12 CONCLUSION

12.1 Introduction

This EIA has focused on identifying and providing mitigation options for the potential impacts associated with both the construction and operational phases of the road widening project.

The following aspects have been assessed:

- Air Quality;
- Noise;
- Water Quality;
- Waste Management Implications;
- Ecology (Terrestrial and Aquatic);
- Landscape and Visual Impacts; and
- Cultural Heritage

The findings of the assessments are summarised in Table 12.1 which details:

- Key impacts (without mitigation measures) for each of the environmental aspects considered;
- Proposed measures (where appropriate) to mitigate against the identified impact; and
- Residual impacts (following implementation of mitigation measures).

The residual impacts define the acceptability of the project, and are categorised in general accordance with guidance offered by the Technical Memorandum on Environmental Impact Assessment Process (EPD, 1997). Five impact categories have been adopted:

- The impact is *beneficial* if the project will improve the overall quality of the environmental aspect under consideration;

- The impact is *acceptable* if the assessment indicates that there will be no significant effects on the environmental aspect under consideration;

- The impact is *acceptable with mitigation measures* if there will be some adverse effects, but these can be eliminated, reduced or offset to a large extent by specific measures;

- The impact is *unacceptable* if the adverse effects are considered excessive and are unable to be practically mitigated. In these circumstances compensation may have to be considered by Government; and

- The impact is *undetermined* if significant adverse effects are likely, but the extent to which they may occur or be mitigated cannot be determined from the study. Further detailed study will be required.

The time scale over which the impacts will occur has also been categorised into short, medium or long term, and reversible or irreversible.

12.2 Air Quality

A qualitative assessment on the construction dust impacts has identified that fugitive dust is the primary potential air pollutant during the road widening works. Established dust suppression techniques such as regular watering of haul roads, covering / dampening any stockpiles and dampening dusty materials before transportation, have been proposed.

Through the proper implementation of the recommended mitigation measures, dust generation will be controlled and will not exceed the acceptable criteria. This, however, will be further verified through the EM&A program which will be undertaken as part of the construction works.

The CALINE4 modelling results indicate that neither the hourly NO_2 AQO or 24-hour RSP AQO will be exceeded during the operation phase of this project. Because these results are based upon both the worst case traffic flows (Year 2020) and wind directions, it is concluded that the traffic related air quality impacts will be insignificant.

12.3 Noise

This EIA has concluded that with the use of silenced equipment, reduction in equipment percentage on-time, as well as 2 to 7 m high purpose-built barriers positioned at appropriate locations during the construction phase of the proposed road widening project, the construction noise impacts will be significantly mitigated. The predicted construction noise levels at 2 schools (SR41 Wong Shiu Chi Middle School and SR45 HK Teacher's Association Secondary School) are found to exceed the noise criterion (during examination period only). However, as confirmed by the school officials, both schools are equipped with adequate noise insulation facilities (i.e., air conditioners and window glazing) at the noise sensitive facades. Therefore, the noisy construction activities will be adequately mitigated by the existing measures, and no residual impacts are anticipated.

Year 2020 road traffic noise impacts caused by the Project's "new" roads are shown to be significantly mitigated through the use of 2 to 8 metres high vertical roadside, and central reserve barriers and canopy type barriers. With the proposed mitigation in place, the noise contribution from the Project's "new" roads at all NSRs satisfies the two assessment criteria: (1) the predicted $L_{10(1\ hour)}$ noise level from the "new" roads must be below the relevant noise standards, i.e., 70 dB(A) for domestic premises and 65 dB(A) for education institutions; and (2) the noise contribution from the "new" roads to the increase in the predicted overall noise level must be less than 1 dB(A) if the overall noise level exceeds the relevant criterion. The criterion as set out in the 24 Hour Opening of the Border Crossing study is also met with the proposed mitigation measures for the Project in place. Therefore, it is concluded that there are no significant traffic noise impacts caused by the proposed road alignment under this Project.

12.4 Water

Water quality impacts have been defined for both construction and operation of phases. It has been concluded that the impacts are both locally confined and controllable within acceptable levels, on the basis that environmental protection measures are included in the Construction Works Programme.

12.5 Waste

In order to suitably manage the potential environmental effects associated with construction related wastes, full consideration must be given of the re-use of surplus clean material on site (where practicable), or within other development projects, once material balances are finalised. This will help lessen the pressure on the filling capacity of the territory's landfills due to excess construction and demolition waste disposal.

All mitigation measures and waste management procedures outlined within the EIA must be implemented in order to control or eliminate the potential impacts to the environment from waste generation and disposal.

12.6 Ecology

The ecological impact assessment has identified a number of minor ecological impacts including habitat loss, disturbance during construction and potential of pollution derived from works areas. However with implementation of good site practice and mitigation measures, the identified impacts are considered to be acceptable provided that the proposed mitigation measures are implemented satisfactorily.

12.7 Landscape and Visual Impact

The construction phase of the proposed scheme would result in sources of visual impact arising from the loss of existing vegetation, the scale of the proposed earthworks and the nature of the construction activities to be undertaken. Although a higher adverse visual impact is predicted for the construction phase, these effects would be temporary in nature.

Overall during the opening year the sources of landscape and visual impacts would arise from the loss of the roadside vegetation, the disturbance caused by the new areas of cut and fill and construction of the proposed noise barriers.

The loss of roadside planting would initially have a large adverse visual impact on VSRs and on the existing landscape character of the local area particularly within the road corridor. This would expose views of the highway, and lead to a loss of the visual integration between the road corridor and the surrounding landscape.

The proposed areas of cut and fill will be visually prominent both within the road corridor and within the wider landscape context of the schemes visual envelope. However the existing level of visual disturbance caused by the highway structures would do much to lessen the perceived level of impact caused by the proposed works.

The proposed barriers and highway structures would, even with the design approach described above, form large and visually prominent structures both within the road corridor and the wider landscape context. The proposed highway structures are generally replacing existing ones and so the level of adverse visual impact would remain largely unchanged. However, in the context of the wider landscape the combination of the proposed noise barriers and the roadside planting would successfully mitigate many of the adverse visual impacts caused by the operation of the proposed carriageway, with its associated engineering structures and vehicular activity.
During the design year, generally described as between ten and fifteen years after opening although in practice often well in advance, the compensatory planting would have reached a level of maturity whereby it will perform the design role for which it was planted. This planting would reduce the adverse visual impacts caused by the proposed highway structures including the vertical barriers and ease the schemes perceived visual integration into the existing landscape.

The level of residual adverse impacts would be relatively low due to the existing disturbance caused by the existing highway and adjacent development, and the combined effect of the proposed mitigation measures. For the majority of the landscape and visual impacts predicted to occur as a result of the operational phase of the proposed widening scheme the residual impact would be ‘acceptable with mitigation’.

The predicted impacts to the Planning and Development Control Framework would be negligible in that the proposed development has been designed where possible to stay within the existing landtake or widened within limited landtake and thus would not affect the viability of the existing planning designations within the road corridor.

12.8 Cultural Heritage

On the basis of the information provided by the Antiquities and Monuments Office, Wun Yiu Kiln, Yuen Chau Tsai (Island House), Mui Shu Hang south, West of Lam Kam roundabout, Wai Tau, Kiu Tau, Tai Hang, to Nam Wa Po (southern end) and Wai Tau to Tai Hang should be monitored during construction. The monitoring work should be conducted by a qualified archaeologist who should apply for a license from the Antiquities Authority beforehand, which is a statutory requirement stated in sections 12 and 13 in the Antiquities and Monuments Ordinance (Cap. 53). After the completion of the monitoring, the archaeologist is required to submit a full report to AMO to explain the finding of the monitoring work.

For Wun Yiu and Yuen Chau Tsai, the clause "construction works in the proximity is carried out as unobtrusively as possible to avoid any damage to the site and discouragement of visitors to the site" should be included in the construction contract.

12.9 Environmental Monitoring and Audit

An environmental monitoring and audit (EM&A) programme is recommended to be undertaken during the implementation of the Project. This is surmised herein and will be elaborated upon in the EM&A Manual.

Table 12.1 Summary of Environmental Assessment Findings

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
Air Quality (*Construction)*	Short term elevated dust levels are expected.	Regular watering of haul road surfaces, covering/dampening of stockpiles in dry/windy conditions.	Acceptable with mitigation measures.	Short term, reversible.
Air Quality *(Operational)*	N / A	N / A	N / A	N / A
Noise *(Construction)*	Elevated construction noise levels are anticipated.	Adoption of silenced equipment, reduction in equipment number, 2 to 7 metres high purpose built noise barrier at locations required.	Acceptable with mitigation measures.	Short term, reversible.
Noise (***Operational)***	Traffic noise impacts from the widened highways and the associated slip roads.	Direct mitigation measures: 2 to 8 m high vertical noise barriers (roadside and central reserve), and 2 types of canopy barriers. Type I consists of 5.5 m high vertical barrier with a 4.5 m cantilever (2.5 m high from base of cantilever, i.e., a total height of 8.0 m), and Type II consists of 5.5 m high vertical barrier with 3.0 m cantilever (2.5 m high from base of cantilever, total height of 8.0 m).	Acceptable with mitigation measures.	Long term, irreversible.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
Water Quality ***(Construction)***	Widening and reconstruction of bridges River training works	Sheet piles to avoid off-site migration and to protect affected areas.	Acceptable with mitigation	Short term, reversible
Water Quality ***(Operational)***	Highway drainage	None	Acceptable	Long term
Waste ***(Construction)***	Wastes produced during construction may include excavated spoil, waste from associated construction works, small quantities of chemical wastes, bentonite slurries, and municipal wastes.	Normal construction waste management measures are proposed, including full consideration on the potential for re-use of excess spoil, segregation of recyclable and non-recyclable wastes (where practicable) and good housekeeping practice to minimise nuisances.	Acceptable with mitigation measures.	Not applicable.
Waste ***(Operational)***	Wastes produced during specific maintenance operations (e.g. road re-surfacing, upkeep of landscaped areas) and may include tarmacadam, concrete and organic wastes (vegetation).	As above.	Acceptable with mitigation measures.	Not applicable.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
Ecology ***(Construction)***	Various forms of waste derived from construction activities could potentially caused adverse impacts to ecological impacts, e.g. solid waste, spillages of oil/petrol/diesel into water courses.	Such impacts can be mitigated by implementing on site facilities to minimise such issues, e.g. strict control of placement of construction material, and placement of on site sedimentation tank and oil/petrol interceptors.	Acceptable with mitigation measures.	Not applicable.
	Damage to adjoining habitats due to encroachment of works areas, and placement of works materials.	Works areas should be fenced off to minimise damage to ecological habitats.	Acceptable with mitigation measures.	Not applicable.
	Identify the location of mature trees.	A tree survey should be undertaken prior to the works to identify the location of any mature specimens. Works in the vicinity of these should be avoided wherever possible.	Acceptable with mitigation measures.	Not applicable.
	Constructional activities may induce elevated levels of dust, which could settle on vegetation there by reducing photosynthesis levels, and also collect in local water courses thereby increasing suspended sediment levels	Facilities should be set up for vehicle washing to minimise the spread of dust.	Acceptable with mitigation measures.	Short term, reversible.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
	Key ecological impacts to be lost shall include : 0.04 ha of *Fung Shui* woodland, 0.74 ha of natural woodland and 60m of natural watercourses.	Ecological impacts can be minimised by careful site practice to minimise damage to ecological habitats as sited above. In addition, following completion of the highway widening scheme habitats that have been subjected to disturbance can be enhanced by various methods such as replanting the roadside with species preferred by local wildlife. Refer to list of floral species for recommended roadside planting documented in Appendix 8.2.	Acceptable with mitigation measures.	Long term, reversible.
Ecology ***(Operational)***	No adverse impacts beyond levels currently experienced are anticipated.	No residual impacts would be envisaged and no further mitigation measures would be necessary.	No residual impacts would be envisaged and no further mitigation measures would be necessary.	Not applicable.
Landscape Impacts (Construction)	Loss of roadside tree vegetation as landscape buffer	Preservation of existing vegetation, where possible, by modifications to alignment Tree Survey in accordance with WBTC 24/94 and tree felling, transplanting and retention proposals Conservation of topsoil Compensatory tree and shrub planting	Acceptable with mitigation measures.	Medium term, reversible.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
	Disturbance of temporary works areas situated to the east of Tai Po and south of Kiu Tau.	Preservation of existing vegetation, where possible, through design of the works site, and protection from works activity during the construction period. Site design including the use of hoarding and temporary lighting to limit temporary landscape impacts. Conservation of topsoil for replacement following the construction period. Restoration of existing landscape through the implementation tree and shrub planting.	Acceptable with mitigation measures.	Short term, reversible
	Disturbance and loss of housing at Tai Hang would cause the disruption of the existing settlement pattern and the loss of visual cohesion of the settlement edge.	Preservation of the existing character of the remaining village area through the implementation of a landscape buffer zone to visually separate the village from the road corridor. This buffer would involve the use of noise barriers and soft landscape works which would consist of trees and shrub planting in the residual spaces resulting from the necessary demolition of residential property. This planting would not form a continuous screen but would reduce the apparent visual mass of the proposed noise barriers in views from Tai Hang.	Acceptable with mitigation measures.	Short term, reversible.
	Potential loss of footpath	Re-instatement or re-routing of footpath and cycleway where required	Acceptable with mitigation measures.	Short term, reversible.
	Regrading of slopes	Minimisation of slope cutting and formation Retention of topsoil Regrading of slopes to produce more naturalistic contours, where possible Compensatory planting of slopes	Acceptable with mitigation measures.	Short term, reversible.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
Landscape Impacts (*Operational)*	Loss of roadside tree vegetation as landscape buffer	Retention of vegetation, where possible Compensatory tree planting along roadside working in conjunction with the proposed noise barriers to reduce the potential visual intrusion caused by the widening proposals.	Acceptable with mitigation measures.	Medium term, reversible.
Visual Impacts (*Construction)*	Loss of roadside tree vegetation as screen and visual buffer	Retention of vegetation, where possible Compensatory tree planting along roadside working in conjunction with the proposed noise barriers to reduce the potential visual intrusion caused by the widening proposals	Acceptable with mitigation measures.	Medium term, reversible.
	Views of construction works including the temporary works areas situated to the east of Tai Po and south of Kiu Tau.	Construction of hoarding along works boundary at selected visually sensitive locations during construction period. It should be noted however that it may not be feasible to construct hoarding for the entire length of the proposed scheme.	Acceptable with mitigation measures.	Short term, reversible.
	Regrading and formation of new slopes	Regrading of slopes with natural contours Planting of slopes, where possible	Acceptable with mitigation measures.	Short term, reversible.
Visual Impacts *(Operation)*	Additional, and extension of, road structures, e.g. viaducts	Design of new structures to be unobtrusive and recessive, and where structures are being extended match those existing.	Acceptable with mitigation measures.	Short term, reversible.
	Visual screening by noise barriers	Design of noise barriers to be unobtrusive through the use of visually recessive colour and tone, and through the use of transparent materials where appropriate. The proposed use of tree and shrub planting to reduce the apparent visual mass of the proposed structures, ease their visual integration into the existing landscape and reduce their horizontal emphasis.	Acceptable with mitigation measures.	Short term, reversible.

Environmental Aspect	Key impacts (without mitigation measures)	Proposed Mitigation Measures	Residual Impacts (following mitigation)	Time Scale of Impacts
Cultural Heritage ***(Construction)***	Widening works in vicinity west of Lam Kam roundabout.	Monitoring work to be conducted by a qualified archaeologist	N/A	N/A
	Widening works in vicinity of Wun Yiu kiln and Yuen Chau Tsai	Clause will be included in contract document to require works to be carried out as unobtrusively as possible	N/A	N/A