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Appendices

8 WASTE MANAGEMENT

8.1 Legislation and Standards

8.1.1 The following legislations relate to the handling, treatment and disposal of waste in HKSAR, and will be considered in assessing potential impacts and their avoidance or mitigation:

- Waste Disposal (Amendment) Ordinance (Cap 354);
- Dumping at Sea Ordinance (Cap 466);
- Land (Miscellaneous Provisions) Ordinance (Cap 28), and
- Public Health and Municipal Service Ordinance (Cap 132) – Public Cleansing and Prevention of Nuisances By-laws.

8.1.2 Under the Waste Disposal (Amendment) Ordinance, some of the regulations are relevant to this EIA, including:

- Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Cap 354); and
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354).

Waste Disposal (Amendment) Ordinance and the Waste Disposal (Charges for Disposal of Constrcution Waste) Regulation

8.1.3 The Waste Disposal (Amendment) Ordinance (WDO) prohibits unauthorised disposal of wastes. Schedule 5 of the Waste Disposal (Charges for Disposal of Construction Waste) Regulation (Charging Regulation) defines that inert construction waste includes rock, rubble, boulder, earth, soil, sand, concrete, brick, tile, masonry or used bentonite.

8.1.4 Under the WDO and the Charging Regulation, wastes can only be disposed of at designated waste disposal facilities licensed by EPD. For construction work with a value of more than HK$1M, the main contractor is required to establish a billing account at EPD before transporting the construction waste to the designated waste disposal facilities (eg landfill, public fill etc). The vessels for delivering construction waste to public fill reception facility would need prior approval from EPD. Breach of these regulations can lead to a fine and/or imprisonment.

Waste Disposal (Chemical Waste) (General) Regulation

8.1.5 Chemical waste includes any scrap materials, or unwanted substances specified under Schedule 1 of this Regulation, if such a substance or chemical occurs in such a form, quantity or concentration that causes pollution or constitutes a danger to health or risk of pollution to the environment.

8.1.6 A person shall not produce, or cause to be produced, chemical wastes unless he is registered with EPD. Any person who contravenes this requirement commits an offence and is liable to a fine and/or imprisonment. Chemical wastes must be treated, utilising on-site plant licensed by EPD or have a licensed collector to transport the wastes to a licensed facility. For each consignment of wastes, the waste producer, collector and disposer of the wastes must sign all relevant parts of a computerised trip ticket. The system is designed to trace wastes from production to disposal.

8.1.7 This regulation also prescribes the storage facilities to be provided on site including labelling and warning sign. To minimise the risks of pollution and danger to human health or life, the waste producer is required to prepare and make available written emergency procedures for spillage, leakage or accidents arising from storage of chemical wastes. The waste producer must also provide employees with training for such procedures.

Dumping at Sea Ordinance

8.1.8 According to the Dumping at Sea Ordinance, a permit from EPD is required if any waste producer intend to dump materials from vessels to designated marine dumping areas. The Authority will consider a number of factors including sources and nature of materials to be dumped, dumping rates, need for inspection/ testing, water pollution avoidance measures etc before determining whether such a permit would be granted and, where deemed necessary, any conditions to be complied with. Breach of the requirements in the permit would result in a fine and/ or to imprisonment.

Public Cleansing and Prevention of Nuisances Regulation

8.1.9 This regulation provides further control on illegal dumping of litter or waste in street and public places (including water course, stream, channel etc). Offence of this regulation would result in a fine and / or to imprisonment.

Other Relevant Guidelines

8.1.10 The following documents and guidelines also relate to waste management and disposal:

Table 8-1 Other relevant documents and information

Bureau / Department	Documents / Guidelines / Technical Circulars
EPD	• Technical Memorandum on Environmental Impact Assessment Process (TM-EIAO), Annex 7 – Criteria for Evaluating Waste Management Implications and Annex 15 – Guidelines for Assessment of Waste Management Implications • Waste Reduction Framework Plan, 1998 • Code of Practice on the Packaging, labeling and Storage of Chemical Wastes (1992)
Development Bureau	• Works Branch Technical Circular (WBTC) No. 32/92, The Use of Tropical Hard Wood on Construction Site • WBTC No. 2/93, Public Dumps • WBTC No 2/93B, Public Filling Facilities • WBTC No. 16/96, Wet Soil in Public Dumps • WBTC Nos. 4/98 and 4/98A, Use of Public Fill in Reclamation and Earth Filling Project • WBTC Nos. 25/99, 25/99A and 25/99C, Incorporation of Information on Construction and Demolition Material Management in Public Works Sub-committee Papers • WBTC No. 12/2000, Fill Management • WBTC No. 19/2001, Metallic Site Hoardings and Signboards • WBTC No. 06/2002, Enhanced Specification for Site Cleanliness and Tidiness • WBTC No. 12/2002, Specification Facilitating the Use of Recycled Aggregates • Environment, Transport and Works Bureau Technical Circular (ETWBTC) (Works) No. 33/2002, Management of Construction and Demolition Material Including Rock • ETWBTC (Works) No. 34/2002, Management of Dredged / Excavated Sediment • ETWBTC (Works) No. 31/2004, Trip-ticket System for Disposal of Construction and Demolition Material • ETWBTC (Works) No. 19/2005, Environmental Management on Construction Sites
EPD / CEDD	• New Disposal Arrangements for Construction Waste (1992)
PlanD	• Environmental Guidelines for Planning In Hong Kong (1990), Hong Kong Planning Standards and Guidelines

Construction & Demolition Material Management

8.1.11 According to ETWBTC (Works) No. 33/2002, for Designated Projects, a Construction & Demolition Material Management Plan (C&DMMP) has to be submitted together with the Environmetnal Impact Assessment (EIA) Report to the Public Fill Committee (PFC) for approval in case of C&D materials exceed 50,000m³.

8.1.12 ETWBTC (Works) No. 19/2005 sets out the policy and procedures requiring contractors to prepare and implement an environmental management plan to encourage on-site sorting of C&D materials and to reduce C&D waste generation during construction.

Disposal Criteria for Dredged Sediment

8.1.13 ETWBTC (Works) No. 34/2002 stipulates the procedures for seeking approval to dredged sediment and the management framework for marine disposal of such sediment. Applications for approval of dredging proposal and allocation of marine disposal shall be made to the Secretary of Marine Fill Committee (MFC). Marine Dumping Permits as stipulated under the Dumping at Sea Ordinance are required from EPD for the disposal of dredged sediment.

8.2 Construction Phase – Evaluation of Waste Generation

8.2.1 The construction of HKLR and HKBCF will involve a number of activities which will generate wastes. The major construction activities are described in **Section 4** and are summarised below:

HKLR
- Dredging, construction of seawalls, and reclamation to a formation level of about +5.0mPD to provide an approximately 23 ha land platform in which about 19 ha is for the tunnel/at-grade road in HKLR and the remaining 4 ha is provided for HKBCF to construct the connection road between HKBCF and airport;
- Construction of land and marine viaducts with a total length of about 9.4 km;
- Construction of about 1.1 km long tunnel; and
- Construction of roads, footpaths, roadside planters, signage and road markings, road lighting, utility works, landscaping works and all other associated roadworks.

HKBCF
- Dredging, construction of seawalls, and reclamation to a formation level of about +5.0mPD to provide an approximately 130 ha land platform;
- Construction of buildings including Passenger Clearance Buidling and accommodation for and facilities of the frontline departments;
- Construction of highway structures and roads for connection of HKBCF to HZMB, HKLR, TMCLKL and Airport;
- Construction of the Automated People Mover (APM) to serve the transit passengers between HKBCF and the Airport;
- Construction of stormwater drainage system, sewerage system, water supply system;
- Construction of supporting infrastructure including public transport interchange and government supporting facilities, etc; and
- Construction of roads, footpaths, roadside planters, signage and road markings, road lighting, utility works, landscaping works and all

other associated roadworks.

8.2.2 These construction activities would generate a variety of wastes including:

- Dredged marine sediment;
- C&D materials / waste;
- Chemical waste; and
- General refuse.

8.2.3 In addition to the above materials and wastes, the reclamation would also require fill materials. The handling and disposal of these materials and wastes will require proper management in order not to cause environmental impacts and nuisance. The nature and quantity of each of these waste types are discussed below.

Assessment Methodology

8.2.4 The C&DMMP has been prepared as per ETWBTC (Works) No. 33/2002 and is attached in **Appendix 8A** for HKLR and **Appendix 8B** for HKBCF for reference. The quantities and nature of the wastes have been estimated in the C&DMMP and are extracted and presented in this EIA Report for easy reference.

8.2.5 The potential environmental impacts associated with the handling and disposal of waste arising from the construction works will be assessed in accordance with the following:

- Estimation of the types, timing and quantities of the wastes to be generated; and
- Assessment of the potential environmental impact on the capacity of waste collection, transfer and disposal facilities.

8.2.6 Secondary environmental impacts due to the management of waste, including potential air emission and noise impact arising from the temporary surcharging, barging facility etc have been assessed and evaluated in other relevant sections.

Dredged Marine Sediment – HKLR & HKBCF

8.2.7 As discussed in the C&DMMP attached in **Appendix 8A** and **Appendix 8B,** both non-dredged and dredged reclamation methods had been considered in various aspects including environmental, engineering practicability, proven technology etc. It has been concluded that, irrespective of using either non-dredged or dredged reclamation methods, the use of non-dredge method such as Sand Compaction Piles (SCP) in HKLR and HKBCF is subject to the site constrains and programme requirements. Therefore, the dredging for seawall foundation would be inevitable so as to achieve the required stability of seawalls.

8.2.8 The current engineering design in the reclamation of HKLR and HKBCF has minimized the fully dredged areas so as to reduce the sediment dredging as far as practicable. The detailed description of the reclamation layout of HKLR and HKBCF considered in this Chapter of EIA Report is provided in the C&DMMP attached in **Appendix 8A** and **Appendix 8B.** A summary of the reduction in dredging amount (bulk volume with bulking factor of 1.3) between the dredged and proposed reclamation method is given below.

	Dredged Method	**Proposed Reclamation Method**	**Reduction in Dredging Amount**
HKLR (reclamation+ piling)	6.3 Mm^3	6.0 Mm^3	0.3 Mm^3 (ie about 5 % reduction)

	Dredged Method	Proposed Reclamation Method	Reduction in Dredging Amount
HKBCF	45.1 Mm^3	18.7 Mm^3	26.4 Mm^3 (ie about 59 % reduction)

Note: Above figures include dredging to form the pits for Mf sediment and the excavation of sediments in bored pile excavation works.

8.2.9 For the reclamation of HKLR, it is narrow in shape along the east shoreline of Airport Island. Therefore, a large portion of the reclamation area in HKLR is occupied by the dredged seawall trench and tunnel. Dredged method is required at the tunnel area so as to avoid the stability and seepage problems due to deep excavation in the soft materials during open-cut construction of the tunnel after the land is reclaimed. In addition, the dredged method is to be adopted at the seawalls for stability reason. Apart from the above areas, non-dredged method is adopted, but the remaining areas that could adopt the non-drdged method is not much. Therefore, there is not much room to reduce dredging amount when compared to the dredged method for the entire HKLR reclamation as shown in the table in 8.2.8 above.

8.2.10 To summarise, this minimized amount of marine sediment (ie 5.3 Mm^3 in HKLR and 17.8 Mm^3 in HKBCF) has to be dredged due to the following reasons. The generation of the sediment would be mostly within the first and second years of construction.

- Achieve the required stability of seawalls; and
- Avoid the stability and seepage problems due to deep excavation in the soft materials during construction of the underground structures (such as the tunnel and underground APM station) after the land is reclaimed.

8.2.11 A preliminary marine ground investigation with sediment sampling and laboratory testing has been undertaken in accordance with the requirements in ETWBTC (Works) No. 34/2002.

8.2.12 According to the ETWBTC (Works) No. 34/3002, the marine sediment to be dredged is classified as Category L (i.e. require Type 1 - Open Sea Disposal), Category Mp (i.e. require Type 1 - Open Sea Disposal (Dedicated Sites)), Category Mf (i.e. require Type 2 - Confined Marine Disposal), Category Hp (i.e. require Type 2 - Confined Marine Disposal) and Category Hf (i.e. require Type 3 - Special Treatment /Disposal).

8.2.13 Chemical and biological tests had been conducted as per the technical requirements in ETWBTC (Works) No. 34/2002. The measurement and assessment methodology are detailed in **Section 7**. The following table summarises the estimated quantity of each category of sediment to be dredged:

Table 8-2 Summary of Sediment to be Disposed

Disposal Method [1]	Category [1]	Quantity to be disposed (bulk volume), Mm^3
HKLR		
Type 1 – Open Sea Disposal	L [2]	5.44 Mm^3 [5]
Type 1 – Open Sea Disposal (Dedicated Site)	Mp [3]	0.18 Mm^3 [5]
Type 2 – Confined Marine Disposal	Mf [4]	0.33 Mm^3 [6]
Type 2 – Confined Marine Disposal	Hp	--
Type 3 – Special Treatment/Disposal	Hf	--
Total		5.95 Mm^3
HKBCF		
Type 1 – Open Sea Disposal	L [2]	13.69 Mm^3 [5]
Type 1 – Open Sea Disposal (Dedicated Site)	Mp [3]	4.68 Mm^3 [5]
Type 2 – Confined Marine Disposal	Mf [4]	0.35 Mm^3 [6]

Disposal Method [1]	Category [1]	Quantity to be disposed (bulk volume), Mm^3
Type 2 – Confined Marine Disposal	Hp	--
Type 3 – Special Treatment/Disposal	Hf	--
Total		18.72 Mm^3

Notes: [1] as per ETWBTC (Works) No. 34/2002
[2] < Lower Chemical Exceedance Level
[3] > Lower & =< Upper Chemical Exceedance Level, biological test passed.
[4] > Lower & =< Upper Chemical Exceedance Level, biological test failed.
[5] For Category L and Mp sediments, cross-boundary disposal to mainland is proposed.
[6] For the Category Mf sediment, it is proposed to redeposit the dredged Mf sediment within the corresponding reclamation site (i.e. Mf from HKLR to be redeposited within HKLR reclamation site and Mf from HKBCF to be redeposited within HKBCF reclamation site). Details and the assessment of water quality impacts are provided in Section 9.10.4.

8.2.14 The dredging operations, and the handling and disposal of contaminated sediments may cause impacts to the marine environment and its ecology if proper management measures are not implemented. The dispersion of suspended solids and the release of contaminants from the contaminated sediment into the water column can lead to significant consequences, including effects to marine organisms and the food chain. Assessment of potential impacts relating to sediment and water quality has been documented in **Section 9**. With proper preventive and mitigation measures in place for handling, transport and disposal as per the requirements given in the ETWBTC (Works) No. 34/2002, no insurmountable environmental impacts would be anticipated.

C&D Materials Generated – HKLR

8.2.15 The following **Table 8-3a** gives the estimated quantity of C&D materials to be generated in accordance with the C&D Material Management Plan for HKLR (see **Appendix 8A**).

Table 8-3a Estimated Quantities of C&D Materials Generated in HKLR

Material	Weight (million tonnes)	Sources
Inert C&D soft materials	1.00	• Excavation for tunnels. • Bored pile excavation of viaducts (land portion).
	0.90	• Materials generated from removal of surplus surcharge materials from the reclamation at last stage.
Grade III rock (low quality rock)	0.10	• Excavation for tunnels. • Bored pile excavation of viaducts.
Grade I & II rock (good quality rock)	0.40	• Excavation for tunnels. • Bored pile excavation of viaducts.
C&D Waste	0.019	• Formwork after used. • Excavated top soil.
Total:	2.42	

Notes:
1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The above quantities are estimated from ground investigation information currently available. These quantities will be reviewed when the foundation design of infrastructure works and the further ground investigation information are available in the detailed design stage.*

8.2.16 The estimated quantity of C&D materials (soft and rock material, not including surplus surcharge) generated in HKLR is about 1.5 million tonnes (bulk volume 0.81 Mm^3). It is anticipated that a large portion of the C&D materials from the infrastructure works (such as the tunnel excavation works within the reclamation) would be generated after the reclamation of HKLR. For those excavated C&D materials (about 0.78 million tonnes out of the total of 1.5 million tonnes)

generated after Early 2013 when the reclamation is completed, it could not be reused as the reclamation fill in HKLR and therefore they would need to be disposed off site. These surplus C&D materials would be delivered to HKBCF and reused as the fill material in HKBCF reclamation in which filling work is scheduled to be carried out up to 2014 according to the tentative programme. The above arrangement will be reviewed when the detailed construction programme of HKLR and HKBCF is available.

8.2.17 The reclamation surcharge material is the imported public fill and it would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. However, the last stage surcharge material would need to be disposed off site. The estimated quantity of last stage surcharge material to be disposed is about 0.9 million tonnes (bulk volume 0.5 Mm^3).

8.2.18 Measures to minimise generation of C&D materials in HKLR including:

- Use the non-dredged reclamation method as far as practicable – Apart from the seawall trench and tunnel area in which full-dredging is required, the non-dredge method with band drains and surcharge is adopted in other reclamation areas as far as practicable.
- Adoption of viaduct instead of tunnel – It is proposed to adopt tunnel only from Scenic Hill to the SE side of Airport Island in order to minimize the environmental and visual impacts to Tung Chung. The use of viaduct instead of tunnel at other portions of HKLR would reduce the generation of C&D materials.
- Adoption of steel forwork for standard sections of RC structures – steel formwork would be used for the RC structural works as far as practicable to minimize the use of timber formwork and generation of C&D waste.

C&D Materials Generated – HKBCF

8.2.19 The following **Table 8-3b** gives the estimated quantity of C&D materials to be generated in accordance with the C&D Material Management Plan for HKBCF (see **Appendix 8B**).

Table 8-3b Estimated Quantities of C&D Materials Generated in HKBCF

Material	Weight (million tonnes)	Soruces
Inert C&D soft materials	2.55	• Bored pile excavation for viaducts, footbridges and other structures. • Excavation for the shallow foundation of the buildings. • Excavation for land portion of APM tunnel and the underground station in HKBCF.
	4.50	• Materials generated from removal of surplus surcharge materials from the reclamation at last stage.
Others C&D (reusable bituminous material)	0.018	• Excavation of existing bituminuous carriageways in Airport Island.
Grade III or below rock	0.36	• Bored pile excavation (i.e. rock socket) for the viaducts, footbridges and other structures.
C&D Waste	0.012	• Timber formwork after used. • Muddy material (i.e. marine sediment) from bored pile escavation.
Total:	7.44	

Notes:
1. The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3

respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.

2. *The above quantities are estimated from ground investigation information currently available. These quantities will be reviewed when the foundation design of infrastructure works and the further ground investigation information are available in the detailed design stage.*

8.2.20 The estimated quantity of C&D materials (soft and rock material, not including surplus surcharge) generated in HKBCF is about 2.93 million tonnes (bulk volume 1.61 Mm^3). It is anticipated that most of the C&D materials generated from the works in HKBCF Phase 1 would be utilized as fill materials for subsequent reclamation works in HKBCF Phase 2, and thus minimizing disposal of C&D materials off site. However, the C&D materials generated from the works in HKBCF Phase 2 (about 0.71 million tonnes out of the total of 2.93 million tonnes) would need to be disposed off site as these land works are to be carried out after the reclamation.

8.2.21 The reclamation surcharge material is the imported public fill and it would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. However, the last stage surcharge materials would need to be disposed off site. The estimated volume of last stage surcharge materials to be disposed is about 4.5 million tonnes (bulk volume 2.5 Mm^3).

8.2.22 The excavated bituminuous material of carriageway (an inert construction material) could be transported to the asphalt production plant/recycling facilitate for the production of reclaimed asphalt pavement material which could be mixed with virgin aggregates and bitumen for new asphalt materials for use in the pavement construction in HKBCF or other roadwork projects.

8.2.23 Measures to minimise generation of C&D materials in HKBCF including:

- Minimize the reclamation area – The BCF layout has been considered in the Value Management Workshop as well as the Option Assessment Report with a view to minimize the reclamation area necessary to support the infrastructure required for the operation of BCF.
- Use the non-dredged reclamation method as far as practicable – The recommended reclamation method is Sequence B given in **Section 4** which maximize the use of non-dredged reclamation method with band drains and surcharge as far as practicable.
- Adoption of steel formwork for standard sections of RC structures – The reduction in using steel formwork for the RC structural works would minimize the generation of C&D waste.

On-site sorting of C&D material & Temporary Stockpiles – HKLR & HKBCF

8.2.24 All C&D materials arising from the construction will be sorted on-site to recover the inert C&D materials and reusable and recyclable materials prior to disposal off-site. All inert C&D materials will be broken down by handheld breakers according to the Dumping Licence conditions before disposal to public filling outlets.

8.2.25 Any surplus C&D materials will become the property of the Contractor once they are removed from the site. The Contractor will be responsible for devising a system to work for on-site sorting of C&D materials and promptly remove all sorted and processed material arising from the construction activities to optimise temporary stockpiling on-site. It is recommended that the system should include the identification of the source of generation, estimated quantity, arrangement for on-site sorting and / or collection, temporary storage areas, and frequency of collection by recycling Contractors or frequency of removal off-site.

8.2.26 It has been assumed that inert C&D materials (e.g. soil, building debris, concrete) will be sorted out from C&D materials at source to avoid double handling.

C&D Waste – HKLR & HKBCF

8.2.27 About 18,800 tonnes or 10,000 m^3 (bulk volume) of C&D waste will be generated in HKLR throughout the construction works of general site clearance works (i.e. excavation of top soil) and the used formwork for construction of various structures. The content of the waste include vegetation/ organic waste, timber, metal, packaging waste etc. About 14,800 tonnes or 8,000 m^3 (bulk volume) of C&D waste is the excavated top soil generated during construction of the tunnel portal. It is proposed to stockpile the excavated top soil and reuse it as the planting soil at the proposed roadside planters and landscaping areas within the site. For the remaining 4,000 tonnes or 2,000 m^3 (bulk volume) of C&D waste, it has to be disposed of at landfills after on-site sorting/separation of recyclable waste.

8.2.28 About 12,000 tonnes or 6,700 m^3 (bulk volume) of C&D waste will be generated in HKBCF throughout the construction works and the used formwork for construction of various structures. For the bored pile foundation of viaducts, footbridges and other structures located within the non-dredged areas of HKBCF reclamation, it is estimated that an average thickness of 20m soil excavated from the bored piles of these structures would be muddy in nature as the marine deposit at these areas had not been dredged. The total insitu volume of muddy soil spoil generated would be around 0.2 million m^3. Based on the current GI information, this muddy material (i.e. marine sediment) is classified as Category L and Mp sediment. As the excavated muddy material could not be reused as fill material and therefore they would be disposed together with the dredged Category L and Mp sediment from the reclamation works of HKBCF. However, if Category Mf or H sediment is found at the areas of above bored pile foundation in the detailed GI works to be carried, a review will be carried out to see if the Mf or H material excavated from bored piles needs to be disposed to the landfill

8.2.29 The majority of the C&D waste in HKBCF is the muddy soil excavated from the bored piles of viaducts, footbridges and other structures located at the non-dredged reclamation areas. The content of waste includes organic waste and other artificial materials such as timber, metal, packaging waste etc. The C&D waste has to be disposed of at landfills after on-site sorting/separation of recyclable waste.

Summary of Materials to be Reused or Disposed – HKLR & HKBCF

8.2.30 The following **Tables 8-4a and 8-4b** summarise the C&D materials, C&D wastes and marine sediment in HKLR and HKBCF to be reused or disposed of, together with the breakdown for various disposal destinations.

Table 8-4a Summary of C&D Materials, Wastes & Marine Sediment in HKLR

Material	Estimated Quantities [1]				
	Generated	Reused on Site	Rused in other projects[3]	Disposed of at Landfill	Other [4]
Inert C&D Soft Material	1.00 (0.55)	0.4 (0.22)	0.60 (0.33)	-	-
Surplus surcharge	0.90 [2] (0.50)	-	0.90 (0.50)	-	-
Grade III rock (Low quality rock)	0.10 (0.05)	0.06 (0.03)	0.04 (0.02)	-	-
Grade I or II rock (Good quality rock)	0.40 (0.20)	0.26 (0.13)	0.14 (0.07)	-	-
C&D Waste	0.019 (0.010)	0.015 (0.008)	-	0.004 (0.002)	-

Material	Estimated Quantities [1]				
	Generated	Reused on Site	Rused in other projects[3]	Disposed of at Landfill	Other [4]
Category L sediment	6.28 (5.44)	-	-	-	6.28 (5.44)
Category Mp sediment	0.21 (0.18)	-	-	-	0.21 (0.18)
Category Mf sediment	0.38 (0.33)	-	-	-	0.38 (0.33)

Notes:

1. *The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively*
2. *All the surcharge materials is the imported public fill and it is included in the imported public fill (soft materials) in Table 8-5a below. The last stage of surcharge is about 0.9 million tonnes and this figure represents the surplus surcharge material to be disposed off site.*
3. *Arrangement will be made to reuse the surplus C&D materials in HKBCF reclamation as far as practicable. This will be reviewed when the detailed construction programme of HKLR and HKBCF is available.*
4. *For the Category L and Mp sediments, cross-boundary disposal to Mainland is proposed. For the Category Mf sediment, it is proposed to redeposit the dredged Mf sediment within the corresponding reclamation site (i.e. Mf from HKLR to be redeposited within HKLR reclamation site and Mf from HKBCF to be redeposited within HKBCF reclamation site). Details and the assessment of water quality impacts are provided in Section 9.10.4.*

Table 8-4b Summary of C&D Materials, Wastes & Marine Sediment in HKBCF

Material	Estimated Quantities [1]					
	Generated	Reused on Site	Reused in Other Projects[4]	Disposed of at Public Fill Reception Facilities	Disposed of at Landfill	Other[5]
Inert C&D Soft Material	2.55 (1.42)	1.85 (1.03)	0.70 (0.39)	-	-	-
Surplus surcharge	4.50 [2] (2.50)	-	0.45 [5] (0.25)	4.05 (2.25)	-	-
Grade III or below rock	0.36 (0.18)	0.35 (0.17)	-	0.01 (0.01)	-	-
Others C&D (Reusable Bituminous Material)	0.018 (0.01)	0.018 [3] (0.01)	-	-	-	-
C&D Waste	0.012 (0.0067)	-	-	-	0.012 (0.0067)	-
Category L sediment	15.80 (13.69)	-	-	-	-	15.80 (13.69)
Category Mp sediment	5.40 (4.68)	-	-	-	-	5.40 (4.68)
Category Mf sediment	0.41 (0.35)	-	-	-	-	0.41 (0.35)

Notes:

1. *The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *All the surcharge materials is the imported public fill and it is included in the imported public fill (soft materials) in Table 8-5b below. The last stage of surcharge is about 4.5 million tonnes and this figure represents the surplus surcharge material to be disposed off site (i.e. to be reused in other projects or disposed of at Public Fill Reception Facilities).*
3. *The bituminous material will be reused for pavement construction n HKBCF or other roadwork projects.*

4. *The disposal of surplus C&D material to other projects is subject to further discussions with the project office of these projects. Details of the liaison with the project office of these projects are given in Appendix 8B.*
5. *For the Category L and Mp sediments, cross-boundary disposal to Mainland is proposed. For the Category Mf sediment, it is proposed to redeposit the dredged Mf sediment within the corresponding reclamation site (i.e. Mf from HKLR to be redeposited within HKLR reclamation site and Mf from HKBCF to be redeposited within HKBCF reclamation site). Details and the assessment of water quality impacts are provided in Section 9.10.4.*

Imported Fill Material – HKLR & HKBCF

8.2.31 The estimated quantity of imported fill/ rock materials in the reclamation of HKLR is about 10.98 million tonnes or 6.04 Mm^3 (bulk volume). The tentative programme for importing fill/ rock materials is detailed in **Table 8-5a** below.

Table 8-5a Tentative Programme for Importing Fill/ Rock Materials in HKLR

Material Type	Weight (million tonnes)							
	2010	2011	2012	2013	2014	2015	2016	Total
Soil (sandfill)		2.15	4.00	0.95				7.10
Rock (exclude armour)		0.40	0.28					0.68
Others (armour)		0.10	0.20	0.20				0.50
Others (public fill, soft materials) including surchage			2.50	0.20				2.70
Total		2.65	6.98	1.35				10.98

8.2.32 The estimated quantity of imported fill/ rock materials in the reclamation of HKBCF is about 69.17 million tonnes or 37.97 Mm^3 (bulk volume). The tentative programme for importing fill/ rock materials is detailed in **Table 8-5b** below.

Table 8-5b Tentative Programme for Importing Fill/ Rock Materials in HKBCF

Material Type	Weight (million tonnes)							
	2010	2011	2012	2013	2014	2015	2016	Total
Soil (sandfill)	2.47	22.50	16.60	1.85				43.42
Others (armour)			0.90	0.60				1.50
Others (public fill – soft materials) including surcharge		0.45	12.05	4.30	0.65			17.45
Others (public fill –rock materials)		5.05	1.75					6.80
Total	2.47	28.00	31.30	6.75	0.65			69.17

8.2.33 For the public fill (soft materials) to be used in the reclamation of this project, it should (besides meeting the general requirements for public fill) also comply with the requirements for General Filling material as stipulated in the General Specification for Civil Engineering Works.

8.2.34 For the public fill (rock materials) to be used in seawalls, it should (besides meeting the general requirements for public fill) also comply with the requirements of Grade 400 Rock Fill materials as stipulated in the General Specificiation for Civil Engineering Works for the filling in seawall trench and seawall core.

8.2.35 Sandfill is assumed from various sources such as Mainland China. Public fill is assumed from the Fill Bank and other projects which generate substantial C&D materials. According to the latest information from MTRCL on their new railway projects, about 6.8 million tonnes public fill (rock materials) would be available from Early 2011 to Mid 2012 and it is planned that these materials would be reused in the construction of seawalls in HKBCF project. Therefore the rock fill material required in HKLR needs to be imported from other sources. Liaison is being made with the project office of other projects such as Development at Anderson Road and Harbour Area Treatment Scheme Stage 2A to see if surplus rock material could be available from these projects and priority will be given to use these materials in HKLR.

8.2.36 For the public fill (soft materials), about 22 million tonnes would be available from MTRCL's projects between 2011 and 2016. In addition, there is about 0.57 million tonnes of surcharge material stockpiled at Tung Chung Phase IIIA and more than 10 million tonnes public fill available from the Fill Bank for the reclamation works of HKLR and HKBCF. Arrangement will also be made to reuse the surplus C&D materials from HKLR and TMCLKL as filling materials in HKBCF as far as practicable. Therefore, there should be sufficient supply of public fill (soft materials) from the above sources. Liaison with relevant parties such as CEDD and MTRCL is in progress to confirm the detailed arrangement of supplying the public fill materials to HKLR and HKBCF.

8.2.37 According to the latest information received, the tentative programme showing the C&D materials available from other projects (e.g. MTRCL's railway projects) and the demand of public fill in HKLR and HKBCF is given in **Appendix 8C**.

Chemical Waste

8.2.38 Chemical wastes likely to be generated from the construction activities and associated facilities will include:

- Scrap batteries or spent acid/alkali from their maintenance;
- Used paint, engine oils, hydraulic fluids and waste fuel;
- Spent mineral oils/cleansing fluids from mechanical machinery; and
- Spent solvents/solutions, some of which may be halogenated, from equipment cleansing activities.

8.2.39 Chemical waste may pose serious environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the Waste Disposal (Chemical Waste) (General) Regulation and the Code of Practice on the Packing, Labelling and Storage of Chemical Waste. These hazards may include:

- Toxic effects to workers;
- Adverse effects on air quality, water quality and land contamination from spills;
- Disruption of sewerage treatment works if chemical waste enter into the sewerage system; and
- Fire hazards.

8.2.40 It is difficult to quantify the amount of chemical waste as it will be highly dependent on the Contractor's on-site maintenance practice and the quantities of plant and vehicles utilized. However, it is anticipated that the quantity of chemical waste, such as lubricating oil and solvent produced from plant maintenance will be small and in the order of few hundred litres per month.

8.2.41 Chemical waste, irrespective of the likely small amount, would pose serious environmental, health and safety hazards if not properly managed. Such hazards would include:

- Toxic effects to workers;
- Adverse effects on water quality from spills;
- Fire hazards;
- Disruption of sewage treatment works should the chemical waste enter the sewerage system.

8.2.42 The amount of chemical waste arising from the construction activities would depend on the contractor's on-site maintenance practices and the amount of plant and number of vehicles deployed. Relatively small quantity of chemical waste, such as lubricating oil and solvent, produced from plant maintenance would be anticipated, which would be collected by licensed collectors for subsequent disposal at licensed waste disposal facilities, such as the Chemical Waste Treatment Centre in Tsing Yi. With the implementation of proper preventive and mitigation measures for handling, transport and disposal, no insurmountable environmental impacts would be anticipated.

Sewage

8.2.43 Sewage will arise from amenity facilities used by the construction workforce and site office's sanitary facilities. Night soil from chemical toilets will also be generated. The sludge needs to be properly managed to minimise odour and potential health risks to the workforce by attracting pests and other disease vectors.

8.2.44 The number of construction workers to be employed on site is not available at this stage, but is anticipated to be about 600 staff in HKLR and 700 staff in HKBCF in the peak period. As the workers will be scattered within the construction site, the most cost-effective solution will be to provide adequate number of portable toilets within the site to ensure that sewage from site staff is properly collected. Depending on site conditions, land availability and site activities, the locations and number of portable toilets will be determined in the Environmental Management Plan (EMP) to be submitted by the Contractor. No adverse waste impact is envisaged provided that maintenance by licensed contractors is conducted regularly.

General Refuse

8.2.45 The presence of a construction site with workers and site office will result in the generation of a variety of general refuse requiring disposal. General refuse will mainly consist of food waste, aluminium cans and waste paper.

8.2.46 The storage of general refuse has the potential to give rise to adverse environmental impacts. These include odour if the waste is not collected frequently (for example, daily), windblown litter, water quality impacts if waste enters waster bodies, and visual impact. The sites may also attract pests, vermin, and other disease vectors if the waste storage areas are not well maintained and cleared regularly. In addition, disposal of wastes at sites other than approved landfills, can also lead to similar adverse impacts at those sites.

8.2.47 The number of work force (clerical and workers) to be employed for the project is not available at this stage, but is anticipated to be about 600 staff in HKLR and 700 staff in HKBCF in the peak period. On this basis, the total refuse generated per day would be about 850kg/day, assuming the refuse generated rate is 0.65kg/head/day. Provided that the mitigation measures are adopted, the potential environmental impacts caused by the storage, handling, transport and disposal of general refuse is expected to be minimal. It is recommended that

general refuse should be collected on a daily basis for disposal. Given the small quantity of general refuse, adverse impacts to the operation of the landfills are not expected.

8.3 Construction Phase – Recommended Mitigation Measures

8.3.1 The requirements as recommended in ETWBTC (Works) No. 19/2005 Environmental Management on Construction Sites and its latest version, and other relevant guidelines, should be included in the Particular Specification for the Contractor as appropriate.

8.3.2 Each tenderer should be requested to submit an outline WMP for tender assessment. Prior to the commencement of construction work, the Contractor should prepare a WMP to provide an overall framework for waste management and reduction. It should contain the following key elements:

- Waste management policy;
- Record of generated waste;
- Waste reduction target;
- Waste reduction programme;
- Role and responsibility of waste management team;
- Benefit of waste management;
- Analysis of waste materials;
- Reuse, recycling and disposal plans;
- Transportation process of waste products; and
- Monitoring and action plan.

8.3.3 Waste management options with less environmental impacts are preferred. The waste management hierarchy should be as follows:

- Avoidance and minimization;
- Reuse of materials;
- Recovery and recycling; and
- Treatment and disposal.

8.3.4 This hierarchy should be used to evaluate the waste management options to allow maximum waste reduction and often reducing costs. For example, by reducing or eliminating over-ordering of construction materials, waste is avoided and costs are reduced both in terms of purchasing raw materials and disposing of wastes. Records of quantities of wastes generated, recycled and disposal (locations) should be properly kept.

8.3.5 A trip-ticket system should be established in accordance with ETWBTC (Works) No. 31/2004 and Waste Disposal (Charges for Disposal of Construction Waste) Regulation to monitor the disposal of public fill and solid wastes at public filling facilities and landfills, and to control fly-tipping. A trip-ticket system will be included as one of the contractual requirements and implemented by the Contractor. The Engineer shall audit the result of the system.

8.3.6 A recording system for the amount of waste generated, recycled and disposed of (including the disposal sites) should be established during the construction phase. The Contractor should provide training to workers on the concepts of site cleanliness and on appropriate waste management procedures, including waste reduction, reuse and recycling at the beginning of the Contract.

8.3.7 The recommended mitigation measures for other waste types are described as follows.

C&D Materials

8.3.8 The Project Proponent shall notify CEDD of the estimated spoil volumes to be generated, and liaise and agree with the Public Fill Committee for the disposal of any surplus inert C&D materials including good quality rock during detailed design of the project. Wherever practicable, C&D materials should be segregated from other wastes to avoid contamination and ensure acceptability at public filling areas or reclamation sites. The surplus C&D material, mainly surcharge material resulting from reclamation works, would be reused within the site as much as possible. The following mitigation measures should be implemented in handling the waste:

- Maintain temporary stockpiles and reuse excavated fill material for backfilling and reinstatement;
- Carry out on-site sorting;
- Make provisions in the Contract documents to allow and promote the use of recycled aggregates where appropriate;
- Adopt 'Selective Demolition' technique to demolish the existing structures and facilities with a view to recovering broken concrete effectively for recycling purpose, where possible;
- Implement a trip-ticket system for each works contract to ensure that the disposal of C&D materials are properly documented and verified; and
- Implement an enhanced Waste Management Plan similar to ETWBTC (Works) No. 19/2005 – "Environmental Management on Construction Sites" to encourage on-site sorting of C&D materials and to minimize their generation during the course of construction.
- In addition, disposal of the C&D materials onto any sensitive locations such as agricultural lands, etc. should be avoided. The Contractor shall propose the final disposal sites to the Project Proponent and get its approval before implementation.

C&D Waste

8.3.9 Standard formwork or pre-fabrication should be used as far as practicable in order to minimise the arising of C&D materials. The use of more durable formwork or plastic facing for the construction works should be considered. Use of wooden hoardings should not be used, as in other projects. Metal hoarding should be used to enhance the possibility of recycling. The purchasing of construction materials will be carefully planned in order to avoid over ordering and wastage.

8.3.10 The Contractor should recycle as much of the C&D materials as possible on-site. Public fill and C&D waste should be segregated and stored in different containers or skips to enhance reuse or recycling of materials and their proper disposal. Where practicable, concrete and masonry can be crushed and used as fill. Steel reinforcement bar can be used by scrap steel mills. Different areas of the sites should be considered for such segregation and storage.

8.3.11 HKSAR has developed and implemented a charging policy for the disposal of waste to landfill. It will provide additional incentive to reduce the volume of waste generated and to ensure proper segregation to allow disposal of inert material to public filling areas.

Chemical Waste

8.3.12 Chemical waste producers should be registered with EPD. For those processes which generate chemical waste, the Contractor shall identify any alternatives that generate reduced quantities or even no chemical waste, or less dangerous types of chemical waste.

8.3.13 Chemical waste should be handled in accordance with the Code of Practice on the Packaging, Handling and Storage of Chemical Wastes as follows. Containers used for storage of chemical wastes should:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in a good condition, and securely closed;
- Have a capacity of less than 450 L unless the specification have been approved by EPD; and
- Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

8.3.14 The storage area for chemical wastes should:

- Be clearly labelled and used solely for the storage of chemical wastes;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding, of capacity to accommodate 110% of the volume of the largest container or 20% by volume of the chemical waste stored in the area, whichever is greatest;
- Have adequate ventilation;
- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposed as chemical waste, if necessary); and
- Be arranged so that incompatible materials are adequately separated.

8.3.15 Disposal of chemical waste should:

- Be via a licensed waste collector; and
- Be to a facility licensed to receive chemical waste, such as the CWTC which also offers a chemical waste collection service and can supply the necessary storage containers; or
- Be to a re-user of the waste, under approval from EPD.

Sewage

8.3.16 Adequate numbers of portable toilets should be provided for the workers. The portable toilets should be maintained in a reasonable state, which will not deter the workers from utilizing these portable toilets. Night soil should be collected by licensed collectors regularly.

General Refuse

8.3.17 General refuse generated on-site should be stored in enclosed bins or compaction units separately from construction and chemical wastes. A reputable waste collector should be employed by the Contractor to remove general refuse from the site, separately from construction and chemical wastes, on a daily basis to minimize odour, pest and litter impacts. Burning of refuse on construction sites is prohibited by law.

8.3.18 Aluminium cans are often recovered from the waste stream by individual collectors if they are segregated and made easily accessible. Separate labelled bins for their deposit should be provided if feasible.

8.3.19 Office wastes can be reduced through the recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme should be considered by the Contractor. In addition, waste separation facilities for paper, aluminium cans, plastic bottles etc., should be provided.

8.4 Operational Phase

Types of Wastes

8.4.1 During the operational phase, the station and the associated facilities will generate the following wastes. However, given the variation in the nature of the business, it is not possible to quantify the amount of waste that would be generated by the logistic operators. It is also assumed that each operator would need to consider waste separation within their premises they consider appropriate.

- General refuse.
- Industrial waste.
- Chemical waste.

General Refuse Waste

8.4.2 General refuse will arise from the future operators of the HKLR and HKBCF. It is anticipated there would not be any insurmountable impacts during the operational phase.

Chemical Waste

8.4.3 The requirements given in the Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes should be followed in handling of these chemical wastes. A trip-ticket system should be operated in accordance with the Waste Disposal (Chemical Waste) (General) Regulation to monitor all movements of chemical wastes which will be collected by a licensed collector to a licensed facility for final treatment and disposal.

8.5 Residual Environmental Impacts

8.5.1 With the implementation of recommended mitigation measures, residual impacts are not anticipated for both the construction and operational phases.

8.6 Conclusion

Construction Phase

8.6.1 The quantity and timing for the generation of waste during the construction phase have been estimated. Measures including the opportunity for on-site sorting, reusing excavated materials for reclamation etc, are devised in the construction methodology to minimise the surplus materials to be disposed off-site. The annual disposal quantities for C&D materials and their disposal methods have also been assessed.

8.6.2 Measures have also been recommended for the Contractor to implement during the construction period to minimise the waste generation and any off-site disposal.

Operational Phase

8.6.3 The types and quantities of waste that would be generated during the operational phase have been assessed. Recommendations have been made to ensure proper treatment and proper disposal of these wastes.

APPENDIX 8A

HKLR – Construction & Demolition Materials Management Plan

Highways Department of HKSAR

Agreement No. CE 26/2003 (HY)
Hong Kong Section of Hong Kong-Zhuhai-Macao Bridge and Connection with North Lantau Highway – Investigation
(now renamed as HZMB Hong Kong Link Road)

Construction and Demolition Material Management Plan

Rpt Ref. 121-03

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1 PURPOSE

1.1 In accordance with ETWB Technical Circular No. 33/2002, a Construction & Demolition Materials Management Plan (C&DMMP) should be prepared and submitted to Public Fill Committee (PFC) for approval for projects classified as designated projects under Schedule 2 of the EIAO, which generate more than 50,000m³ of construction and demolition (C&D) materials including rock or that requiring import fill in excess of 50,000m³. Hong Kong Link Road is a designated project under the EIAO. In addition, it requires a total fill volume of more than 10 million m³ (bulk volume). Therefore, approval of C&DMMP by PFC is required.

1.2 The purpose of this C&DMMP is to introduce measures to minimize C&D materials generation and to maximize reusing the C&D materials generated within the project. The C&D materials are surplus materials arising from any land excavation or formation, civil/building construction, roadwork, building renovation or demolition activities. They comprise the materials of rocks, concrete, asphalt, rubbles, bricks, stones, timber and earth. As the marine deposit does not belong to the above materials, the proposed arrangement to deal with dredged marine deposit in this project will be submitted and agreed separately with the Marine Fill Committee. Therefore, the details of the dredge marine deposit are not covered in this C&DMMP.

2 BACKGROUND OF THE DEVELOPMENT

2.1 In the 8th Hong Kong-Zhuhai-Macao Bridge (HZMB) Advance Work Co-ordination Group meeting on 28 February 2008, the government of HKSAR (HKSARG), Guangdong Province and Macao Special Administrative Region agreed to build their own boundary crossing facilities and link roads within their respective territories. As a result, HKSARG will need to provide a link road within Hong Kong territory connecting the HZMB Main Bridge and the Hong Kong Boundary Crossing Facilities (HKBCF). The link road within Hong Kong (hereafter referred to as the Hong Kong Link Road (HKLR)) will replace the former HZMB Hong Kong Section and North Lantau Highway Connection.

2.2 The Investigation Study of this Project commenced in March 2004 which formulated and assessed the alignment options for the following:

(i) The section of HZMB from HKSAR Boundary to its landing point at northwest Lantau, referred to as HZMB Hong Kong Section.

(ii) The proposed highway connecting (i) with the North Lantau Highway, referred to as North Lantau Highway Connection.

The Investigation Study, however, has been inactive since early 2006 due to the need to align with the developments on the implementation of HZMB including the HKBCF arrangement

2.3 In view of the latest development of HZMB and the new impetus to move the entire HZMB project ahead expeditiously, the Investigation Study was reactivated on 15 August 2008. As the major task of this investigation Study after reactivation, the alignment option has been reviewed and modified in accordance with the latest development of HZMB. The Investigation Study is on-going to work out the details to such an extent to enable the Project to proceed to detailed design and construction stages.

3 SCOPE OF THE PROJECT

3.1 The proposed HKLR is a dual 3-lane carriageway connecting HZMB Main Bridge at the HKSAR boundary to the HKBCF proposed to be located at the north-east waters of the Airport. The total length of HKLR is about 12 km.

3.2 The HKLR alignment will take the form of sea viaduct from HKSAR boundary to the landing point at San Shek Wan headland and then up to Scenic Hill after skirting along the southern seawall of Airport Island near the Airport Channel. For the portion of HKLR from Scenic Hill to HKBCF, a combination of tunnel and at-grade road has been developed after consolidating the residents' views through the public engagement exercises conducted since September 2008.

3.3 The recommended alignment of HKLR is shown in **Figure 3.1**. The scope of HKLR project comprises, but not limited to the following:

(a) construction of a dual 3-lane carriageway in the forms of viaduct, tunnel and at-grade road between the HZMB Main Bridge at the HKSAR boundary and HKBCF. Each carriageway will consist of three traffic lanes together with a hard shoulder;

(b) reclamation to provide land of about 23 ha in which about 19 ha is for the tunnel/at-grade road in HKLR and the remaining 4 ha is provided for HKBCF to construct the connection road between HKBCF and airport;

(c) provision of ventilation and administration buildings and other tunnel portal facilities, traffic control and surveillance systems, power supply, street lighting, fire fighting system, street furniture, traffic aids (including sign gantries), ship impact protection system, drainage and other facilities associated with the carriageway; and

(d) associated civil, structural, building, electrical and mechanical, geotechnical, marine, environmental protection, landscaping works, drainage mitigation measures and meteorological equipment relocation/enhancement measures including the reprovisioning of a weather station, addition of wind sensors and upgrading of a wind profiler station.

4 IMPLEMENTATION PROGRAMME

4.1 Currently, it is targeted to commence the construction works of HKLR in Early 2011. The completion date of HKLR will need to match the HZMB Main Bridge. The HZMB Main Bridge is now endeavoured to commence the construction works in 2009 and is expected to be completed by 2015. In order to tie in with the HZMB Main Bridge, HKLR needs to be completed in 2015 for the commissioning of HZMB. The tentative implementation programme of HKLR is shown in **Appendix A**.

4.2 Tentatively, it is proposed that the Project will be implemented under 3 contract packages:

- Package 1 – Portion of HKLR from HKSAR boundary to San Shek Wan headland (i.e. the open-sea marine viaduct portion) exclude the TCSS works.
- Package 2 – Portion of HKLR from San Shek Wan headland to Scenic Hill (i.e. the viaduct structures along/across the Airport Channel plus a small portion on land overpassing J/O Scenic Road/ Chek Lap Kok South Road) exclude the TCSS works.
- Package 3 – Portion of HKLR from Scenic Hill to HKBCF (i.e. partly in the form of tunnel and partly in the form of at-grade road) and the TCSS works for the entire HKLR.

The interface between the contract packages will be identified and included in the contract documents. In addition, it is important that a Works Area of sufficient area would be available for the use in each of Package 1 and Package 2 to facilitate the manufacturing of bridge components. If there is only one Works Area could be available, Packages 1 and 2 may need to be merged and this will be further reviewed.

5 DEVELOPMENT CONSTRAINTS

5.1 The major development constraints that need to be considered in this project are shown in **Figures 5.1 and 5.2** and summarized as follows:

(i) Airport is a major development in the vicinity of HKLR. The proposed layout of HKLR should avoid/minimise impact on both the existing and future development layout of the Airport.

(ii) The proposed HKLR alignment must avoid infringing the Airport Height Restriction (AHR) during both construction and operation stages. The zone around the runway is particularly critical as the AHR contours there are particularly low. In addition, the proposed HKLR should avoid running close to the helipads within the Government Flying Service (GFS) area in Airport Island in order not to affect the landing of the helicopters.

(iii) The vertical profile of sea viaduct in HKLR needs to allow the appropriate class of vessel to pass underneath at the navigation channel in order to minimize the impacts to the existing marine traffic.

(iv) As there are concerns from the Tung Chung residents, it is necessary to minimize the environmental and visual impacts arising from HKLR, in particular the portion between Scenic Hill and HKBCF.

(v) The alignment of HKLR should not affect the following features:

- Ngong Ping 360's Angle-Station and associated facilities – the proposed alignment of HKLR should avoid affecting the structure of Ngong Ping 360 facilities.
- Archaeological Sites – the alignment of HKLR should avoid or span over all the known archaeological Sites including Sha Lo Wan (West) Archaeological Site and Ha Law Wan Archaeological Site.
- Airport Road and Airport Express Line (AEL) – the proposed alignment of HKLR will be in the form of a tunnel underpassing the Airport Road and Airport Express Line. The tunnelling works should not affect the Airport Road and Airport Express Line.
- The existing facilities and sensors within or in the vicinity of Airport to monitor the airflow – The proposed alignment of HKLR should not affect the monitoring of airflow by Hong Kong Observatory (HKO) for the safety of aviation.

(vi) The ecological features in the Airport Channel are valuable. The proposed works of HKLR should avoid adverse water quality impact to the Airport Channel.

(vii) The existing Aviation Fuel Tank Farm in the Airport Island is close to the proposed alignment of HKLR. Special attention needs to be paid in designing the alignment of HKLR to ensure the safety to the road users.

5.2 The measures to overcome the development constraints including the following:

(a) Close liaison with the Airport Authority Hong Kong on the interface issues between HKLR and the Airport to avoid/minimise the impact on both the existing and future development layout of the Airport.

(b) The vertical profile of HKLR will be designed to avoid infringing the AHR. Close liaison with the Civil Aviation Department, GFS and Airport Authority Hong Kong will be made to ensure that aviation safety will not be affect by the HKLR.

(c) To minimize the environmental and visual impacts, the portion of HKLR between Airport Island and HKBCF will take the form of at-grade road/ low-profile viaduct at the east coastline of Airport Island.

(d) In designing the alignment of HKLR, sufficient distance will be provided between HKLR and the adjacent existing/planned features. Close liaise will be made with relevant parties such as MTRCL, Antiquities and Monuments Office (AMO) and Hong Kong Observatory (HKO) to avoid affecting these features and the operation of the airflow monitoring facilities.

(e) The water quality impact arising from the proposed works of HKLR will be assessed in the EIA Study of this Project. Mitigation measures such as silt curtain would be provided in order to avoid adverse impact to the Airport Channel.

(f) Special attention will be paid in designing the alignment of HKLR to keep clear of the smoke zone of Aviation Fuel Tank Farm (AFTF) to avoid the smoke hazard to the future road users in case of tank fire with fuel splash. A Hazard Assessment will be carried out to address hazard-to-life issues during construction and operation stages.

6 DEVELOPMENT OPTIONS

6.1 Alignment options

6.1.1 Various alignment options have been considered taking account the factors of implementation programme, cost-effectiveness, transport performance, engineering, environmental issues, land, marine, planning and development matters, topography, geology, cultural heritage preservation, local views/objections, C&D material management, impact on airport operation and future development potential, landscape and visual aspects.

6.1.2 The recommended alignment of HKLR is shown in **Figure 3.1**. As shown in this figure, the recommended alignment will take the form of viaduct from the Interface Point with HZMB Main Bridge at the HKSAR's western boundary to the landing point at San Shek Wan headland and then up to Scenic Hill after skirting along the southern seawall of Airport Island near the Airport Channel. The profile of HKLR will provide adequate headroom at the navigation channel in the waters west of Lantau and the alignment of viaduct will move away from the severe constraint of AHR due to the touchdown zone of the airport southern runway. The viaduct of HKLR will straddle over the landing point at San Shek Wan headland without physical landing at this point. The alignment of this portion of HKLR (previously known as HZMB Hong Kong Section and Western of North Lantau Highway Connection) was endorsed at the Project Steering Group Meeting held on 28 July 2005.

6.1.3 When compare to other options such as tunnel, the recommended option of viaduct from the HKSAR boundary up to Scenic Hill will minimize the generation of C&D materials. As a large portion of the viaduct will be located at the sea, bored pile foundation is adopted as it is more durable with less maintenance issues than the steel driven piles in the marine environment. A typical section of the viaduct with the pile foundation is shown in **Figure 6.1**.

6.1.4 For the alignment of HKLR from Scenic Hill to HKBCF, the following alignment options as shown in **Figure 6.2** have been considered:

(i) The Viaduct Scheme – The alignment is in the form of viaduct runs along the NW side of Scenic Hill and then span across the Airport Road and Airport Express Line. At the eastern portion of HKLR, the alignment will skirt through the waters on the eastern side of Airport Island and then connect to HKBCF.

(ii) The Tunnel Scheme – Unlike the Viaduct Scheme, the Tunnel Scheme takes the form of a 3km long tunnel all the way from Scenic Hill to HKBCF. After entering the waters adjacent to the south-eastern side of Airport Island, it will take the form of a marine-based tunnel passing the waters outside Tung Chung waterfront until it reaches HKBCF.

At the southern-most part of the marine portion tunnel, the tunnel's crown will stick above the seabed level and therefore permanent reclamation is required to protect this portion of tunnel from collision by vessels. In addition, the construction of marine-portion tunnel will adopt the form of a cut-and-cover tunnel in which temporary reclamation is required to form the land for the tunnel works. The temporary reclamation is to be removed after the tunnel construction works.

(iii) Tunnel cum At-Grade Scheme – The land-tunnel of this scheme starting from Scenic Hill is similar to that in the Tunnel Scheme. After underpassing the Airport Express Line, the tunnel will embark upon the waters on SE side of Airport Island and it will rise up to daylight at a point near Dragonair Headquarter. The alignment of HKLR will continue as an At-Grade Road on embankment (i.e. reclamation) along the east coast of Airport Island until it reaches HKBCF.

6.1.5 A comparison of the schemes (i.e. Viaduct Scheme, Tunnel Scheme and Tunnel cum At-Grade Scheme) for the estimated construction cost, reclamation extent and the dredging/Mud disposal volume is given below:

Table 6.1 Comparison of the Schemes

	Viaduct Scheme	Tunnel Scheme	Tunnel cum At-Grade Scheme
Order of construction cost	HK$ 1.7 billion	HK$ 5.5 billion	HK$ 2.6 billion
Reclamation extent	Nil	Permanent reclamation 8 ha + temporary reclamation 23 ha	Permanent reclamation 23 ha (including 4ha for road connection between HKBCF/airport)
Estimated volume of dredging/mud disposal volume (bulk volume)	~ 0.15 Mm^3 for bored piles only	~ 13 Mm^3 (include the removal of temporary reclamation)	~ 4.9 Mm^3

6.1.6 The public engagement exercise for HKLR/HKBCF has revealed that some of the Tung Chung residents are against the proposal to locate HKBCF at NE side of the Airport and connect it with viaducts facing Tung Chung waterfront as it would disturb the seaview that are currently enjoying and that the proposed roads would result in significant air and noise pollution. Whilst the site location of HKBCF will be addressed separately under the HKBCF projects, efforts have been taken to consider the options of HKLR from Scenic Hill to HKBCF with a view to minimize the environmental and visual impacts as far as practicable.

6.1.7 As Tung Chung residents are against the Viaduct Scheme due to the concerns of environmental and visual impacts, the Viaduct Scheme is not considered further. As shown in Table 6.1 above, the Tunnel cum At-Grade Scheme is advantageous compared with the Tunnel Scheme considering cost, extent of reclamation and volume of dredging/mud-disposal involved. Therefore, the Tunnel cum At-Grade Scheme is recommended for the portion of HKLR from Scenic Hill to HKBCF. In addition, the reclamation in Tunnel cum At-Grade Scheme could also provide the land along the east coastline for the connection road between HKBCF and airport. This could minimise the length of seawall and thus the dredging and filling for seawall if the reclamation for HKLR and the HKBCF's connection road is integrated.

6.2 Construction method of seawalls

6.2.1 The seawall is a retaining structure to protect the reclaimed fill. Both the dredged and non-dredged options of seawall have been considered for the HKLR. Typical section of the dredged and non-dredged seawall is shown in **Figure 6.3**.

6.2.2 The design of seawall should achieve a minimum Factor of Safety to ensure the stability against the slip failure and provide adequate bearing capacity to support the seawall without significant settlement. Based on the available ground investigation results, preliminary assessment of the seawall stability and settlement is summarised in the following table:

	Evaluation Results	
	Dredged Option	**Non-dredged Option (without ground improvement)**
Stability Assessment – in terms of Factor of Safety	Min. 1.34 > 1.3 (OK)	Max. 0.32 << 1.3 (Failed)
Settlement Assessment – in terms of Total Residual Settlement (mm)	Max. 340mm < 500mm (OK)	Min. 2000mm >> 500mm (Failed)

6.2.3 From the above assessment, it was found that the non-dredged option without ground improvement fails to provide sufficient stability and settlement control to the seawall. As a common practice, full-dredging is adopted for forming the seawall base so as to ensure the stability and minimise the settlement of the seawall. However, it is important to consider the feasibility of non-dredged option with ground improvement measure for the seawall with a view to minimize the dredging of marine deposit.

6.2.4 For the non-dredged option with ground improvement measure for seawall, the use of band drains and surcharge is considered to be inadequate as it could not improve the shear strength of marine deposit to ensure the seawall stability. The use of Sand Compaction Pile (SCP) and Deep Cement Mixing (DCM) as the seawall foundation was adopted in some overseas projects. However, there is no track record of the application of SCP and DCM in Hong Kong. The feasibility to adopt SCP or DCM for the seawall foundation will be discussed in the following Sections.

6.2.5 DCM is an applied chemical solidification technique which inserts and mechanically mixes cementing agents with soft soils to create a stiff soil-cement mix. However, it is important to note that the marine application of DCM may result in possible leakage of cement grout into the surrounding waters during the mixing process and this would cause adverse environment impacts. For the land application of DCM after the seawall is constructed, there are difficulties for DCM to penetrate through the rockfill in seawall core. In view of the above, it is considered that application of DCM is not suitable for the seawalls in HKLR.

6.2.6 SCP is considered to be one of the effective ground improvement methods for the seawall structure on soft marine deposit. This is because SCP can increase the shear strength of ground by installing well compacted sand piles in the ground and stabilizes the seawall structure. Although there is lack of track record in the application of SCP in Hong Kong, the use of SCP as the seawall foundation has been widely adopted in Japan and Korea reclamation projects.

6.2.7 It is important to note that the application of SCP is subject to some site constraints. As the reclamation of HKLR is located next to the Airport Island, the Airport Height Restrictions (AHR) would impose constraint to the working height of SCP plant. According to the information from SCP contractor, the minimum height of SCP plant is 40m above the sea level. Allowing for safety margin, SCP is applicable only to the seawalls where the AHR contour is +45mPD or above.

6.2.8 Another important issue of SCP is the up-heaving of seabed after installation of SCP. In the shallow water, the up-heaved seabed would affect the operation of the SCP barges as well as other vessels. The seabed at HKLR reclamation portion is very shallow from about -2mPD to -3mPD. With the consideration of lower replacement of SCP to reduce the effect of up-heaving, the seabed level should be -6mPD or below so as to have adequate water depth to ensure the proper operation of SCP barge without affecting by the up-heaving of seabed.

6.2.9 In considering the above constraints, the non-dredged method of SCP could not be applied for the seawalls in HKLR as the seabed is very shallow and the up-heaving of seabed after installation of SCP would affect the operation of SCP barges as well as other vessels. Therefore, the fully-dredged method is to be adopted for the seawalls in HKLR.

6.3 Reclamation option of HKLR

6.3.1 The proposed reclamation layout of HKLR is shown in **Figure 6.4**. The reclamation in HKLR is to provide land for the tunnel and at-grade road. Therefore, it is narrow in shape along the east shoreline of Airport Island. As shown in the above reclamation layout, a large portion of the reclamation area in HKLR is occupied by the dredged seawall trench and tunnel. Fully dredged method is required at the tunnel area so as to avoid the stability and seepage problems due to deep excavation in the soft materials during open-cut construction of the tunnel after the land is reclaimed. In addition, the fully dredge method is to be adopted in the seawalls as discussed in Section 6.2 above. Apart from the seawall and tunnel areas, non-dredged method is to be adopted in the remaining reclamation area. Therefore, the proposed dredging works in HKLR is minimized by adopting the fully dredged method at the seawall and tunnel areas only.

6.3.2 The envisaged programme of the recommended reclamation method in HKLR is shown in **Figure 6.5**. The assumed construction rates and the period allowed for the surcharging and the infrastructure works of HKLR is attached in **Appendix B**.

6.3.3 The estimated quantity of dredging and imported filling in HKLR (for both reclamation and pile foundation of marine viaduct) is given in Table 6.2 below:

Table 6.2 Dredging / filling quantities of marine works in HKLR

Items	Bulk Volume of Marine Deposit to be Dredged (million m³) [1]	Weight of Imported Fill Materials (million tonnes) [2], [3]
Reclamation	4.9 Mm^3	10.98 Mm^3
Piled foundation	0.4 Mm^3	--
Total	5.3 Mm^3	10.98 Mm^3

Notes:
1. *For the quantities of dredging, a bulking factor of 1.3 is applied.*
2. *The quantities of fill materials are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
3. *Fill materials include sand fill, public fill, rock fill, seawall armour and surcharge.*

6.4 Reclamation fill options

6.4.1 The use of sandfill and public fill as the reclamation material has been considered. Sandfill has the advantage that the material is quite uniform and the residual settlement due to creeping of fill material could be easily controlled within an acceptable limit without scarifying the implementation programme.

6.4.2 For public fill, strict site control is necessary to ensure that the public fill does not contain unsuitable material such as oversized boulder, rubbish, topsoil with organic matter. In general, the grading of public fill is much more variable than that of sandfill and this lead to longer time to achieve the required limit of residual settlement due to creeping of fill material.

6.4.3 It should also be noted that there is programming advantage to use sandfill as vibrocompaction could be carried out to reduce the surcharge period required for the reclamation. For public fill, it would be impracticable for the vibrocompaction to penetrate through the public fill.

6.4.4 The residual settlement comprises residual consolidation (primary and secondary) settlement of soft marine deposit and alluvial clay and residual creep settlement due to fill material. The amount of creep settlement contributes as one of the major component of the total residual settlement and hence the use of sandfill and public fill will be one of the control factors for the control of residual settlement.

6.4.5 A residual settlement limit of 500mm is proposed for the proposed reclamation of HKLR based on the following considerations:

1) Allowable settlement of utilities at the interface of HKLR reclamation/existing airport island.

2) Long term function of underground drainage system.

3) Integrity of the roadwork pavement.

6.4.6 The amount of sandfill and public fill to be used in the reclamation should be aimed to achieve the required residual settlement limit of the project. Four options of reclamation filling: completely use of public fill, completely use of sandfill, use of sandfill below +2.50mPD & public fill above +2.50mPD, use of sandfill below +2.50mPD & public fill above +2.50mPD, have been evaluated.

6.4.7 Apart from the seawall and tunnel areas, the non-dredged method is to be adopted in the reclamation of HKLR. Based on the available ground investigation results, preliminary

assessment of residual settlement of non-dredged reclamation method is summarized in the following table:

Options (Non-dredged reclamation with sandfill/ public fill)	Max. thickness of MD (m)	Max. thickness of alluvial clay (m)	Max. residual settlement (mm)
All public fill	12	17	695
All sandfill	12	17	466
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	12	17	541
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	12	17	491

Note:
1. This assessment is carried out based on the GI information of HKLR and non-dredged reclamation option is adopted.
2. 1m spacing band drain through the marine deposit, 8m high surcharge and 9 months surcharge period is assumed.
3. The vibrocompaction needs to be carried out at +2.50mPD above the sea level. The use of public fill below +2.50mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.8 For the dredged areas such as seawall trench, the preliminary estimated residual settlement of different reclamation fill options is summarized in the following table:

Options (Fully-dredged reclamation with sandfill/ public fill at the back of Seawall)	Max. thickness of alluvial clay (m)	Max. thickness of sandfill / public fill (m)	Max. residual settlement (mm)
All public fill	17	0 / 20	820
All sandfill	17	20 / 0	405
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	17	16.5 / 3.5	515
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	17	17.5 / 2.5	430

Note:
1. This assessment is carried out based on the GI information of HKBCF reclamation where dredged reclamation option is adopted.
2. No surcharge is placed near the seawall due to the stability issue.
3. The vibrocompaction needs to be carried out at +2.5mPD above the sea level. The use of public fill below +2.5mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.9 From the above assessment, it was found that the options of using public fill as filling material and public fill above +1.50mPD fail to achieve the required residual settlement limit of 500mm. Both the options of sandfill and use of sandfill below +2.50mPD & public fill above +2.50mPD are capable to achieve the required residual settlement limit.

6.4.10 In order to maximize the use of public fill, the option of using sandfill below +2.50mPD and public fill above +2.50mPD is therefore adopted.

7 MANAGEMENT OF C&D MATERIALS

7.1 C&D Materials Quantities

7.1.1 The C&D materials generated from the HKLR project will come from the following major items of works:

- Excavation for the bored piles of marine and land portions of viaducts; and
- Excavation for the tunnels and associated structures.

7.1.2 In addition, substantial amount of filling materials would be imported for the construction of seawalls and reclamation. A breakdown of the estimated quantities of public fill and C&D waste generated and the filling material required in this Project is summarized in the following Sections.

7.2 Generated Public Fill Material

7.2.1 The estimated quantities of different types of public fill that generated from this Project are given in Table 7.1 below:

Table 7.1 Estimated Quantities of Public Fill Generated

Material	Weight (million tonnes)	Remarks
Inert C&D Soft Materials	1.00	• Excavation for tunnels. • Bored pile excavation of viaducts (land portion).
	0.90	• Materials generated from removal of surplus surcharge materials from the reclamation at last stage.
Grade III rock (low quality rock)	0.10	• Excavation for tunnels. • Bored pile excavation of viaducts.
Grade I & II rock (good quality rock)	0.40	• Excavation for tunnels. • Bored pile excavation of viaducts.
Total	**2.40**	

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The above quantities are estimated from ground investigation information currently available. These quantities will be reviewed when the foundation design of infrastructure works and the further ground investigation information are available in the detailed design stage.*

7.3 Fill Materials for Seawalls and Reclamation

7.3.1 As discussed in Section 6.4 above, sandfill is proposed for the reclamation below +2.5mPD and public fill for the reclamation from +2.5mPD to the formation level in order to achieve the residual settlement limit.

7.3.2 The estimated quantities of filling materials required for the seawalls and reclamation of HKLR is summarized in Table 7.2 below:

Table 7.2 Estimated Quantities of Filling Materials Required

Works	Weight (million tonnes)			
	Sand Fill	Public Fill (soft materials) (including surcharge)	Rock (exclude armour)	Armour
Reclamation	3.0	3.1(2)	--	--
Seawalls	4.1	--	1.00	0.50
Total	**7.1**	**3.1(2)**	**1.00**	**0.50**

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The public fill material to be imported includes the surcharge material. The disposal of last stage surcharge material is not included in the above table. The quantity of the disposal of last stage surcharge material is included in Table 7.1 above.*

7.3.3 The anticipated settlement of reclamation during the surcharge period is about 1m in average. The quantity of public fill in Table 7.2 above allows the additional fill taking account of the anticipated settlement. To maximize the use of public fill, the surcharge would be formed by public fill. After removal of the surcharge in each stage, the surcharge material would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. Therefore, the quantity of surcharge material is included as public fill in the above table. However, the last stage surcharge materials would need to be disposed off site and the quantity of this disposal is given in Table 7.1 above.

7.3.4 For the public fill (soft materials) to be used in the reclamation of this project from +2.5mPD to the formation level, it should (besides meeting the general requirements for public fill) also comply with the requirements for General Filling material as stipulated in the General Specification for Civil Engineering Works.

7.3.5 Sandfill is assumed from various sources such as Mainland China. Public fill is assumed from the Fill Bank and other projects which generate substantial C&D materials. According to the latest information from MTRCL on their new railway projects, about 6.8 million tonnes public fill (rock materials) would be available from Early 2011 to Mid 2012 and it is planned that these materials would be reused in the construction of seawall in HKBCF project. Therefore, the rock fill material required in HKLR needs to be imported from other sources. Liaison is being made with the project office of other projects such as Development at Anderson Road and Harbour Area Treatment Scheme Stage 2A to see if surplus rock material could be available from these projects and priority will be given to use these materials in HKLR.

7.3.6 For the public fill (soft materials), about 22 million tonnes would be available from MTRCL's projects between 2011 and 2016, which is more than 19.3 million tonnes required in HKBCF. In addition, there should be more than 10 million tonnes public fill (soft materials) available from the Fill Bank during the reclamation works of HKLR. Therefore, there should be sufficient supply of public fill (soft materials) form the above sources. Liaison with relevant parties such as CEDD and MTRCL is in progress to confirm the detailed arrangement of supplying the public fill materials to HKLR.

7.4 C&D Wastes

7.4.1 For the structures such as viaducts and tunnel portal buildings in HKLR, steel formwork is assumed for the standard sections such as columns and deck segments. However, it is considered that timber formwork will still be required for the non-typical sections of these

RC structures such as the pile cap and abutment of the viaducts. Preliminary estimate shows that the area of timber formwork, a source of C&D waste, required is 0.3 million m^2. Assuming the formwork could be reused for 3 times, the area of formwork required is 0.1 million m^2. For 19mm plywood, the volume of formwork being need in this project is 1,900m^3, say 2,000m^3

7.4.2 The soft soil to be excavated in this Project includes about 7,400 m^3 of top soil mainly from the site clearance for the construction of tunnel portal. The excavated top soil is classified as C&D waste due to the presence of organic materials. The excavated top soil could be stockpiles and reused as planting soil at the proposed roadside planters and landscaping areas within the site. Based on the estimate of landscaping requirement in HKLR, all the above excavated top soil would be reused within the site. The stockpiled top soil should be covered by impervious sheeting and continuous water spraying if necessary to prevent wind erosion and generation of dust. As the top soil is not contaminated, it is not considered that the stockpiled top soil would cause significant environmental impacts provided that the above measures are implemented on site.

7.4.3 In view of the above, the total estimated insitu volume of C&D waste to be disposed and reused is 2,000m^3 and 7,400m^3 respectively. Assuming the insitu and bulk density of C&D waste is 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively, the total estimated quantity of C&D waste to be disposed and reused is about 4,000 tonnes (or bulk volume of 2,200m^3) and 14,800 tonnes (or bulk volume of 8,200m^3) respectively.

7.5 Disposal Programme for C&D Materials

7.5.1 The tentative programme of reclamation and infrastructure of HKLR is shown in **Figure 6.5**. This programme will be subject to further review as the project progresses.

7.5.2 It is anticipated that a large portion of the C&D materials from the infrastructure works (such as the tunnel excavation works within the reclamation) would be generated after the reclamation of HKLR. For those excavated C&D materials generated after Early 2013 when the reclamation is completed, it could not be reused as the reclamation fill and therefore they would need to be disposed off site. Similarly, the last stage surcharge materials will also need to be disposed off site. In view of the above, the tentative programme for disposal of C&D materials and C&D Waste are given in Table 7.3 below:

Table 7.3 Tentative Disposal Programme for C&D Materials

Material Type	Weight (million tonnes)					
	2010	2011	2012	2013	2014	Total
Insert C&D Soft materials (exclude surcharge)				0.20	0.40	0.60
Grade III rock				0.04		0.04
Grade I & II below rock				0.14		0.14
Surplus surcharge				0.90		0.90
C&D Waste			0.002	0.002		0.004
Total			**0.002**	**1.282**	**0.400**	**1.684**

7.5.3 According to the tentative programme of HKBCF, the filling of HKBCF reclamation would require public fill (soft material) of about 4.3 million tonnes in 2013 and 0.65 million tonnes of in 2014. As discussed with the project team of HKBCF, arrangement could be made such that surplus C&D material (excluding C&D waste) generated from HKLR given in Table 7.3 above would be reused as the filling material in HKBCF as far as practicable. To

maximum the reuse of surplus C&D material from HKLR, the rock materials would be broken into smaller size to meet the filling requirement of HKBCF. The above arrangement will be reviewed when the detailed construction programme of HKLR and HKBCF is available.

7.5.4 Apart from the C&D materials to be reused on site, the tentative programme of fill materials to be imported for the construction of seawalls and reclamation is given in Table 7.4 below:

Table 7.4 Tentative Programme for Fill Materials to be Imported

Material Type	Weight (million tonnes)					
	2010	2011	2012	2013	2014	Total
Soil (sandfill)		2.15	4.00	0.95		7.10
Rock (exclude armour)		0.40	0.28			0.68
Others (armour)		0.10	0.20	0.20		0.50
Others (public fill, soft materials)			2.50	0.20		2.70
Total		**2.65**	**6.98**	**1.35**		**10.98**

7.6 Materials Minimization Strategy

Minimizing Generation of C&D Material

7.6.1 Generation of C&D materials will be minimized with the following measures:

(i) Use the non-dredged reclamation method as far as practicable – Apart from the seawall trench and tunnel area in which full-dredging is required, the non-dredge method with band drains and surcharge is adopted in other reclamation areas as far as practicable.

(ii) Adoption of viaduct instead of tunnel – It is proposed to adopt tunnel only from Scenic Hill to the SE side of Airport Island in order to minimize the environmental and visual impacts to Tung Chung. The use of viaduct instead of tunnel at other portions of HKLR would reduce the generation of C&D materials.

(iii) Adoption of steel formwork for standard sections of RC structures – steel formwork would be used for the RC structural works as far as practicable to minimize the use of timber formwork and generation of C&D waste.

Optimising Usage of Fill in the Contracts

7.6.2 The fill required for reclamation will utilize the excavated C&D materials from the infrastructure works, which can be effectively achieved through the following:

(i) The Resident Site Staff (RSS) will monitor the Contractor's management on the C&D materials.

(ii) Arranging ad-hoc coordination meeting with the contractors as necessary, and advise the contractors regarding the ways to utilize and import fill materials in the C&D material management.

(iii) Arranging and identifying temporary storage area for surplus fill such that it could be used at later stage.

Maximizing the Use of C&D Material

7.6.3 Recycling of C&D material will be maximized with the following measures:

(i) The excavated top soil during the site clearance works can be temporarily stockpiled subject to the availability of temporary storage areas to be identified. The stockpiled top soil will be reused at the proposed landscaping areas of HKLR.

(ii) Arrangement will be made to reuse the surplus C&D material generated from HKLR as the filling materials in HKBCF as far as practicable. This will be reviewed when the detailed construction programme of HKLR and HKBCF is available.

8 CONCLUSION

8.1 This C&DMMP presents the estimated quantities of C&D materials produced and the fill materials required in the reclamation and infrastructure works of the HKLR, their respective volume are summarized in Tables 8.1 and 8.2 below:

Table 8.1 Summary of C&D Materials and Waste Generated and Disposed of

Material	Estimated Quantities [1]			
	Generated	Reused on Site	Reused in other projects [3]	Disposed of at Landfill
Inert C&D Soft Material	1.00 (0.55)	0.4 (0.22)	0.60 (0.33)	-
Surplus Surcharge	0.90 [2] (0.50)	-	0.90 (0.50)	-
Grade III Rock (Low Quality Rock)	0.10 (0.05)	0.06 (0.03)	0.04 (0.02)	-
Grade I or II Rock (Good Quality Rock)	0.40 (0.20)	0.26 (0.13)	0.14 (0.07)	-
C&D Waste	0.019 (0.010)	0.015 (0.008)	-	0.004 (0.002)

Notes:

1. *The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *All the surcharge materials is the imported public fill and it is included in the imported public fill (soft materials) in Table 8.2 below. The last stage of surcharge is about 0.9 million tone and this figure represents the surplus surcharge material to be disposed off site.*
3. *Arrangement will be made to reuse the surplus C&D material as filling materials in HKBCF reclamation as far as practicable. This will be reviewed when the detailed construction programme of HKLR and HKBCF is available.*

Table 8.2 Summary of Reclamation Material Requirement

Material	Estimated Quantities[1]		
	Total Required	Reused from other C&D materials within the site	Import from outside sources
Soil (sandfill)	7.10 (3.94)	-	7.10 (3.94)
Rock (exclude armour)	1.00 (0.50)	0.32 (0.16)	0.68 (0.34)
Others (armour)	0.50 (0.25)	-	0.50 (0.25)
Others (public fill, soft materials) including surcharge	3.10 (1.72)	0.40 (0.22)	2.70 (1.50)

Notes:

1. The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.

8.2 Various means to minimize the C&D materials generation and to maximize the reuse of C&D materials have been considered, as discussed in Section 7.6 above.

9 RECOMMENDATION

9.1 This report provided the estimated quantities of C&D materials that would be generated and used in this project. It is envisaged that detailed figure would be refined slightly during the detailed design in reviewing and updating this C&DMMP accordingly. To this, the following actions are recommended:

(1) Further review of the programme of HKLR and HKBCF will be carried out such that arrangement could be made to reuse the surplus C&D materials from HKLR in HKBCF reclamation as far as practicable.

(2) Continue liaison with MTRCL and other relevant parties to agree the quantities and arrangement of delivery the public fill materials generated from their projects for use as reclamation fill in HKLR.

(3) This C&DMMP shall be regularly reviewed and updated during the detailed design as well as construction stage. The construction work on site should also be closely monitored.

(4) Appropriate specification should be included in the contract document to control the generation of C&D materials.

(5) The resident site staff supervising the reclamation work should be fully aware of this plan and closely monitor the works on site such that recommendations in this plan would be duly carried out.

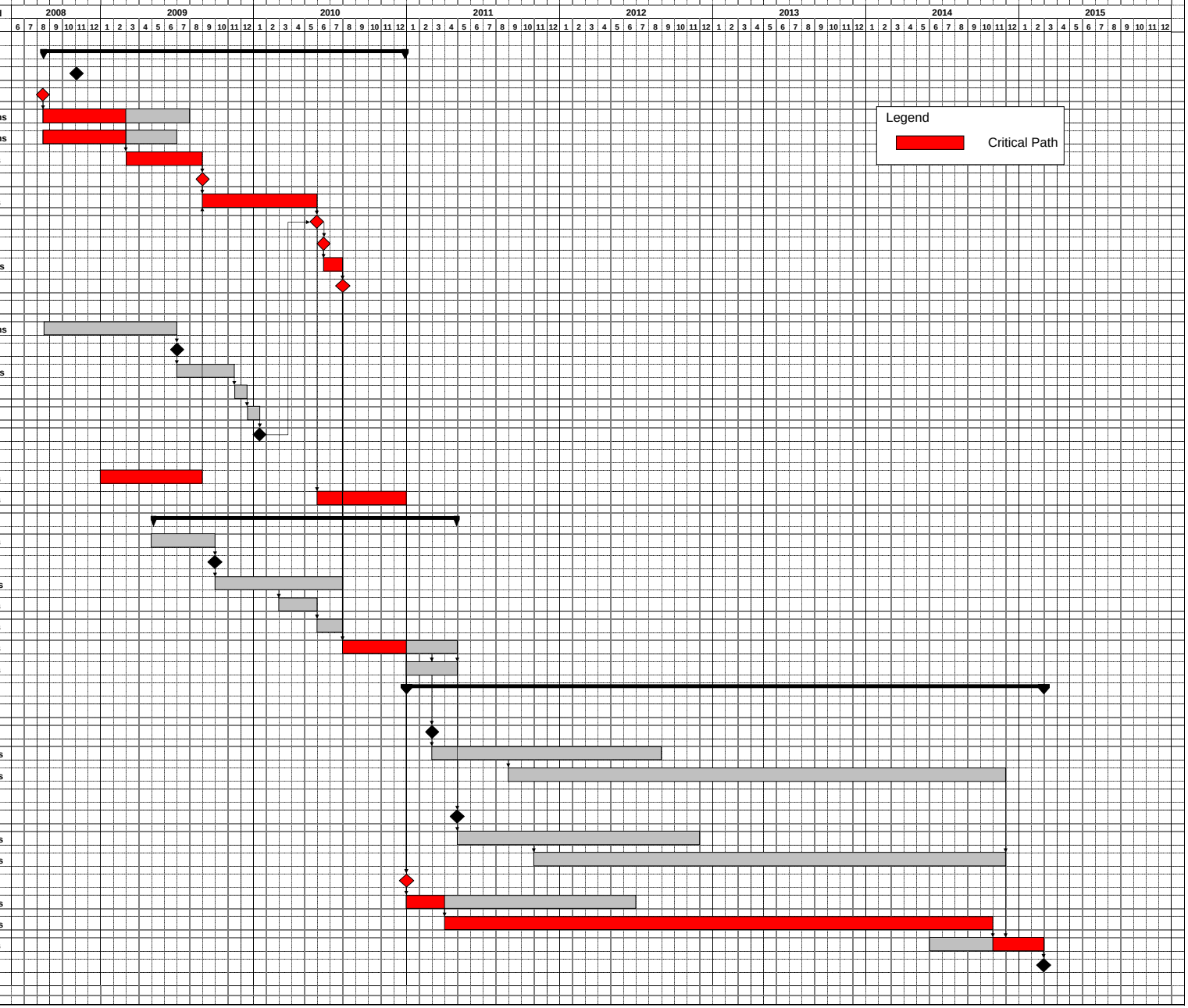
(6) This plan should be provided to the contractor in due course, probably at an early stage of the construction in the preparation of Waste Management Plan.

APPENDIX A

Tentative Implementation Programme of HKLR

HZMB Hong Kong Link Road - Implementation Programme

Activities Item	Description	Estimated Duration
	Investigation & Preliminary Design Stage	
1	Issurance of PDS for HKLR	
2	Reactivation of I&PD Consultancy	
3	Preliminary Design	11.5 months
4	Public Engagement	10.5 months
5	Preparation of Gazette Plan and Dcouments	6 months
6	Gazette under Roads Ordinance	
7	Objection Period/ Resolve Objections	9 months
8	Authorization under Roads Ordinance	
9	PWSC Meeting	
10	Funding application for Works Contracts	1.5 months
11	Upgrading to Cat. A	
12	Environmental issues	
12a	EIA Study	10.5 months
12b	Submission of EIA Report	
12c	EIAO process	4.5 months
12d	EPD approval of EIA Report	1 month
12e	Application for Environmental Permit	1 month
12f	EPD issue of Environmental Permit	
13	Land Issues	
13a	Preparation & Finalisation of Land Requirement Plan	8 months
13b	Land Resumption	7 months
	Tendering Stage	
14	Employment of T&C Consultant	5 months
15	Commencement of T&C Consultancy	
16	Tender Dcoumentation for construction works	10 months
17	Prequalification Documentation + Prequalification Period	3 months
18	Prequalification Assessment & shortlist of tenderers	2 months
19	Tender Invitation and Assessment (for three contracts)	9 months
20	Award of Contract (for three contracts)	4 months
	Construction Stage	
21	Package 1 Contract	
21a	Commencement of Contract	
21b	Design + GI works	18 months
21c	Viaduct Construction + Roadworks	39 months
22	Package 2 Contract	
22a	Commencement of Contract	
22b	Design + GI works	19 months
22c	Viaduct Construction + Roadworks	37 months
23	Package 3 Contract	
23a	Design + GI works	18 months
23b	Reclamation + Tunnel + At-Grade Road Construction	43 months
23c	Testing & Commissioning (All three Contracts)	9 months
24	Road Opening	



APPENDIX B

Assumed Construction Rates and Period Allowed in the Programme

Appendix B

Hong Kong-Zhuhai-Macao Bridge
Hong Kong Link Road
Assumed construction Rate of major reclamation activities

The following construction rates are based on 16 working hours per day (i.e. 7:00 am to 7:00pm without noise permit + 7:00pm to 11:00pm with noise permit). In view of the distance between HKLR site and the sensitive receivers in Tung Chung, there would be stringent requirements to obtain noise permit to work through mid-night (i.e. 11:00pm to 7:00am). There is risk to assume the construction plant could work 24 working hours per day at this stage as delay would occur if the noise permit for working 24 hours could not be obtained during construction. Therefore, 16 working hours per day is assumed.

Dredging - Grab dredger

Assume 11m^3 grab dredger and 1.5 min for each cycle of dredging considering the average dredging depth is about 15m below sea level.

For 16 working hours per day, the construction rate of 11m^3 grab dredger is:
= 16 x 60/1.5*11 m^3
= 7040 m^3 /day

For 25 working days per month, the construction rate of 11m^3 grab dredger is about 180,000 m^3 /barge/month

Sandfilling – Pelican Barges

As the reclamation size of HKLR is small (i.e 23ha), it is assumed that the sadfilling would be carried out by pelican barges instead of Trailer Suction Hopper Dredger. In addition, the seabed level at HKLR reclamation is about -2mPD to -3mPD. As the water level is very shallow, it is not suitable to use the large Trailer Suction Hopper Dredger to carry out the filling work in this case.

Assume 1000 m^3 pelican barge which deliver the sand one time per day. For 16 working hours per day and 25 working days per month, the filling rate of a pelican barges = 1,000 x 25 = 25,000 m3/barge/month

Geotextile

Width = 40m
Length = up to 150m per day (i.e. 16 hours)
Construction rate = 6,000m^2 per day or 150,000m^2/barge/month (25 working days per month)

Appendix B

Vertical Drain (by marine method)

The average depth of marine deposit is about 20m
A panel = 4 row x 12 column i.e. triangles of 1m spacing
Two vertical drains to be installed at the same time
A panel takes 24 shots to complete
Assume 1 shot = 3.5 minutes
1 panel = 84min to complete
Shift location of barge take 25min to 30 min
Hence each cycle = 120 min to complete 48 nos. vertical drains.

For 16 working hours a day, 8 panels could be completed in a day

The construction rate=384 nos or 7,680m/day or 192,000m/barge/month (25 working days per month).

Vertical Drain (by land method)

The average length of each band drain = 30m (10m filling + 20m thick marine deposit)
Assume installation time of each band drain = 4.0 minutes

For 16 working hours a day, the no. of band drains to be installed = 16x 60/4 = 240 nos. day.

For 25 working days per month, the construction rate = 240 x 30m x 25
= 180,000m/rig/month

Summary of Construction Plant (HKLR)

Plant	Estimated Quantity	Assumed Construction Rates
Grab dredger	2 nos.	180,000m^3/barge/mth
Installation of band drains (marine method)	2 nos.	192,000m/barge/mth
Installation of band drains (land method)	20 nos.	180,000m/rig/mth
Laying of geotextile	15 nos.	150,000m^2/barge/mth
Sand filling (pelican barges)	14 nos.	25,000m^3/barge/mth(Note 1)
		12,500m^3/barge/mth(Note 2)
Filling by public fill	1 item.	150,000m^3/barging point/mth

Note:

1) The construction rates are based on 16 working hours/day and 25 working days/month
2) The construction rate of sandfiling is 350,000m^3/barge/mth for dredging area and 350,000m^3 for non-dredging area to take of the addition time to place the fill carefully to avoid mud-wave at the non-dredged area

Other Programme Requirements

Items	Period Allowed
Surcharge Period (non-dredge area)	9 months (8m high surcharge)
Surcharge Period (fully-dredge area)	3 months (4m high surcharge)
Tunnel construction (at reclamation area)	about 1 years 6 months
At-grade road (at reclamation area)	about 1year

Note:

1) The period allowed for the surcharge period takes into account the latest available ground investigation information.
2) The period allowed for the infrastructure works includes the testing and commissioning

FIGURES

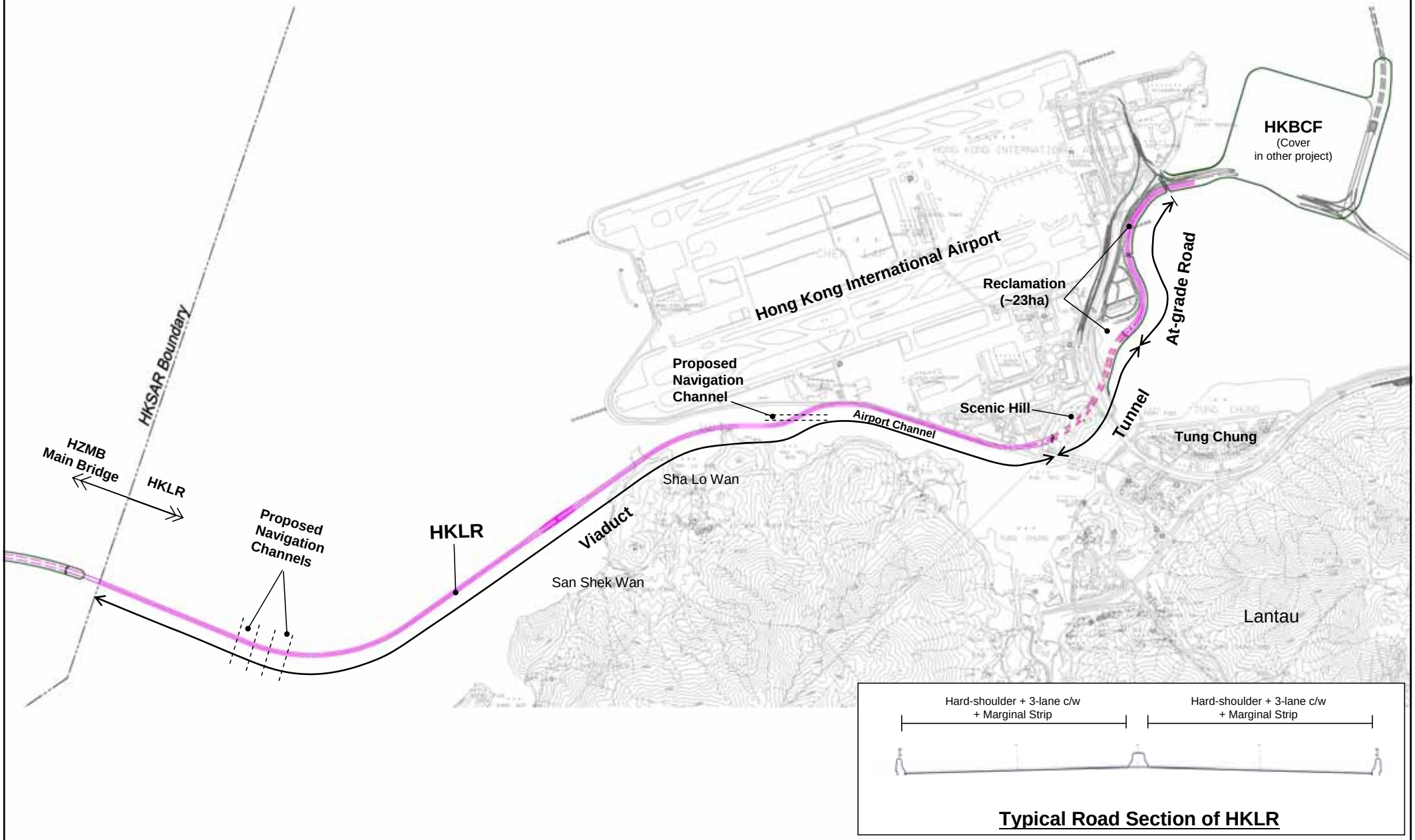


Figure 3.1 – Overall Layout of HKLR

ARUP

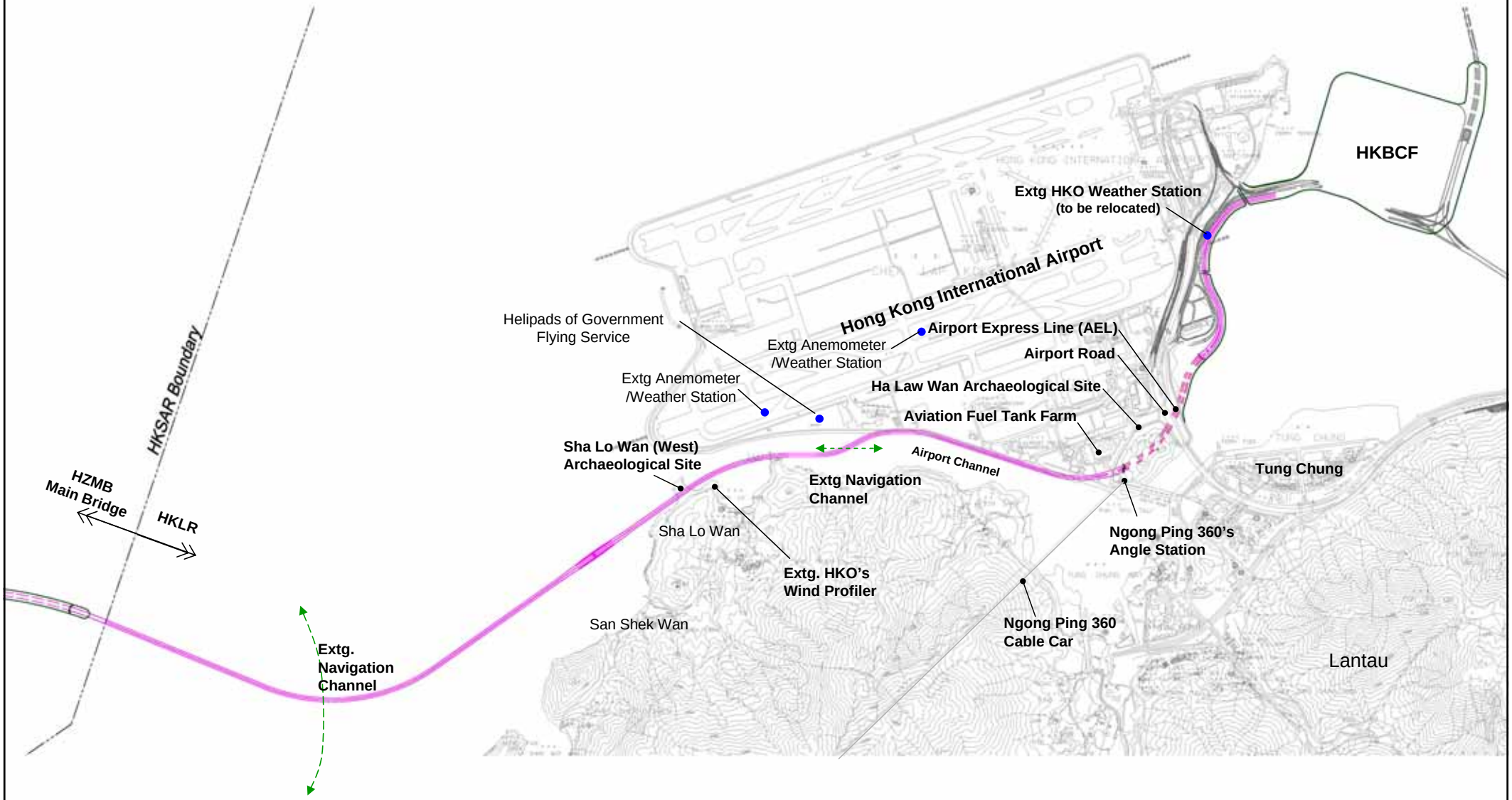


Figure 5.1 – Development Constraints – Sheet 1 of 2

ARUP

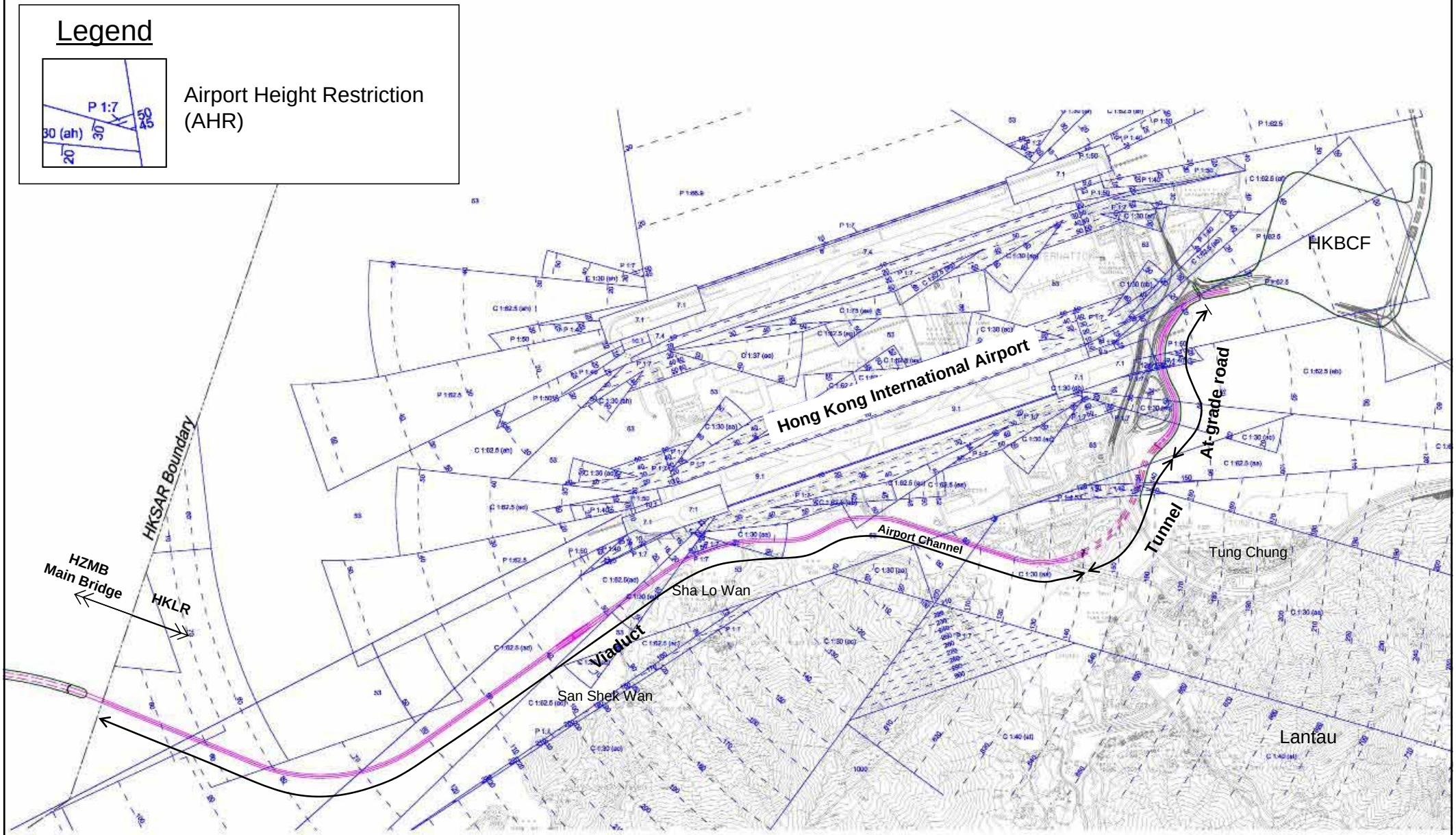


Figure 5.2 – Development Constraints – Sheet 2 of 2

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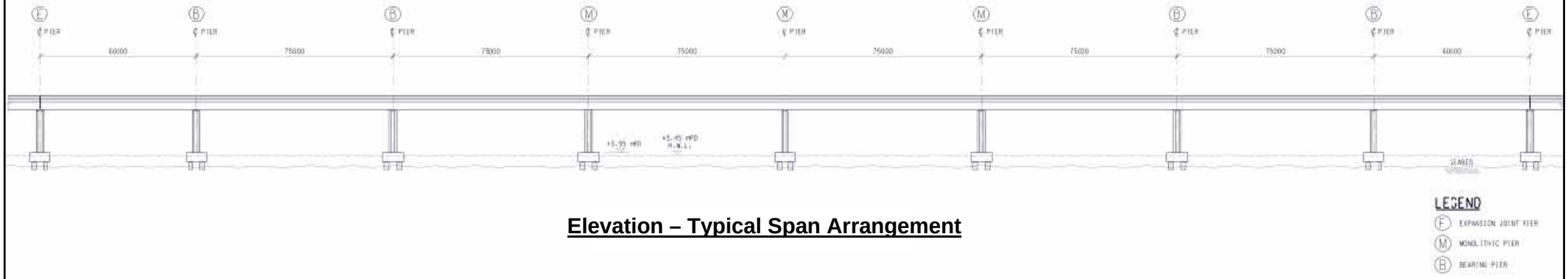
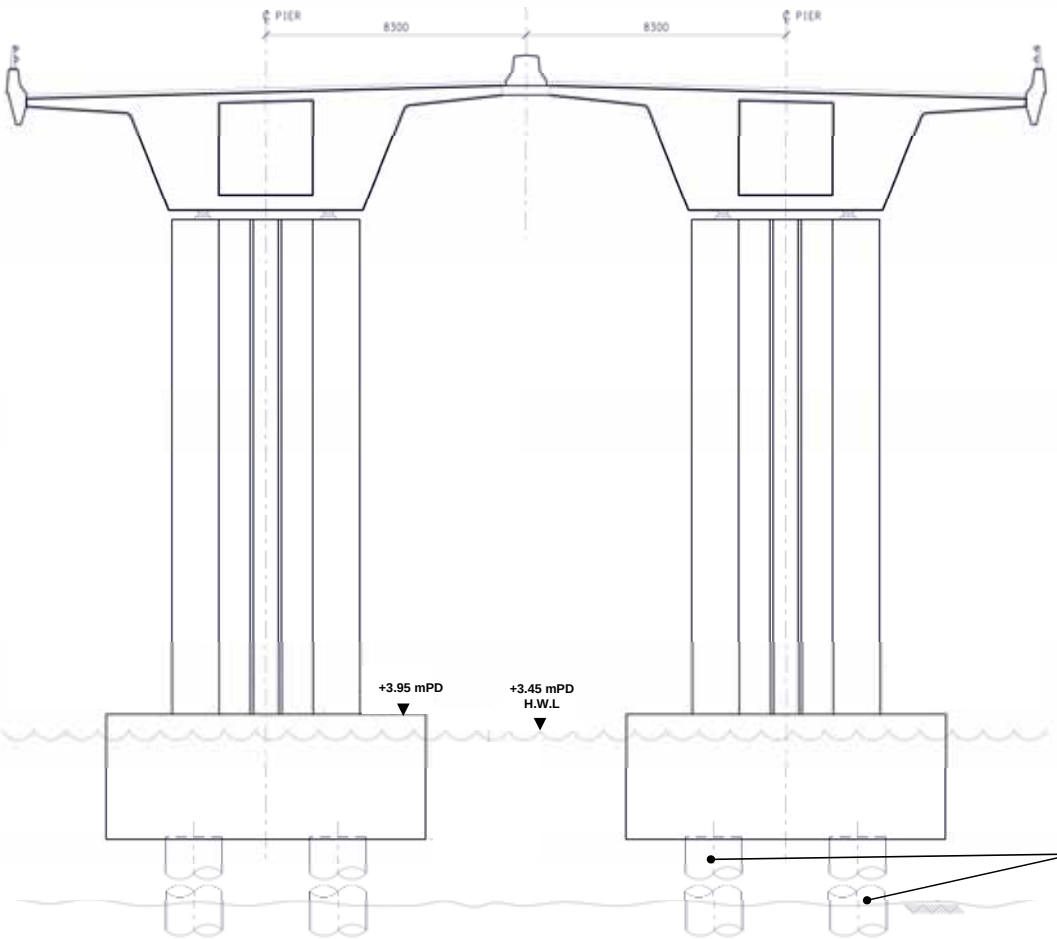


Elevation – Typical Span Arrangement

LEGEND
- (E) EXPANSION JOINT PIER
- (M) MONOLITHIC PIER
- (B) BEARING PIER



Typical Pier Section

Figure 6.1 – Typical Layout of Sea Viaduct of HKLR

ARUP

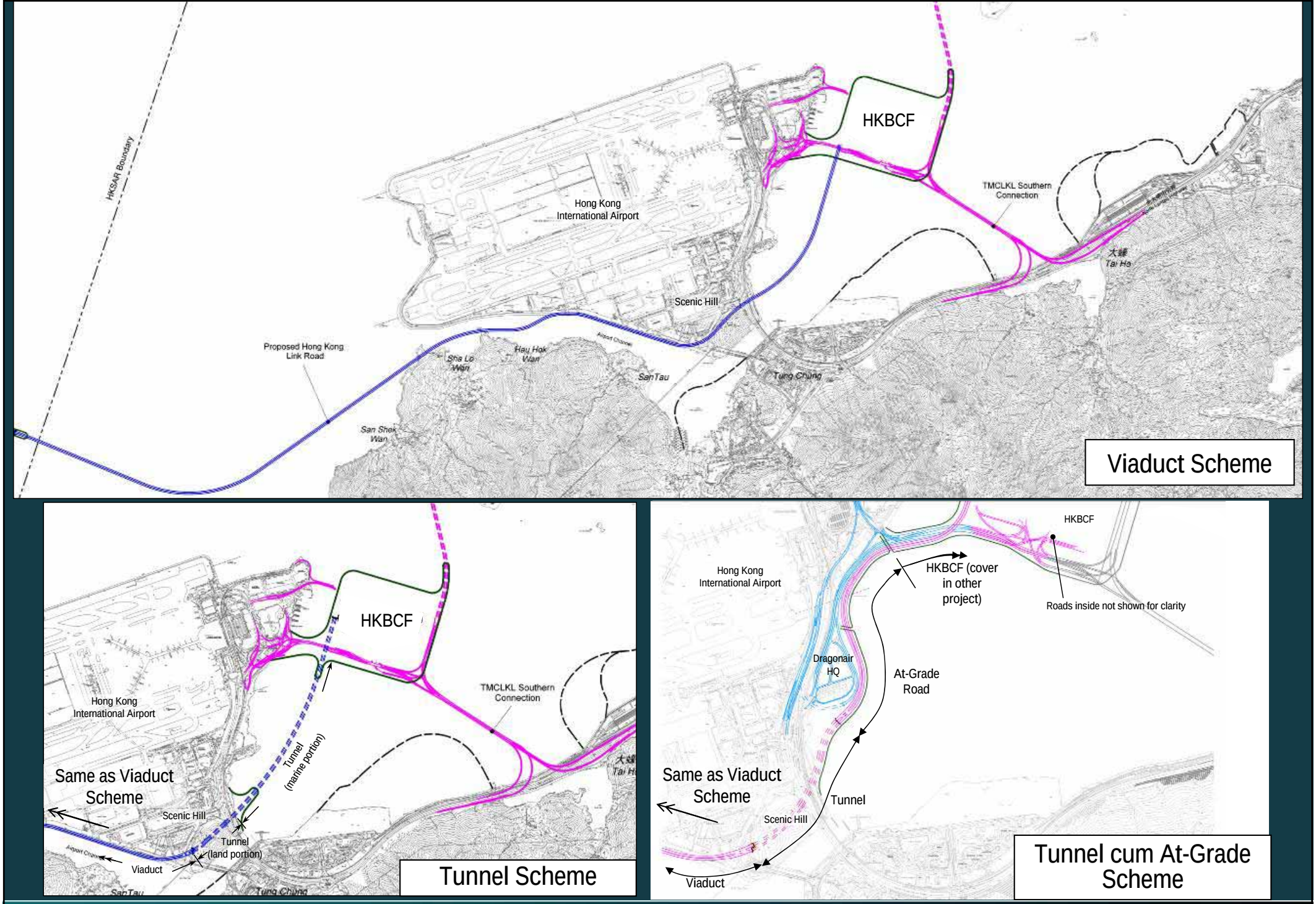


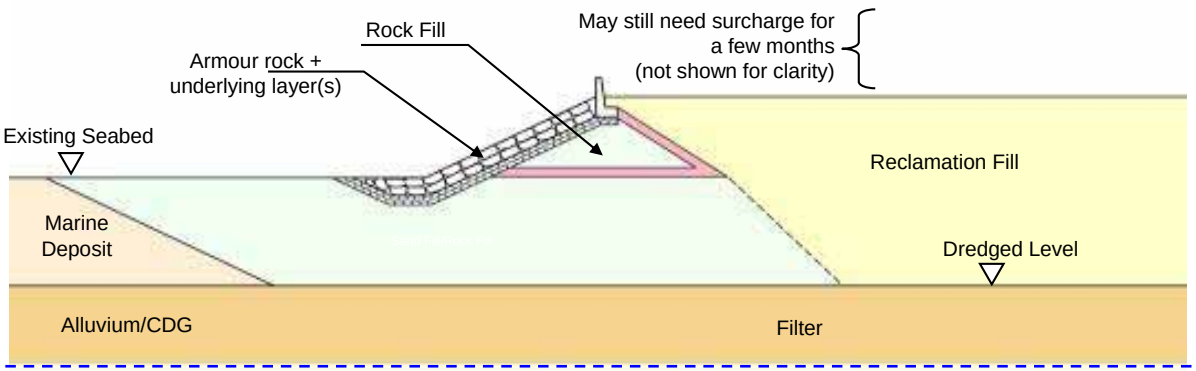
Figure 6.2 – Alignment Options for the Eastern-most Portion of HKLR

ARUP

Seawall Method

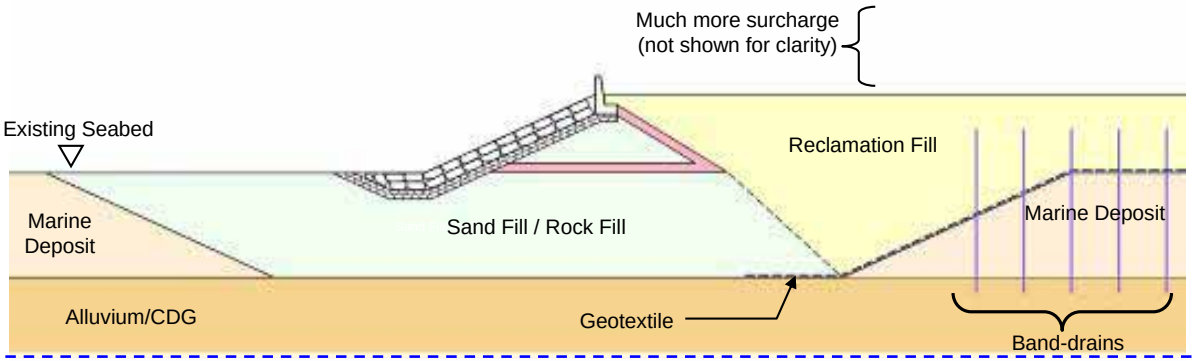
Reclamation Method

Fully-dredged Seawall



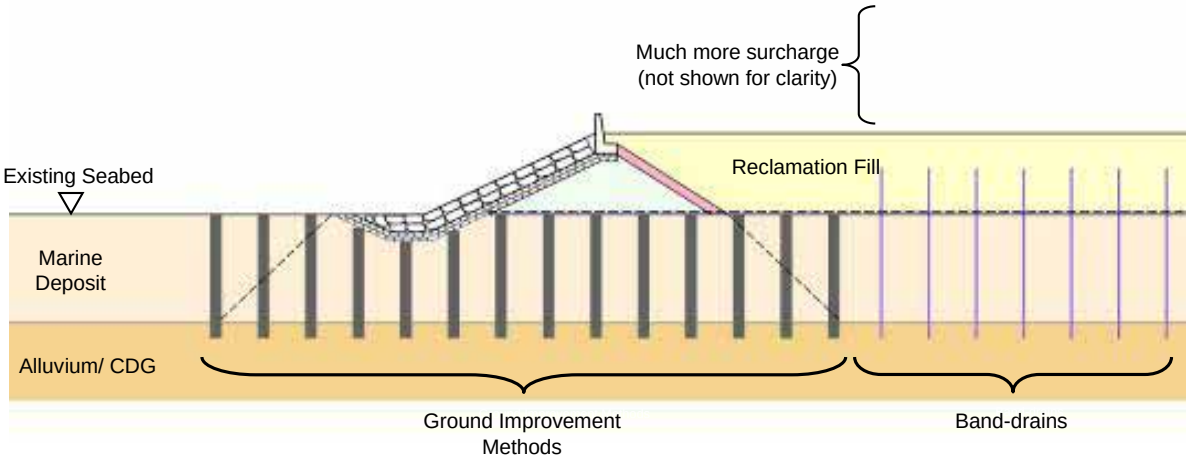
Fully-dredged Reclamation

Fully-dredged Seawall



Non-dredged Reclamation (with Band Drains)

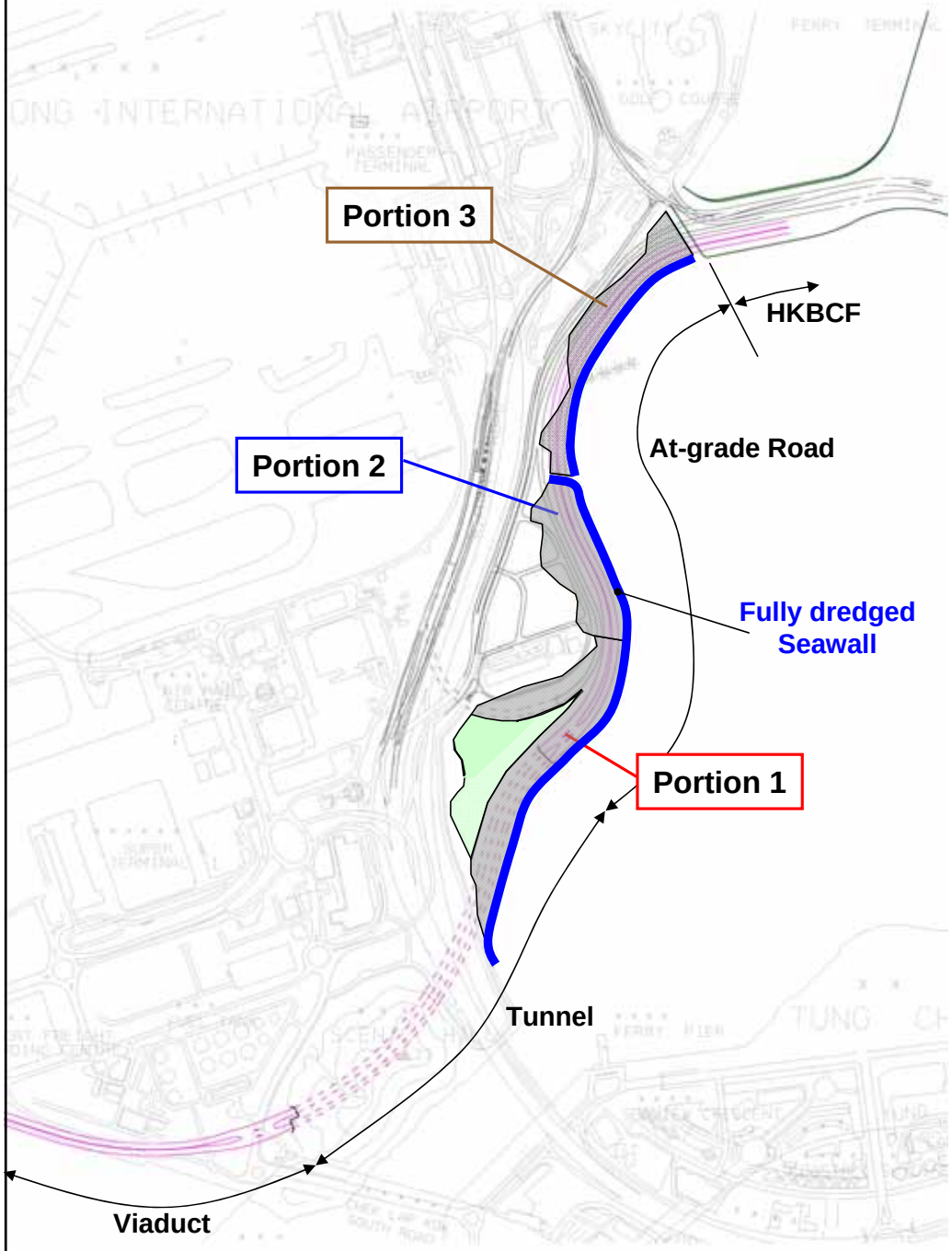
Non-dredged Seawall with Ground Improvement Method



Non-dredged Reclamation (with Band Drains)

Figure 6.3 – Typical Sections of Dredged & Non-dredged Seawalls/Reclamation

ARUP



Seawall – Fully Dredged

Reclamation:

Portion 1
- Fully dredged at seawall and tunnel area
- Non-dredged at other area

Portion 2 - Fully Dredged
Portion 3 - Fully Dredged

Fully dredged

Non-dredged (with Band Drains)

Figure 6.4 – Reclamation Layout of HKLR

ARUP

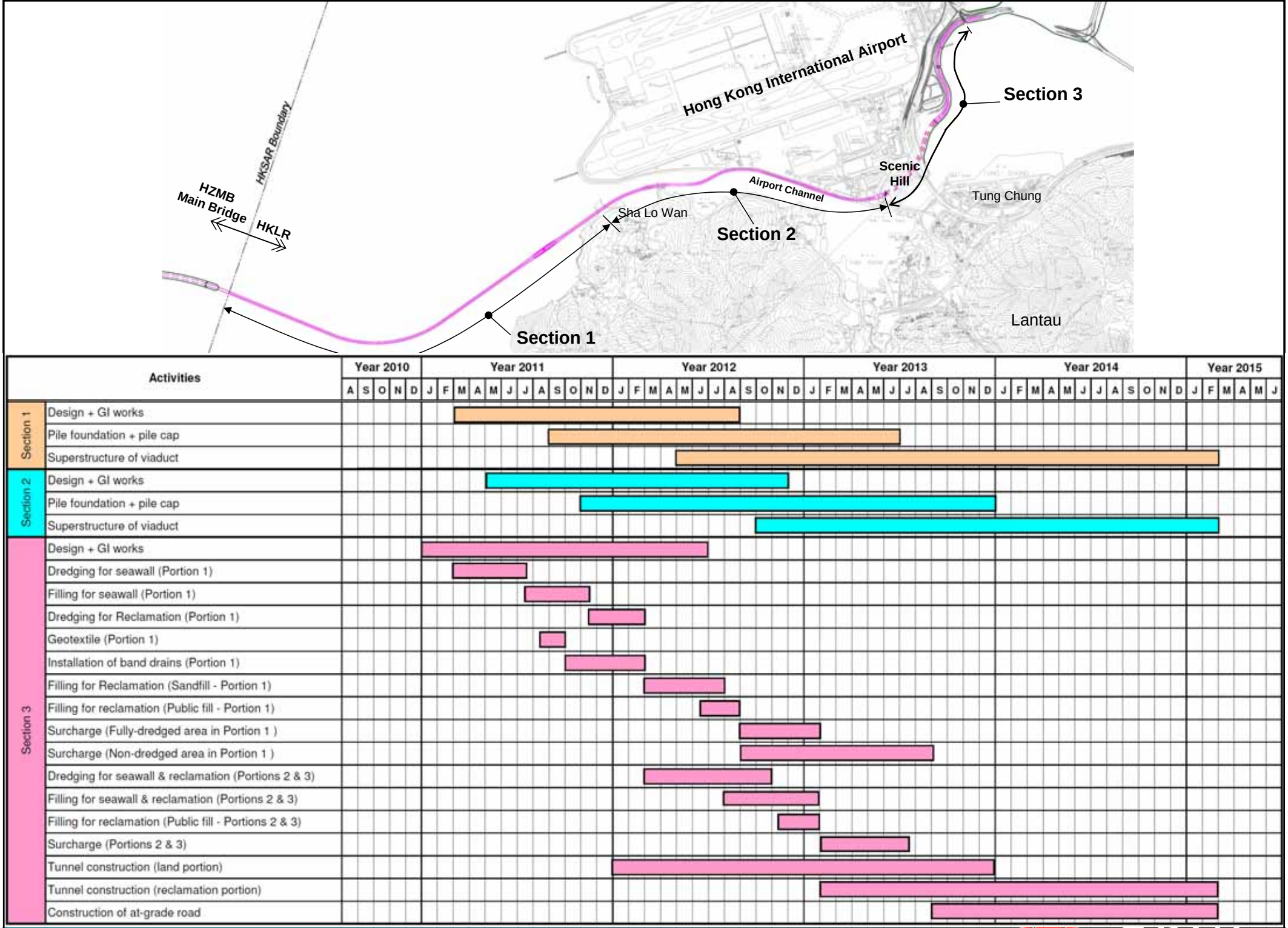


Figure 6.5 – Envisaged Programme for HKLR

APPENDIX 8B

HKBCF – Construction & Demolition Materials Management Plan

Highways Department of HKSAR

Agreement No. CE 14/2008 (CE) Hong Kong-Zhuhai-Macao-Bridge
Hong Kong Boundary Crossing Facilities – Investigation

2nd Revised Construction and Demolition Material Management Plan

Rpt Ref. 054-03

Contents

Appendices

Figures

1 PURPOSE

1.1 In accordance with ETWB Technical Circular No. 33/2002, a Construction & Demolition Materials Management Plan (C&DMMP) should be prepared and submitted to Public Fill Committee (PFC) for approval for projects classified as designated projects under Schedule 2 of the EIAO, which generate more than 50,000m³ of construction and demolition (C&D) materials including rock or that requiring import fill in excess of 50,000m³. Hong Kong Boundary Crossing Facilities (HKBCF) is a designated project under the EIAO. In addition, it requires a total fill volume of more than 40 million m³ (bulked volume). Therefore, approval of C&DMMP by PFC is required.

1.2 The purpose of this C&DMMP is to introduce measures to minimize C&D materials generation and to maximize reusing the C&D materials generated within the project. The C&D materials are surplus materials arising from any land excavation or formation, civil/building construction, roadwork, building renovation or demolition activities. They comprise the materials of rocks, concrete, asphalt, rubbles, bricks, stones, timber and earth. As the marine deposit does not belong to the above materials, the proposed arrangement to deal with dredged marine deposit in this project will be submitted and agreed separately with the Marine Fill Committee. Therefore, the details of the dredge marine deposit are not covered in this C&DMMP.

2 BACKGROUND OF THE DEVELOPMENT

2.1 In the 8th Hong Kong-Zhuhai-Macao Bridge (HZMB) Advance Work Co-ordination Group meeting on 28 February 2008, the government of HKSAR (HKSARG), Guangdong Province and Macao Special Administrative Region agreed to build their own boundary crossing facilities and link roads within their respective territories. Therefore, the HKSARG will need to provide the Hong Kong Boundary Crossing Facilities (HKBCF) as well as the Hong Kong Link Road (HKLR) within Hong Kong to connect with the HZMB Main Bridge.

2.2 In May 2007, Highways Department commissioned a Site Selection Study (Consultancy Agreement No. CE 7/2007) for searching a suitable location of HKBCF within Hong Kong territory. The study was completed in early 2008 and it recommended locating HKBCF at the north-east waters of the Airport as a first priority option. The current Investigation Study for HKBCF commenced in July 2008 has also recommended locating HKBCF at the north-east waters of the Airport and developed the layout of HKBCF based on this recommended site. The Investigation Study is on-going to work out the details to such an extent to enable the Project to proceed to detailed design and construction stages.

3 SCOPE OF THE PROJECT

3.1 The proposed layout of HKBCF is shown in **Figure 3.1**. The scope of HKBCF project comprises, but not limited to the following:

(a) Reclamation to provide land of about 130 ha for the development of HKBCF. It should be noted that reclamation of about 20 ha for the Southern Landfall of Tuen Mun Check Lap Kok Link (TMCLKL) will be provided next to HKBCF. The issues related to reclamation and infrastructure at this area will be addressed separately under TMCLKL project.

(b) Cargo processing facilities including kiosks for clearance of goods vehicles, customs inspection platforms, X-ray building, etc.

(c) Passenger related facilities including processing kiosks and examination facilities for private cars and coaches, passenger clearance building, etc

(d) Accommodation for and facilities of the frontline departments including a police operation base with an observation tower, fire station cum ambulance depots and other buildings/facilities.

(e) Provision of Public transport interchange, and transport drop-off and pick-up areas.

(f) Other peripheral structures and supporting facilities such as vehicle holding areas, passenger queuing areas, road networks, footbridges, fencing, sewage and drainage systems, water supply system, utilities, electronic system, and traffic control, surveillance and information system, etc.

(g) Provision of Automated People Mover (APM) to serve the transit passengers between HKBCF and the Airport.

(h) Provision of road access for connection of HKBCF to HZMB Hong Kong Link Road, TMCLKL and Airport.

(i) Landscape works.

4 IMPLEMENTATION PROGRAMME

4.1 Currently, it is targeted to commence the construction works of HKBCF in 2010. The completion date of HKBCF will need to match the HZMB Main Bridge. The HZMB Main Bridge is now endeavoured to commence the construction works in 2009 and is expected to be completed by 2015. In order to tie in with the HZMB Main Bridge, HKBCF needs to be completed with sufficient parts by 2015 for the commissioning of HZMB.

4.2 As there is an extremely tight programme for HKBCF, it has been planned that the HKBCF should be completed in 2 phases – Phase 1 (which will be large enough for facilities to handle the first few years of operation of HZMB) and then Phase 2 (for facilities to handle long term need at HKBCF). Phase 1 is to be completed in 2015 and Phase 2 is to be completed in 2016. An outline phasing demarcation of HKBCF is shown in **Figure 4.1**.

4.3 It has been planned that HKBCF will be implemented under two contracts: reclamation contract and infrastructure contract. In view of the reclamation construction sequence, the reclamation works need to be carried out first, before the BCF infrastructure works could start. This implementation strategy would allow the early commencement of the reclamation contract as it is not necessary to wait for the completion of the design for the infrastructure works, which is time-consuming due to the involvement of many end-users. Therefore, there is programme benefit to implement the HKBCF project under the reclamation contract and infrastructure contract.

5 DEVELOPMENT CONSTRAINTS

5.1 The preferred site option of HKBCF is based on the reclamation at the north-east waters of the Airport. One of the major advantages of this option is that it can afford synergetic benefit for transit passengers (i.e. hassle free arrangement for air-land transit passengers) between HKBCF and the Airport). It could also provide a better road connection with the Airport and TMCLKL. In addition, the recommended site is located in the area which is developed and away from the Chinese White Dolphins active area when compared to other options. Therefore, this option of locating HKBCF at the north-east waters of the Airport would result in less environmental impacts than other site locations.

5.2 Although there are advantages of locating HKBCF at the north-east waters of the Airport, the major development constraints that need to be considered in this project are shown in **Figures 5.1 and 5.2** and summarized as follows:

(i) The HKBCF will need to match the HZMB Main Bridge. Therefore, it is essential to design the method of reclamation and infrastructure that could meet the programme requirements.

(ii) The Airport is a major development in the vicinity of HKBCF. The proposed layout of HKBCF should avoid/minimise impact on both the existing and future development layout of the Airport.

(iii) The HKBCF development must avoid infringing the Airport Height Restriction (AHR) during both construction and operation stages. The zone around the runway is particularly critical as the AHR contours there are particularly low.

(iv) The operation of East Sea Rescue Station of FSD, SkyPier and Marine Cargo Terminal at the north-east corner of the Airport shall be maintained throughout the construction and operation phases.

(v) There are 3 existing submarine telecommunication cables (2 nos. for HGC and 1 no. for NWT) connecting between Tuen Mun and Airport Island across the Urmston Road. The proposed HKBCF development will inevitably conflict with the submarine telecommunication cable and therefore require diversion.

(vi) The marine access of Tung Chung Navigation Channel to/from Tung Chung and Airport Channel needs to be maintained. The proposed HKBCF development should avoid encroaching upon or affecting the operation of Tung Chung Navigation Channel.

(vii) Contaminated mud pits are found at the east of Sha Chau (i.e. at north of Airport Island) with one of them still in operation. In addition, seven numbers of proposed contaminated mud pits will fail in the vicinity of HKBCF, with four of them located at the east of Sha Chau and the remaining three at South of Brothers. The site options of HKBCF should avoid encroaching upon these mud pits.

(viii) Sufficient distance should be provided between HKBCF and Tai Mo To to minimise the impact on navigation safety and the hydrodynamic impact on the deep-waters adjacent to Tai Mo To.

5.3 The measures to overcome the development constraints including the following:

(a) Appropriate construction method for HKBCF will be considered to meet the programme requirements.

(b) Close liaison with the Airport Authority Hong Kong on the interface issues between HKBCF and the Airport to avoid/minimise the impact on both the existing and future development layout of the Airport.

(c) High building and construction plant for HKBCF is avoided in order to avoid infringing the AHR. Close liaison with the Civil Aviation Department and Airport Authority Hong Kong will be made to ensure aviation safety will not be affect by the HKBCF development.

(d) Close liaise will be made with the relevant utility undertakers to divert the existing submarine telecommunication cables before the commencement of reclamation works in HKBCF.

(e) In designing the layout of HKBCF, sufficient distance will be provided between HKBCF site and the adjacent existing/planned features such as East Sea Rescue Station of FSD, SkyPier and Marine Cargo Terminal at the north-east corner of the Airport, Tai Mo To, Tung Chung Navigation Channel and proposed contaminated mud pits at east of Sha Chau and South of Brothers.

6 DEVELOPMENT OPTIONS

6.1 Reclamation Footprint

6.1.1 Various reclamation footprints of HKBCF have been considered. For the seawall, it can either take the sloping or vertical form. The following criteria have been considered in selecting the seawall form:

- The appearance of vertical seawall is more artificial as it uses the concrete blocks rather than the natural stone in the sloping seawall. To minimize the visual impact, sloping seawall should be used as far as practicable.
- The ecological value of sloping seawall is larger than the vertical seawall.
- Construction cost of vertical seawall is higher than sloping seawall and therefore the vertical seawall should only be considered where there is requirement of berthing or cargo handling.

As the HKBCF reclamation area is accessible abundantly by land transport, there is no substantial need for berthing of vessels. Accordingly, the seawall along HKBCF's periphery will substantially be sloping seawall with rock-armour surface, as this type of seawall is generally more cost-effective and performs well in wave adsorption, whereas the vertical type of seawall is usually adopted only if there is a need for berthing of vessels. (At detailed design stage, the need for berthing may arise, but it is not anticipated that the extent involved will be significant, i.e. at most this will lead to some local short sections of vertical seawalls.)

6.1.2 The overall reclamation footprint of HKBCF is shown in **Figure 3.1**. The size of reclamation is about 130ha. There is not much room to change the reclamation footprints of HKBCF due to the operation requirements of BCF and the development constraints such as AHR and the existing/planned features mentioned in Section 5 above. Therefore, this C&DMMP will mainly discuss the recommended reclamation method of HKBCF with a view to minimize C&D materials generation and to maximize reusing the C&D materials generated within the project or from other sources.

6.1.3 Apart from the reclamation, the following items of works in HKBCF will also involve dredging and filling. Although the scale of these works is much less than the main reclamation of HKBCF, they will be covered in the following Sections of this C&DMMP.

(i) About 450m marine portion of APM tunnel between HKBCF and Airport which will be constructed by the Immerse Tube Method.

(ii) Reprovision of the East Sea Rescue Station of FSD as it is in conflict with the proposed alignment of APM.

6.2 Construction method of seawalls

6.2.1 The seawall is a retaining structure to protect the reclaimed fill. Both the dredged and non-dredged options of seawall have been considered for the HKBCF. Typical section of the dredged and non-dredged seawall is shown in **Figure 6.1.**

6.2.2 The design of seawall should achieve a minimum Factor of Safety to ensure the stability against the slip failure and provide adequate bearing capacity to support the seawall without significant settlement. Based on the available ground investigation results, preliminary assessment of the seawall stability and settlement is summarised in the following table:

	Evaluation Results	
	Dredged Option	**Non-dredged Option (without ground improvement)**
Stability Assessment – in terms of Factor of Safety	Min. 1.42 > 1.3 (OK)	Max. 0.33 << 1.3 (Failed)
Settlement Assessment – in terms of Total Residual Settlement (mm)	Max. 485mm < 500mm (OK)	Min. 3000mm >> 500mm (Failed)

6.2.3 From the above assessment, it was found that the non-dredged option without ground improvement fails to provide sufficient stability and settlement control to the seawall. As a common practice, full-dredging is adopted for forming the seawall base so as to ensure the stability and minimise the settlement of the seawall. However, it is important to consider the feasibility of non-dredged option with ground improvement measure for the seawall with a view to minimize the dredging of the marine deposit.

6.2.4 For the non-dredged option with ground improvement measure for seawall, the use of band drains and surcharge is considered to be inadequate as it could not improve the shear strength of marine deposit to ensure the seawall stability. The use of Sand Compaction Pile (SCP) and Deep Cement Mixing (DCM) as the seawall foundation was adopted in some overseas projects. However, there is no track record of the application of SCP and DCM in Hong Kong. The feasibility to adopt SCP or DCM for the seawall foundation will be discussed in the following Sections.

6.2.5 DCM is an applied chemical solidification technique which inserts and mechanically mixes cementing agents with soft soils to create a stiff soil-cement mix. However, it is important to note that the marine application of DCM may result in possible leakage of cement grout into the surrounding waters during the mixing process and this would cause adverse environment impacts. For the land application of DCM after the seawall is constructed, there are difficulties for DCM to penetrate through the rockfill in seawall core. In view of the above, it is considered that application of DCM is not suitable for the seawalls in HKBCF.

6.2.6 SCP is considered to be one of the effective ground improvement methods for the seawall structure on soft marine deposit. This is because SCP can increase the shear strength of ground by installing well compacted sand piles in the ground and stabilizes the seawall structure. Although there is lack of track record in the application of SCP in Hong Kong, the use of SCP as the seawall foundation has been widely adopted in Japan and Korea reclamation projects.

6.2.7 It is important to note that the application of SCP is subject to some site constraints. As the HKBCF is located next to the Airport Island, the Aviation Height Restrictions (AHR) would impose constraint to the working height of SCP plant. According to the information from SCP contractor, the minimum height of SCP plant is 40m above the sea level. Allowing for safety margin, SCP is applicable only to the seawalls where the AHR contour is +45 mPD or above.

6.2.8 Another important issue of SCP is the up-heaving of seabed after installation of SCP. In the shallow water, the up-heaved seabed may affect the operation of the SCP barges as well as other vessels. In HKBCF, the seabed is about -3 mPD to -10.5 mPD. With the consideration of lower replacement of SCP to reduce the effect of up-heaving, the seabed level should be -6 mPD or below so as to have adequate water depth to ensure the proper operation of SCP barge without affecting by the up-heaving of seabed.

6.2.9 In considering the above constraints, the non-dredged method of SCP could only be applied at the seawalls located at the northern edge of HKBCF site in Phase 2. The extent of seawalls without restrictions on the use of SCP is shown in **Figure 6.2**. It should also be

noted that SCP is required to be mobilized from overseas as the SCP is new to local contractors. According to the information from the overseas SCP contractor, their plant are currently working in Japan and Korea and they would require about 1 year advance notice for booking their plant to work in Hong Kong. The 1 year advance notice includes the mobilization time and travelling time of their plant to Hong Kong. This should be taken into account in considering whether the adoption of SCP could meet the programme requirements of HKBCF.

6.2.10 For the environmental performance of SCP, it serves to reduce the amount of dredging, hence reducing the amount of seawall-filling too. Therefore, it should constitute an improvement to the conventional fully dredged method. Nevertheless, after discussions with EPD, it is considered that a full-scale trial may be required for SCP to establish the viability of SCP. The full-scale trial cannot be accommodated in the construction programme of HKBCF. Therefore, SCP may be worth considering for the portion of seawall mentioned in 6.2.9 above provided that the following issues can be overcome:

(a) That further data could be obtained to obviate the need for a trial such as arrangement of water quality monitoring under a relevant overseas project;

(b) That the actual mobilization time of the SCP plant will enable the method to be applicable to a significant proportion of HKBCF's seawalls.

For item (b) above, the feasibility to adopt SCP in HKBCF will be further discussed together with the envisaged programme of different reclamation options in Section 6.3 below. .

6.3 Reclamation options of HKBCF

6.3.1 Both the dredged and non-dredged options of reclamation have been considered for the HKBCF. Typical section of these two reclamation options is shown in **Figure 6.1**.

6.3.2 In the fully dredged reclamation method, dredging will be carried out to remove the marine deposit until to a firm stratum, commonly the alluvial layer. This serves to eliminate post-reclamation settlement due to consolidation of soft material deposit layer. Instead of dredging the marine deposit, the non-dredged reclamation method will leave the marine deposit in place, but will add measures to prevent the occurrence of mud wave, and to accelerate consolidation of the marine deposit so as to mitigate the risk of excessive post-reclamation settlement. These measures will include:

- Laying of geotextile and sand blanket over the marine deposit;
- Installation of band drains to accelerate consolidation of marine deposit;
- Placing the reclamation fill in thin layer with adequate leading edge to prevent the occurrence of mud wave; and
- Surcharging.

6.3.3 Two reclamation options are formulated and they are referred to as Sequence A and Sequence B as described below:

- Sequence A – Fully-dredged at seawalls and reclamation areas critical to completion.
- Sequence B – Minimize the fully-dredged areas.

6.3.4 The reclamation layout of Sequence A is shown in **Figure 6.3**. In Sequence A, the non-dredged method with band drains and surcharge is assumed except the following areas where the fully-dredged method is required:

1) Seawall areas – full-dredging of seawall trench is required to ensure the seawall stability. However, the non-dredge method of SCP will be considered at the northern edge of HKBCF site in Phase 2 as discussed in Sections 6.2.9 and 6.2.10 above.

2) Critical reclamation areas and temporary seawalls – There is a very tight programme to complete the Passenger Clearance Building (PCB) in Portion A and other Government buildings in Portion B of HKBCF due to the long period of testing and commissioning required for the facilities in these buildings. In this option, fully-dredged method is assumed in Portions A and B to assess the programme benefit by fast tracking the reclamation works. In addition, temporary seawall as shown in **Figure 6.3** is proposed in order to enable early commencement of filling in Portions A & B by protecting the reclaimed fill from the wave action.

3) Portion D – This area is to provide land for main roadlink connecting to Airport Island. The reclamation area is narrow in shape and the dredged trench for the seawall at both sides of Portion D nearly overlap each other. Therefore dredged reclamation is adopted in Portion D.

4) Automatic People Mover (APM) station and tunnel – APM station and tunnel are underground structures and the dredging of marine sediment at these areas is required to avoid the stability and seepage problems due to deep excavation in the soft materials during the construction of these structures after the land is reclaimed.

6.3.5 Different to Sequence A, Sequence B minimize the fully dredged areas and use the non-dredged reclamation method with band drains and surcharge in HKBCF as far as practicable. In this way, the reclamation method of Portions A & B is changed from fully-dredged to non-dredged. In addition, no temporary seawall for phased reclamation is assumed in this option. However, the fully-dredged method for permanent seawall areas, Portion D, APM station and tunnel remains unchanged for the reasons stated in Section 6.3.4 above. The reclamation layout of Sequence B is shown in **Figure 6.5**.

6.3.6 In Sequence B, sufficient length of seawall as highlighted in **Figure 6.5** needs to be constructed first to protect the filling against the wave action mainly from the north-west and north-east directions. Therefore, the seawall at the northern edge of HKBCF site, where there is no constraint on the use of SCP, becomes critical in programme so as to enable the filling at Portions A and B in HKBCF Phase 1 as soon as possible. As mentioned in Section 6.2.9 above, 1 years advance notice from the commencement of the Works is required for booking the SCP Plant to work in Hong Kong. The long mobilization period of SCP would cause delay to the project in this case. Therefore, the fully-dredged method is assumed for all seawalls in Sequence B.

6.3.7 The estimated volume of marine deposit to be dredged, weight of C&D materials generated and weight of imported fill in Sequences A and B is summarized in the following table:

Option	Bulk Volume of Marine Deposit to be Dredged (million m³) [1]	Weight of C&D materials generated (million tonnes) [2]	Weight of imported fill materials (million tonnes) [2], [3]
Sequence A	29.00	7.41 [4]	86.87
Sequence B	17.80	7.41 [4]	69.17

Notes:

1. *For the quantity of dredging, a bulking factor of 1.3 is applied. The quantity of dredging does not include the excavated muddy soil mentioned in Section 7.5.2 below.*
2. *The quantities of C&D materials and fill materials are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
3. *Fill materials include sand fill, public fill, rock fill, seawall armour and surcharge.*
4. *C&D materials would be generated mainly from the infrastructural works and therefore there is no difference between Sequence A and B. The C&D materials in the above table also include the last stage of surcharge which is about 4.5 million tonnes. This surcharge material is imported public fill and it become surplus after the last stage of surcharging.*

6.3.8 A brief review on the construction programme of Sequences A and B has been carried out. Assuming that the construction of HKBCF would commence in August 2010, the anticipated completion date of HKBCF Phases 1 and 2 in each reclamation option is given below:

Option	Anticipated Completion date of HKBCF Phase 1	Anticipated Completion date of HKBCF Phase 2
Sequence A	Dec 2014	Oct 2016
Sequence B	Dec 2015	Oct 2016

The envisaged construction programme of Sequences A and B is shown in **Figures 6.4 and 6.6** respectively. The assumed construction rates and the period allowed for the surcharging and the infrastructure works of HKBCF are attached in **Appendix A**.

6.3.9 Sequence A has significant programme advantage than Sequence B as the commissioning of HKBCF Phase 1 would be one year earlier. This is achieved by adopting the fully-dredged method at the critical reclamation areas of Portions A and B in HKBCF Phase 1 and the provisions of temporary seawalls to enable early commencement of filling in these critical reclamation areas. However, additional dredging and filling are required in Sequence A to expedite the reclamation works.

6.3.10 Although a longer construction time is required in Sequence B for HKBCF Phase 1 due to the non-dredge method, it still meets the current targeted commissioning date of HKBCF Phase 1 in 2015. In order to minimize the dredging and disposal of marine deposit, Sequence B is considered to be the preferred option for HKBCF reclamation. As the completion of HKBCF will need to match the HZMB Main Bridge, the reclamation method of HKBCF will be reviewed closely.

6.3.11 In view of the above, the estimated quantities of dredging and filling works in the following Sections of this C&DMMP will base on Sequence B of HKBCF reclamation.

6.4 Reclamation fill options

6.4.1 The use of sandfill and public fill as the reclamation material has been considered. Sandfill has the advantage that the material is quite uniform and the residual settlement due to creeping of fill material could be easily controlled within an acceptable limit without scarifying the implementation programme.

6.4.2 For public fill, strict site control is necessary to ensure that the public fill does not contain unsuitable material such as oversized boulder, rubbish, topsoil with organic matter. In general, the grading of public fill is much more variable than that of sandfill and this lead to longer time to achieve the required limit of residual settlement due to creeping of fill material.

6.4.3 It should also be noted that there is programming advantages to use sandfill as vibrocompaction could be carried out to reduce the surcharge period required for the reclamation. For public fill, it would be impracticable for the vibrocompaction to penetrate through the public fill.

6.4.4 The residual settlement comprises residual consolidation (primary and secondary) settlement of soft marine deposit and alluvial clay and residual creep settlement due to fill material. The amount of creep settlement contributes as one of the major component of the total residual settlement and hence the use of sandfill and public fill will be one of the control factors for the control of residual settlement.

6.4.5 A residual settlement limit of 500mm is proposed for the proposed reclamation of HKBCF based on the following considerations:

1) Allowable settlement of utilities at piled structure/pavement interface
2) Allowable settlement of utilities at existing airport island/new reclamation interface
3) Long term function of underground drainage system
4) Integrity of buildings on shallow foundation
5) Integrity of the roadwork pavement

6.4.6 The amount of sandfill and public fill to be used in the reclamation should be aimed to achieve the required residual settlement limit of the project. Four options of reclamation filling: completely use of public fill, completely use of sandfill, use of sandfill below +1.50mPD & public fill above +1.50mPD, use of sandfill below +2.50mPD & public fill above +2.50mPD, have been evaluated.

6.4.7 The majority of reclamation area in Sequence B would be carried out by the non-dredge reclamation method. Based on the available ground investigation results, preliminary assessment of residual settlement of non-dredged reclamation method under Sequence B is summarized in the following table:

Options (Non-dredged reclamation with sandfill/ public fill)	Max. thickness of MD (m)	Max. thickness of alluvial clay (m)	Max. residual settlement (mm)
All public fill	28	33	680
All sandfill	28	33	440
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	28	33	530
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	28	33	455

Note:
1. This assessment is carried out based on the GI information of HKBCF reclamation where non-dredged reclamation option is adopted.
2. 1m spacing band drain through the marine deposit, 8m high surcharge and 9 months surcharge period is assumed.
3. The vibrocompaction needs to be carried out at +2.5mPD above the sea level. The use of public fill below +2.5mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.8 For the dredged areas such as seawall trench, the preliminary estimated residual settlement of different reclamation fill options is summarized in the following table:

Options (Fully-dredged reclamation with sandfill/ public fill at the back of Seawall)	Max. thickness of alluvial clay (m)	Max. thickness of sandfill / public fill (m)	Max. residual settlement (mm)
All public fill	33	0 / 32	780
All sandfill	33	32 / 0	430
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	33	28.5 / 3.5	520
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	33	29.5 / 2.5	445

Note:
1. This assessment is carried out based on the GI information of HKBCF reclamation where dredged reclamation option is adopted.
2. No surcharge is placed near the seawall due to the stability issue.
3. The vibrocompaction needs to be carried out at +2.5mPD above the sea level. The use of public fill below +2.5mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.9 From the above assessment, it was found that the options of using public fill as filling material and public fill above +1.50mPD fail to achieve the required residual settlement limit of 500mm. Both the options of sandfill and use of sandfill below +2.50mPD & public fill above +2.50mPD are capable to achieve the required residual settlement limit.

6.4.10 In order to maximize the use of public fill, the option of using sandfill below +2.50mPD and public fill above +2.50mPD is therefore adopted.

7 MANAGEMENT OF C&D MATERIALS

7.1 C&D Materials Quantities

7.1.1 The C&D materials generated from the HKBCF project will come from the following major items of works:

- Excavation for the shallow foundation of buildings;
- Excavation for the bored piles of viaducts, footbridges and other structures;
- Excavation for the basement structure of APM underground station in HKBCF; and
- Modification of existing roads in Airport Island for new roads connection.

7.1.2 In addition, substantial amount of filling materials would be imported for the construction of seawalls and reclamation. A breakdown of the estimated quantities of public fill and C&D waste generated and the filling material required in this Project is summarized in the following Sections.

7.2 Generated Public Fill Material

7.2.1 The estimated quantities of different types of public fill that generated from this Project is given in Table 7.1 below:

Table 7.1 Estimated Quantities of Public Fill Generated

Material	Weight (million tonnes)	Remarks
Phase 1		
Inert C&D Soft Materials	1.60	• Bored pile excavation for viaducts, footbridges and other structures. • Excavation for the shallow foundation of the buildings. • Excavation for the land portion of APM tunnel by cut-and-cover method.
Grade III or below rock	0.35	• Bored pile excavation (i.e. rock socket) for the viaducts, footbridges and other structures. • Excavation for the land portion of APM tunnel by cut-and-cover method.
Total for Phase 1:	**1.95**	
Phase 2		
Inert C&D Soft Materials	0.95	• Bored pile excavation for viaducts, footbridges and other structures. • Excavation for the shallow foundation of the buildings. • Excavation for the basement of APM underground station in HKBCF.
	4.5	• Materials generated from removal of surplus surcharge materials from the reclamation at last stage.
Grade III or below rock	0.01	• Bored pile excavation (i.e. rock socket) for the viaducts, footbridges and other structures.
Total for Phase 2:	**5.46**	
Total for Phase 1& 2:	**7.41**	

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The above quantities are estimated from ground investigation information currently available. These quantities will be reviewed when the foundation design of infrastructure works and the further ground investigation information are available in the detailed design stage.*

7.3 Recyclable Material

7.3.1 Recyclable material would be generated from excavating the existing bituminous carriageways in Airport Island. The excavated bituminous material will be disposed of at an asphalt recycling plant in Tuen Mun, which is capable to produce asphalt mixes using in excess of 50% Recycled Asphalt Pavement material from excavation. The estimated quantity of bituminous materials being excavated and recycled is about 18,000 tonnes or 10,000 m^3 (bulk volume) based on the insitu and bulk density of bituminous materials to be 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively.

7.4 Fill Materials for Seawalls and Reclamation

7.4.1 As discussed in Section 6.4 above, sandfill is proposed for the reclamation below +2.5mPD and public fill for the reclamation from +2.5mPD to the formation level in order to achieve the residual settlement limit.

7.4.2 Apart from the reclamation, additional materials is also required for the construction of seawalls. Sandfill and selected public fill (rock materials) are proposed for the filling of seawall trench. Discussions have been made with MTRCL as substantial C&D materials

would be generated from their new railway projects between 2010 and 2018. Apart from the public fill (soft materials), rock fill materials would also be generated from the tunnel excavation works in MTRCL's projects. The creep settlement of these public fill (rock materials) is expected to be similar to the sandfill and therefore it could be used together with the sandfill for filling the seawall trench and seawall core to achieve the residual limit of reclamation. According to the latest information from MTRCL, about 6.8 million tonnes public fill (rock materials) would be available during the construction of seawall in HKBCF (i.e. Early 2011 to Mid 2012). Based on the available information and recent discussions with MTRCL, it is proposed to use the above public fill (rock materials) for filling the seawall trench and seawall core in HKBCF subject to further discussions with MTRCL on the detailed arrangements of delivery of these materials to HKBCF.

7.4.3 Apart from the public fill (rock materials), the estimated quantities of public fill (soft materials) to be generated from MTRCL's railway projects is about 22 million tonnes between 2011 and 2016 according to the latest information from MTRCL. The public fill (soft materials) available from MTRCL's projects are more than that required in HKBCF from +2.5mPD to the formation level. In addition, there would be about 1.68 million tonnes of surplus C&D material to be generated from HKLR project in 2013 and 2014 and this material could also be reused as filling material in HKBCF. Detailed arrangement will be discussed with MTRCL and the project team of HKLR.

7.4.4 For the public fill (soft materials) to be used in the reclamation of this project, it should (besides meeting the general requirements for public fill) also comply with the requirements for General Filling material as stipulated in the General Specification for Civil Engineering Works.

7.4.5 For the public fill (rock materials) to be used in seawalls, it should (besides meeting the general requirements for public fill) also comply with the requirements of Grade 400 Rock Fill material as stipulated in the General Specification for Civil Engineering Works for the filling in seawall trench and seawall core.

7.4.6 The estimated quantities of filling materials required for the seawalls and reclamation of HKBCF is summarized in Table 7.2 below:

Table 7.2 Estimated Quantities of Filling Materials Required

Works	Weight (million tonnes)			
	Sand Fill	Public Fill (soft materials) (including Surcharge)	Public Fill (rock materials)	Armour
Reclamation	23.90	19.30(2)	--	--
Seawalls	19.52	--	7.15	1.50
Total	**43.42**	**19.30(2)**	**7.15**	**1.50**

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The public fill material to be imported includes the surcharge material. The disposal of last stage surcharge material is not included in the above table. The quantity of the disposal of last stage surcharge material is included in Table 7.1 above.*

7.4.7 The anticipated settlement of reclamation during the surcharge period is in average about 3m. The quantity of public fill in Table 7.2 above allows the additional fill taking account of the anticipated settlement. To maximize the use of public fill, the surcharge would be formed by public fill. After removal of the surcharge in each stage, the surcharge material

would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. Therefore, the quantity of surcharge material is included as public fill in the above table. However, the last stage surcharge materials would need to be disposed off site and the quantity of this disposal is given in Table 7.1 above.

7.4.8 Sandfill is assumed from various sources such as Mainland China. Public fill is assumed from the Fill Bank and other projects which generate substantial C&D materials. According to the latest information, there should be more than 10 million tonnes public fill (soft materials) available from the Fill Bank, 22 million tonnes public fill (soft materials) and 6.8 million tonnes public fill (rock materials) available from MTRCL's railway projects during the reclamation works of HKBCF. Arrangement will also be made to reuse the surplus C&D materials from HKLR and TMCLKL projects as far as practicable. Therefore, there should be sufficient supply of public fill from the above sources. Liaison with relevant parties such as CEDD and MTRCL is in progress to confirm the detailed arrangement of supplying the public fill materials to HKBCF.

7.5 C&D Wastes

7.5.1 For the Passenger Clearance Building (PCB) and other government buildings, steel formwork is assumed for the casting the standard sections such as columns and beams. However, it is considered that timber formwork will still be required for the non-typical sections of RC structures of these buildings. In addition, construction of some sections of the viaducts and footbridges are more effective by the in-situ method considering the site constraints and curvature of these structures. Preliminary estimate shows that the area of timber formwork, a source of C&D waste, required is 0.9 million m^2. Assuming the formwork could be reused for 3 times, the area of formwork required is 0.3 million m^2. For 19mm plywood, the volume of formwork being need in this project is 5,700m^3, say 6,000m^3

7.5.2 For the bored pile foundation of viaducts, footbridges and other structures located within the non-dredged areas of HKBCF reclamation, it is estimated that an average thickness of 20m soil excavated from the bored piles of these structures would be muddy in nature as the marine deposit at these areas had not been dredged. The total insitu volume of muddy soil spoil generated would be around 0.2 million m^3. Based on the current GI information, this muddy material (i.e. marine sediment) is classified as Category L sediment (i.e. Type 1 – Open Sea Disposal) and Mp sediment (i.e. Type 1 – Open Sea Disposal (Dedicated Sites)). As the excavated muddy material could not be reused as fill material and therefore they would be disposed together with the dredged Category L and Mp sediment from the reclamation works of HKBCF. However, if Category Mf or H sediment (i.e. Type 2 – Confined Marine Disposal) is found at the areas of above bored pile foundation in the detailed GI works to be carried, a review will be carried out to see if the Mf or H material excavated from bored piles needs to be disposed to the landfill site.

7.5.3 In view of the above, the total estimated insitu volume of C&D waste to be disposed due to the used timber formwork = 6,000m^3 (insitu volume). Assuming the insitu and bulk density of C&D waste is 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively, the total estimated quantity of C&D waste to be disposed is about 12,000 tonnes or 6,700 m^3 (bulk volume).

7.6 Disposal Programme for C&D Materials

7.6.1 An envisaged programme has been derived for the recommended option of HKBCF reclamation works based on Sequence B as shown in **Figure 6.6**. The tentative programme for the infrastructural works of HKBCF is also shown in this programme. This programme will be subject to further review as the project progresses.

7.6.2 It is anticipated that most of the C&D materials generated from the works in HKBCF Phase 1, though limited in quantity, would be utilized as fill materials for subsequent reclamation works in HKBCF Phase 2, and thus minimizing disposal of C&D materials off site. Similarly, the surcharge materials would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. However, the last stage surcharge materials will need to be disposed off site. Taking account of the reuse of materials on site, the tentative programme for disposal of C&D materials and C&D Waste are given in Table 7.3 below:

Table 7.3 Tentative Disposal Programme for C&D Materials

Material Type	Weight (million tonnes)							
	2010	2011	2012	2013	2014	2015	2016	Total
Insert C&D Soft materials (exclude surcharge)						0.55	0.15	0.70
Grade III or below rock						0.01		0.01
Surplus surcharge						4.50		4.50
C&D Waste				0.003	0.005	0.003	0.001	0.012
Total				**0.003**	**0.005**	**5.063**	**0.151**	**5.222**

7.6.3 According to the latest information from the Public Fill Committee, the projects of SENT Landfill Extension and Central Kowloon Route would require Public Fill (soil material) in 2015 and beyond 2015. Discussions have been made with the project office of these two projects and the preliminary advice from them shows that arrangement could be made to deliver the surplus C&D material generated from HKBCF to their projects and reuse it as filling materials. However, this is subject to further review of the programme and arrangement between the projects. Based on the information received in the above discussions, the estimated quantity of C&D material that could be delivered to these two projects in 2015 and 2016 is given below:

(i) SENT Landfill Extension – Public Fill (soft material) of 0.8 million tonnes in 2015 and 0.9 million tonnes in 2016.

(ii) Central Kowloon Route – Public Fill (soft material) of 0.2 million tonnes in 2015.

In view of the above, the inert C&D soft materials (including surplus surcharge) of about 1.0 million tonnes in 2015 and 0.15 million tonnes in 2016 generated from HKBCF may be delivered to the above two projects subject to further liaison with the project office of these two projects. The remaining 4.05 million tonnes of inert C&D soft materials would need to be disposed to the public fill reception facilities.

7.6.4 To minimize the disposal of C&D material to the public fill reception facilities, a review will be carried out to see whether the temporary stockpile area of sufficient size would be available in HKBCF or SENT Landfill Extension to temporary stockpile part of the surplus C&D material generated from HKBCF in 2015 and reuse in SENT Landfill Extension in 2016.

7.6.5 The quantity of surplus C&D rock material (Grade III or below) generated from HKBCF is only 0.01 million tonnes. Efforts are being made to identify the project that could receive this small quantity of surplus C&D rock material. However, other projects like Central Kowloon Route and MTRCL's railway projects would produce more C&D rock material in 2015 and therefore it is easier for these projects to make the arrangement with other project

for disposal of these materials. Therefore, it is assumed that the surplus C&D rock material generated from HKBCF would disposal to the public fill reception facilities.

7.6.6 Apart from the C&D materials to be reused on site, the tentative programme of fill materials to be imported for the construction of seawalls and reclamation is given in Table 7.4 below:

Table 7.4 Tentative Programme for Fill Materials to be Imported

Material Type	Weight (million tonnes)							
	2010	2011	2012	2013	2014	2015	2016	Total
Soil (sandfill)	2.47	22.50	16.60	1.85				43.42
Others (armour)			0.90	0.60				1.50
Others (public fill – soft materials)		0.45	12.05	4.30	0.65			17.45
Others (public fill –rock materials)		5.05	1.75					6.80
Total	**2.47**	**28.00**	**31.30**	**6.75**	**0.65**			**69.17**

7.7 Materials Minimization Strategy

Minimizing Generation of C&D Material

7.7.1 Generation of C&D materials will be minimized with the following measures:

(i) Minimize the reclamation area – The BCF layout has been considered in the Value Management Workshop as well as the Option Assessment Report with a view to minimize the reclamation area necessary to support the infrastructure required for the operation of BCF.

(ii) Use the non-dredged reclamation method as far as practicable – The recommended reclamation method is Sequence B which maximum the use of non-dredged reclamation method with band drains and surcharge as far as practicable.

(iii) Adoption of steel formwork for standard sections of RC structures – The reduction in using steel formwork for the RC structural works would minimize the generation of C&D waste.

Optimising Usage of Fills in the Contracts

7.7.2 The fill required for reclamation will utilize the excavated C&D materials from the infrastructure works, which can be effectively achieved through the following:

(i) The Resident Site Staff (RSS) will monitor the Contractor's management on the C&D materials.

(ii) Arranging ad-hoc coordination meeting with the contractors as necessary, and advise the contractors regarding the ways to utilize and import fill materials in the C&D material management.

(iii) Arranging and identifying temporary storage area for surplus fill such that it could be used at later stage.

Maximizing the Use of Recycled C&D Material

7.7.3 Recycling of C&D material will be maximized with the following measures:

(i) The bituminous material excavated during the road realignment works will be disposed of at an asphalt recycling plant in Tuen Mun. The recycled material can then be used for pavement construction in HKBCF or other roadwork projects.

(ii) The top soil excavated during the modification of existing roads in the Airport Island is considered to be minimal as the infrastructural works would be carried out in the reclaimed land or urban area. Even there is excavated top soil, it could be stored aside and reused at the designated planting areas within HKBCF.

8 CONCLUSION

8.1 This C&DMMP presents the estimated quantities of C&D materials produced and the fill materials required in the reclamation and infrastructure works of the HKBCF, their respective volume are summarized in Tables 8.1 and 8.2 below:

Table 8.1 Summary of C&D Materials and Waste Generated and Disposed of

Material	Estimated Quantities[1]				
	Generated	Reused on Site	Reused in Other Projects [4]	Disposed of at Public Fill Reception Facilities	Disposed of at Landfill
Inert C&D Soft Material	2.55 (1.42)	1.85 (1.03)	0.70 (0.39)		-
Surplus Surcharge	4.50 [2] (2.50)	-	0.45 [5] (0.25)	4.05 [5] (2.25)	-
Grade III or below Rock	0.36 (0.18)	0.35 (0.17)	-	0.01 (0.01)	-
Others C&D (Reusable Bituminous Material)	0.018 (0.01)	0.018 [3] (0.01)	-	-	-
C&D Waste	0.012 (0.0067)	-	-	-	0.012 (0.0067)

Notes:

1. *The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *All the surcharge material is the imported public fill and it is included in the imported public fill (soft materials) in Table 8.2 below. The last stage of surcharge is about 4.5 million tonnes and the figure represents the surplus surcharge material to be disposal off site.*
3. *The bituminous material will be reused for pavement construction in HKBCF or other roadwork projects.*
4. *The disposal of surplus C&D material to other projects is subject to further discussions with the project office of these projects.*
5. *If temporary stockpile area is available as mentioned in Section 7.6.4 above, more surplus C&D material could be delivered to SENT Landfill Extension project. In this case, the estimated quantity of "Reused in Other Project" is 1.2 million tonnes (0.67 million m^3) and the "Disposal to Public Fill Reception Facilities" is 3.3 million tonnes (1.83 million m^3).*

Table 8.2 Summary of Reclamation Material Requirement

Material	Estimated Quantities[1]		
	Total Required	Reused from other C&D materials within the site	Import from outside sources
Sand Fill	43.42 (24.12)	-	43.42 (24.12)
Armour	1.50 (0.75)	-	1.50 (0.75)
Public Fill (soft materials) including surcharge	19.30 (10.72)	1.85 (1.03)	17.45 (9.69)
Public fill (rock materials)	7.15 (3.58)	0.35 (0.18)	6.80 (3.40)

Note:

1. The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.

8.2 Various means to minimize the C&D materials generation and to maximize the reuse of C&D materials have been considered, as discussed in Section 7.7 above.

9 RECOMMENDATION

9.1 This report provided the estimated quantities of C&D materials that would be generated and used in this project. It is envisaged that detailed figure would be refined slightly during the detailed design in reviewing and updating this C&DMMP accordingly. To this, the following actions are recommended:

(1) This C&DMMP shall be regularly reviewed and updated during the detailed design as well as construction stage. The construction work on site should also be closely monitored.

(2) Appropriate specification should be included in the contract document to control the generation of C&D materials.

(3) The resident site staff supervising the reclamation work should be fully aware of this plan and closely monitor the works on site such that recommendations in this plan would be carried out duly.

(4) This plan should be provided to the contractor in due course, probably at an early stage of the construction in the preparation of Waste Management Plan.

(5) Continue liaison with MTRCL or other relevant parties to agree the quantities and arrangement of delivery the public fill materials generated from their projects for use as reclamation fill in HKBCF.

(6) Further discussions will be made with the project office of other projects to receive the surplus C&D materials generated from HKBCF.

APPENDIX A

Assumed Construction Rates and Period Allowed in the Programme

Appendix A

Hong Kong-Zhuhai-Macao Bridge
Hong Kong Boundary Crossing Facilities
Assumed construction Rate of major reclamation activities

The following construction rates are based on 16 working hours per day (i.e. 7:00 am to 7:00pm without noise permit + 7:00pm to 11:00pm with noise permit). In view of the distance between HKBCF site and the sensitive receivers in Tung Chung, there would be stringent requirements to obtain noise permit to work through mid-night (i.e. 11:00pm to 7:00am). There is risk to assume the construction plant could work 24 working hours per day at this stage as delay would occur if the noise permit for working 24 hours could not be obtained during construction. Therefore, 16 working hours per day is assumed.

Dredging - Grab dredger

Assume 11m^3 grab dredger and 1.5 min for each cycle of dredging considering the average dredging depth is about 15m below sea level.

For 16 working hours per day, the construction rate of 11m^3 grab dredger is:
= 16 x 60/1.5*11 m^3
= 7040 m^3 /day

For 25 working days per month, the construction rate of 11m^3 grab dredger is about 180,000 m^3 /barge/month

Sandfilling – Trailer Suction Hopper Dredger

Assume 9,000 m^3 Trailer Suction Hopper Dredger (TSHD) with cycle time of each operation is 5 hours based on following assumptions:
- 1.5 hours travelling time to sand borrow area
- 1 hour to collect the sand
- 1.5 hours travelling time back to the site
- 1 hour to fill the sand in reclamation

For 16 working hours per day and 25 working days per month, the construction rate of TSHD is
= 16/5*9000*25
= 720,000 m^3 /TSHD/month

If the filling work is carried out at the non-dredged areas, extra time is required to place the fill carefully to avoid the mud wave. Therefore the filling rate at non-dredged areas is assumed to be half = 360,000m^3/TSHD/month

Geotextile

Width = 40m
Length = up to 150m per day (i.e. 16 hours)
Construction rate = 6,000m^2 per day or 150,000m^2/barge/month (25 working days per month)

Appendix A

Vertical Drain (by marine method)

The average depth of marine deposit is about 20m
A panel = 4 row x 12 column i.e. triangles of 1m spacing
Two vertical drains to be installed at the same time
A panel takes 24 shots to complete
Assume 1 shot = 3.5 minutes
1 panel = 84min to complete
Shift location of barge take 25min to 30 min
Hence each cycle = 120 min to complete 48 nos. vertical drains.

For 16 working hours a day, 8 panels could be completed in a day

The construction rate=384 nos or 7,680m/day or 192,000m/barge/month (25 working days per month).

Vertical Drain (by land method)

The average length of each band drain = 30m (10m filling + 20m thick marine deposit)
Assume installation time of each band drain = 4.0 minutes

For 16 working hours a day, the no. of band drains to be installed = 16x 60/4 = 240 nos. day.

For 25 working days per month, the construction rate = 240 x 30m x 25
= 180,000m/rig/month

Summary of Construction Plant

Plant	Quantity	Assumed Construction Rates
Grab dredger	8 ~ 10nos.	180,000m^3/barge/mth
Installation of band drains (marine method)	5~ 8nos.	192,000m/barge/mth
Installation of band drains (land method)	20 nos.	180,000m/rig/mth
Laying of geotextile	5 nos.	150,000m^2/barge/mth
Sand filling (TSHD)	2 ~ 4 nos.	720,000m^3/TSHD/mth(Note 1)
		360,000m^3/TSHD/mth(Note 2)
Installation of SCP	4 nos.	8,750m/barge/mth

Note:

1) The construction rates are based on 16 working hours/day and 25 working days/month
2) The construction rate of TSHD is 720,000m3/TSHD/mth for dredging area and 360,000m3/TSHD/mth for non-dredging area

Other Programme Requirements

Items	Period Allowed
Surcharge Period (non-dredge area)	9 months (8m high surcharge)
Surcharge Period (fully-dredge area)	3 months (4m high surcharge)
Passenger Clearance Building	2 years 9 months
Government buildings	2 years
Other infrastructure works	1year 6 months

Note:

1) The period allowed for the surcharge period takes into account the latest available ground investigation information.
2) The period allowed for the infrastructure works include the testing and commissioning

FIGURES

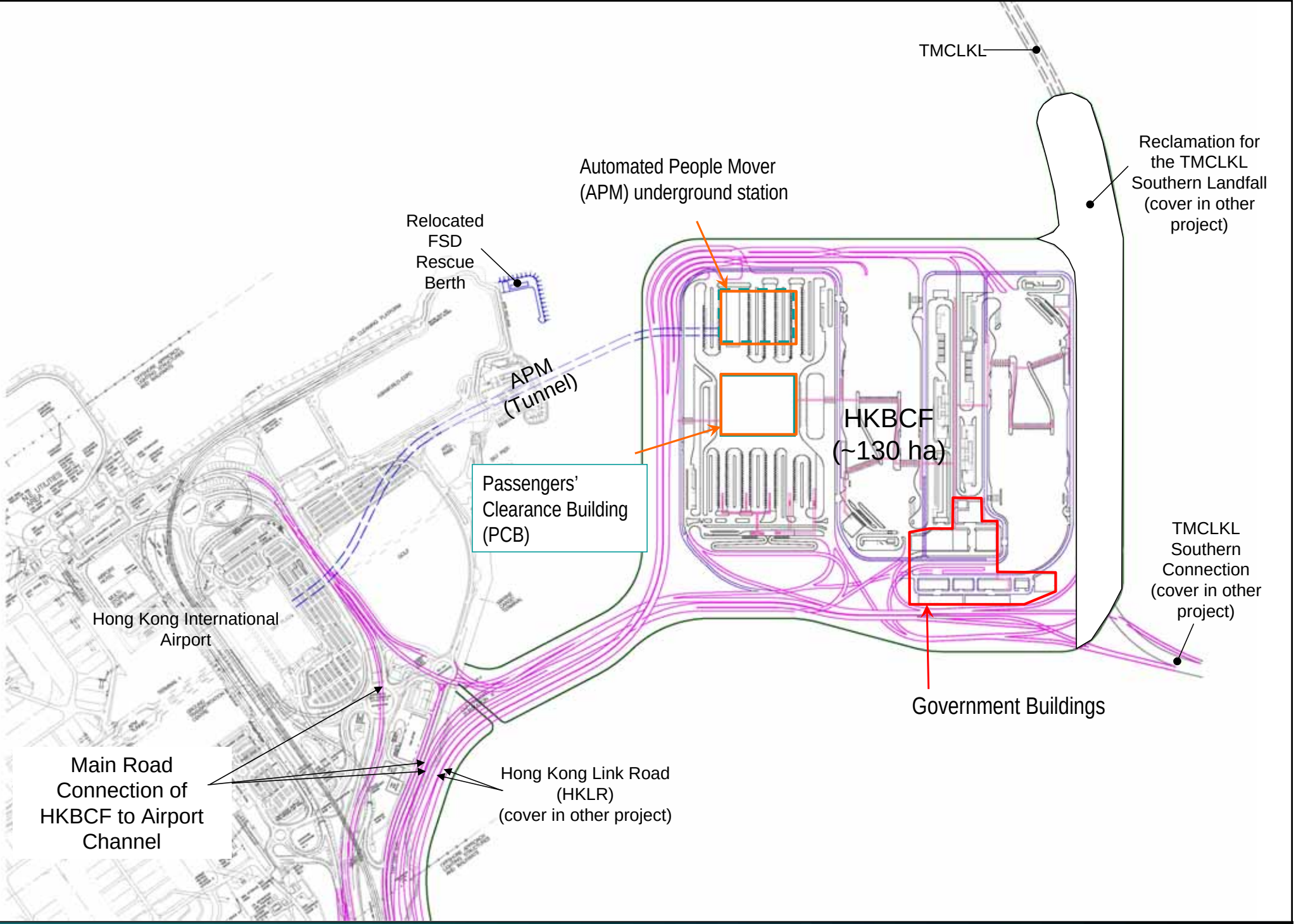


Figure 3.1 – Overall Layout of HKBCF

ARUP

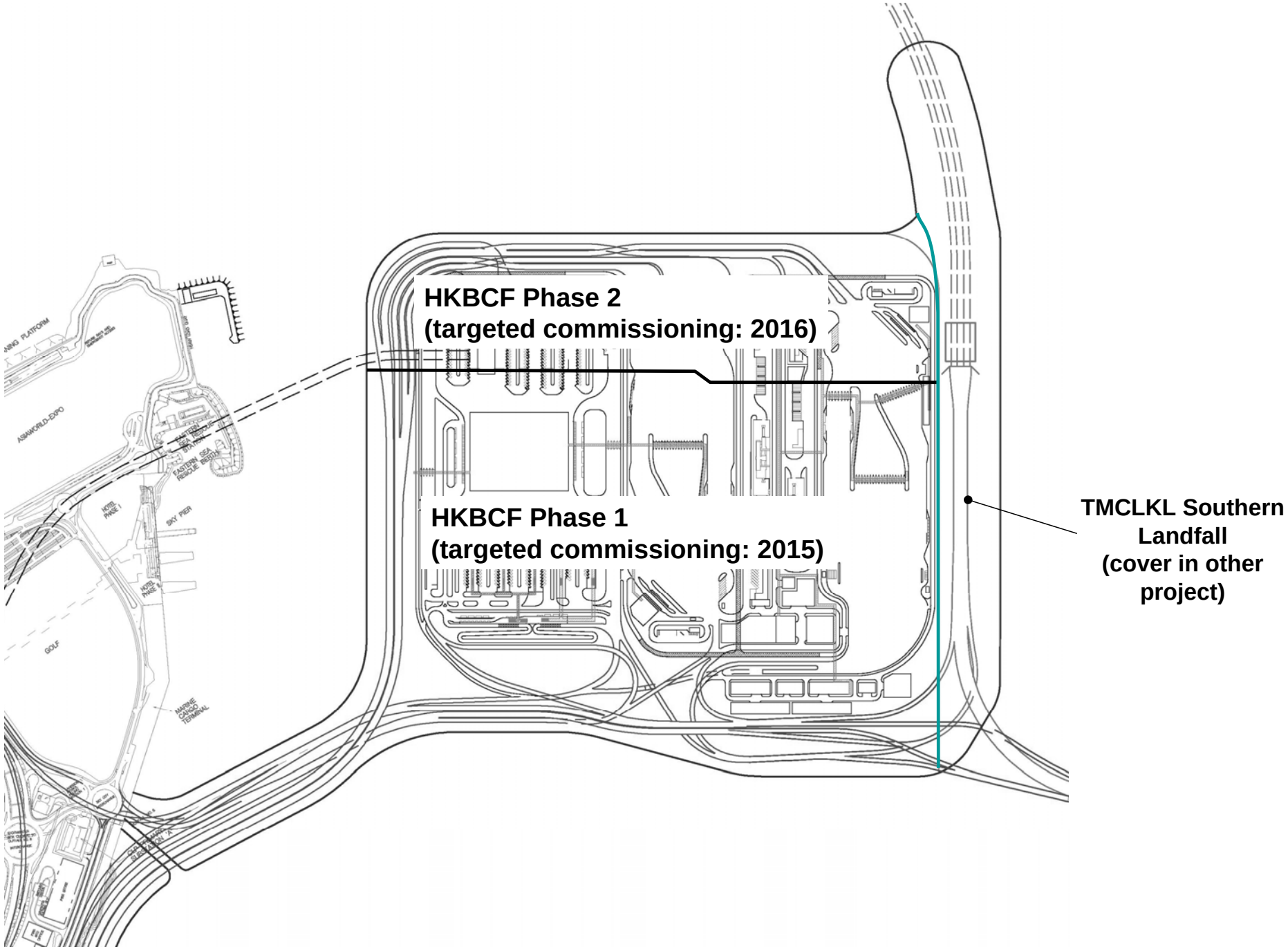


Figure 4.1 – Outline Phasing Demarcation of HKBCF

ARUP

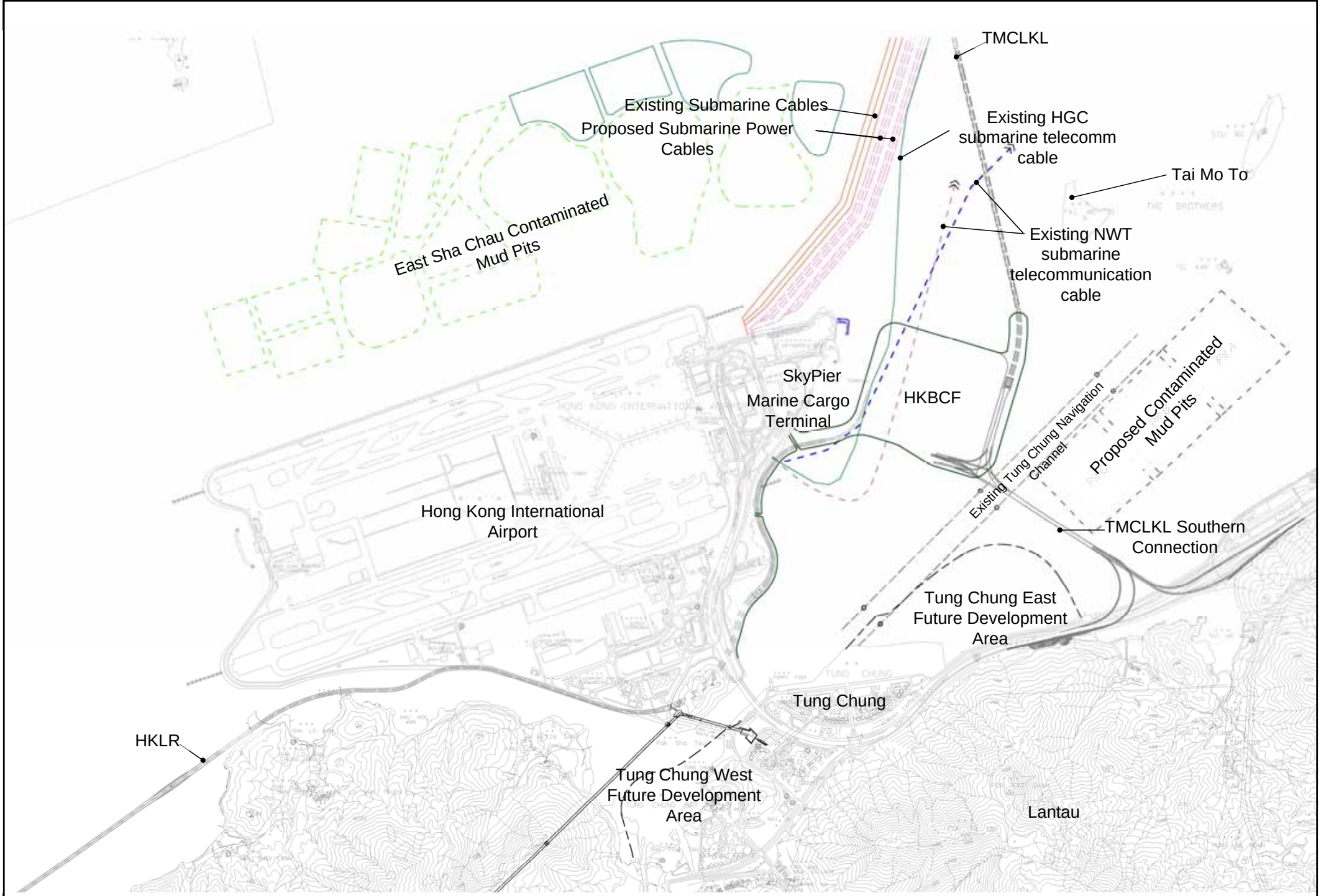


Figure 5.1 – Development Constraints (Sheet 1 of 2)

ARUP

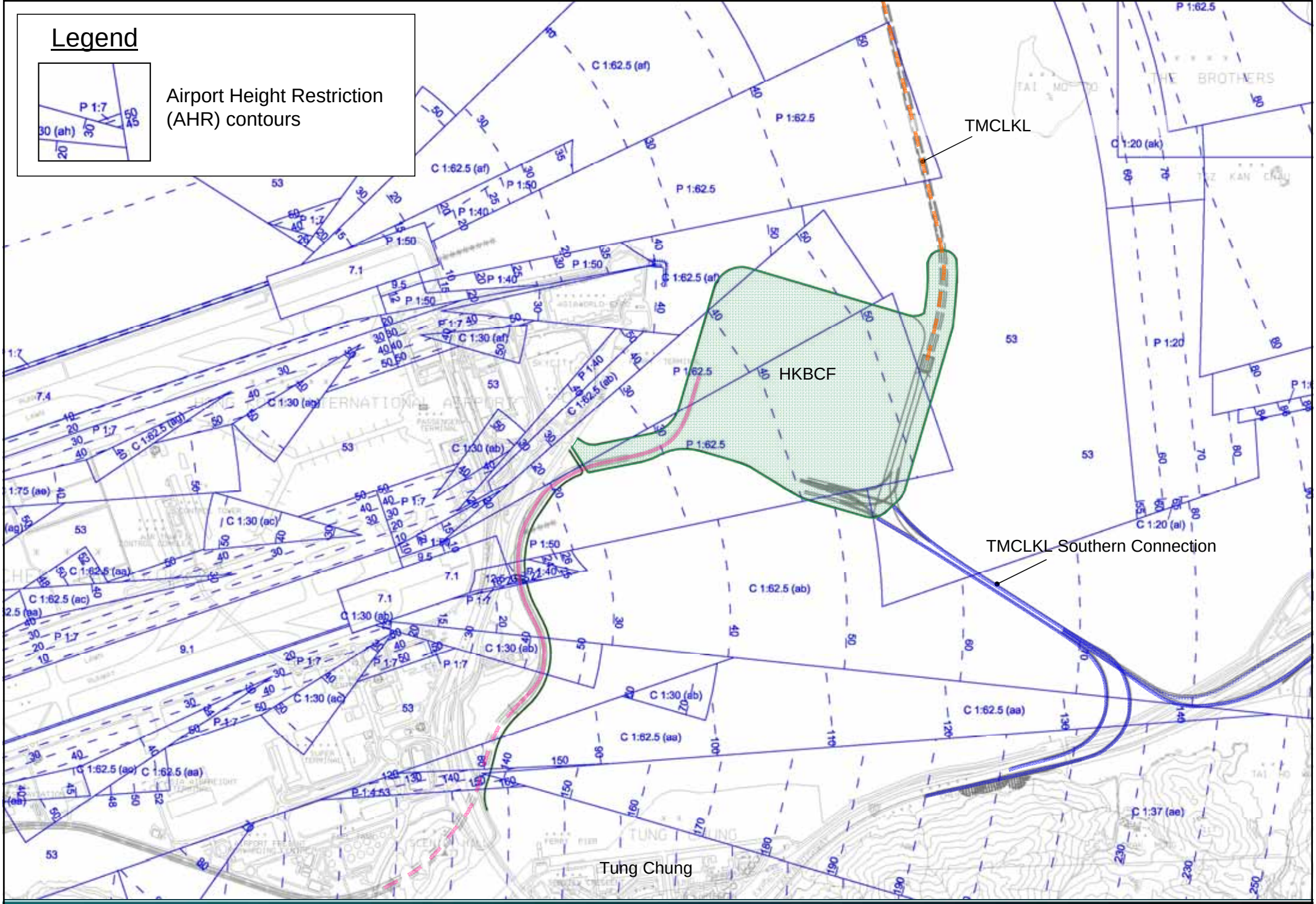


Figure 5.2 – Development Constraints (Sheet 2 of 2)

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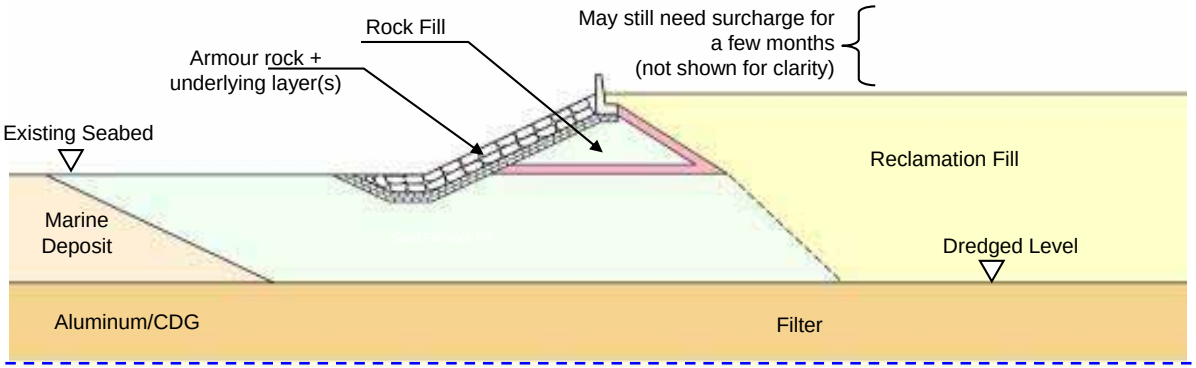
Seawall Method

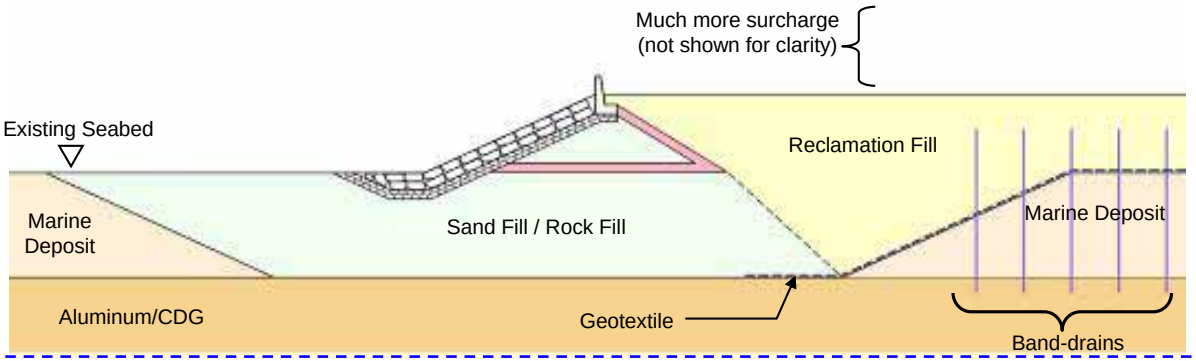
Reclamation Method

Fully-dredged Seawall



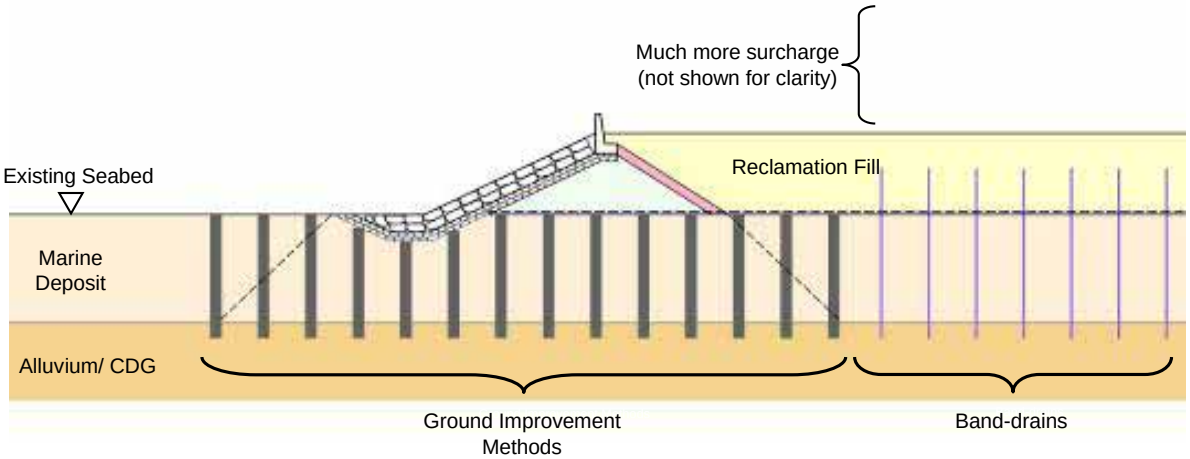
Fully-dredged Reclamation

Fully-dredged Seawall



Non-dredged Reclamation (with Band Drains)

Non-dredged Seawall with Ground Improvement Method



Non-dredged Reclamation (with Band Drains)

Figure 6.1 – Typical Sections of Dredged & Non-dredged Seawalls/Reclamation

ARUP

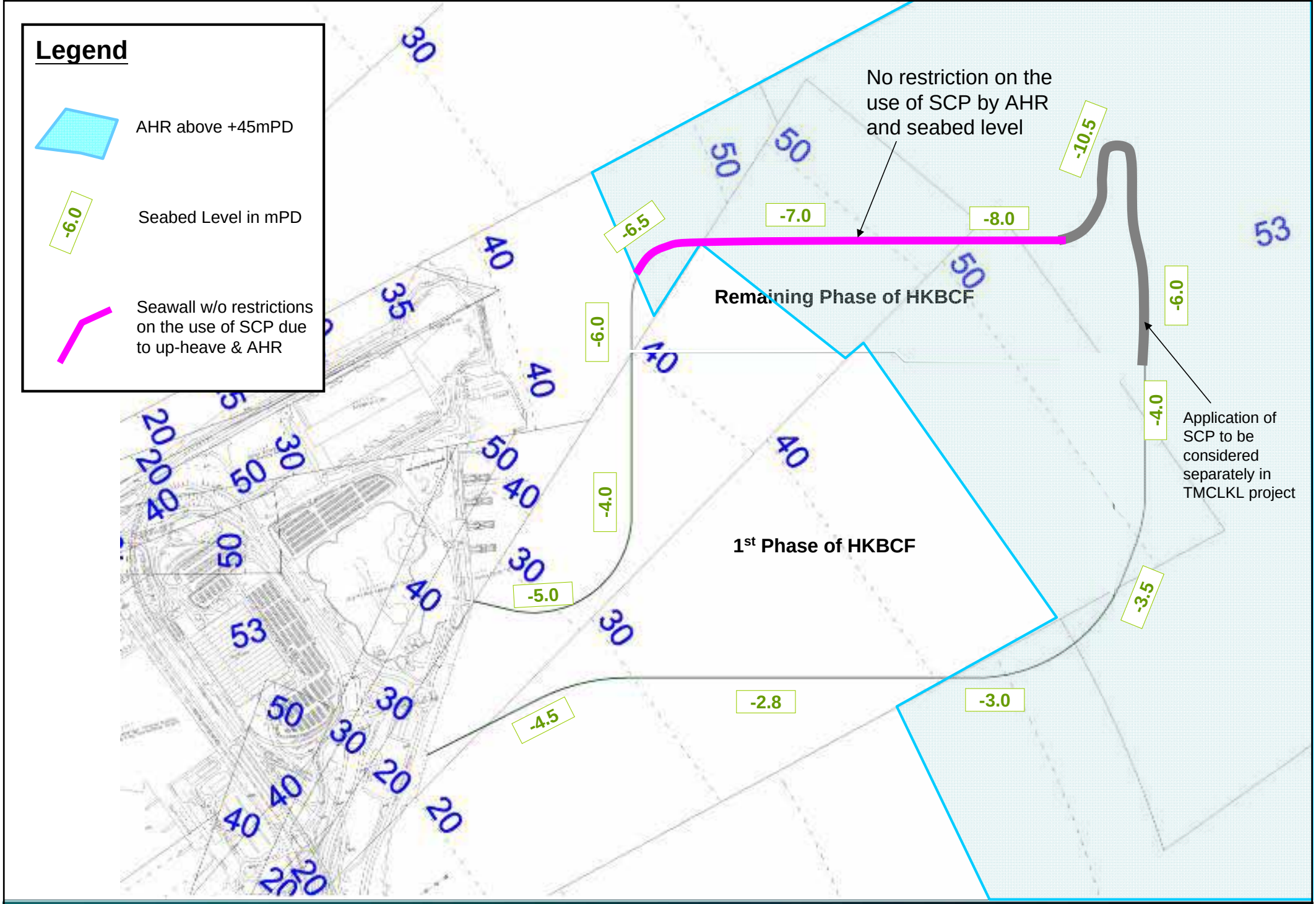


Figure 6.2 – Extent of Seawall without Restrictions on the Use of Sand Compaction Pile

ARUP

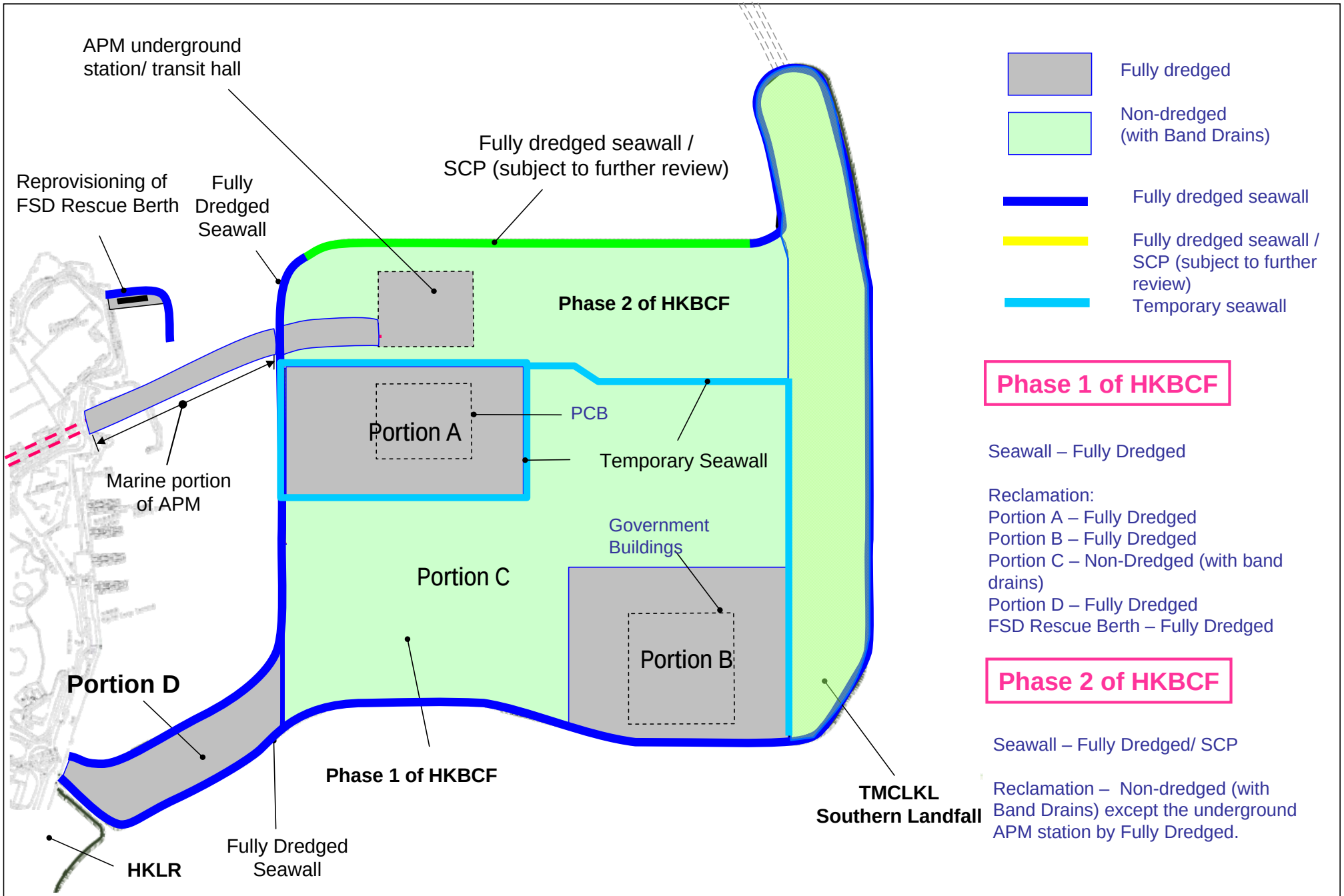
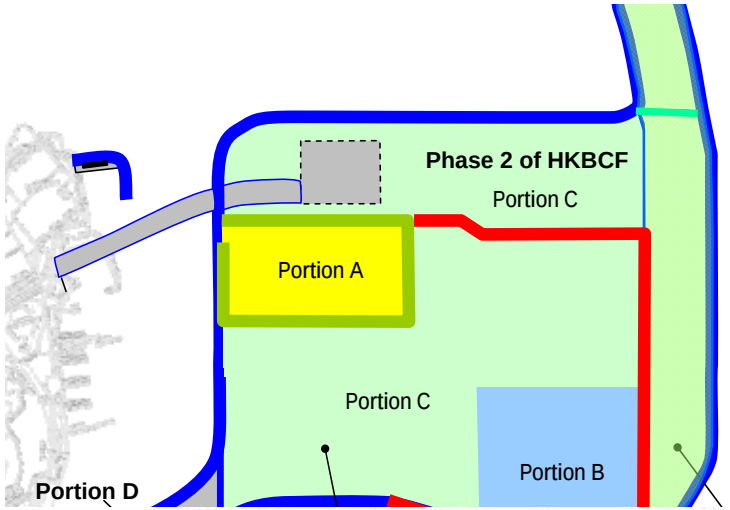
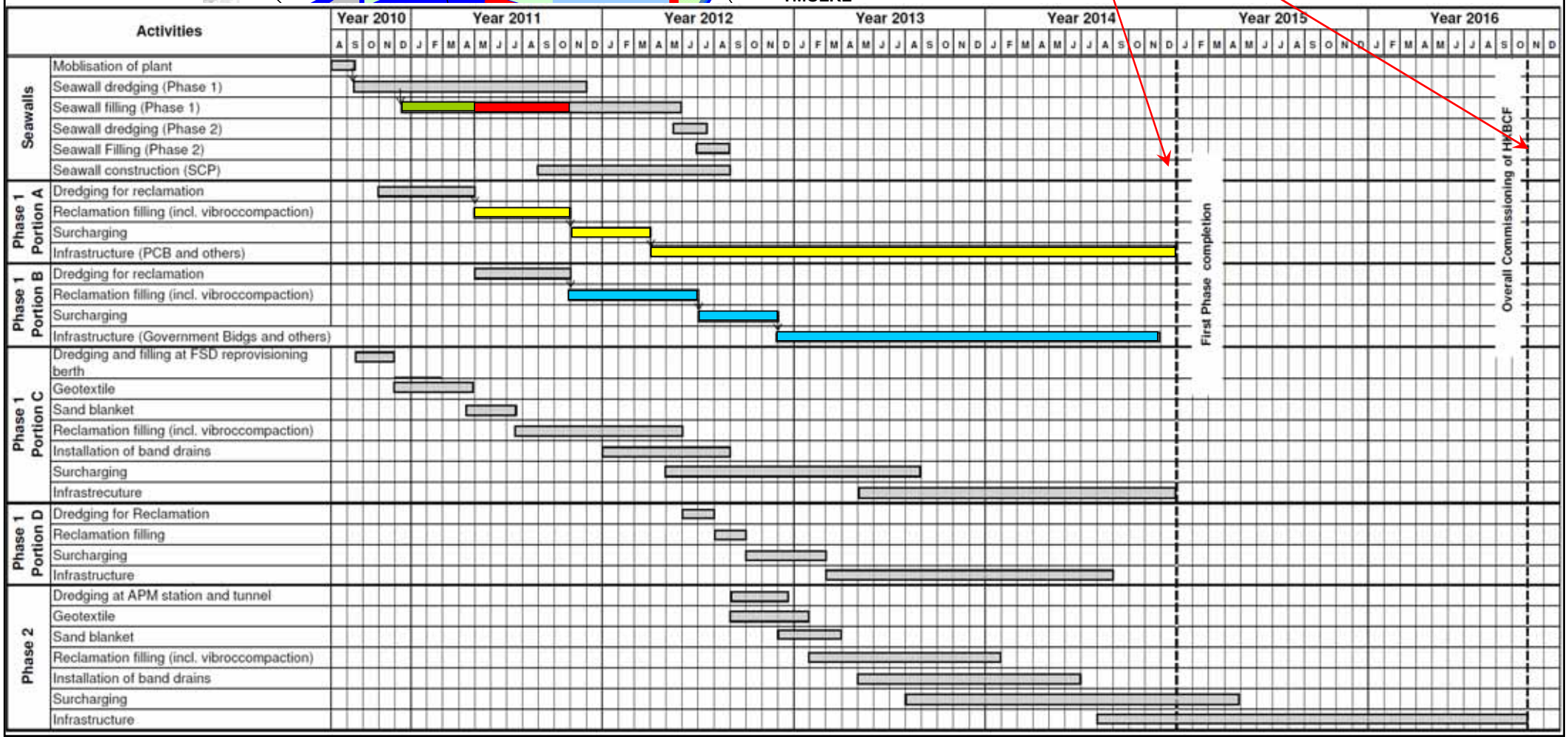


Figure 6.3 – Reclamation Layout of Sequence A

Figure 6.4 – Envisaged Programme for Sequence A of HKBCF Reclamation



Commissioning of HKBCF Phase 1 in Dec 2014 and Phase 2 in Oct 2016



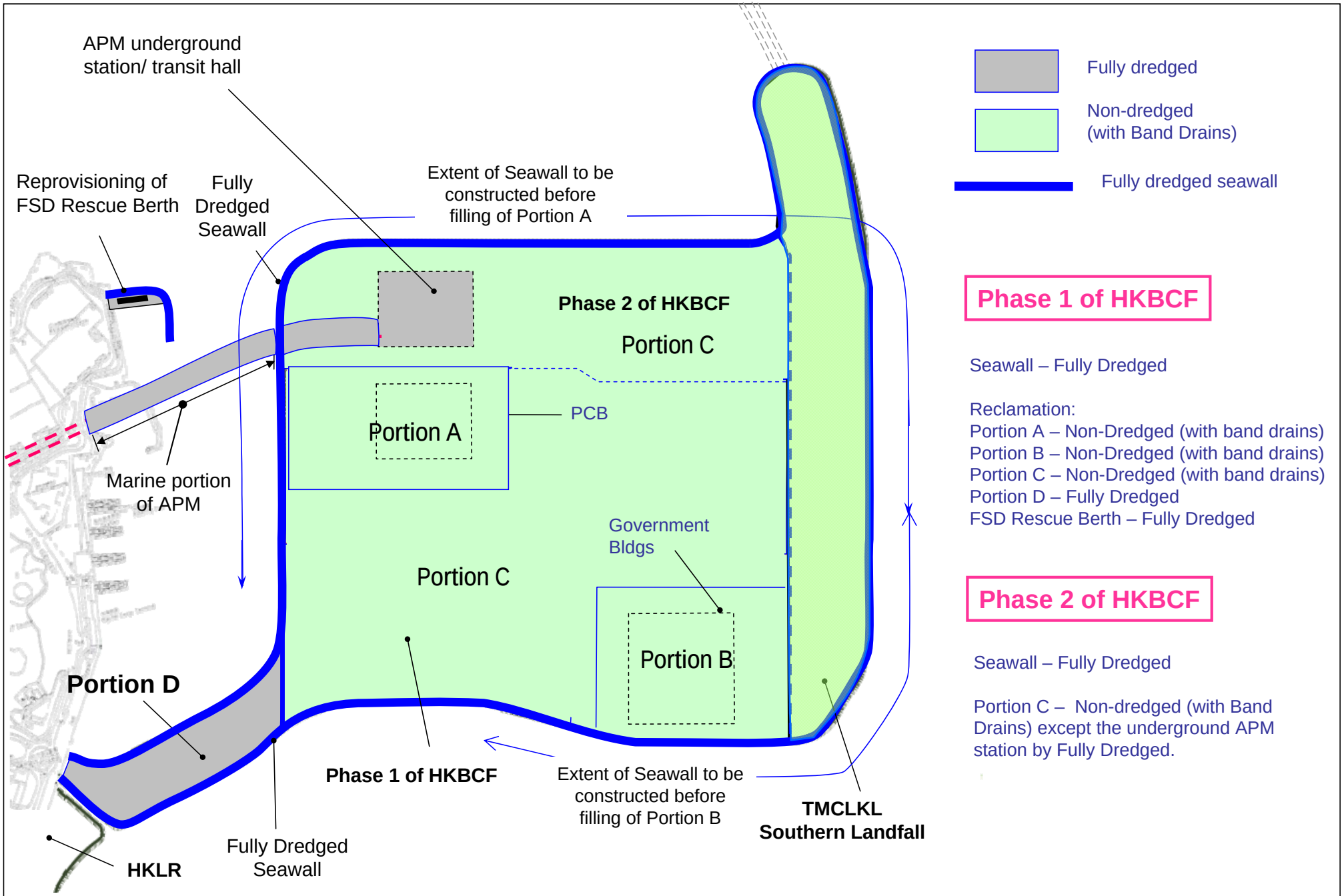
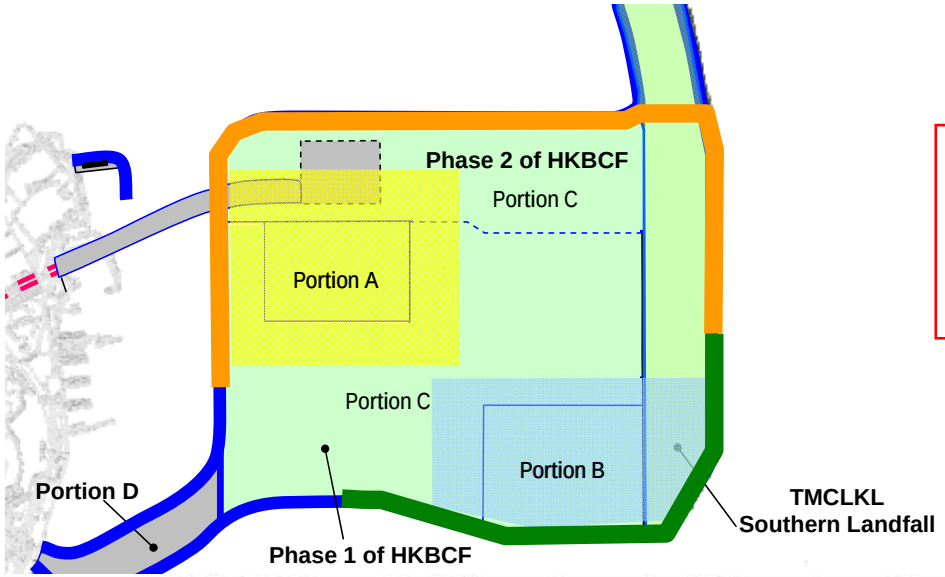
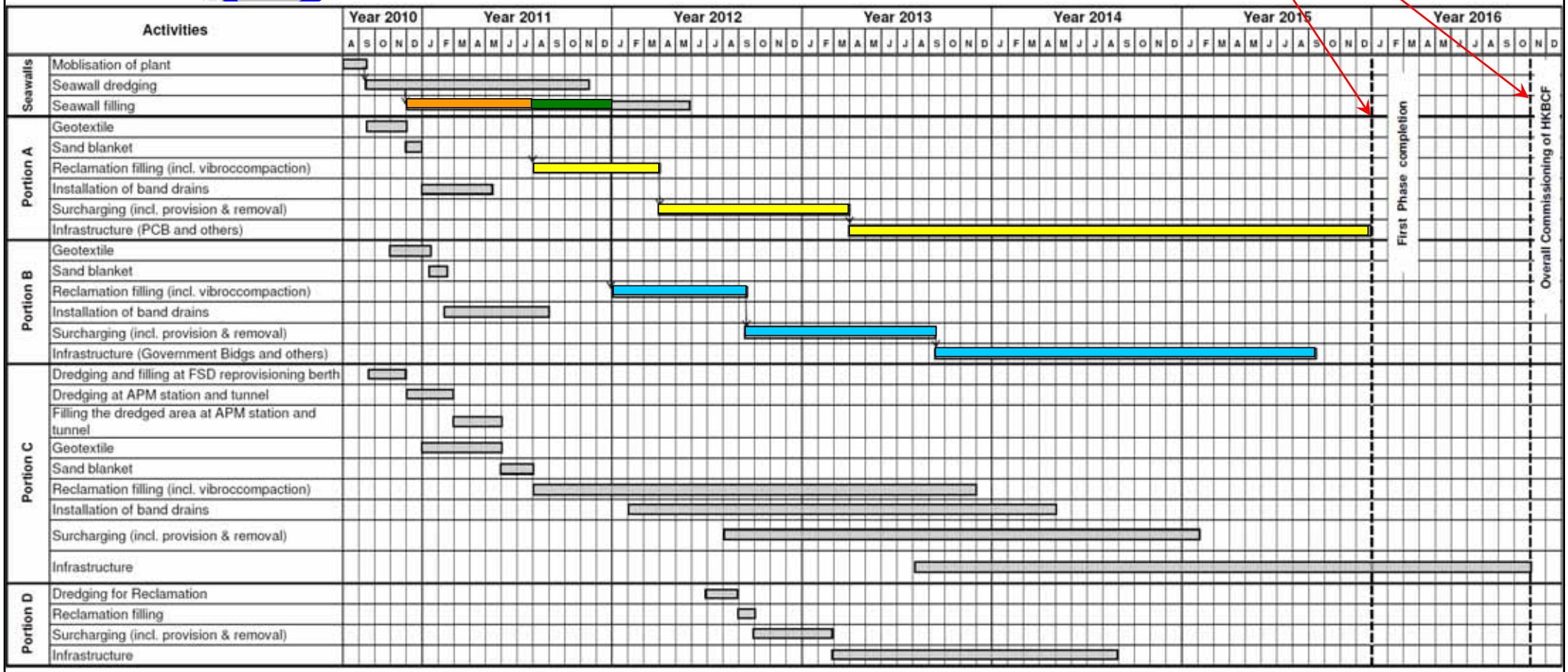


Figure 6.5 – Reclamation Layout of Sequence B

Figure 6.6 – Envisaged Programme for Sequence B of HKBCF Reclamation



Commissioning of HKBCF Phase 1 in Dec 2015 and Phase 2 in Oct 2016



APPENDIX 8C

Tentative Programme of C&D Materials from Other projects and Demand of Public Fill in HKLR and HKBCF

Preliminary Estimate of Excavated Materials from MTRC Railway Projects (4 May 2009)

MTR

Projects	Construction Methods	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
WIL	TBM (soft & rock)	-	-	-	-	-	-	-	-	-	-	-
	D&B Tunnel (rock)	-	0.25	0.61	0.01	-	-	-	-	-	-	0.87
	Others (soft material)	-	0.13	0.38	0.04	-	-	-	-	-	-	0.56
	Others (rock)	-	0.03	0.08	0.02	-	-	-	-	-	-	0.13
	Total	-	0.42	1.08	0.07	-	-	-	-	-	-	1.56
SIL(E)	TBM (soft & rock)	-	-	-	-	-	-	-	-	-	-	-
	D&B Tunnel (rock)	-	-	0.75	0.77	0.06	-	-	-	-	-	1.58
	Others (soft material)	-	0.09	0.62	0.17	0.10	0.02	-	-	-	-	1.01
	Others (rock)	-	0.01	0.23	0.20	0.14	0.05	-	-	-	-	0.63
	Total	-	0.10	1.60	1.15	0.30	0.07	-	-	-	-	3.21
SCL (EWL)	TBM (soft & rock)	-	-	-	-	0.30	0.15	-	-	-	-	0.45
	D&B Tunnel (rock)	-	-	-	0.17	0.51	0.14	-	-	-	-	0.82
	Others (soft material)	-	-	0.65	1.49	1.02	0.36	0.20	-	-	-	3.72
	Others (rock)		-	0.01	0.03	-	-	-	-	-	-	0.04
	Total	-	-	0.65	1.68	1.84	0.65	0.20	-	-	-	5.04
SCL (NSL)	TBM (soft & rock)	-	-	-	0.02	0.06	0.07	0.05	0.005	-	-	0.21
	D&B Tunnel (rock)	-	-	-	0.02	0.06	0.08	0.06	0.01	-	-	0.23
	Others (soft material)	-	-	-	0.21	0.52	0.70	0.47	0.04	-	-	1.94
	Others (rock)	-	-	-	0.05	0.12	0.15	0.10	0.01	-	-	0.43
	Total	-	-	-	0.31	0.76	1.01	0.67	0.06	-	-	2.81
KTE	TBM (soft & rock)	-	-	-	-	-	-	-	-	-	-	-
	D&B Tunnel (rock)	-	-	0.17	0.52	0.08	-	-	-	-	-	0.78
	Others (soft material)	-	-	0.47	0.26	0.02	-	-	-	-	-	0.75
	Others (rock)	-	-	0.08	0.31	0.04	-	-	-	-	-	0.43
	Total	-	-	0.71	1.10	0.15	-	-	-	-	-	1.96
XRL	TBM (soft & rock)	-	-	0.57	2.41	0.09	-	-	-	-	-	3.06
	D&B Tunnel (rock)	-	0.62	2.68	3.78	-	-	-	-	-	-	7.08
	Others (soft material)	-	1.08	4.69	2.91	0.46	-	-	-	-	-	9.14
	Others (rock)	-	-	-	0.37	0.60	-	-	-	-	-	0.97
	Total	-	1.70	7.93	9.48	1.14	-	-	-	-	-	20.25
Sub-total	TBM (soft & rock)	-	-	0.57	2.43	0.45	0.22	0.05	0.005	-	-	3.73
	D&B Tunnel (rock)	-	0.87	4.20	5.28	0.72	0.22	0.06	0.01	-	-	11.35
	Others (soft material)	-	1.30	6.81	5.09	2.13	1.09	0.67	0.04	-	-	17.13
	Others (rock)	-	0.04	0.40	0.97	0.89	0.20	0.10	0.01	-	-	2.63
	Total	-	2.21	11.98	13.78	4.19	1.73	0.88	0.06	-	-	34.83

Fill Demand

	Fill Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
HKLR	General Fill			0	2.5	0.2	0	0			
	Rock Fill			0.4	0.28	0	0	0			
HKBCF	General Fill			0.45	12.05	4.3	0.65	0			
	Rock Fill			5.05	1.75	0	0	0			
Total	General Fill			0.45	14.55	4.5	0.65	0			
	Rock Fill			5.45	2.03	0	0	0			

Notes:

1) All figures are in Million Metric Tonne.

2) The estimates are indicative only and subject to change in conjunction with the detailed design.

3) Assumption: Unit weight of soft material = 1.84 metric tonnes/m^3;
Unit weight of rock: 2.65 metric tonnes/m^3;
Unit weight of TBM material = 2.25 metric tonnes/m^3