during these hours.</li> </ul> <p><i>Road Traffic Noise</i></p> <ul style="list-style-type: none"> <li>• The EIAO-TM requires that road traffic noise levels outside the facades of domestic premises which rely upon openable windows for ventilation should not exceed <math>L_{10 (1hour)}</math> 70 dB(A).</li> <li>• There are no statutory limits or guidelines for Country Parks for all types of operational noise sources.</li> </ul>

Issue	Construction Phase	Operational Phase
Potential Impacts	<p><i>Construction Works during daytime &amp; evening</i></p> <ul style="list-style-type: none"> <li>Noise emitted by the use of PME is the major source of impact during construction.</li> <li>A range of 37-62 dB(A) was predicted at N1-a (Peng Chau).</li> <li>A range of 36-64 dB(A) was predicted at N2-a (Discovery Bay).</li> <li>A range of 70-75 dB(A) was predicted at N3-a (Luk Keng Tsuen).</li> <li>A range of 49-64 dB(A) was predicted at the Proposed Country Park Extension Area.</li> </ul> <p><i>Construction Works during night-time</i></p> <ul style="list-style-type: none"> <li>A range of 37-43 dB(A) was predicted at N1-a (Peng Chau).</li> <li>A range of 39-45 dB(A) was predicted at N2-a (Discovery Bay).</li> <li>Luk Keng Tsuen will not be affected by night-time works as night-time works are concentrated at Penny's Bay area.</li> </ul>	<p><i>Fixed Plant Noise</i></p> <ul style="list-style-type: none"> <li>Predicted noise levels at NSRs N1-a (Peng Chau) and N2-a (Discovery Bay) from the operation of Theme Park were within the EIAO-TM/IND-TM criterion.</li> <li>Noise impact from the proposed sewage pumping station was predicted to be minimal, given its relatively large distances to the NSRs.</li> <li>Noise impact from the GTP was predicted to be minimal and well within the EIAO-TM/IND-TM criterion at all NSRs. The noise level predicted at the Proposed Country Park Extension Area is approximately 59 dB(A).</li> <li>Noise impacts from the fixed plant of Penny's Bay Rail Link were predicted to be minimal to the NSRs due to the large separation distances and noise shielding between the noise source and the NSRs. Exceedances of EIAO-TM/IND-TM criteria are not anticipated.</li> <li>Noise impacts from the PTIs at Yam O and Penny's Bay were predicted to be well within the referenced IND-TM criteria. Noise levels in the range of 38-43 dB(A) were predicted in the Proposed Country Park Extension Area from the Penny's Bay PTI.</li> </ul> <p><i>Fireworks Noise</i></p> <ul style="list-style-type: none"> <li>With the careful choosing of the types of fireworks items to be used in the Theme Park, the noise emission from the fireworks displays will comply with the <math>L_{Aeq, 15 \text{ min}}</math> 55 dB(A) reference criterion at both N1-a (Peng Chau) and N2-a (Discovery Bay).</li> <li>It is anticipated that maximum levels of approximately 85 dB(A) would be perceived at N1-a (Peng Chau) and N2-a (Discovery Bay). Such maximum levels are from the effects related to individual fireworks items.</li> </ul> <p><i>Railway Noise</i></p> <ul style="list-style-type: none"> <li>The predicted noise levels at Luk Keng Tsuen will comply with the statutory requirements of the NCO and the EIAO-TM. Adverse noise impacts from operational trains are not expected.</li> <li><math>L_{eq, 30 \text{ min}}</math> noise level in the range of 49-56 dB(A) were predicted at the</li> </ul>

Issue	Construction Phase	Operational Phase
		<p>Proposed Country Park Extension Area. The <math>L_{max}</math> level ranges between 57-65 dB(A).</p> <p><i>Road Traffic Noise</i></p> <ul style="list-style-type: none"> <li>Noise levels in the range of 40-70 dB(A) were predicted at the Proposed Country Park Extension Area.</li> <li>Traffic noise impact at other NSRs was anticipated to be minimal due to their large separation distances away from the noise source.</li> </ul>
Mitigation Measures	<ul style="list-style-type: none"> <li>Where available, use of quiet plant at all construction work sites.</li> <li>Use of temporary and movable noise barriers for evening time works at the following locations:               <ol style="list-style-type: none"> <li>construction sites near Yam O Interchange</li> <li>Yam O works area</li> <li>work site of CKWLR (from Yam O to Penny's Bay Interchange)</li> <li>work site of Road P2 (from Northern Development to Theme Park West)</li> <li>work site of the Access Road</li> <li>work site of the PBRL (mainly near Yam O Station)</li> <li>work sites of services infrastructure which are to be built along the road alignment such as CKWLR, Road P2 and the Access Road.</li> </ol> </li> </ul>	<ul style="list-style-type: none"> <li>No criteria exceedances were predicted for operational noise impact and thus no mitigation measures are required. However, the following structures can, to a certain extent, reduce the noise impacts:               <ol style="list-style-type: none"> <li>5 m - 9 m earth berm encircling the Theme Park.</li> <li>9 m earth berm encircling the proposed sewage pumping station.</li> <li>9 m earth berm encircling the GTP.</li> </ol> </li> <li>For fireworks displays, a maximum duration of 5 minutes for mid-level shows and a maximum height of 100 m are recommended.</li> </ul>
Environmental Acceptability	Acceptable	Acceptable