CHAPTER 5 OPTION 2 : EXPANDING INTO A THREE-RUNWAY SYSTEM

Unconstrained Air Traffic Demand Forecast under a Three-Runway System

5.1 The ultimate handling throughput of HKIA is constrained by the practical maximum air traffic movements (ATMs, also known as flight movements) capacity of the two-runway system (420,000 ATMs per year). To remove capacity constraints and serve the unconstrained air traffic demand forecast for 2030 and possibly beyond, HKIA needs to build a Third Runway.

5.2 **The three-runway system could support a practical maximum ATM capacity of 102 per hour or about 620,000 per annum.** This may increase by around 10% in future if there are enhancements in aircraft or air traffic control (ATC) technology or the Pearl River Delta (PRD) airspace structure, which can improve operations further. Increasing runway capacity would allow the airport to meet baseline unconstrained demand forecasts of air traffic movements, passengers and cargo (see Figures 5.1 to 5.3) until 2030.

Figure 5.1 : Unconstrained Air Traffic Movement Demand Forecast

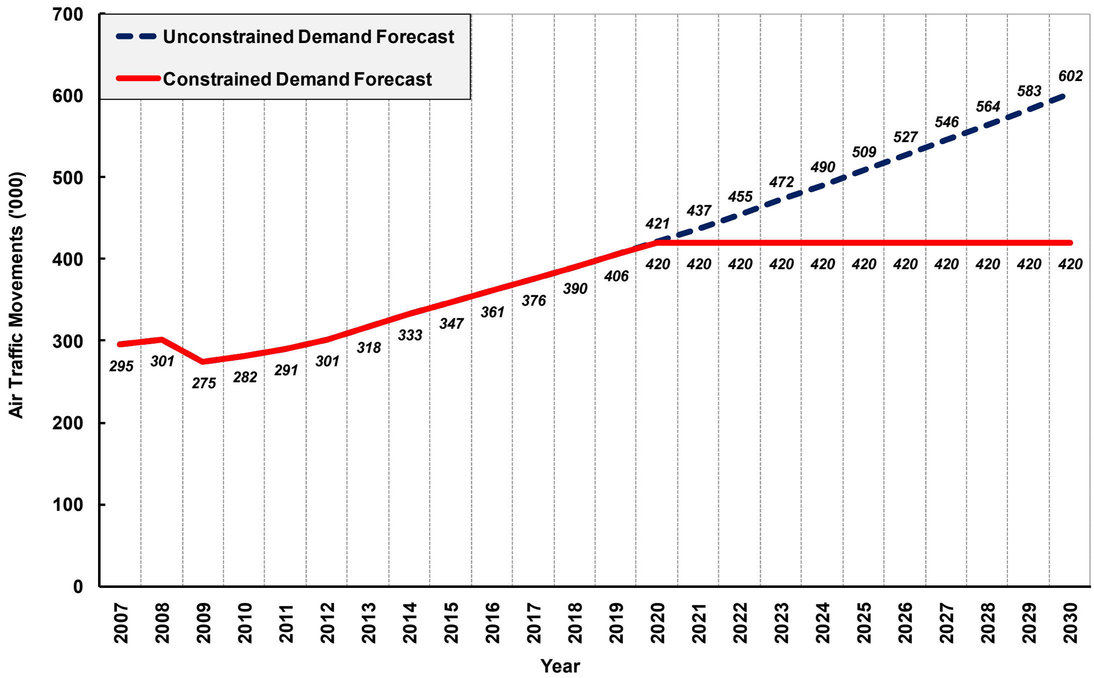


Figure 5.2 : Unconstrained Passenger Demand Forecast

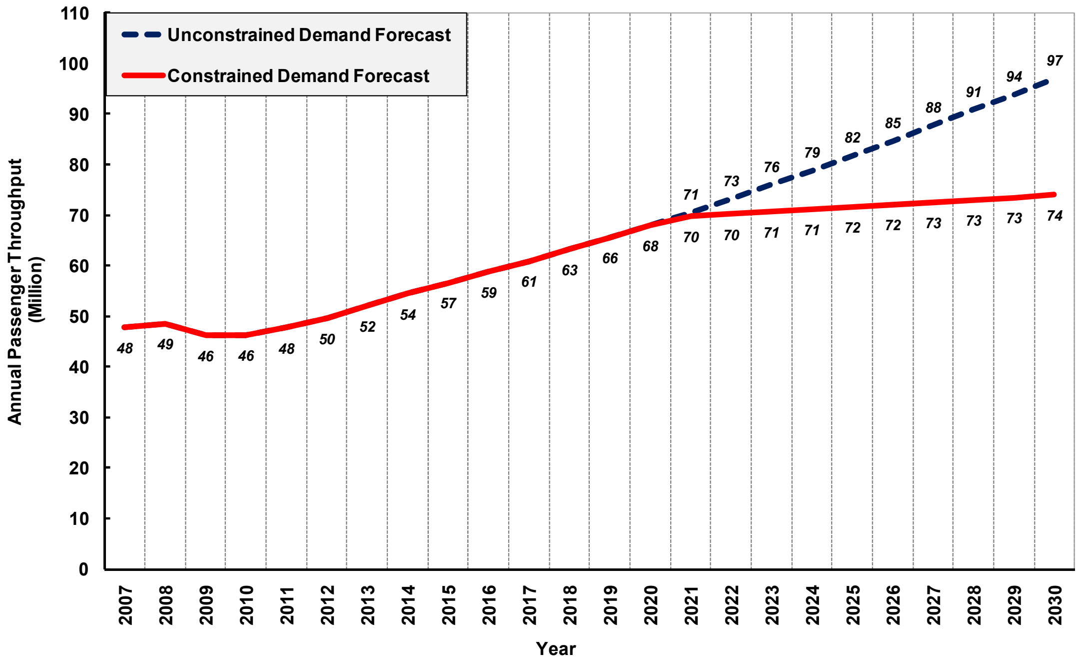
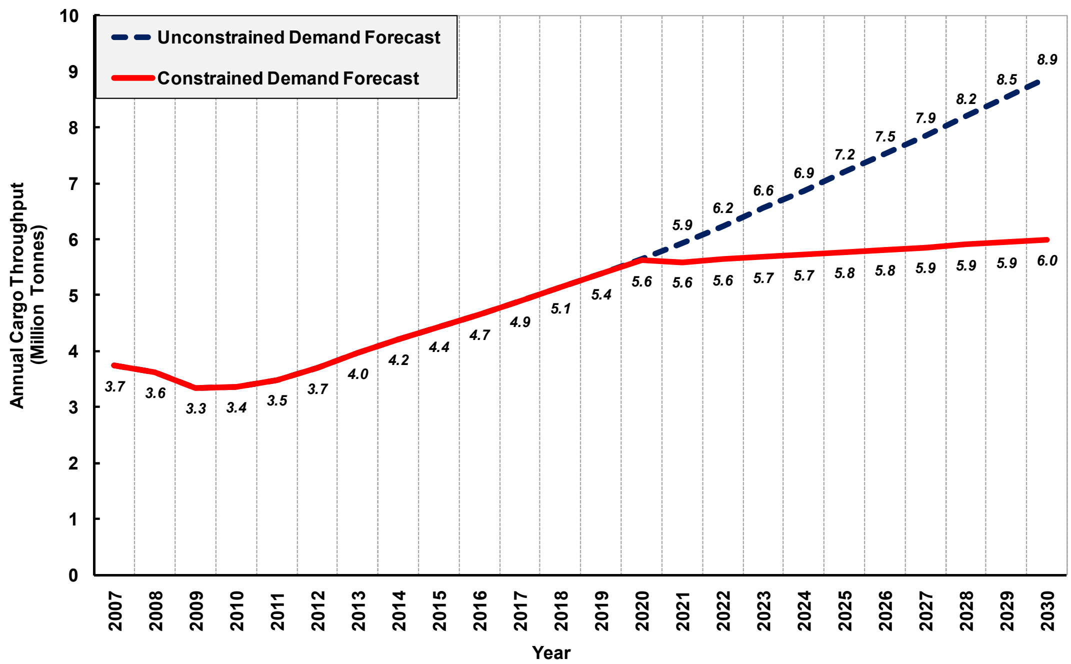


Figure 5.3 : Unconstrained Cargo Demand Forecast



5.3 **The annual demand is forecast to be 97 million passengers, 8.9 million tonnes of cargo and 602,000 air traffic movements by 2030.** Therefore the addition of a Third Runway needs to be matched by a corresponding expansion in operational and support facilities on the ground.

5.4 The first stage of airport expansion is evaluation of the airfield configuration (i.e. runways and taxiways), which in turn drives the development strategy of the passenger terminal, concourse and apron complex, cargo terminal and apron complex, support and ancillary facilities, surface access and airport related developments, etc., such that safety standards, integrity and efficiency of airport operations are maintained even as the capacity increases.

Airfield Configuration Evaluation

Third Runway Alignment options

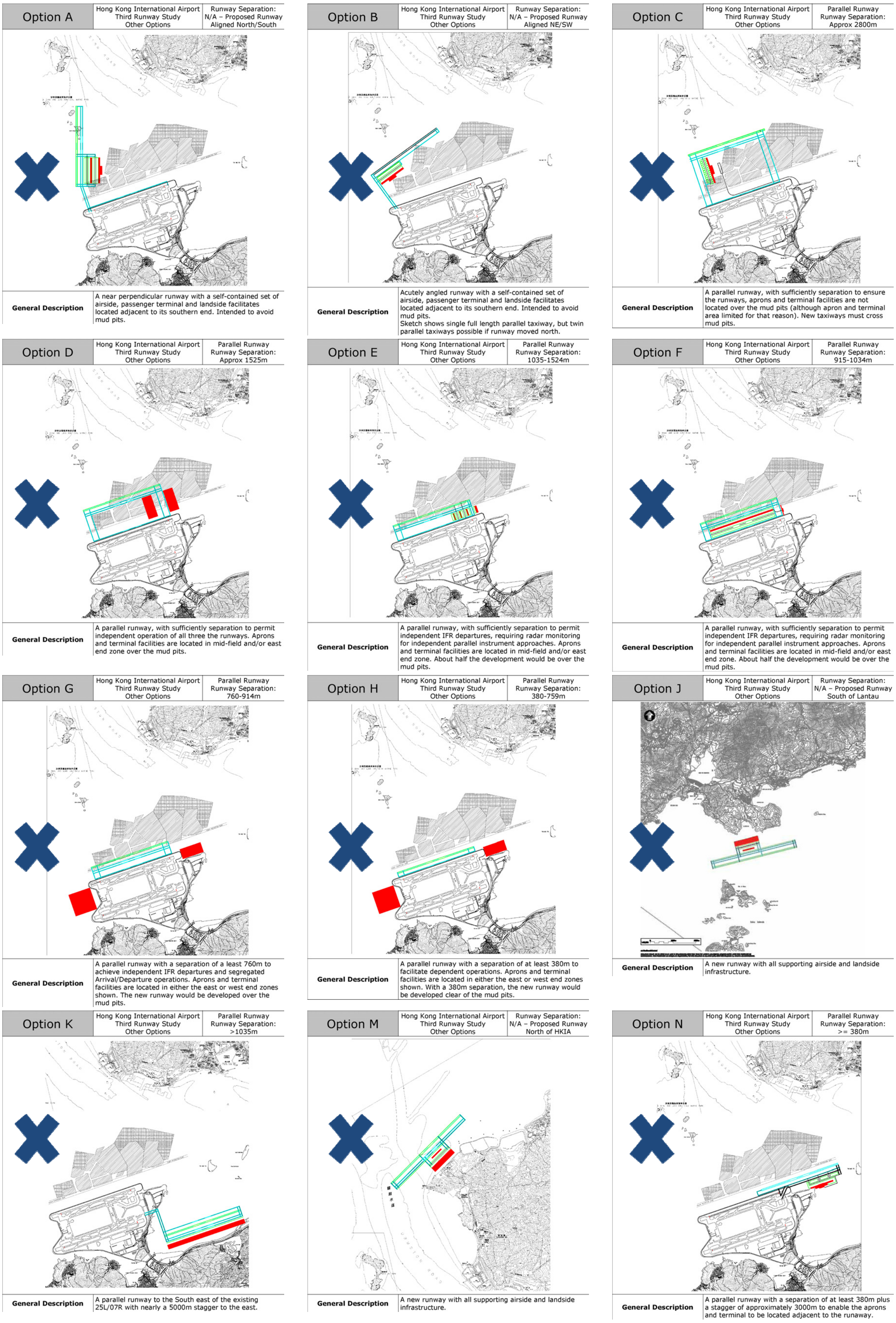
5.5 The Third Runway needs to be located on Chek Lap Kok, the existing airport island. Locating it elsewhere would lead to a split of flight operations into two "de-facto" airports resulting in very inconvenient and time-consuming landside flight connections between the two airports. This could completely negate HKIA's long standing competitive edge as an efficient transfer hub with a minimum connection time as low as 50 minutes.

5.6 NATS has considered the following factors while assessing the feasibility of the Third Runway:

- Limitations due to terrain, wind direction and other meteorological factors;
- Identification of safe and viable modes of operation (arrivals only, departures only or mixed mode) for the three-runway system;
- Modification of air traffic procedures for the immediate airspace surrounding the airport; and
- Modification of air traffic procedures for the wider PRD airspace, in particular independence of operations from those of the surrounding airports.

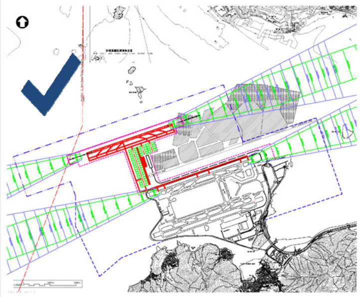
5.7 Considering the geographical constraints on the potential expansion of HKIA, viz. the terrain to the south of HKIA on Lantau and to the north-east of HKIA in North West New Territories (see Figure 3.3), NATS has generated 15 possible runway alignment options, including parallel, angled or crossed runways (see Figure 5.4) for comparative evaluation in the study.

Figure 5.4 : 15 Runway Alignment Options Evaluated by NATS



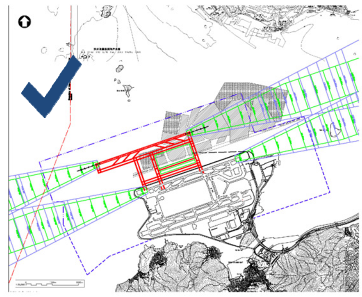
Note: X = options not taken forward in developing the Third Runway option due to considerations of wind direction, runway capacity, ATC operational and PRD airspace issues etc.

Option P	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 2240m



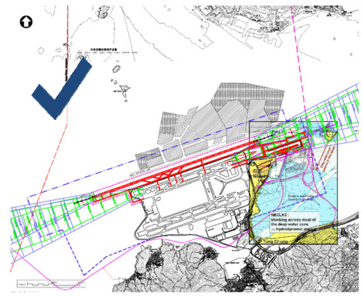
General Description	A parallel runway, with a westerly stagger of 2000m to enable the terminal and aprons to be provided outside the mud pits. The runway has been shortened to ensure that the approach lights do not enter Chinese Territorial Waters.

Option R	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 1525m



General Description	A parallel runway positioned with a western stagger of approximately 1430m. The terminal and apron facilities can be provided in mid field zone.

Option S Ext Variant D	Hong Kong International Airport Third Runway Study Detailed Options	Parallel Runway Runway Separation: 380m

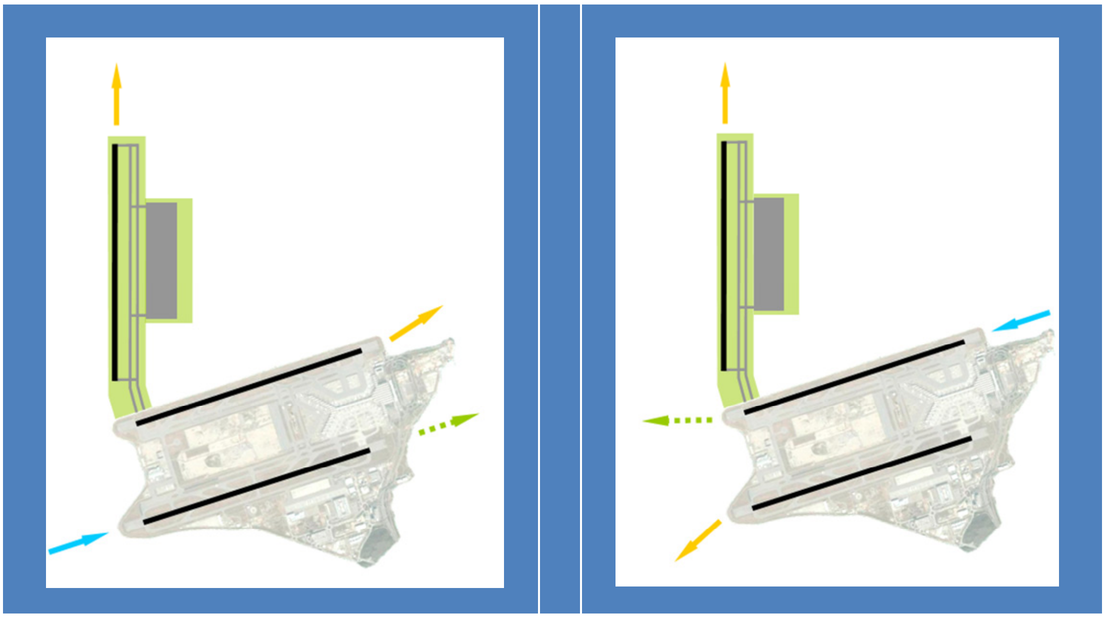


General Description	A very long parallel runway with a separation of 380m. The 1889m stagger in the westerly direction provides close to SOIR compliance between the 07C SID and the 07L missed approach in respect of the runway offset. In the Runway 25 direction, the additional 1000m offset over Variants A,B and C provides some additional separation between the 25C SID and 25R missed approach while not fully SOIR compliant.

5.8 The 15 alignment options can indeed be categorised into three main families of alignment options for evaluation in terms of operational safety, obstacle clearance, PRD airspace constraint issues, air traffic control procedures, and optimum mode of operations including runway usability and capacity.

5.9 **Alignment Option A** – Construct a near-perpendicular runway (see Figure 5.5) to the existing runways. In this case the Third Runway can be used for departures to the north only, resulting in a huge imbalance in departure and arrival capacity. Furthermore, in the Runway 25[55] direction, the Third Runway can be used in certain wind conditions only. Therefore this category appears infeasible for capacity expansion.

Figure 5.5 : Alignment Option A - Near Perpendicular Runway to the Existing Runways



Alignment Option A – Runway 07 Direction			**Alignment Option A – Runway 25 Direction**		
Runway	**Use**	**Capacity**	**Runway**	**Use**	**Capacity**
Third	Departures	35	Third	(Departures)	(35)
07L	Departures	35	25R	Arrivals	35
07R	Arrivals	33	25L	Departures	33
Total		**103**	**Total**		**68(103)**
Increase		**35**	**Increase**		**0 (35)**

Key

Departure

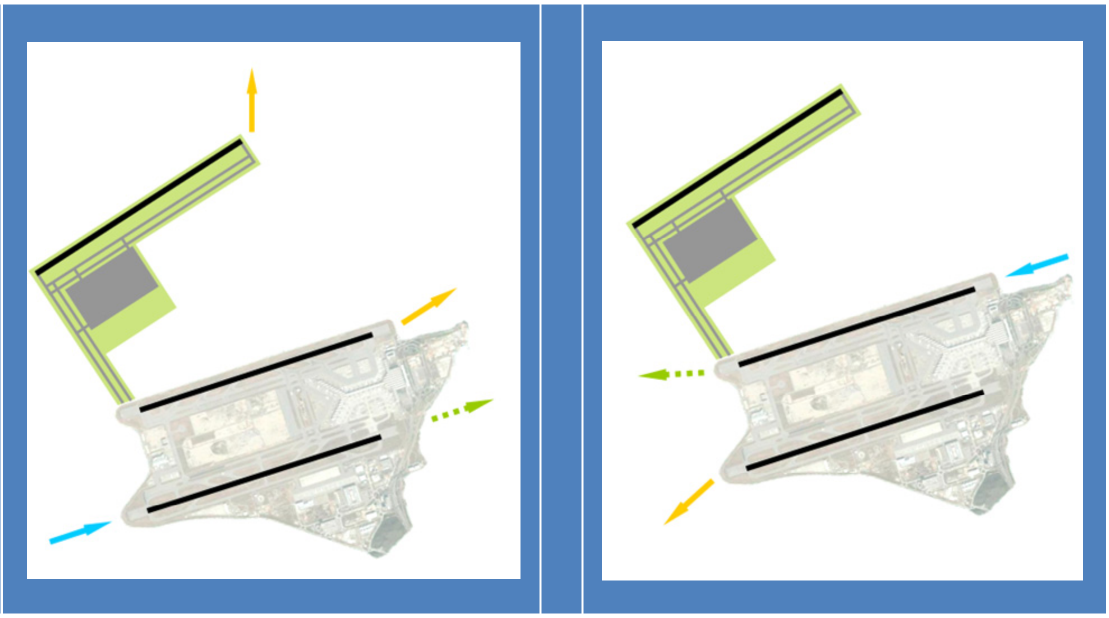
Arrival

Missed Approach

[55] Runway number, times 10, corresponds with the direction of the runway in degrees from magnetic north. For example, runway 25 direction refers to the direction 250 degrees from north. The L/R after the runway number designates the side (left or right side) that the runway is on if there is more than one runway facing the same direction. For example, 07L refers to the runway on the left side when flying towards the direction 70 degrees from north, and 07R the runway on the right side.

5.10 **Alignment Option B** – Construct a Third Runway aligned at an angle to the existing runways (see Figure 5.6). This conflicts with air traffic procedures between the Third Runway and the existing runways in the Runway 25 direction. Here, dependent operations create little or no additional capacity increase. The lack of usability of the Third Runway in Runway 25 direction makes this option impractical.

Figure 5.6 : Alignment Option B – Runway Aligned at an Angle to the Existing Runways



Alignment Option B – Runway 07 Direction			Alignment Option B – Runway 25 Direction		
Runway	**Use**	**Capacity**	**Runway**	**Use**	**Capacity**
Third	Departures	35	Third		0
07L	Departures	35	25R	Arrivals	35
07R	Arrivals	33	25L	Departures	33
Total		**103**	**Total**		**68**
Increase		**35**	**Increase**		**0**

Key

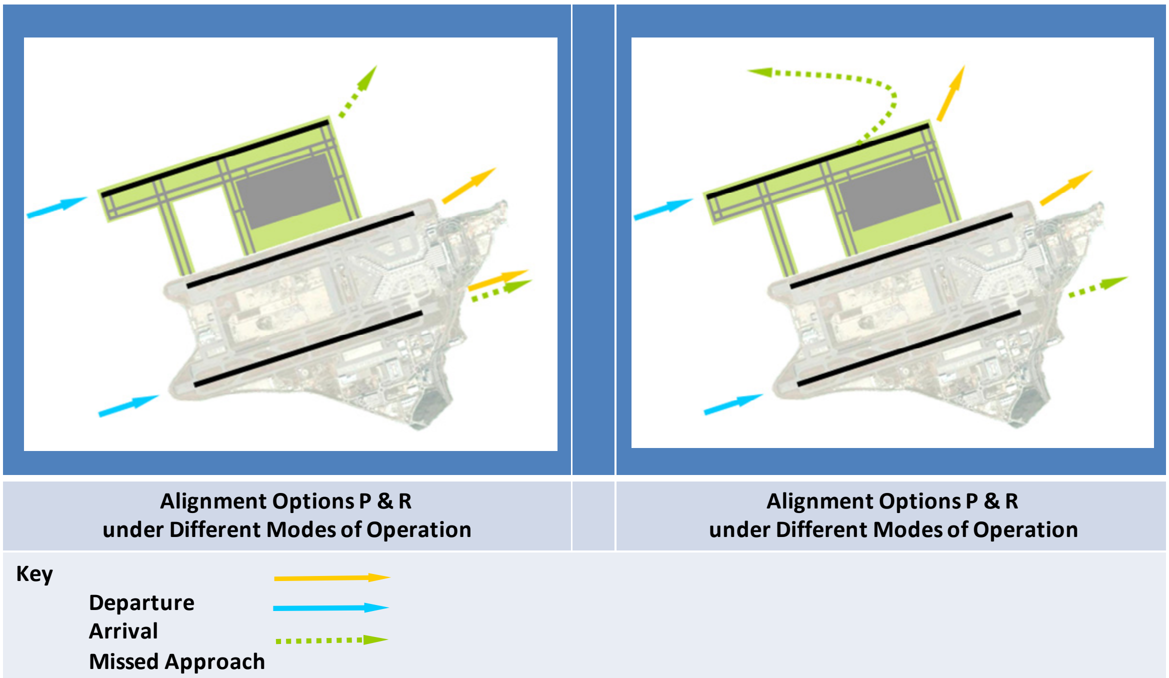
Departure

Arrival

Missed Approach

5.11 **Alignment Option C** – The most effective alignment should allow fully independent parallel operations of all three runways. This is achievable only through a parallel alignment of the Third Runway, provided that the runway separation is adequate for independent operation (see Figure 5.7). As per International Civil Aviation Organisation (ICAO) guidelines a runway separation of at least 1525m will allow independent parallel approaches in variable meteorological conditions.

Figure 5.7 : Alignment Option C - Parallel Runway with the Existing Runways

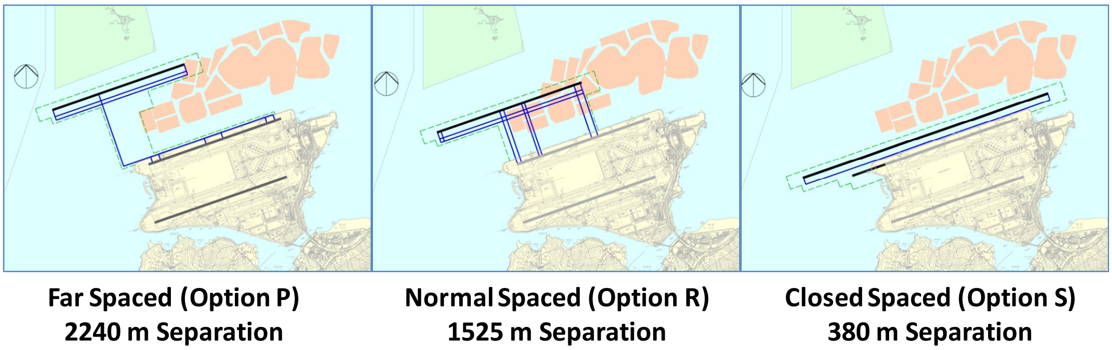


5.12 In conclusion, NATS has eliminated any non-parallel new runway options due to the following:

- Terrain constraints on Lantau Island south of the airport restrict the use of the non-parallel runway aircraft either departing to or arriving from the north;
- Conflicts with air traffic procedures for the existing runways;
- Clashes with traffic flying into and out of Macao and Shenzhen Airports;
- The difficulty of landing safely on a non-parallel runway without imposing very restrictive operating dependencies on the existing runways; and
- The negligible gains in capacity offered by a non-parallel alignment.

5.13 Given the geographical constraints of the airport, viz. Tung Chung township and Lantau Island to the south, the Hong Kong Boundary Crossing Facilities (HKBCF) and Tuen Mun-Chek Lap Kok Link (TMCLKL) to the east, and the territorial boundary of HKSAR waters to the west, only three runway alignment options have been shortlisted from NATS' recommendations (see Figure 5.8). Different separation distances from the existing North Runway require different extent of overlap with the existing contaminated mud pits (situated to the north of the airport island).

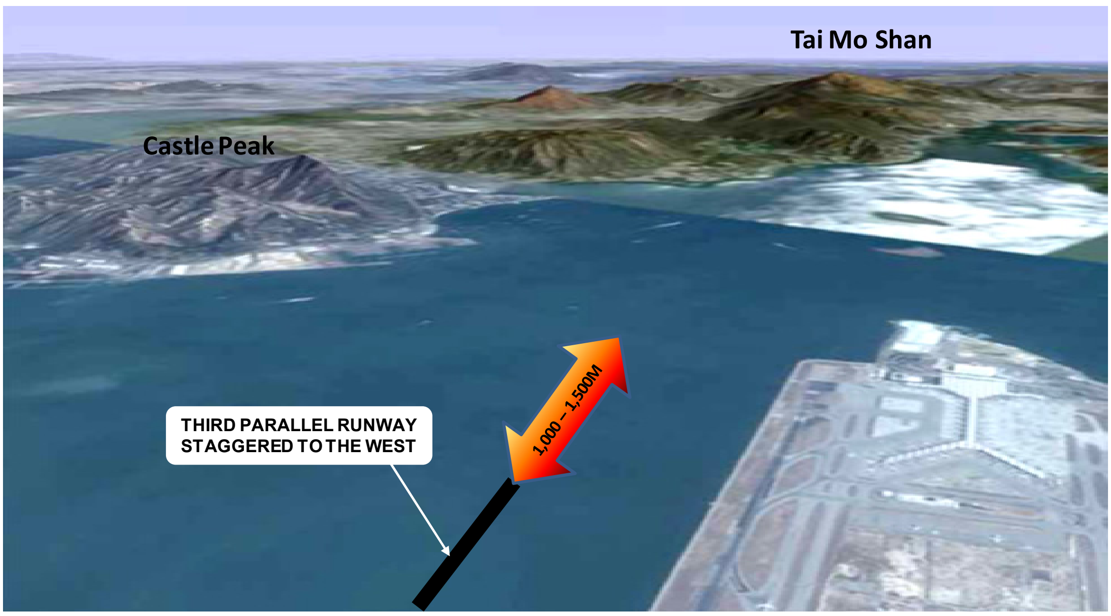
Figure 5.8 : Shortlisted Three-Runway Alignment Options



Need to Stagger the Third Parallel Runway

5.14 The east-west position of the Third Parallel Runway depends on the terrain surrounding the airfield such as Tai Mo Shan and Castle Peak. Preliminary procedure design work by NATS indicates that a fully parallel alignment of the Third Runway with respect to the existing two runways' positions would provide for better integration of airport operations but would have an unacceptable climb gradient for missed approach and departure in the Runway 07 direction. As a result, some staggering of the runway to the west by around 1,000 - 1,500m (see Figure 5.9) with respect to the existing North Runway's threshold position will be required. The subsequent airport layout evaluation steps have recommended a western stagger by around 1,140m for the Third Runway, which will be subject to further ATC procedural design studies during the detailed design stage.

Figure 5.9 : Requirement to Stagger the Third Parallel Runway to the West due to Terrain



Third Runway Length

5.15 The length of the runway required depends on performance characteristics of the critical aircraft, runway elevation and weather considerations at the airport site. Take-off operations require greater runway length than landing operations, with the most critical wide-bodied aircraft type taking off at maximum design take-off weight requiring a runway length of around 3,800m.

5.16 The proposed primary use of the Third Runway is for arrivals. The suggested length is 3,800m, which is the same as the existing two runways, in order to retain the flexibility of switching the Third Runway to a mixed mode runway (a combination of departures and arrivals), thereby increasing the total capacity of the system in the future.

Optimising Runway Capacity with a Third Runway

Mode of Operations and Hourly Capacity of the Three-Runway System

5.17 Runways can be operated in one of the three modes: departures only; arrivals only; or mixed mode, each of which sets a different limit on its maximum capacity (see Figure 5.10 and Chapter 3 for more details):

Figure 5.10 : Practical Maximum Runway Capacity of a Runway Under Different Modes of Operation

Runway Mode of Operation	ICAO Guidelines on Minimum Separation	Maximum Runway Capacity (Hourly Movements)
Arrivals Only	3NM *	33
Departures Only **	90 seconds	35
Constrained Mixed Mode	8NM arrival spacing	34
Unconstrained Mixed Mode	6NM	44

Note: *'NM' means nautical miles

**90 seconds between all departures except two minutes vortex separation as appropriate

5.18 NATS recommends the primary mode of operation for the three-runway system to be "Arrivals only, Departures only, Mixed" (ADM) for the new Third, Second (current North) and First (current South) Runways respectively (see Figure 5.11). This mode was derived to maximise runway capacity, while considering factors like terrain, flight track separation, wake vortex[56], operability and capacity. The recommendation is based on the following:

a) The Third Runway can only be used for arrival operations in order to avoid conflict with the Shenzhen airport arrival circuit in the Runway 07 direction (i.e. take off to the north east). Departure traffic using the Third Runway for takeoff would pass abeam the Shenzhen arrival circuit at roughly the same altitude (3,000 feet to 4,000 feet) and is therefore not possible.

b) Independent mixed mode operations cannot occur on both the First and Second Runways (as explained in Chapter 3 paragraph 3.11).

c) As independent parallel approaches are not permitted for the First and Second Runways, the Second Runway is restricted to departures, while the First Runway

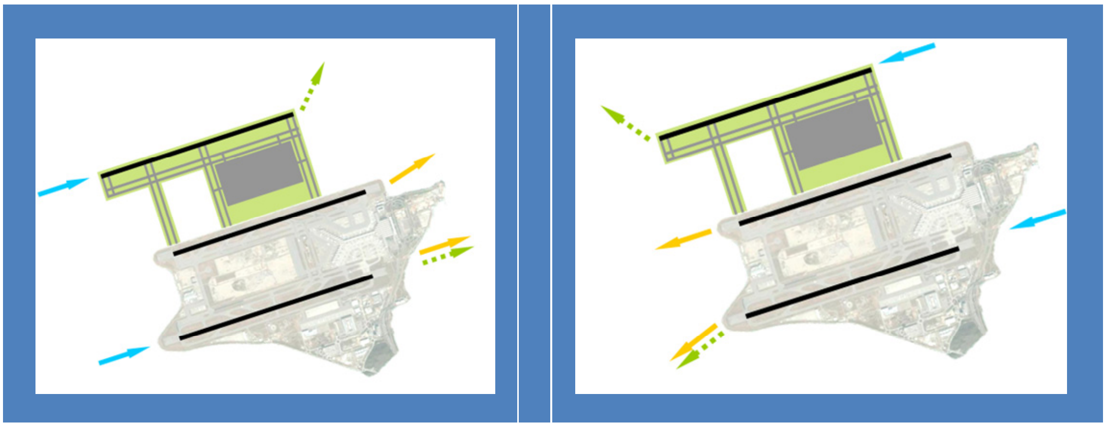
[56] An aircraft leaves a wake in the air. An aircraft's wake is in the form of two counter-rotating swirling rolls of air (or wake vortices) that trail from the wings of the aircraft. The wake vortex pair may last for several minutes and stretch for many kilometres behind the aircraft. The strength of the vortices basically depends on the aircraft weight, divided by the product of air density, flying speed and wingspan. This property generally increases with aircraft weight.

operates in mixed mode to balance the overall take-off and landing slot availability in each hour.

d) The proposed alignment would also permit independent parallel approaches to the First and Third Runways which are the widest apart.

The ADM mode of operation for a three-runway configuration (see Figure 5.11) provides a maximum total capacity of 102 movements per hour. With the development of future aircraft navigation technology and improvements in airspace and air traffic management, runway capacity could potentially be stretched even further.

Figure 5.11 : Proposed Primary Mode of Operations (Third Runway as Arrival, Second Runway as Departure and First Runway as Mixed)



Options P & R - Runway 07 Direction		Options P & R - Runway 25 Direction		
Runway	**Use**	**Arrival**	**Departure**	**Capacity**
07L/25R	Arrivals	33		33
07C/25C	Departures		35	35
07R/25L	Mixed	17	17	34
Total		**50**	**52**	**102**

Key

Departure

Arrival

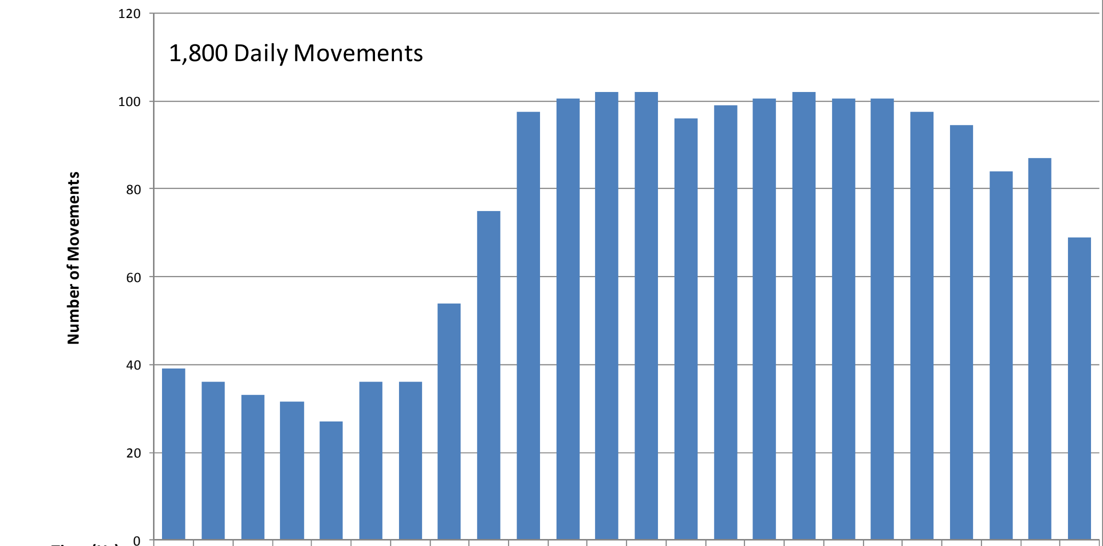
Missed Approach

Practical Maximum Capacity of the Three-Runway System

5.19 NATS estimates the practical maximum ATM capacity to be 1,650 to 1,800 movements a day for the three-runway system as opposed to the 1,100 to 1,200 movements a day for the two-runway system. Using the historical Design Day/Annual ATM ratio of 0.0029, this provides an annual ATM capacity ranging from 570,934 to 622,837 for the three-runway system.

5.20 As with the two-runway option, the projected practical maximum daily movement profile of the three-runway system (see Figure 5.12) needs to build in a contingency allowance for runway direction changes for all three runways. At night, one of the three runways will be closed for maintenance and it is assumed that the hourly distribution of flights at that time will have a similar profile to the two-runway system wherein the South Runway stays in standby mode where possible to reduce noise impact. Recovery periods to cope with these contingencies have been built into the schedule incorporating all stakeholder inputs on their duration and placement.

Figure 5.12 : Daily Movement Profile Based on 1,800 Movements per Day



Time (Hr)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Air Traffic Movements	39	36	33	32	27	36	36	54	75	98	101	102	102	96	99	101	102	101	101	98	95	84	87	69

PRD Airspace Restructure Requirement of the Three-Runway System

5.21 Based on NATS' analysis, to fully realise the potential capacity gain of a Third Runway, the PRD airspace will need to be redesigned to be able to provide:

- A northern circuit at HKIA;
- Long final approach tracks; and
- Independent arrival procedures.

5.22 The development and implementation of the required changes in the PRD airspace requires further discussions amongst the Civil Aviation Administration of China (CAAC), Hong Kong Civil Aviation Department (CAD) and Autoridade de Aviacao Civil Macao (AACM) in the Pearl River Delta Tripartite Working Group. This alignment will have to take place in tandem with the physical development of airport infrastructure.

Airport Layout Options Evaluation

5.23 Based on the three short-listed Third Runway alignment options, the consultant for airport facilities planning, AECOM, has developed 18 airport layout options (see Figure 5.13) to cover all possible permutations of apron, passenger terminal and concourse expansion locations. These were then evaluated comprehensively across key operational and functional parameters.

5.24 For the purpose of high level master planning, (see Figure 5.14 for evaluation criteria), the 18 airport layout options have been streamlined into two families for further in-depth assessment.

Figure 5.13 : Eighteen Airport Layout Options

Option 1 (P)

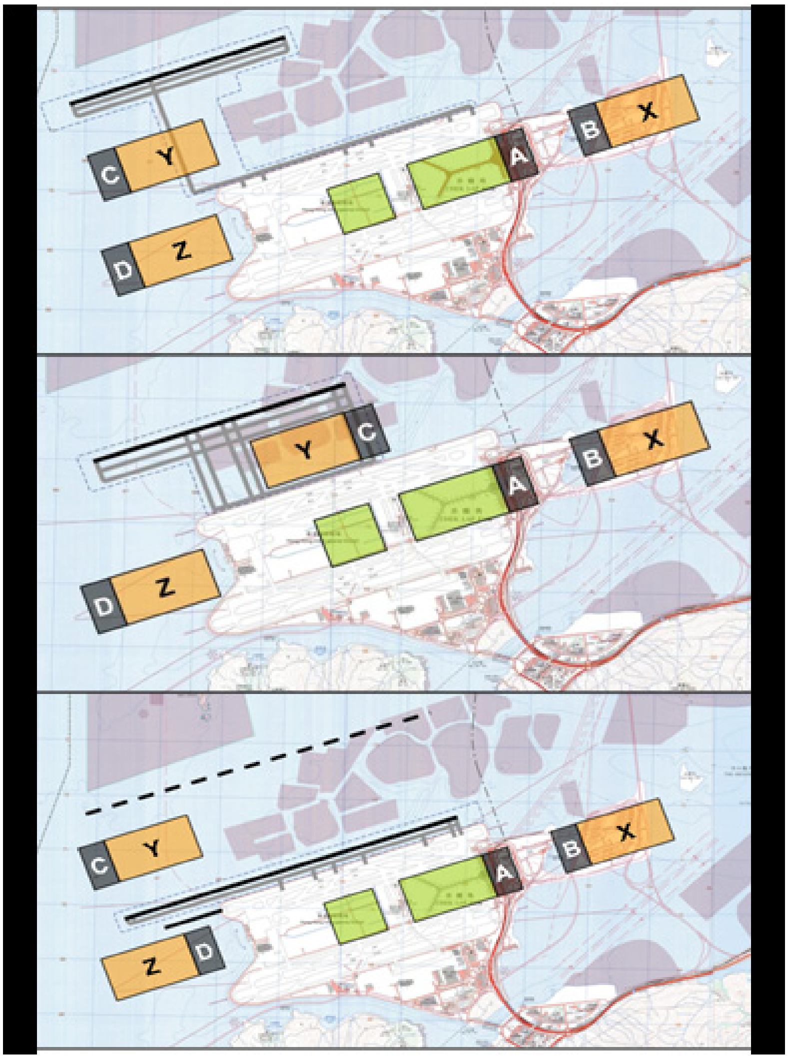
- A + X
- A + Y
- A + Z
- B + X
- C + Y
- D + Z

Option 2 (R)

- A + X
- A + Y
- A + Z
- B + X
- C + Y
- D + Z

Option 3 (S)

- A + X
- A + Y
- A + Z
- B + X
- C + Y
- D + Z



LEGEND

A, B, C & D show the possible location of Passenger Processing Terminal (where passengers are processed for check-in, Customs/Immigration/Quarantine and security screening)

X, Y & Z show the possible location of Aircraft Apron and Passenger Concourse Area (where aircraft gates are located)

P, R & S denote spacing between the Third and existing North runways (i.e. far-spaced, normal-spaced and close-spaced) respectively

Figure 5.14 : High Level Evaluation Criteria

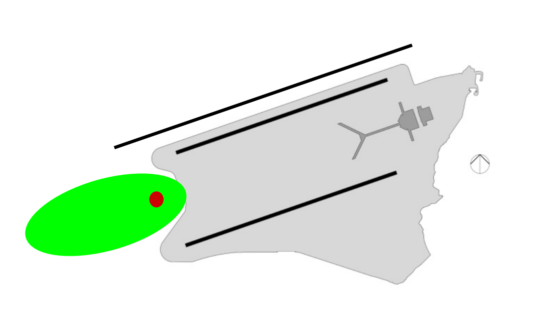
1.	**AIRFIELD**	
	- Taxiing Time/Distance	Relative compared to each option
	- Runway Crossings	Relative compared to each option
	- Additional Control Tower	If needed for operations or for blocked lines of sight
	- Balance East/West	—
	- Cargo Connectivity	Proximity of stands/access to cargo
2.	**TERMINAL**	
	- Passenger Connectivity	Minimum transfer time, APM complexity and capacity
	- Baggage Connectivity	Connection time/complexity
	- Duplication of Facilities	Terminal processor, Retail, Surface Access Interchange, APM, etc
	- Synergy with Airport Related Development (ARD)	Proximity
3.	**SURFACE ACCESS**	
	- Road Access & Capacity	Extension of existing roads and capacity of new road
	- Airport Express Line (AEL)	Ability to extend existing line, or the need to create a secondary bifurcation
	- Cross Boundary Transport Facilities	Ability to serve cross boundary air/surface transit passengers via Coach, SkyPier and potentially WEL
4.	**LONG-TERM CAPACITY/FLEXIBILITY**	
	- Strategic Consideration	Ability to meet demand growth beyond 2030
5.	**CONSTRUCTIBILITY/COST**	
	- Runway/Taxiways	Runway/Taxiway Length or area
	- Construct Over Mud Pits	Cost (and possible lead time)
	- Terminal Processor	Expansion/Extension of Terminal 1 (T1)/Terminal 2 (T2), or reclamation for a new terminal
	- Surface Access – Road/Rail	Short extension of existing versus major line extensions/bifurcation
	- Total Land Reclamation Area	Land take-up
	- Operational Impact	—

The two families of airport layout options, as shown in Figure 5.15 are:

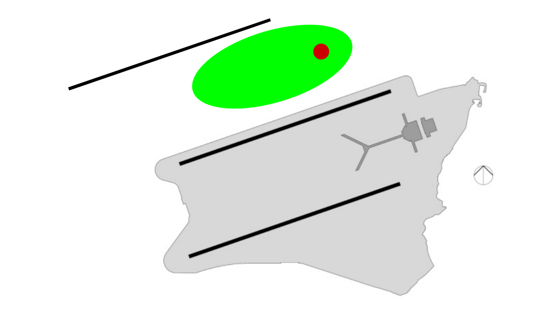
- Westward expansion: The Third Runway adopts a close-spaced runway separation, at around 380m from the existing North Runway; and
- Northward expansion: The Third Runway adopts a similar runway separation as that between the existing two runways. The Third Runway is around 1,645m from the existing North Runway, while the existing two runways are 1,540m apart.

Figure 5.15 : Expansion Options

(i) Westward Expansion Option (W)



(ii) Northward Expansion Option (N)



LEGEND

 Passenger Concourse and Aircraft Apron Area

 Passenger Processing Terminal Location

5.25 After analysis of both families of options from the airport planning, engineering and environmental perspectives, the consultant has recommended the northward expansion option as the basis for developing the preferred airport layout. The comparative performance between the two expansion options is summarised below:

Figure 5.16 : Comparative Performance between the Two Expansion Options

Criteria	Westward Expansion	Northward Expansion
Airfield Efficiency	×	✓
Passenger Convenience	×	✓
Surface Access	×	✓
Cargo Operations Efficiency	×	✓
Degree of Environmental Impact	×	✓

(More information about the comparative evaluation is in Appendix 3.)

The development needs of the key components of the preferred airport layout option are outlined below.

Airport Infrastructure and Facilities Needed to Support the Three-Runway System

Passenger Processing Terminal

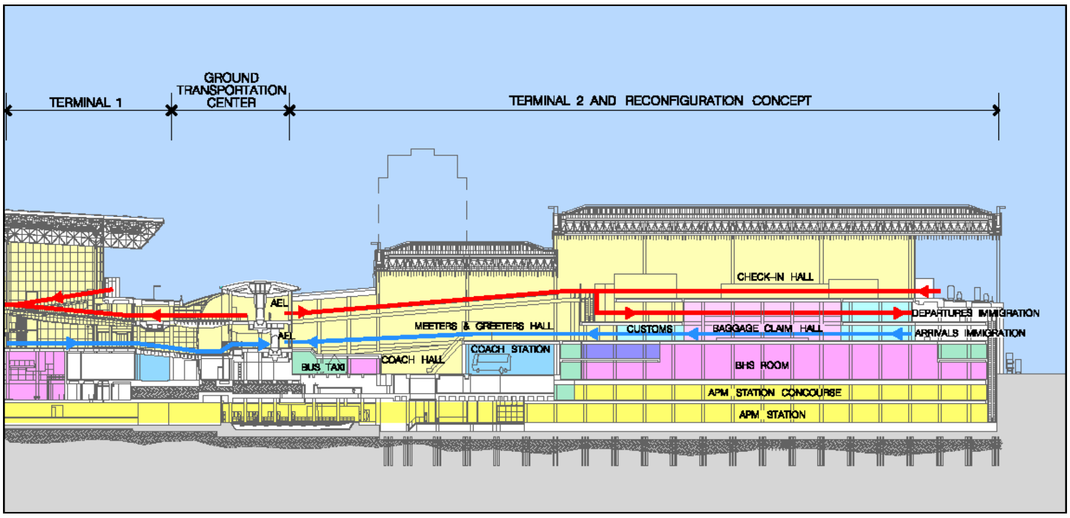
5.26 *Passenger Processing Terminal Expansion Considerations*

Passenger processing terminal handling capacity at HKIA needs to increase significantly to meet the unconstrained passenger demand forecast of 97 million per annum by 2030.

5.27 No enhancement of the Terminal 1 (T1) passenger concourse is required, as passenger traffic from T1 will be redistributed to a reconfigured/expanded Terminal 2 (T2). T2 will be linked to the new Third Runway passenger concourse by automated people mover (APM) and baggage handling system (BHS).

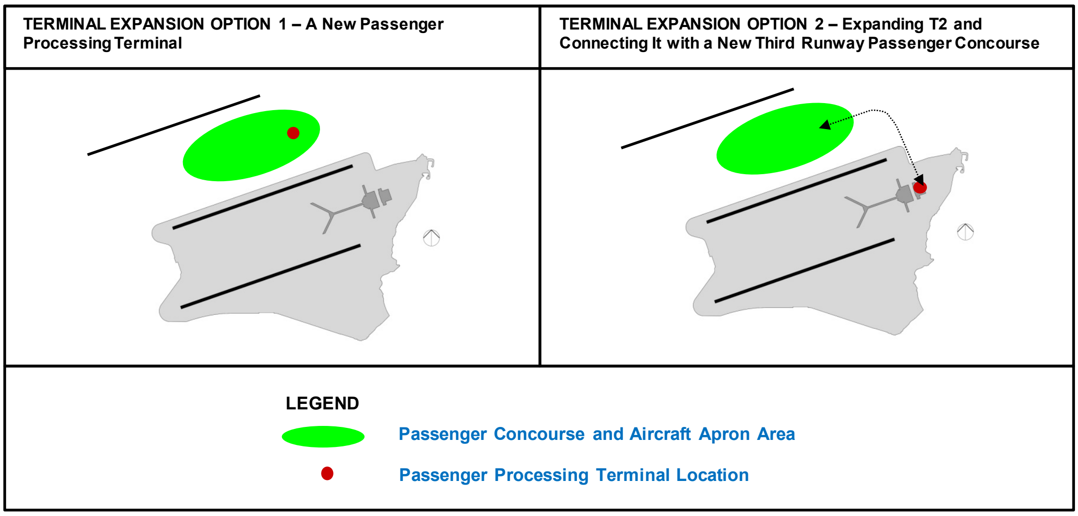
5.28 The reconfiguration/expansion of T2 involves adding an arrivals floor; increasing the building footprint to accommodate the new APM and BHS systems; and relocating the departures kerb from the western side to the eastern side of T2, with an increased number of departure kerb lanes (see indicative cross section of reconfigured/expanded T2 in Figure 5.17).

Figure 5.17 : Indicative Cross Section of Reconfigured/Expanded T2



5.29 Both alternatives for the passenger processing terminal required to meet demand beyond 2020, viz. reconfigure/expand T2 or build a new Terminal 3 in the reclaimed area adjacent to the third passenger concourse, were studied (see Figure 5.18). Building a new Terminal is not recommended for the reasons below:

Figure 5.18 : Terminal Options to Enhance Passenger Processing Terminal Handling Capacity

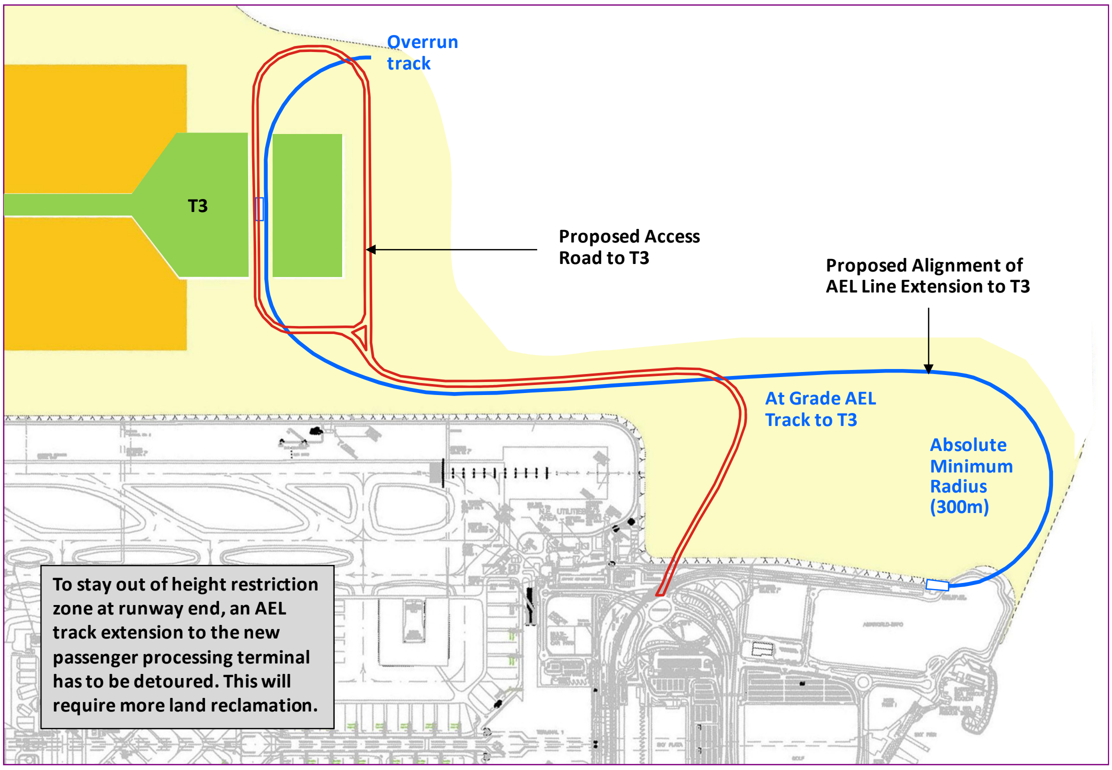


5.30 *Option 1: Building a New Passenger Processing Terminal Adjacent to a New Third Runway Passenger Concourse*

This has the benefit of a shorter travelling distance (approximately 1 minute) between the passenger processing terminal and concourse, versus three to four minutes for option 2 (expansion of current terminal). However, there are several disadvantages:

- The existing airport access road and tunnel system would have to be extended to serve the new passenger terminal, entailing more land reclamation.
- It is technically challenging to develop a suitable alignment for the direct extension of the Airport Express Line (AEL) that allows it to stay out of the height restriction zone of the Second Runway (see Figure 5.19). A more circuitous AEL route and hence more reclamation would be required.
- Route recovery would be very difficult for departing passengers who inadvertently arrive at the wrong passenger processing terminal, because of the physical distance between the new terminal and T1/T2.
- Additional land reclamation would also be needed for all the new access roads and car parking facilities.

Figure 5.19 : Explored Alignment of AEL Track and New Access Road to a New Passenger Processing Terminal



5.31 *Option 2: Reconfiguring/Expanding T2 and Connecting It with the New Third Runway Passenger Concourse*

This has several advantages:

- The Airport Express Line (AEL) is already connected to T2;
- There is an easier route recovery between T1 and T2 for departing passengers; and
- Less reclamation is needed.

5.32 The major disadvantage of this option is a longer (two to three minutes more) APM ride between T2 and the new Third Runway passenger concourse.

5.33 Overall however, **Option 2 - having a reconfigured/expanded T2 with links to the new Third Runway passenger concourse - is preferred.**

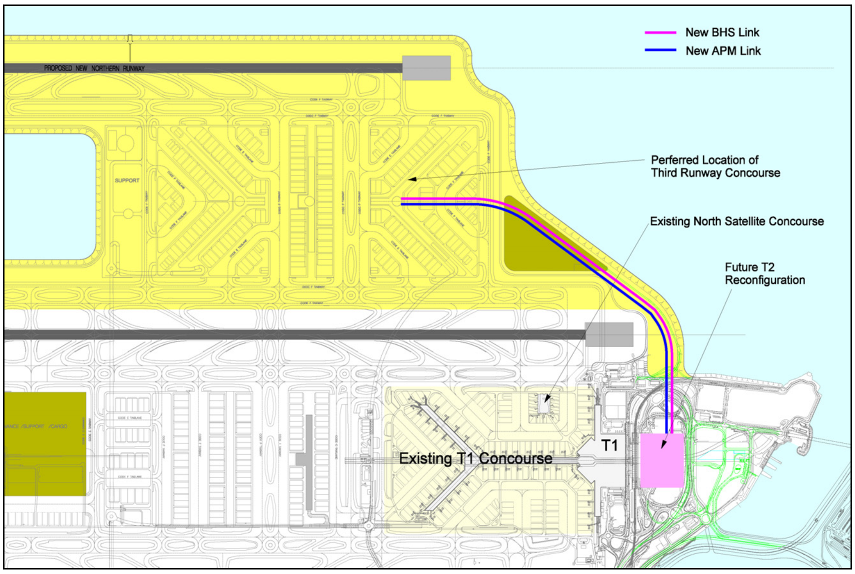
Passenger Aircraft Apron and Passenger Concourse

5.34 A new passenger concourse (Third Runway passenger concourse) with its associated aircraft parking apron should be located between the Second and Third Runways (see Figure 5.20). This will improve airfield operational efficiency and shorten passenger travelling distance to and from its passenger processing terminal T2.

5.35 By 2020, 116 passenger aircraft parking stands will be required, increasing to 169 by 2030 to fulfil the unconstrained passenger demand forecast. Given the existing 86 full-service aircraft parking stands[57] and the incremental 20 that AAHK has already committed to develop at Midfield by 2015, around 60 more passenger aircraft stands will need to be added in phases between 2016 and 2030.

[57] The 86 full-service aircraft parking stands exclude the 11 temporary parking stands. These temporary parking stands are planned to be converted into full-service stands, as part of the 20 new parking stands at Midfield.

Figure 5.20 : Proposed Third Runway Passenger Concourse and Aircraft Parking Areas with Associated APM and BHS Links with T2

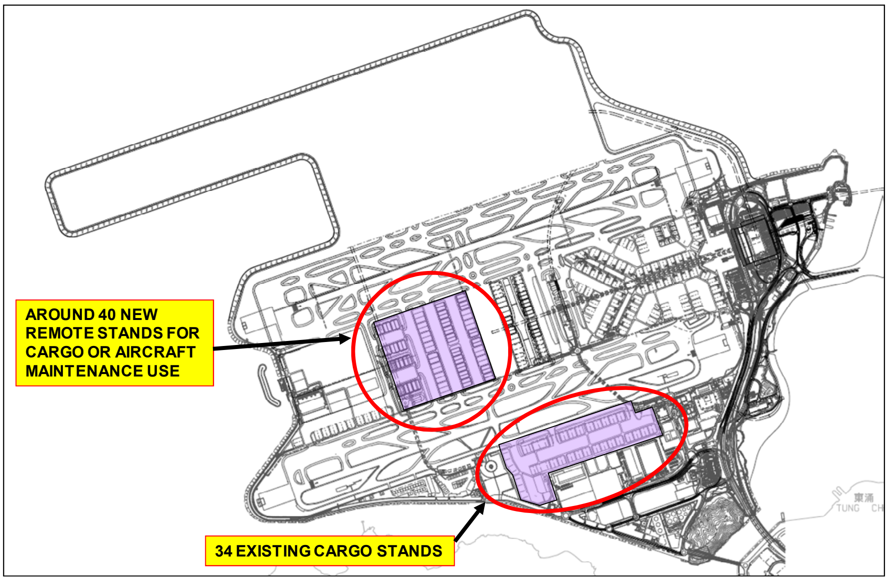


Cargo Aprons

5.36 By 2020, 47 cargo stands will be required, increasing to 72 by 2030 to meet the unconstrained cargo aircraft movement forecast. Given the existing 34 cargo stands, around 40 more will be needed gradually over the next 20 years to support forecast demand.

5.37 Since the planned cargo terminals are to be located in the Southern Cargo Precinct, these new stands should be located as close as possible to the cargo area. Since expanding the South Cargo Apron, which already holds 34 cargo stands, is infeasible, the new cargo stands will be located in the Midfield area (see Figure 5.21).

Figure 5.21 : Proposed Freight Stand Development in the Midfield Area



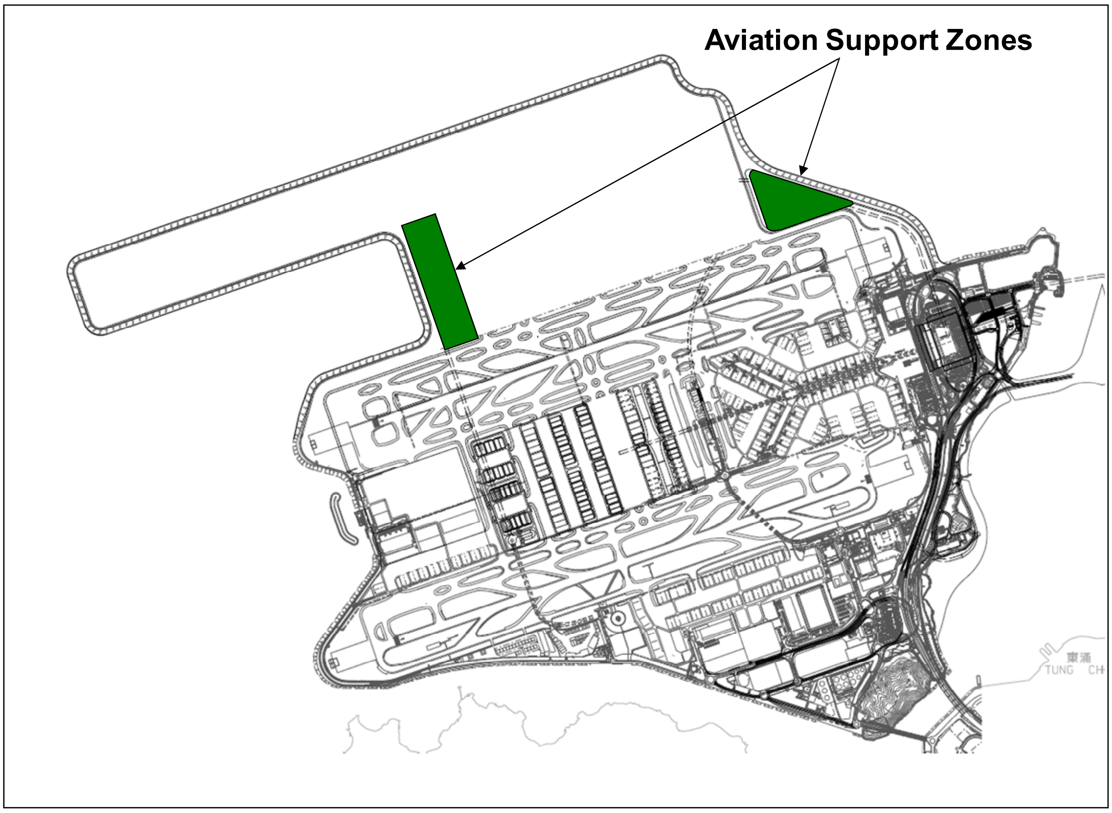
Aviation Support Facilities at the Apron

5.38 Additional space between the Second and Third Runways should be safeguarded for aviation support and government facilities which operational needs require proximity to the new apron such as:

- Aircraft maintenance;
- Ground support equipment (GSE) maintenance;
- Navigational aid and meteorological installations;
- Airline catering
- Airport rescue and fire fighting; and
- Second operational ATC Tower.

Figure 5.22 shows the aviation support zones suggested in the proposed land reclamation area.

Figure 5.22 : Proposed Aviation Support Zones

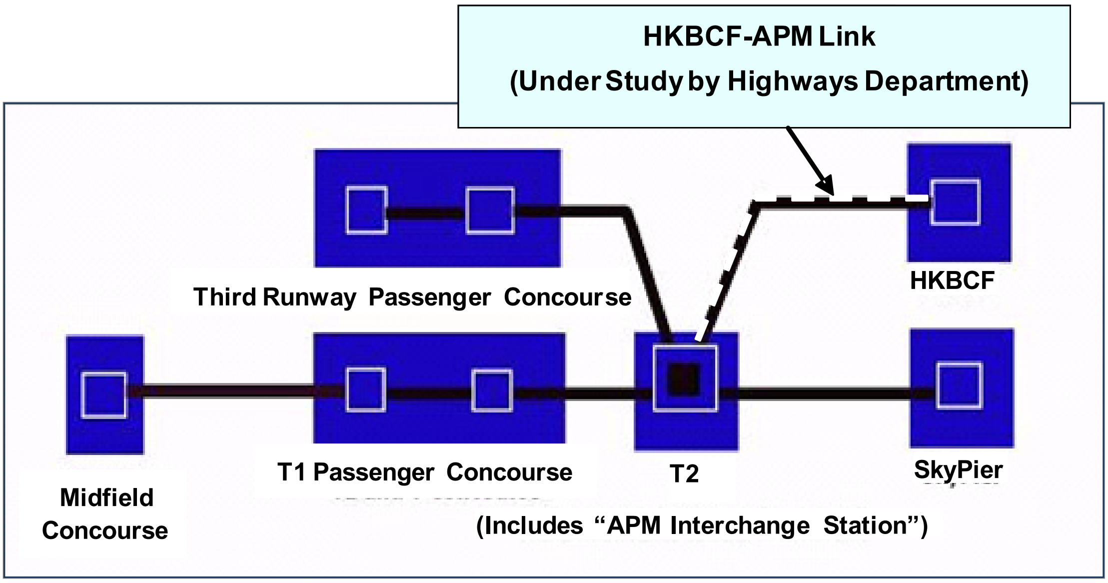


Automated People Mover System

5.39 The automated people mover (APM) system will be the main artery for transporting passengers between the various passenger processing terminals, concourses, SkyPier and potentially the HKBCF. The present APM system connects the West Hall and East Hall of T1, T1 to T2 and the SkyPier to T1. As in Option 1 (two-runway system), the APM system will be extended to connect the Midfield area to T1 by 2015. To meet the 2030 demand, the APM system will need further expansion to include a connection to the Third Runway passenger concourse.

5.40 An outline of the future APM system, which includes a unique "APM Interchange Station" at T2 for interchanges, is shown below.

Figure 5.23 : Proposed Airport APM Network with APM Interchange Station



5.41 Due to the expansion of the APM fleet, a new site will be needed for an APM depot to accommodate maintenance, storage and other needs in the future. The recommendation is to locate it underground and to the immediate east of the reconfigured/expanded T2 for convenient access to all APM lines. Access to the depot from an above-grade road would also be required for ongoing addition/replacement of APM cars.

Baggage Handling System

5.42 A new baggage handling system (BHS) for T2 passengers will be needed to handle projected passenger volume. This will be built within the reconfigured/expanded T2.

Passenger Terminal Area Road Network

5.43 The existing elevated road network around T2 is proposed to be extensively realigned, with the departure kerb for T2 relocated to the east of the terminal building, similar to T1, and an elevated exit road circling the existing North Commercial District (NCD) before rejoining the Airport Road south of T2. The elevated road will be provided with ramps to and from the at-grade road network in the NCD, and also with elevated road links from T1 and T2 to the HKBCF (see Figures 5. 24 and 5.25).

Figure 5.24 : Proposed Road Network in the T2 Area

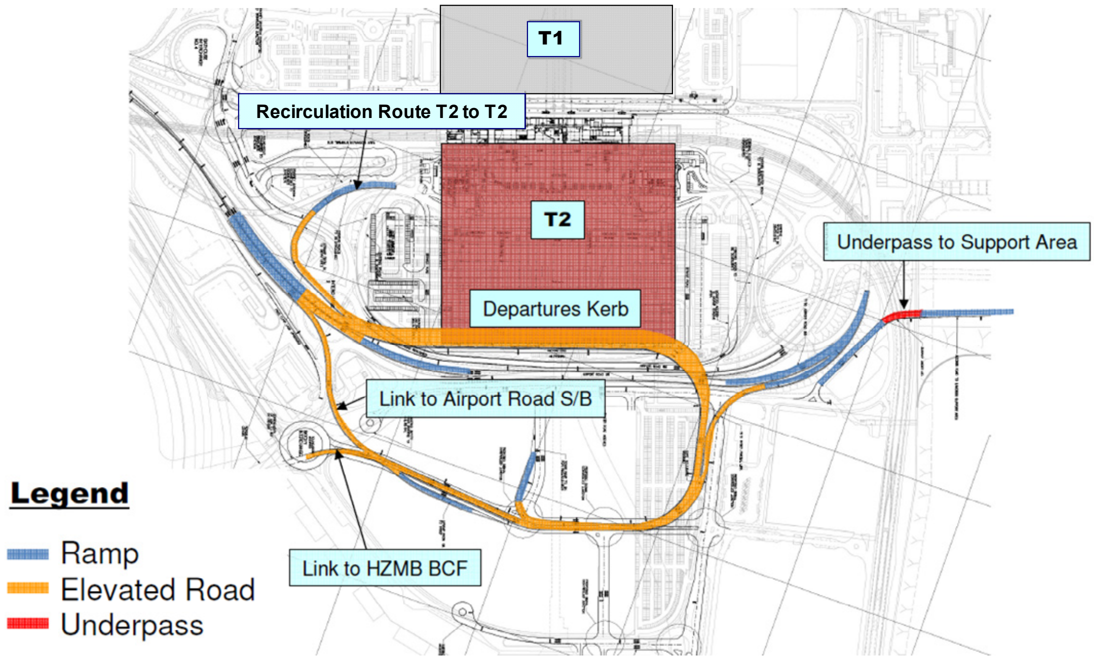
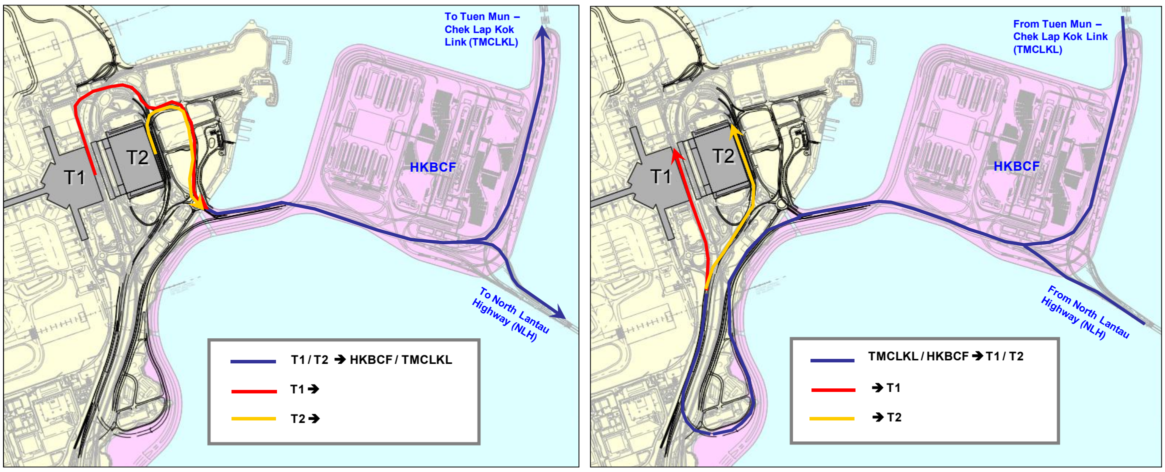


Figure 5.25 : Road Connection to and from the Airport via HKBCF/TMCLKL for Three-Runway Option



5.44 Similarly, the at-grade road network will be reworked around the reconfigured/expanded T2 as well as to the south, with major car parks and vehicle staging areas moved to the NCD (see Figure 4.27 for NCD location), the existing franchised bus terminus expanded close to the existing terminus, and an additional hotel vehicle pick-up facility located south of T2.

Transportation Facilities/Services

5.45 *Buses, Coaches, Limousines and Taxis*

The existing private car and hotel vehicle pick-up area south of T1 will be maintained, and a new one provided south of the reconfigured/expanded T2. The taxi station, taxi staging area and franchised bus terminus will remain at the same location, serving both T1 and T2. In addition, an area immediately to the east of the existing bus terminus has been identified as an expansion area for the franchised bus terminus. The existing coach station in T2 will also be expanded.

5.46 *Car Parking*

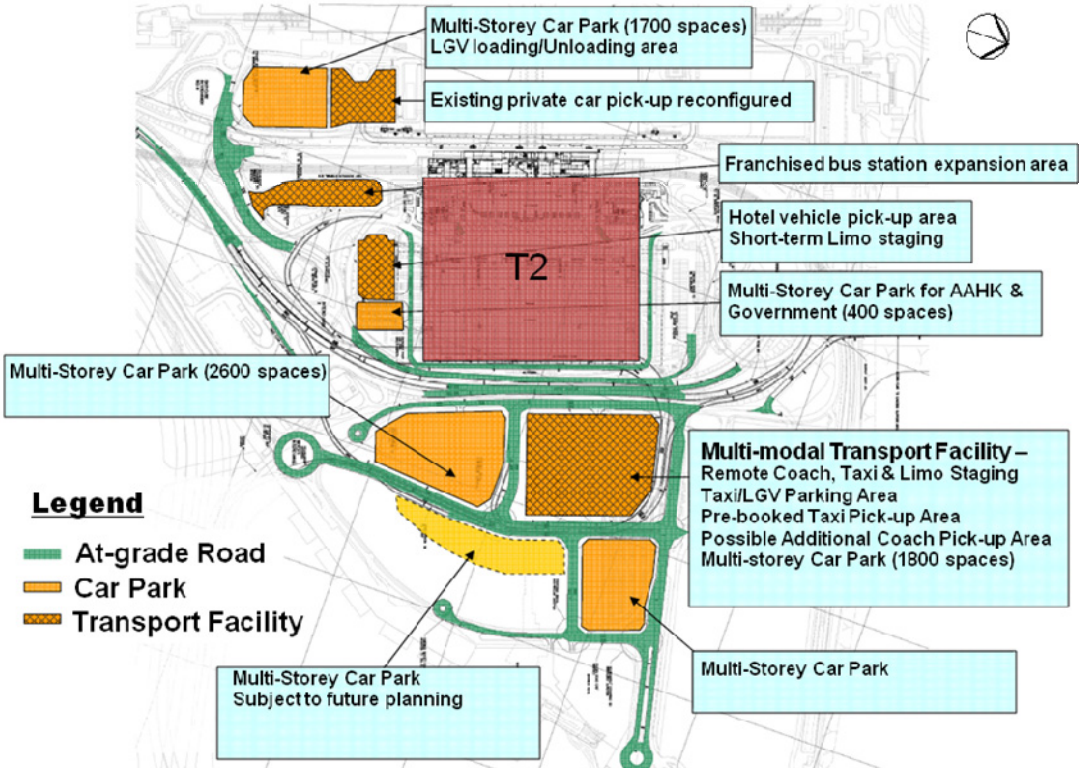
A doubling of passenger throughput by 2030 would require doubling the number of car park spaces to maintain existing service levels. It is estimated that around 6,500 new car park spaces are required, including the re-provisioning of around 1,500 existing public, government and staff car park spaces adjacent to T2 due to the terminal's expansion as well as 1,000 spaces for the existing Sky City car park because of the expansion of the passenger terminal access/exit roads. This estimate is based solely on airport usage and excludes any further parking requirements that may arise for other airport-related uses. These requirements can be met by the provision of four multi-storey car parks south of T1 and adjacent to reconfigured/expanded T2.

5.47 *Coach Staging*

By 2030, it is estimated that approximately 260 coach staging spaces will be needed. The existing coach staging area at T2 provides about 150 spaces. This facility will be retained and designated for future use as a short-stay coach staging area. An additional 110 spaces will be provided in the area to the east of the reconfigured/expanded T2 and immediately to the south of Airport Expo Boulevard. This staging area will be allocated for longer stay and overflow coach parking. It will also be used as a taxi and limousine staging area, taxi/light goods vehicle parking area and pre-booked taxi pick-up area. Allowance has been made for about 200 spaces.

5.48 Figure 5.26 provides an overall view of the proposed locations for future car parking facilities.

Figure 5.26 : Proposed Locations of Future Transportation Facilities

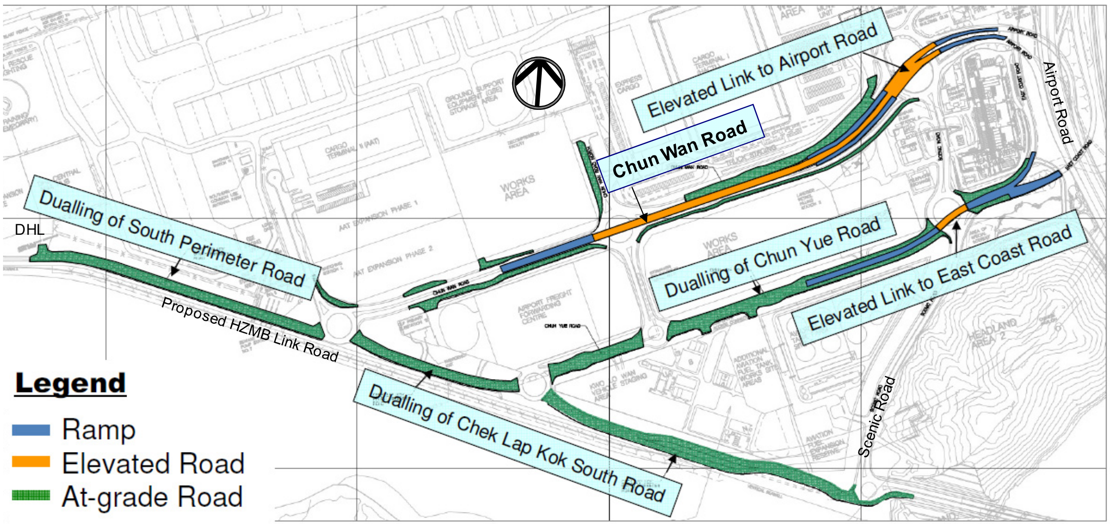


Aviation Support Facilities

5.49 *Cargo Terminal Precinct and Road Network*

The area reserved for the potential new cargo terminal and the required road network enhancements in the Southern Cargo Precinct will be similar to that planned for expansion for the two-runway system. The additional road improvement works would include the widening of Chun Yue Road to dual two-lane standard, local widening of eastbound carriageway of Chun Wan Road to four lanes, and widening of South Perimeter Road (between DHL and Chun Ping Road) (See Figure 5.27).

Figure 5.27 : Proposed Road Improvements in the Southern Cargo Precinct



5.50 *Aviation Fuel Facilities*

The Permanent Aviation Fuel Facility (PAFF) located in Tuen Mun has reserved space for the installation of four additional aviation fuel storage tanks in Phase 2 of its development. The airport onsite fuel storage facility of 223,000 cubic metres, together with PAFF's Phases 1 and 2, will provide a combined capacity of 611,000 cubic metres. This easily exceeds the mandatory 11-day fuel storage requirement (i.e. 400,000 cubic metres based on 2030 forecast aircraft movements).

Airport Related Development

5.51 Because of the need for additional airport operation and support facilities, there will be less space available for airport related development in the North Commercial District compared to Option 1 but the area reserved in Kwo Lo Wan remains.

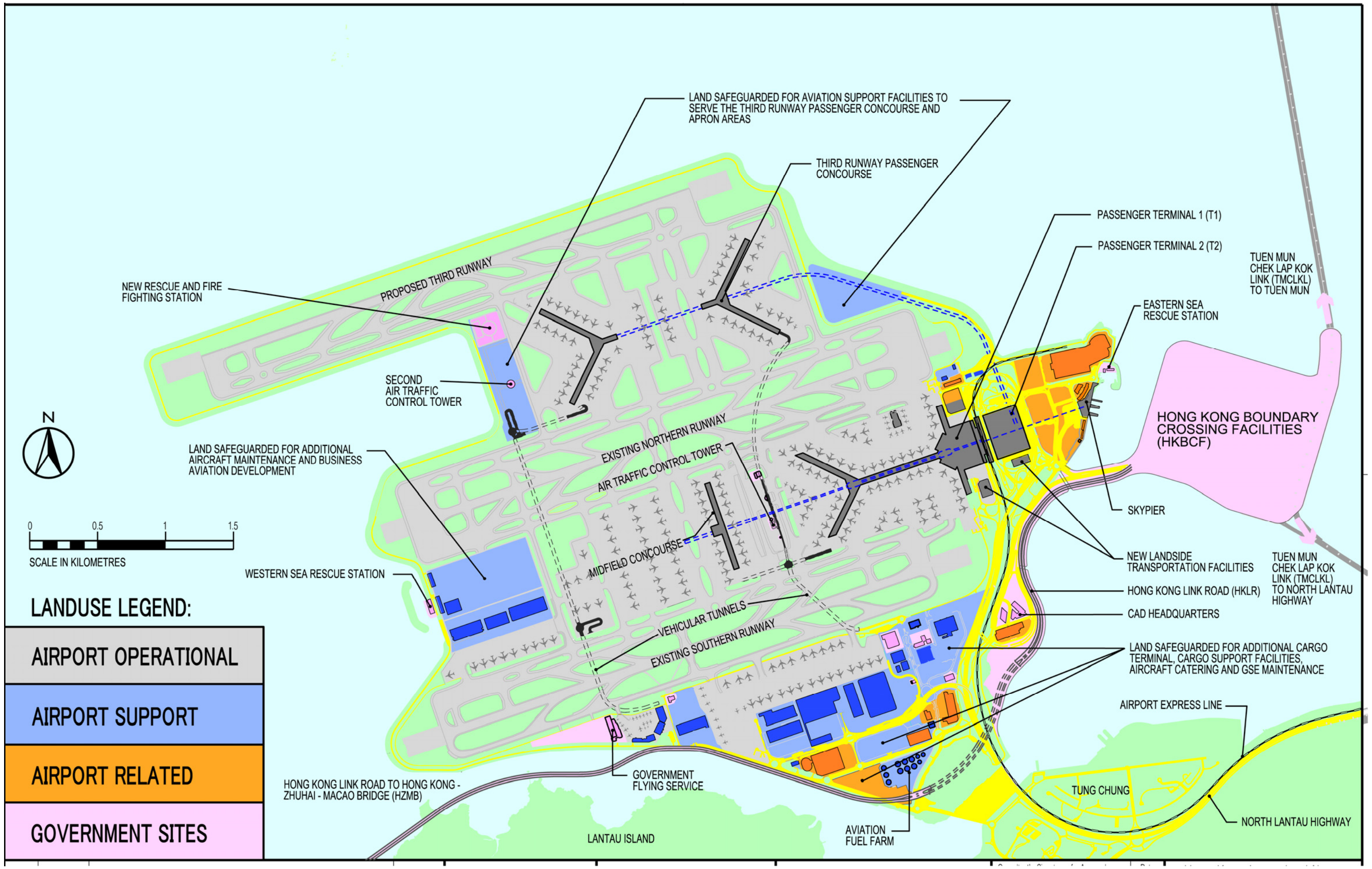
Airport Layout Plan in 2030

5.52 Option 2 proposes expanding the airport island northward, based on the preferred alignment of the Third Runway and the development strategies for operations, support and other ancillary airport functions. It also provides synergy with the HKBCF, TMCLKL and potential WEL project (see Figure 5.28).

5.53 Only the conceptual design has been explored thus far involving preliminary qualitative assessments of potential environmental impacts and challenges. For example, it is estimated that around 650 hectares of reclamation to the north of the existing airport island will be required. Preliminary engineering and environmental considerations attempted to maximise the use of land on the existing airport island, thereby keeping new land reclamation requirements to a minimum.

5.54 When compared to major airports on the Mainland and other hub airports in the region, the existing and planned future area of HKIA is relatively small, particularly when taking into consideration the aircraft movements handled and the planned future handling capacity (see Figure 5.29 and Figure 5.30).

Figure 5.28 : Option 2 (Three-Runway System) – Airport Layout Plan in 2030



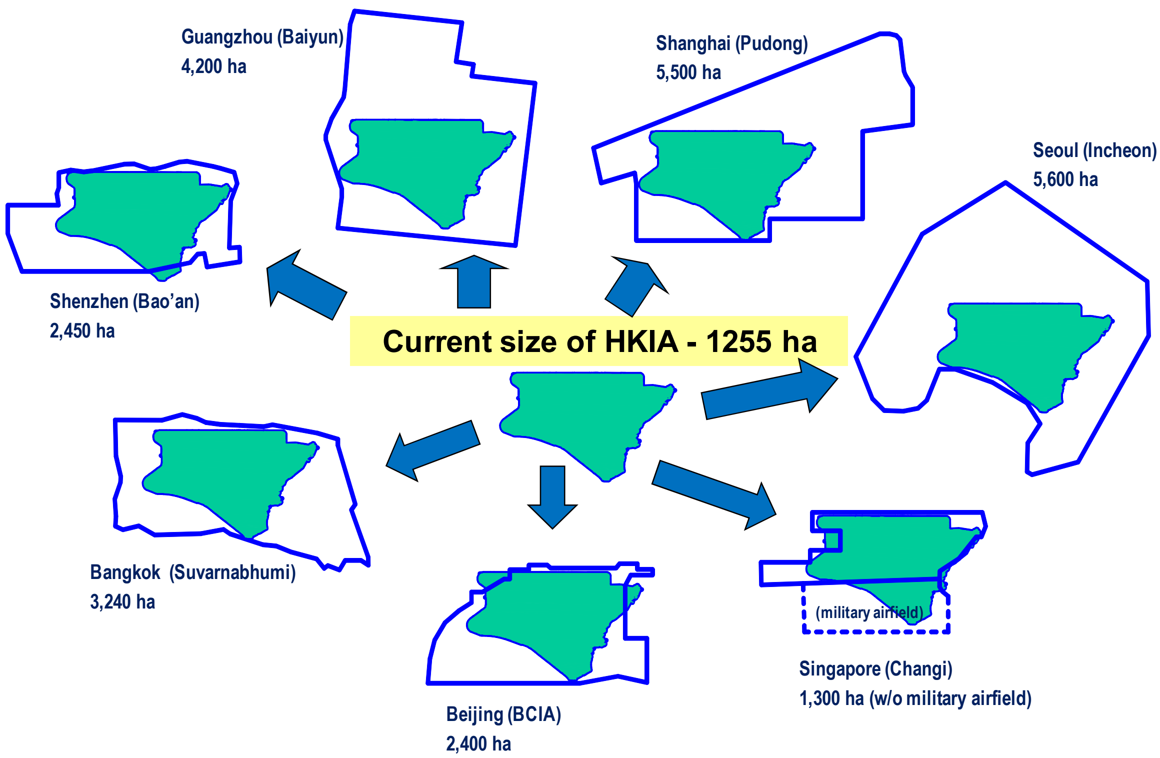
Definitions:

1) Airport Operational Development (AOD) refers to operational facilities such as runways, taxiways, parking aprons, passenger processing terminals and passenger concourses, ground transportation centre and vehicle parking spaces, etc.
2) Airport Support Development (ASD) refers to support facilities such as cargo terminals, aircraft maintenance and engineering, aircraft catering, ground services equipment maintenance, aircraft fuelling, etc.
3) Airport Related Development (ARD) refers to commercial facilities such as freight forwarding, hotels, offices, retail and exhibition centre, etc.
4) Government Sites refer to Government facilities such as the Government Flying Service (GFS), the Headquarters Building of the Civil Aviation Department and the Air Mail Centre, etc.

Figure 5.29 : Development of HKIA compared to Mainland Airports

Airport	Existing Number of Runways	Existing Area (ha)	Air Traffic Movements Handled in 2008	Future Area Planned (ha)	Future Total Number of Runways Planned	Future Air Traffic Movements Capacity Planned (Per Annum)
Hong Kong International Airport	2	1,255	301,000	~1,900	3	620,000 (3 runways)
Shanghai (Pudong)	3	4,500	265,735	5,500	Space reserved for expansion to 5	653,000 (5 runways)
Guangzhou (Baiyun)	2	1,500	280,392	4,200	3 under planning, with space reserved for expansion to 5	620,000 (3 runways)
Beijing Capital	3	2,400	429,646	Planning to build a second international airport.		
Shenzhen (Bao'an)	1	1,100	187,942	2,450 (by 2011)	2 by 2011, with space reserved for expansion to 3	450,000 (2 runways)

Figure 5.30 : Comparison of HKIA's Size with Other Hub Airports in the Region



Preliminary Engineering Feasibility

5.55 Preliminary assessment on the engineering feasibility for each key component of the airport development scheme has been conducted, including land formation, airfield facilities, passenger terminals/concourses, apron facilities, automated people mover (APM), baggage handling system (BHS), access infrastructure and airport utilities. The requirements of the existing facilities and operational areas have been considered while developing the passenger processing terminal, concourse, apron and aircraft parking stand area. The construction techniques considered for the land formation areas seek to minimise potential environmental impact while optimising reclamation phasing.

Traffic Impact Assessment (TIA)

5.56 A preliminary traffic impact assessment (TIA) was undertaken to test the capacity of the existing airport road network and to propose appropriate road improvements/enhancements to accommodate the forecast air passenger and cargo traffic up to 2030. A detailed traffic impact assessment will be undertaken nearer the proposed implementation timeframe of these road network improvement works/upgrades whose detailed design needs to be reviewed and approved by the Transport Department.

Marine Impact Assessment (MIA)

5.57 A preliminary marine impact assessment (MIA) was undertaken, which highlighted the reduction in channel width north of the airport and suggested that appropriate separation measures be introduced to mitigate marine safety risks. The assessment has also identified, in consultation with the Civil Aviation Department (CAD), the possible reconfiguration of the "Hong Kong International Airport Approach Areas (HKIAAA)"[58] of the expanded airport platform to facilitate marine vessels' north-south movement in the west of the Hong Kong waters, while adhering to airport height restrictions to safeguard the operations of the Third Runway. A further detailed marine impact assessment will be carried out in consultation with stakeholders and the Marine Department if and when the formal EIA study is carried out for the Third Runway.

Land Formation

5.58 A series of possible alternative land formation methods has been investigated on a preliminary basis. The key objective is to find a robust solution to the project requirements within the required timeframe.

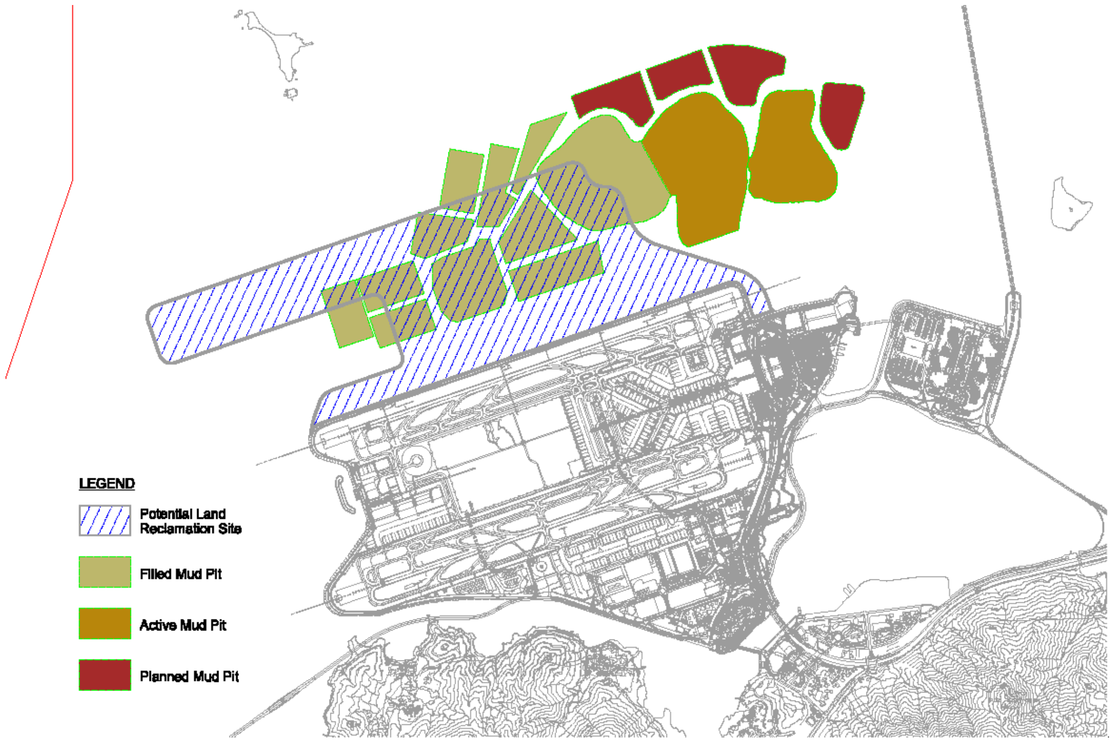
5.59 *Geotechnical Assessment*

A geotechnical assessment of the proposed land formation work has been conducted based on the available ground investigation records in the vicinity, including recent investigation of the contaminated mud pits and an extrapolation of the comprehensive geological model of the existing platform.

[58] The Shipping and Port Control Regulations (Cap 313A) specify the boundary of the HKIAAA where vessels are prohibited from entering and conditions under which vessels are permitted to enter as well as the penalties for contravention.

5.60 Geologically, the site is underlain by a descending sequence of marine deposits (between 10m and 20m thick) and alluvium (20m to 25m thick), which is in turn underlain by decomposed rock and granitic bedrock. Around 320ha of the site is located in the old marine borrowing areas, which have been and continue to be used for the deposit of contaminated mud of mixed content from around the territory. Based on the ground investigation carried out recently at these contaminated mud pits and the available bathymetric survey records, these pits could be up to 27m deep within the site.

Figure 5.31 : Airport Layout with Contaminated Mud Pits



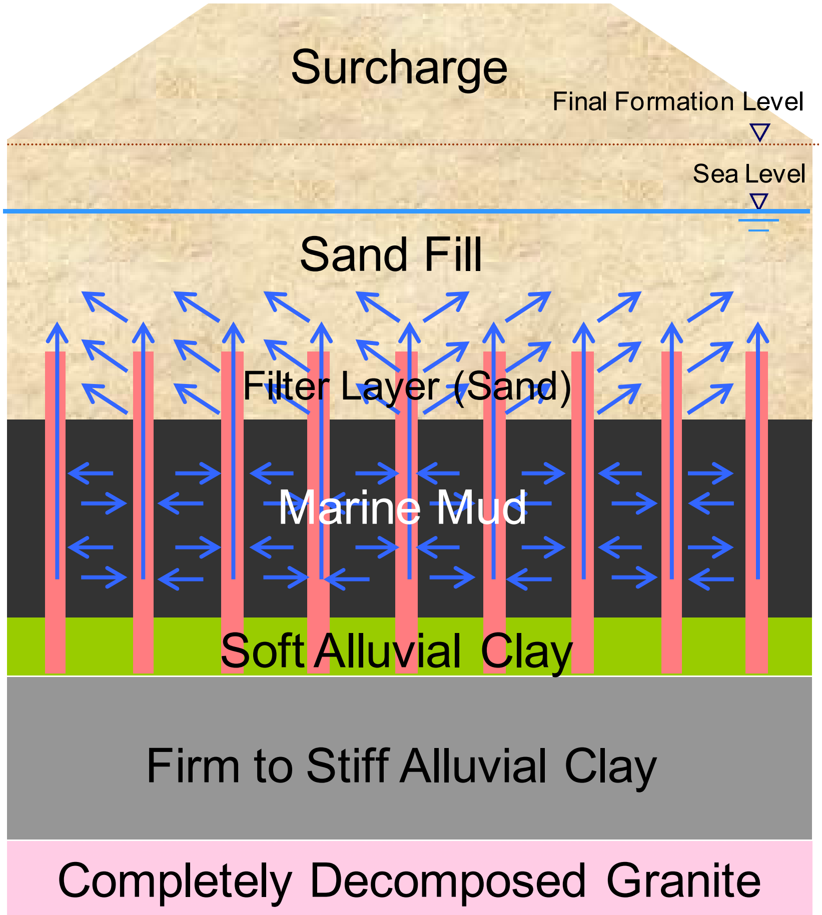
5.61 Using available relevant laboratory results and the land formation experience of the existing airport platform, engineering properties have been investigated and the parameters for the preliminary design of the land formation work established. Since only limited site-specific data is available on the extent and properties of the major geotechnical units, marine deposits and alluvium, the engineering parameters will need to be carefully reviewed and verified at the next design stage through a comprehensive testing programme.

5.62 *Preliminary Reclamation Design*

Dredged reclamation was adopted for construction of the existing airport platform and less than 2m of soft marine sediments were left in place. Other ground treatment options are proposed in the preliminary design of the new platform to minimise the removal of the existing soft marine sediments where possible. It is intended that all contaminated marine mud contained in the mud pits will be retained in situ.

5.63 Most areas of reclamation tend to adopt a drained reclamation solution, which is a locally well established method which avoids dredging of soft marine sediments. In this method, the reclamation fill is placed over the un-dredged marine mud, which is then consolidated by installing vertical wick drains to accelerate release of retained pore water in the marine mud.

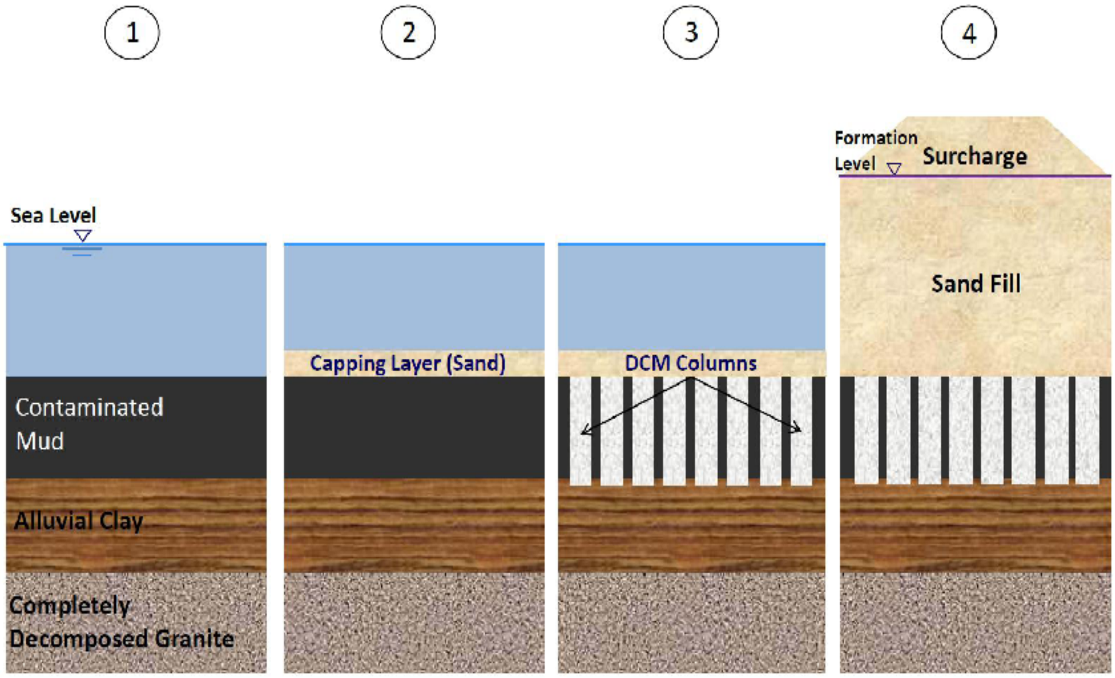
Figure 5.32 : Land Formation by Un-dredged Method with Vertical Drains



5.64 For reclamation above the mud pits, conventional drained reclamation is infeasible due to the considerable time required for the primary consolidation of these softer materials and the potential leaching of contaminated water out from the mud pits through the installed vertical drains. Therefore, in areas above the mud pits, treating and leaving the material in place is recommended. This can be done by increasing the strength and stiffness of the soft mud through a technique called Deep Cement Mixing (DCM). The DCM method, while widely used in Japan has not previously been implemented in Hong Kong. Therefore, site trials would have to be conducted to study and confirm its engineering and environmental feasibility and acceptability before large-scale implementation. For areas of reclamation outside the mud pits but beneath the proposed runway, the marine sediment will be treated with DCM in order to meet the more stringent performance criterion.

Figure 5.33 : Deep Cement Mixing Rigs

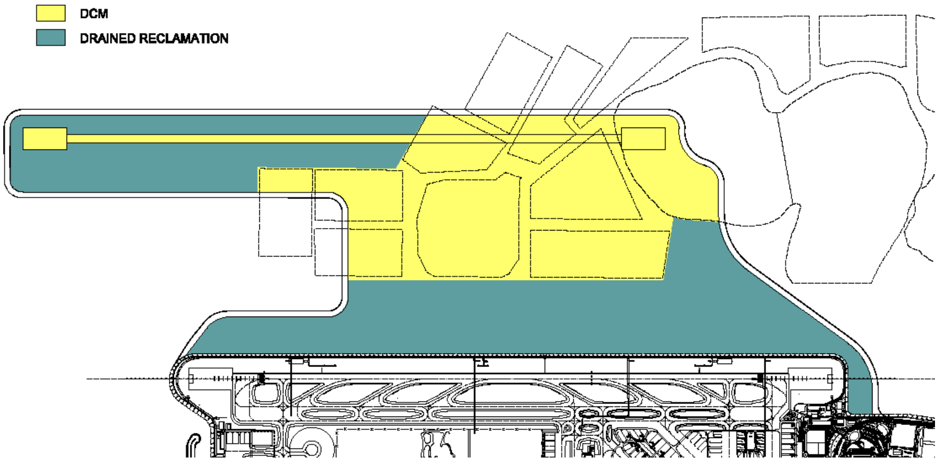
Figure 5.34 : Land Formation by Deep Cement Mixing (DCM) Method



5.65 Sand fill compacted by vibro-compaction is proposed as the key fill material for the reclamation. In all areas, surcharge preloading is proposed to control the anticipated settlement during the service life of the landfill. The duration of surcharge preloading will depend on the results of instrumentation monitoring throughout construction but is anticipated to be in the range of 4 to 12 months.

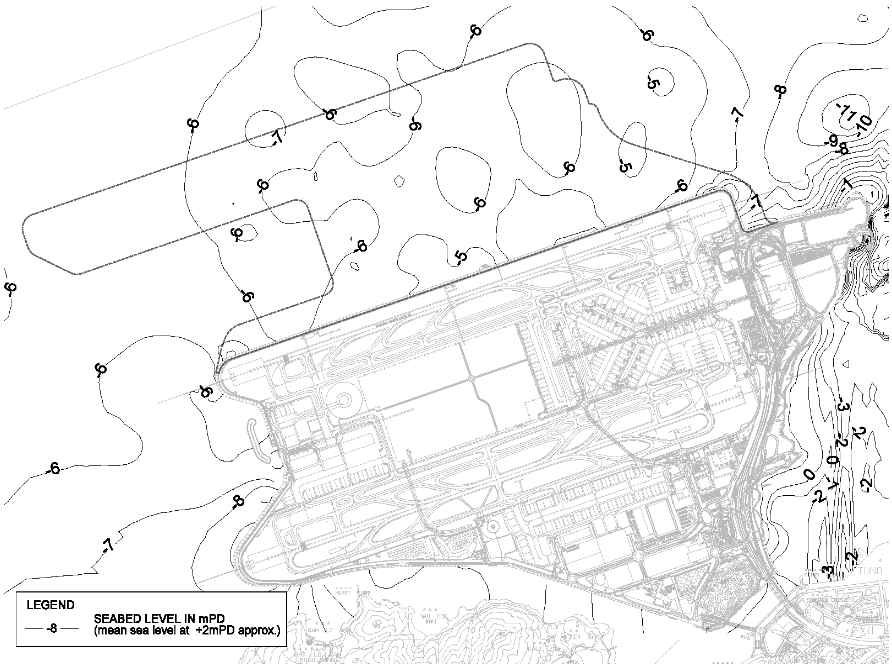
5.66 It is proposed to erect sloping seawalls on a non-dredged formation or over DCM-treated contaminated mud. The seawall armour is designed so as to allow recycling of old armour from the existing seawall which will effectively be relocated to the new sea wall location. The operations of seawall relocation and construction will be coordinated to ensure that the new seawall is in place and provides protection to the section of seawall to be relocated.

Figure 5.35 : Plan of Proposed Reclamation Methods



5.67 The approximate seabed level in the reclamation area is at -6 mPD[59] (see Figure 5.36). Assuming mean sea level at +2 mPD, the average water depth in the reclamation area will be 8m.

Figure 5.36 : Seabed Contour



[59] Note: mPD means metre above principal datum.

5.68 *Fill Acquisition*

Based on the preliminary design, various types of fill will need to be imported for the land formation work. The estimated quantities of fill required are:

- Quantity of Marine Sand: ~80 million cubic metres
- Quantity of Rock Fill and Rock Armour: ~15 million cubic metres

5.69 In view of the impact to the environment and the limited sources available within Hong Kong waters, marine sand and rockfill have to be obtained from the Mainland. This requires assistance from the HKSAR Government for liaison with the Mainland government. However, time has to be allowed for the liaison work and environmental impact assessment.

5.70 Public fill (i.e. construction and demolition material (CDM)) could also be used as reclamation material instead of marine sand. However, the importation rate of public fill is slow and the total quantity of public fill that the fill bank can store is much smaller than that needed. Nevertheless, the Public Fill Committee (PFC) of HKSAR Government welcomes usage of public fill, which can be collected at the fill bank free of charge. Direct procurement of CDM from contemporary projects involving excavation, such as MTR tunnelling work, should also be considered during the detailed design stage.

5.71 The outcome of the preliminary engineering feasibility assessment suggests that a combination of land formation methods including conventional drained reclamation, deep cement mixing and surcharging could address the critical technical issues and environmental concerns to a large extent. Relevant engineering and environmental trials will be needed subsequently to confirm the land formation methodology for the three-runway option.

Airfield and Apron Works

5.72 Preliminary designs have been prepared for the airfield and apron which cover pavement construction, drainage, utilities, firefighting systems, aviation fuel system, airfield ground lighting, apron systems, airside roads, and CAD and Hong Kong Observatory (HKO) airfield facilities.

5.73 The grading of the new airfield and apron will meet CAD and International Civil Aviation Organisation (ICAO) requirements and can match the existing airport. It is proposed to use flexible pavement construction for the runway, taxiways and taxilanes and rigid pavement for the aircraft parking stands.

5.74 The preferred concave profile for the runway will be maintained and paved surfaces will be above a 6.5mPD flood level. The tributary stormwater drainage and oil separation systems will be similar to the existing system at the airport.

5.75 The new runway lighting system, developed in accordance with the system currently used and installed, is based around a CAT IIIA[60] approach on the proposed Runway 25R, as per the existing 25R. Similarly, a CAT II system will be installed on the proposed Runway 07L in line with the existing runway. Two additional sub-stations will be needed to provide power to the new Airfield Ground Lighting system, associated aprons and taxiway equipment.

5.76 The airside road system has been planned and designed in accordance with relevant design criteria. The new head-of-stand road is a three-lane road with two 5-metre lanes separated by a 6-metre dividing lane that can either be designated as two 3-metre through lanes or one 6-metre turning/manoeuvring lane. The new concourse will be connected to the existing airport by means of two road tunnels of four lanes (each lane being 5m wide). These will connect to an east/west road tunnel allowing traffic to reach either end of the new concourse without causing congestion on the head-of-stand road system.

5.77 Preliminary design has taken into account the CAD and HKO facilities' requirements for the new runway and airport expansion area. Further airfield layout refinement will be required to accommodate existing CAD and HKO facilities.

Passenger Processing Terminal and Concourse Remodelling

5.78 *Terminal 2*

The preliminary design assumes that Terminal 2 (T2) will be extensively remodelled to include arrival facilities whilst retaining much of the existing building including the tour coach station, building structure and foundations. It will be bounded by Airport Road to the east, the Ground Transportation Centre (GTC) to the west, and the existing road infrastructure to the north and south. The two office towers will remain in continuous operation, as will the Automated People Mover (APM) from T1 to SkyPier running under the site. Two bands north and south of the terminal have been safeguarded as future expansion areas.

5.79 Several terminal planning options for T2 have been considered with alternate various key facilities such as the departures road, check-in, baggage claim, Meet and Greet hall and car parks. The aim is to emulate the terminal layout and hence the passenger experience of T1 as far as possible. Despite key differences in location of the Airport Express Line (AEL) departures platform relative to check-in and the APM station leading to the new concourse vis-à-vis the main processing areas, there will be an overall equal Level of Service (LOS) between T1 and the remodelled T2.

5.80 Landside retail and food and beverage facilities are provided in a way that offers easy visibility and access from both the arrivals and departures levels. Customs/immigration/quarantine (CIQ) processing areas are largely stacked above each other, allowing potential for sharing between arrivals and departures.

[60] CAT I, II or III (A, B and C) refer to categorisation of the type of approach/runway lighting and ILS system performance required for a precision approach (instrument) runway in order to facilitate aircraft operations during low visibility conditions that may be caused by fog, heavy rain, etc.

5.81 For reasons of construction efficiency, T2 will be remodelled in phases with early phases requiring only some modification of the existing structure. There is potential to build the new T2 baggage hall and the APM Interchange Station serving the new Third Runway passenger concourse, Hong Kong Boundary-Crossing Facilities (HKBCF)/Hong Kong-Shenzhen Western Express Line (this project is under feasibility study by the Government) flows and connectivity to T1 and SkyPier eastwards, outside T2's existing footprint.

5.82 *Third Runway Passenger Concourse*

The Third Runway passenger concourse (TRPC) is an airside concourse that will serve mostly passengers using T2, to which it is connected via an underground APM. The size and shape of the Third Runway passenger concourse will be similar to the T1 concourse with equivalent provisions for APM stations, BHS, retail, transfer facilities, CIP lounges, gate lounges, boarding and queuing areas, toilets, and mechanical and electrical plant rooms. Development of the final configuration of the concourse will require further assessment to ensure that its footprint and shape satisfy efficiency and phasing parameters. For planning and programme considerations, the concourse and apron areas are based upon existing T1 designs, which are proven to satisfy a known passenger throughput.

Automated People Mover

5.83 The following areas had been looked into in the preliminary assessment for the APM system for the three-runway option:

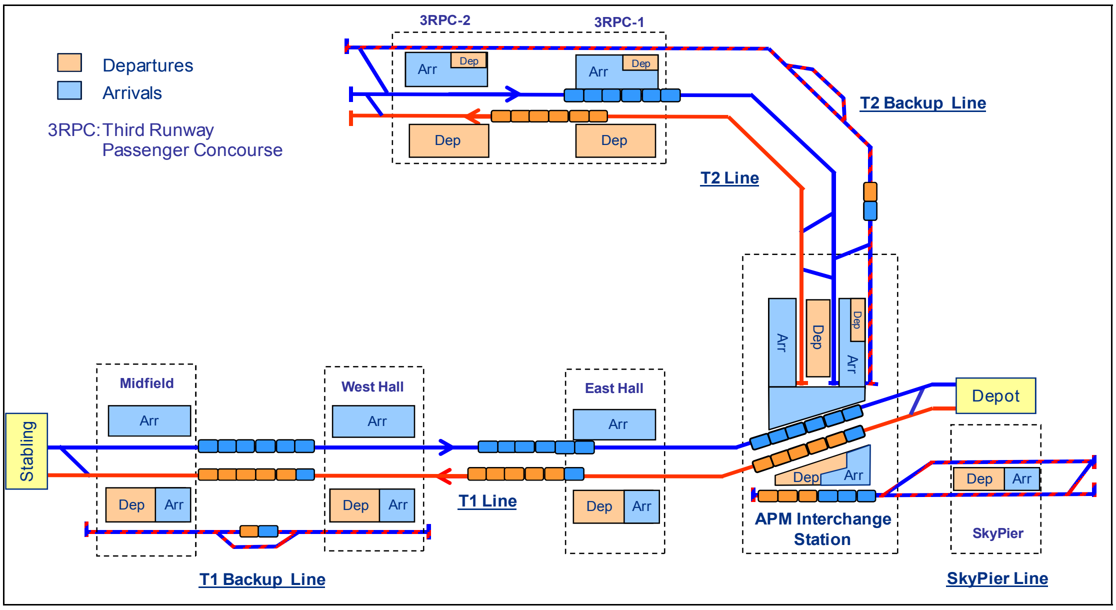
- To develop a concept design for the future APM system serving between T2 and the TRPC;
- To facilitate transfer of passengers between T1, T2 and SkyPier by incorporating an APM Interchange Station at T2;
- To ensure that the APM system is able to cope with the expected airport demand; and
- To study the location and sizing requirement for the APM depot.

5.84 The proposed APM system for the three-runway option will have the following features (see Figure 5.37):

- A separate pinched loop line between T2 and TRPC (T2 Line) to provide a direct service between T2 and TRPC. Separate island platforms for arrivals and departures are provided for the T2 line to improve efficiency;
- A bypass loop between T2 and TRPC (T2 Backup Line) for mixed car trains to allow a double shuttle mode of operation (for backup and route recovery purposes);
- Two APM stations at TRPC;
- Extension of the T1 APM pinched loop line serving the T1 East Hall, T1 West Hall and the Midfield Concourse stations in the two-runway option further eastward to serve the new APM Interchange Station at T2, so as to cater for transfer passengers making flight connections between T1 and T2 in future;
- Security screening for all transfer passengers between T1/Midfield Concourse and TRPC at the T2 APM Interchange Station. The eastbound line of the T1 APM pinched loop will retain the current operational mode carrying only non-secure arrival passengers;

- Upgrading the existing shuttle mode SkyPier Line to pinch loop to provide additional APM capacity. Intermodal T1/T2 Transfer Passengers will be connected to and from SkyPier via the APM Interchange Station at T2 using the SkyPier Line; and
- An APM depot will be located below the existing Golf Course Area close to the T2 APM Interchange Station for maximum efficiency of APM operations.

Figure 5.37 : Proposed APM System Network for the Three-Runway Option



5.85 HKIA needs an APM fleet size of 110 cars to bring its annual handling capacity to 100 million passengers by 2030. It is recommended that the existing APM depot underneath T2 be relocated underground east of T2. This will be sized to accommodate the ultimate APM network capacity but can be constructed in stages.

Baggage Handling System

5.86 The feasibility assessment of the BHS and facilities is based on BHS schematics and estimates of system space requirements. These, in turn, are based on the layout of critical operational areas and interfaces that are the principal drivers of facility size, such as loading docks and make-up areas. Capacity and demand analysis has been used to determine the overall baggage flows and the resulting capacity requirements under a range of planning scenarios.

5.87 Different systems including Destination Coded Vehicle (DCV), high-speed belt conveyor and vehicle based systems were also assessed. The key findings were:

- The DCV system arrangement is the most extensive type of baggage handling system in terms of size of facilities and extent of equipment;
- A vehicle-based arrivals system has several advantages over arrivals by DCV or high-speed conveyor such as: reduced DCV system requirements between T2 and the Third Runway passenger concourse, reduced size of baggage basements and a decrease in the overall requirement for DCV transport system equipment.

DCV high-speed baggage transport vehicles achieve very similar arrivals baggage delivery time performance; and

- High-speed belt systems are currently unproven at very high speed (10m/s) but offer benefits such as a simpler control strategy and potential space-saving, removal of risk from supplier tie-in on matters of software, and simpler maintenance regimes. However this option will require further study and supplier product development.

5.88 T2 will provide the check-in and reclaim functions for the new Third Runway passenger concourse. Check-in provision is based on the T1 facility and comprises a similar arrangement with redundant transport routes to the T2 baggage hall. Security screening is provided for departing bags in T2 and the bags are then loaded onto a high-speed belt conveyor system for point-to-point transport between the terminal buildings. Each terminal building will contain a high-capacity multi-way sorting switch e.g. tilt-tray sorters, as required for the principal routing functions. The T2 system will be a simpler process in terms of sorting, but transport redundancy must be provided for while selecting routing equipment.

5.89 The baggage handling system and operational space requirements in the Third Runway passenger concourse were assessed on the basis of phased baggage facilities. The baggage facility could be located either within the possibly constrained footprint of the concourse or in a single consolidated baggage facility in a building separate to the main concourse buildings. The stand-alone baggage facility has significant advantages for the design of the concourse buildings. The removal of the baggage basements enables the APM to be at a shallower depth, giving shorter transport times and lower construction costs. Additionally, construction phasing is improved with the complex baggage handling system being commissioned and built independently of the concourse buildings.

5.90 Inter-terminal baggage transfer remains a challenge and requires further investigation of facilities and baggage handling strategies.

Vehicular and APM/Baggage Tunnels

5.91 Vehicular, APM and baggage tunnels will be employed to link the existing airport and the Third Runway passenger concourse. Extensions of the Western and Eastern Vehicular Tunnels will pass under the existing North Runway and taxiways linking the Midfield area with the Third Runway passenger concourse. The horizontal alignment of the Eastern Vehicular Tunnel and the vertical alignment of the Western Vehicular Tunnel need to avoid clashing with the existing drainage box culverts. The construction of the vehicular tunnels by cut and cover method will result in temporary closure of the taxiways and/or the North Runway.

Airport Access

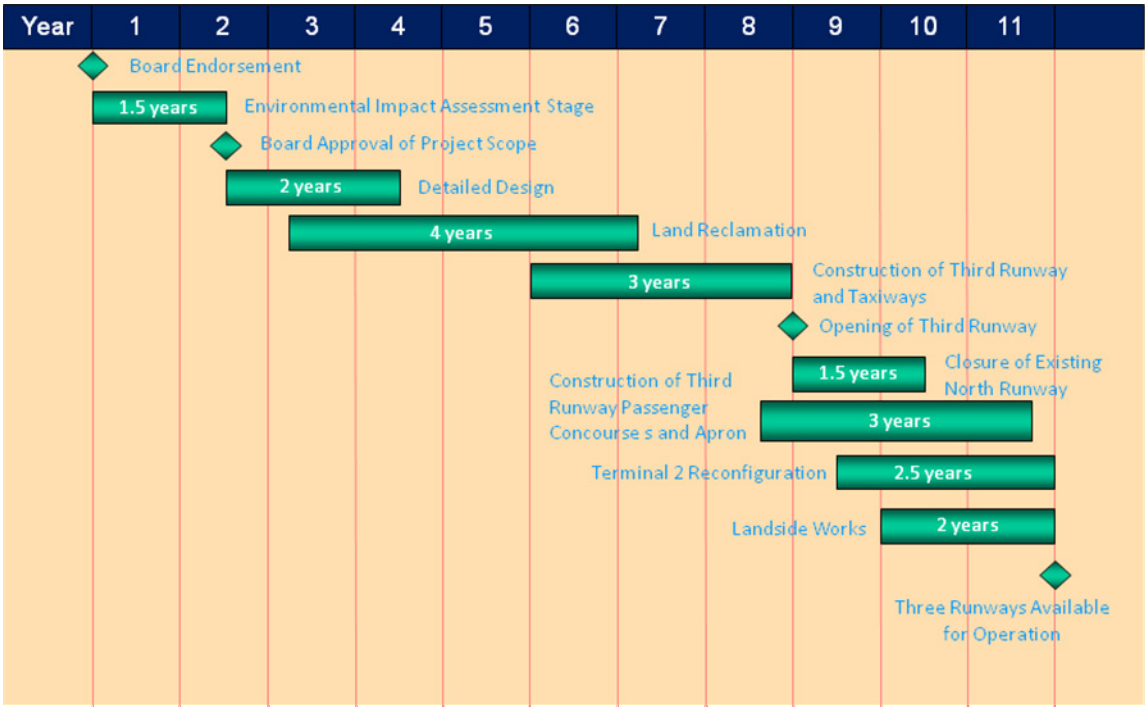
5.92 The Airport Road and Chek Lap Kok Road are the primary links between Tung Chung and the airport island. Additional links in the form of the Hong Kong-Zhuhai-Macao Bridge (HZMB), HZMB-Hong Kong Link Road, and the Tuen Mun-Chek Lap Kok Link (TMCLKL) are proposed for the near future and the additional capacity provided by these links should be sufficient for the forecast 2030 traffic demand.

5.93 Modification plans for the road system have been drawn up in line with the expected increase in origin/destination passenger throughput. (See paragraphs 5.43 and 5.44).

Indicative Third Runway and Associated Infrastructure/Facilities Development Phasing Plan

5.94 Implementing the Third Runway project entails a series of critical activities including undertaking the Environmental Impact Assessment (EIA), reclamation, early completion of the Third Runway and the associated taxiways and the Air Traffic Control tower. The early commission of the Third Runway and closure of the Second Runway will enable the construction of cut and cover airfield tunnels to eliminate the operational risk of tunnel construction under a live runway. The Third Runway project requires a construction lead time of about 10 years (see Figure 5.38), but this may change at the detailed design stage to optimise the programme.

Figure 5.38 : Estimated Implementation Programme of the Third Runway



5.95 The development will be done in incremental stages in line with air traffic demand over the next 20 years to rationalise capital investment. From a long-term growth sustainability perspective, development beyond 2030 has been considered in the context of how much area is needed to accommodate the ultimate capacity of the three-runway system. Based on current assumptions of future PRD airspace arrangements and aviation technology advancements, the three-runway system can be estimated to support a potential capacity of 102 movements per hour.

5.96 Figure 5.39 indicates the development required under each phase.

Figure 5.39 : Indicative Infrastructure/Facility Development Phasing for the Three-Runway System

	Unconstrained Development				
	Phase 1 (2015)	Phase 2 (2020)	Phase 3 (2025)	Phase 4 (2030)	Total
Midfield and Third Runway Aprons Development:					
Additional Number of Airbridge-served and Remote[#] Aircraft Parking Stands	20	44	25	25	114
Passenger Processing Terminal and Concourse Development:					
Reconfiguration and Expansion of Terminal 2 (T2) to Increase Annual Handling Capacity to:	-	15 million passengers	23 million passengers	30 million passengers	
New Passenger Concourse at the Midfield	1st phase of "I" shaped Concourse completed	2nd phase of "I" shaped Concourse completed	-	-	
Third Runway Passenger Concourse	-	East Concourse completed	Southwest Concourse completed	Northwest Concourse completed	

Note: # Remote aircraft parking stands can be used by both passenger aircraft and freighter.

5.97 Areas have been safeguarded for development beyond 2030 to increase the number of aircraft parking stands at the Third Runway passenger concourse area and the Midfield to cater for 120 million passengers and 10 million tonnes of cargo per annum, subject to market demand and the future development of aircraft navigation technology and improvements in airspace and air traffic management which could potentially stretch the runway capacity further.

Brief descriptions of each development phase are given in the following paragraphs.

Indicative Infrastructure/Facility Development Phase 1 (completion by 2015)

5.98 As explained in Chapter 3, a commitment has already been made for Phase 1 of the development programme to ensure that there are sufficient facilities to serve the demand forecast for 2015. In other words, this Phase 1 programme does not in any way pre-empt the final choice of Option 1 (Two-Runway System) or Option 2 (Three-Runway System) for which development plans start to diverge beyond year 2015. To recap, the Phase 1 programme includes:

- The construction of a Midfield concourse with 11 airbridge-served stands and 9 remote parking stands;
- An additional cross-field taxiway to serve the stands on the west side of the Midfield concourse;
- An extension of the APM line and APM tunnel from T1 West Hall to connect with the Midfield concourse, with a back up system in case of APM breakdown or for route recovery;
- Minor enhancement to the BHS; and
- An additional ramp providing access to Midfield concourse from the existing eastern tunnel roundabout, with a tunnel extended west under the new taxiway.

Indicative Infrastructure/Facility Development Phase 2 (completion by 2020)

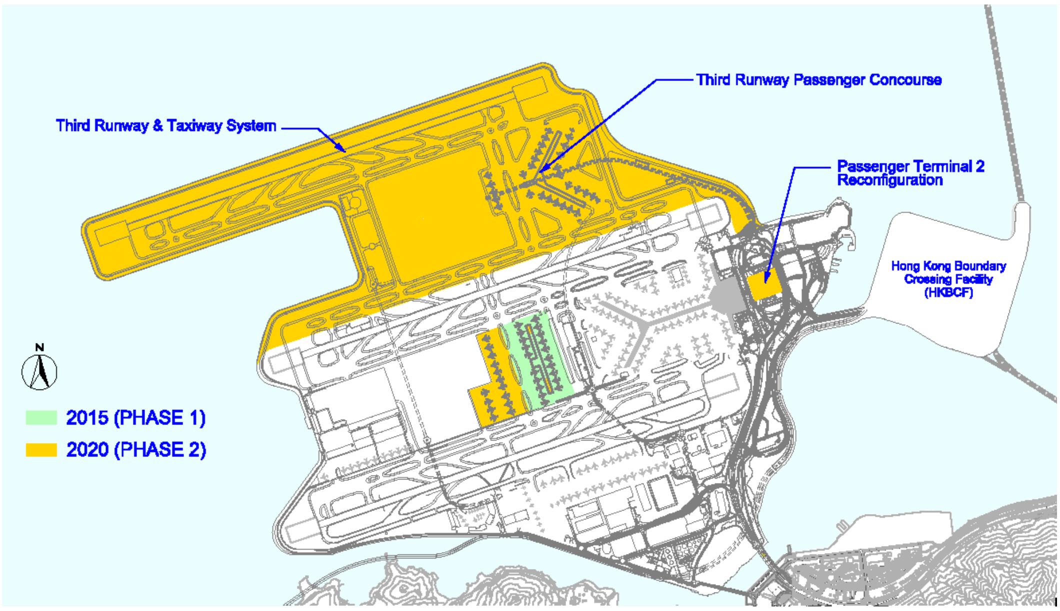
5.99 The development programme (see Figure 5.40) under Phase 2 will include:

- *Completion of land reclamation*: Fulfilling the airport's expansion requirements up to the design capacity of the three-runway layout, with the surcharge completed for Phase 2 portion of the reclamation and completion of infrastructure connecting the new reclamation to landside access roads and utility services;
- *Implementation of the three-runway system*: Putting in place all key elements such as, Third Runway and associated taxiways and apron system, new Air Traffic Control Tower, associated navigational aids, rescue and fire fighting stations within the airport restricted area, necessary utilities stations and operations-related facilities in the new apron;
- The two taxiways connecting the Third Runway and the future Second Runway (existing North Runway) to become operational;
- Reconfiguration of T2 to handle the initial passenger capacity (approximately 15 million passengers per annum); provision of roads and landside transportation facilities connecting to T2;
- Completion of the first phase of Third Runway passenger concourse and aircraft stand development with 30 passenger aircraft stands, as well as connecting taxilanes along the eastern section of the reclaimed apron;
- APM east station and BHS serving the first phase of the Third Runway passenger concourse as it becomes operational; opening of a new APM maintenance depot underneath the existing North Commercial District;
- Opening of the extension of the eastern vehicular tunnel to the Third Runway passenger concourse; construction of the box structure of the Western Vehicular Tunnel underneath the existing North Runway (access to the west end of the new apron, including the new Air Traffic Control Tower and rescue and fire

fighting stations within the airport restricted area, will be via at-grade airside roads and the Eastern Vehicular Tunnel);

- Further expansion of the Midfield concourse with conversion of the 9 remote parking stands built in Phase 1 into airbridge-served stands, along with an additional 14 remote parking stands to the west of the Midfield concourse for common use by passenger and freighter aircraft;
- Construction of a second cross-field taxiway to serve the additional remote parking stands to the west of the Midfield concourse;
- Increasing APM capacity to six cars per train; and
- Addition of two multi-storey car parks.

Figure 5.40 : Indicative Infrastructure/Facility Development Phases 1 & 2



Indicative Infrastructure/Facility Development Phase 3 (completion by 2025)

5.100 The development programme under Phase 3 will include:

- A surcharge for the Phase 3 portion of the reclamation so as to enable expansion of the Third Runway passenger concourse;
- Expansion of T2 to the north to meet Phase 3 capacity;
- Completion of the second phase of the Third Runway passenger concourse (southwest concourse) along with 14 additional passenger aircraft stands and connecting taxilanes;
- Addition of an APM west station to the Third Runway passenger concourse and the BHS to meet Phase 3 demand, and expansion of the new APM maintenance depot to meet Phase 3 operational needs;
- An additional 11 cargo stands in the Midfield together with the required taxilanes and taxiway;
- Opening and extension of the Western Vehicular Tunnel to the new apron to serve both the Midfield area and the western end of Third Runway passenger concourse; and
- Addition of one multi-storey car park.

Indicative Infrastructure/Facility Development Phase 4 (completion by 2030)

5.101 The development programme under Phase 4 will include:

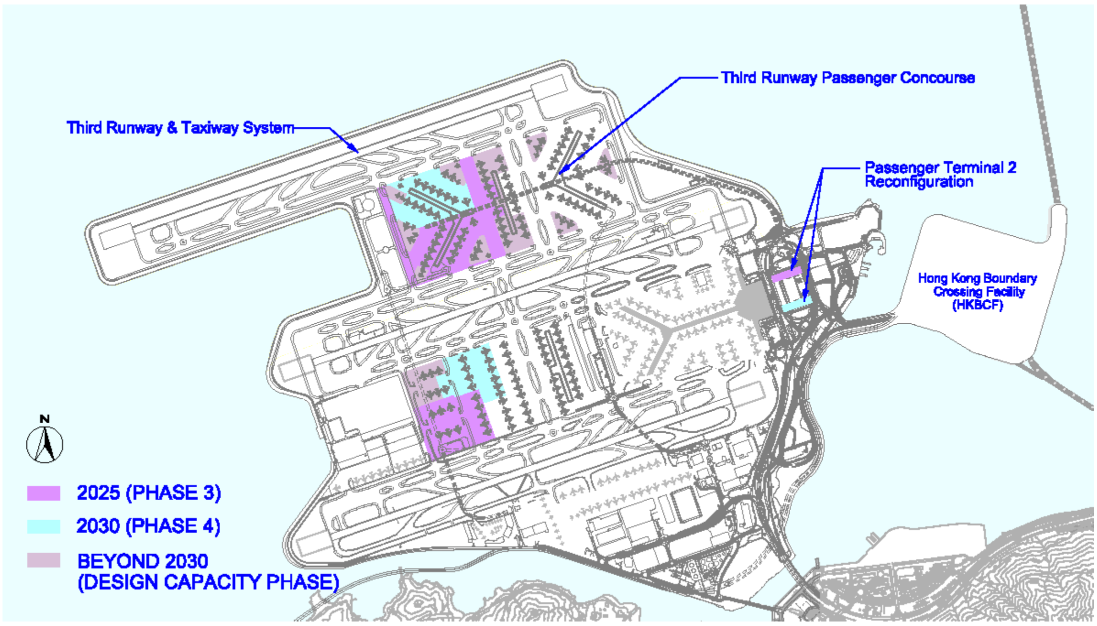
- A surcharge for the Phase 4 portion of the reclamation to enable expansion of the Third Runway passenger concourse;
- Expansion of T2 to the south to meet Phase 4 capacity;
- Completion of the third phase of the Third Runway passenger concourse (northwest concourse) along with an additional 14 passenger aircraft stands and connecting taxilanes;
- Expansion of the BHS and the APM system to meet Phase 4 operational needs;
- An additional 11 cargo stands in the Midfield together with required taxilanes and taxiway; and
- Addition of one multi-storey car park.

Potential Infrastructure/Facility Development Beyond 2030

5.102 The current infrastructure/facility plan embodies further expansion potential which would achieve the full projected capacity of the airport under a three-runway layout. This is possible by way of the following:

- Laying of a surcharge for the remaining portion of the reclamation to enable expansion of the Third Runway passenger concourse;
- Expansion of the Third Runway passenger concourse (central concourse) and apron development so as to increase annual handling capacity to 120 million passengers eventually;
- Expansion of the cargo apron at the Midfield to its full size for optimum utilisation; and
- Enhancement of the APM system and the BHS to full design capacity.

Figure 5.41 : Indicative Infrastructure/Facility Development Phases 3 and 4 and Earmarked Areas for Development Beyond 2030



Estimated Construction Costs

5.103 A preliminary assessment has been carried out to consider the engineering feasibility of each of the key components of the airport expansion scheme such as land formation, airfield facilities, apron facilities, passenger terminals and concourses, automated people mover system, baggage handling system, access infrastructure, and other supporting facilities and utilities.

5.104 The assessment outcome has generated a preliminary cost estimate for each development phase up to 2030 (see Figure 5.42).

Figure 5.42 : Preliminary Phased Development Cost Estimates for a Three-Runway System

Unconstrained Development Phases	Construction Cost HK$ Billion	Design & Project Management HK$ Billion	Contingency HK$ Billion	Total Cost Estimate HK$ Billion
Phase 1 (by 2015)	7.9	0.6	0.8	9.3
Phase 2 (by 2020)	50.2	5.0	10.1	65.3
Phase 3 (by 2025)	10.1	1.0	2.0	13.1
Phase 4 (by 2030)	6.0	0.6	1.2	7.8
Total (Phases 2 – 4)				**86.2**

Committed (hatched)

Estimating Approach & Development

5.105 The indicative capital construction cost estimate for the Preferred Airport Layout Plan in 2030 is based on the following parameters. The rates used in computing these estimates are fixed-price competitive tender rates prevailing in the Fourth Quarter of 2010 subject to future inflation adjustment. The rates used in the cost estimates were compared wherever possible with the relevant government contract rates for similar types of civil works. The preliminary cost estimate was based on the best information available at the master planning stage. These estimates also include contingency, design fees and project management fees. Phase 1 development which is already committed, is at Money-of-the-day (MOD) prices. The three-runway option's development phases from 2016 up to 2030 are estimated to cost HK$86.2 billion in 2010 dollars or HK$136.2 billion at MOD prices.

5.106 Where practical, approximate quantities of work have been measured, corresponding to the level of design details available, applying costs per unit of construction floor area from other similar projects where relevant. Lump sum budget allowances have been inserted for items of uncertain scope. For airport specialist systems such as BHS and

APM, quotations from specialist manufacturers were obtained and supplemented through reference to existing airport project benchmarks.

Environmental Considerations

HKIA's Environmental Commitments

5.107 As mentioned in Chapter 4, a voluntary Environmental Impact Assessment (EIA) was conducted as an integral part of the New Airport Master plan published in 1992, to evaluate potential environmental impacts associated with airport development and operations, resulting in a range of commitments designed to ensure that environmental impacts would be mitigated to acceptable levels and effectively managed.

5.108 In addition to fulfilling the commitments from the EIA, HKIA's environmental programme also addresses the many other challenges inevitably associated with operating a major international airport, focusing on initiatives that prevent or minimise pollution and maximise energy and natural resource use efficiency, by following the principle of continuous performance improvement. Some of its ongoing programmes are outlined below:

5.109 *Carbon and Air Emission Management*

HKIA is running numerous initiatives to reduce local air emissions and carbon emissions as well as to improve energy and resource efficiencies including the following:

- AAHK is a signatory to the Environmental Protection Department's Carbon Reduction Charter and the Aviation Industry Commitment to Action on Climate Change;
- AAHK has undertaken carbon audits since 2008 and is actively working with its business partners on HKIA-wide carbon auditing and reduction;
- To reduce both air pollutant and greenhouse gas emissions, AAHK promotes the use of electric, hybrid and liquefied petroleum gas-powered vehicles at HKIA. The airport has one of Hong Kong's largest fleets of electric vehicles and ground service equipment, and all AAHK's diesel vehicles use B5 biodiesel, a mixture of 95% conventional diesel and 5% biodiesel made from used cooking oil;
- A wide range of measures has been introduced to improve the efficiency of airport lighting, ventilation, air conditioning and hydraulic systems, cumulatively contributing to significant carbon emissions reduction. HKIA has recently pledged as an airport community to reduce airport carbon emissions by 25% per Work Load Unit[61] by 2015 based on 2008 emissions levels;
- AAHK has teamed with other airport community members to enlarge the existing 200-strong fleet of electric vehicles, including the provision of charging infrastructure; and
- AAHK is working to improve the efficiency of the fixed ground power and pre-conditioned air systems used by aircraft during stopovers, so as to further reduce local air pollutant emissions.

[61] A Work Load Unit is equal to 1 passenger or 100kg of cargo

5.110 *HKIA Air Quality Monitoring Programme and Data Interpretation*

AAHK is committed to understanding and managing airport generated air emissions.

- AAHK has three air quality monitoring stations at and near HKIA to measure real-time data on air quality at and north of HKIA. Continual real-time data is collected and can be analysed in conjunction with meteorological information. The data is interpreted on an ongoing basis by an independent team of air quality and atmospheric experts from the Hong Kong University of Science and Technology (HKUST). Their analysis facilitates a better understanding of the effect that HKIA-generated air emissions have on regional air quality, based on airport operations and the real-time air quality and meteorological situation.
- Experts have identified that HKIA's most significant air pollutant, Nitrogen Oxide (NO_x), has not been a key contributor to significant episodes of poor air quality in Tung Chung (i.e. on days when the Tung Chung Air Pollution Index is particularly high). The key contributor there was respirable suspended particulates. From the air quality monitoring dataset and meteorological information, HKUST has shown that when the API is high in Tung Chung the high levels are mainly caused by air pollutants with primary sources to the north and northwest of HKIA.

5.111 *Waste Minimisation and Recycling*

Increasing waste separation at source across the airport and achieving good recycling rates remain key focus areas for AAHK. AAHK is also working closely with the airport community to minimise waste.

- HKIA has striven to continually reduce waste going to Hong Kong's scarce landfills and to increase recycling percentages. During the five years to March 2010, 4,600 tonnes of waste have been recycled, with enhanced efforts to increase recyclables separation achieving a 50% improvement by volume within 2010.
- AAHK is implementing a programme of actively partnering with tenants to drive up waste separation and recycling by providing complimentary bags and bins to tenants to aid separate recyclables and food waste collection from airport restaurants and retail outlets.
- HKIA's wastewater treatment plant, a commitment from the 1991 EIA, has processed 6.4 million cubic metres of wastewater from aircraft catering facilities, aircraft washing bays, passenger terminal restaurants and restroom sinks over the 5 years to March 2010. About 12% of the treated water is used to irrigate the airport's landscaping.

5.112 _Local Biodiversity_

AAHK has an ongoing commitment to the conservation of local, flora and fauna as well as important local habitats.

- AAHK has funded the management of the Sha Chau and Lung Kwu Chau Marine Park. It has also supported research into Chinese White Dolphins, the development of an artificial reef programme in North Lantau waters and a conservation plan for the Romer's Tree Frog, which is native to Hong Kong.
- HKIA has a green area of over 3 million square metres on the airport island and has contributed to substantial off-airport tree and inter-tidal mangrove planting.

Preliminary Environment Assessment for The Expansion of HKIA

5.113 The three-runway development plan represents a significant change from the two-runway layout that was assessed in 1991. Under the EIA Ordinance enacted in 1998, a Third Runway with its supporting infrastructure qualifies as an "environmentally significant material change" to the 1991 scheme, necessitating an Environmental Permit before work can proceed. Obtaining the permit requires that a statutory EIA is completed in accordance with criteria and stipulations detailed in Hong Kong's EIA Ordinance and "Technical Memorandum on EIA Process" (TM).

5.114 The preliminary environmental considerations have been a vital part of the preliminary planning and initial engineering assessments for airport expansion. This initial assessment has helped define the scope of the potential impacts and facilitated a preliminary qualitative comparison of the expansion options. It has included:

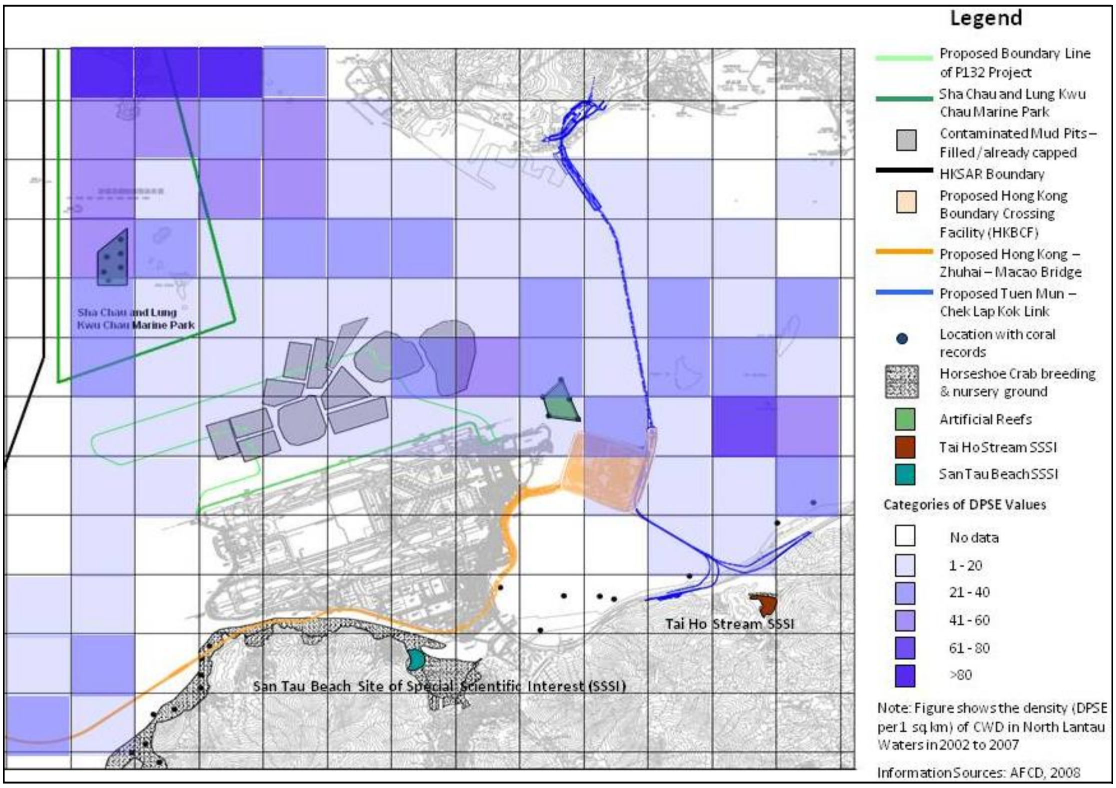
- A review of available and relevant information and data;
- An initial scoping of environmental aspects and issues expected to require formal assessment in the statutory EIA process;
- Early liaison with the Environmental Protection Department, Agriculture, Fisheries and Conservation Department, and other relevant Government departments and bureaux to ascertain key areas and issues of concern;
- Identification of key "differentiating" environmental issues that may arise during the construction and operational phases; and
- A qualitative comparison of the available expansion options.

5.115 The preliminary environmental assessment and comparison exercise were designed to inform the option selection process in this Master Plan, as environmental aspects are important factors in the evaluation and selection of three-runway airport layout options. A number of 'broad brush' differentiators of environmental factors were used in comparing each of the viable three-runway layout options. This part of the options comparison is detailed in Appendix 3.

5.116 *Environmental Review and Issues Scoping*

All available information has been reviewed including academic research papers, statutory EIA reports and non-statutory studies relevant to north Lantau and the natural environment around HKIA. Figure 5.43 identifies ecological and other resources and constraints near HKIA that have a bearing on future airport expansion.

Figure 5.43 : Environmental Resources near HKIA



5.117 It is recognised that the scoping of environmental aspects and the preliminary assessments do not replace the statutory EIA process prescribed in the EIA Ordinance. Should HKIA proceed with the three-runway development plan, a formal EIA will be completed in accordance with the criteria and stipulations detailed in the statutory process. At that point a Project Profile will be submitted to the Director of Environmental Protection (DEP) to start the process, who will carry out a series of formal public consultations. In addition, AAHK will explain the project to stakeholders and seek inputs from interested parties as the Master Plan consultation progresses, to ensure that all environmental and community issues of public concern are addressed adequately in later assessments.

5.118 A key objective of AAHK is to assess and carefully consider the potential environmental impact of reclamation, large infrastructure construction, and the environmental and community impact associated with expanded airport operations. Figure 5.44 provides a summary of the environmental aspects covered by the EIA Ordinance, along with the key issues to be assessed at the construction and operational stages for each aspect.

Figure 5.44 : Summary of Environmental Aspects

Aspect	Issues for Environmental Assessment
Air Quality	*Construction Phase:* ▪ Cumulative impact from land formation and construction dust, as well as from concurrent projects on Air Sensitive Receivers (ASRs) *Operational Phase:* ▪ Potential increase in air emissions from phased increase in aircraft movements and airport operations under the three-runway option. The potential cumulative emissions from nearby infrastructure projects will also be considered ▪ Projections to recognise Air Quality Objectives (AQOs) prevailing by 2030
Marine Cultural Heritage	*Construction and Operational Phases:* ▪ As the area has already been disturbed, substantial archaeological remnants are not expected
Fisheries	*Construction Phase:* ▪ Disturbance to fisheries production ▪ Disturbance to fishing operations ▪ Loss in fisheries value due to construction *Operational Phase:* ▪ Permanent loss in fisheries production ▪ Habitat loss ▪ Potential impact on fishing operations ▪ Potential impact on fisheries value ▪ Potential impact on fisheries operations in Marine Exclusion Zone (MEZ)
Hazard to Life	*Construction and Operational Phases* ▪ No significant issues are expected according to Hong Kong risk guidelines
Landscape and Visual	*Construction and Operational Phases:* ▪ Potential disturbance to Visual Sensitive Receivers (VSRs) in Sha Lo Wan, Tung Chung and northwest New Territories
Marine Ecology	*Construction Phase:* ▪ Potential disturbance to marine ecology and habitats near works areas, including known horseshoe crab nursery grounds, coral and sea-grass habitat near the proposed airport expansion footprint ▪ Potential impact from increased Suspended Solid (SS) concentration on marine Ecologically Sensitive Receivers *Operational Phase:* ▪ Permanent loss of 650 hectares of sea bed and marine habitat, including about 260 hectares already occupied by Contaminated Mud Pits (CMPs) ▪ Potential impact on intertidal habitat, soft-bottom habitats and coral communities *[Note: A significant part of the sea bed in the proposed new land area has been subject to substantial disturbance in the past as a result of CMPs as well as other major developments.]*
Chinese White Dolphins (CWD)	*Construction Phase:* ▪ Disturbance to CWD (noise/water quality/feeding grounds); ▪ Disturbance to dolphin calves *Operational Phase:* ▪ Habitat loss ▪ Permanent loss of feeding grounds ▪ Potential encroachment into CWD travelling "corridors" between known areas of higher dolphin abundance ▪ Proximity to southern boundary of Sha Chau and Lung Kwu Chau Marine Park

Aspect	Issues for Environmental Assessment
Noise	*Construction Phase:* ▪ Potential impacts of land formation and construction on Noise Sensitive Receivers (NSRs) in north Lantau (e.g. residential) *Operational Phase:* ▪ Potential impact on noise sensitive land uses with updated Aircraft Noise Exposure Forecasts (NEFs)
Waste	*Construction Phase:* ▪ Quantity of dredged mud for disposal (e.g. under seawall and runway alignment)
Water Quality and Hydrodynamics	*Construction Phase:* ▪ Increase in Suspended Solid concentration at Water Sensitive Receivers near reclamation ▪ Potential release of sediment fines from mud dredging; methodologies for stabilising CMPs to ensure contained pollutants or interstitial water will not be released to the surrounding areas *Operational Phase:* ▪ Loss of marine area ▪ Potential change in hydrodynamics and tidal flows ▪ Potential change in flushing capacity of existing airport sea channel and water quality in east Tung Chung embayment

5.119 Should the Third Runway option be pursued, each of the above aspects would be assessed fully in accordance with the assessment requirements of the EIA Ordinance.

5.120 The review and scoping exercise helped identify several environmental aspects that are expected to be significant during the statutory assessment process given the expected scale and nature of works required for airport expansion and the increase in airport operations thereafter. Preliminary environmental assessments have been carried out on some of these key aspects at this early stage, which include:

- Potential operational impact on air quality;
- Potential impact from new land formation on marine ecology—in particular on Chinese White Dolphins;
- Potential aircraft noise impact on residential communities near the airport and along the flight paths; and
- Potential water quality impact of new land formation over an area of Contaminated Mud Pits (CMPs) north of HKIA and from any soft mud removal from sea bed areas outside the CMPs. It is worth noting that when the preliminary environmental assessments on the potential impacts of new land formation were carried out, it was assumed that dredging would be undertaken, which represents a worst-case scenario. It was subsequently proposed that only un-dredged methods, namely drained reclamation and DCM, would be used, so as to avoid dredging. Please refer to paragraphs 5.62 to 5.67 for the preliminary reclamation design proposed.

5.121 Quantitative assessments have been done to estimate early levels of operational air quality and aircraft noise impact from expanded airport operations on the surrounding communities. Additional qualitative assessments have also been carried out making use of the existing and comprehensive Chinese White Dolphin abundance database for North Lantau waters, with early work done on identifying a reclamation methodology that will facilitate reclamation over CMPs without disturbing the contained material within.

Preliminary Assessment on Air Quality

5.122 AAHK shares the community's concerns about Hong Kong's air quality and recognises that fresh air is an essential part of a quality living environment. As identified in Figure 5.44, there could be potential impact on air quality at both the construction and operational stages and both will be considered in full in subsequent studies. The potential impact during the operational stage at or on approaching three-runway capacity has warranted further preliminary assessment at this stage to give an early indication on how expected increases in ATMs and airport supporting activities may impact future air quality at local air sensitive receivers (ASRs), such as residential areas near HKIA. The current air quality legislative framework and requirements relating to air quality assessment in Hong Kong is outlined below.

5.123 *Current Air Quality Legislative Framework*

The Air Pollution Control Ordinance (APCO, Cap 311) is the principal law for managing air quality in Hong Kong. Under APCO, there is a set of Air Quality Objectives (AQOs) stipulating limits on seven main air pollutants, namely, Sulphur Dioxide (SO2), Total Suspended Particulates (TSP), Respirable Suspended Particulates (RSP), Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), photochemical oxidants, and Lead (Pb) (see Figure 5.45). The APCO requires the Government to aim to achieve AQOs and the Government, in turn, requires compliance with the AQOs as a pre-requisite; for example, for the issue of permits under the APCO for specified processes (such as for power generation) or for the issue of environmental permits under the Environmental Impact Assessment Ordinance.

Figure 5.45 : Hong Kong Air Quality Objectives

Pollutant	Concentration in micrograms per cubic metre [1] (Parts per million, ppm in brackets)				
	1 Hour [2]	8 Hours [3]	24 Hours [3]	3 Months [4]	1 Year [4]
Sulphur Dioxide	800 (0.3)		350 (0.13)		80 (0.03)
Total Suspended Particulates			260		80
Respirable Suspended Particulates [5]			180		55
Carbon Monoxide	30,000 (26.2)	10,000 (8.7)			
Nitrogen Dioxide	300 (0.16)		150 (0.08)		80 (0.04)
Photochemical Oxidants (as ozone) [6]	240				
Lead				1.5	

Notes:
1) Measured at 298°K and 101.325 kPa.
2) Not to be exceeded more than three times per year.
3) Not to be exceeded more than once a year.
4) Arithmetic mean.
5) Respirable suspended particulates means suspended particulates in the air with a nominal aerodynamic diameter of 10 micrometres or smaller.
6) Photochemical oxidants are determined by measurement of ozone only.

5.124 EIAs for Designated Projects are required to demonstrate compliance with AQOs at Air Sensitive Receivers (ASRs) near any development at both the construction and operational stages before the project proponent can commence development. ASRs are defined (per Annex 12 of the EIA Ordinance Technical Memorandum) as "any domestic premises, hotel, hostel, hospital, clinic, nursery, temporary housing accommodation, school, educational institution, office, factory, shop, shopping centre, place of public worship, library, court of law, sports stadium or performing arts centre."

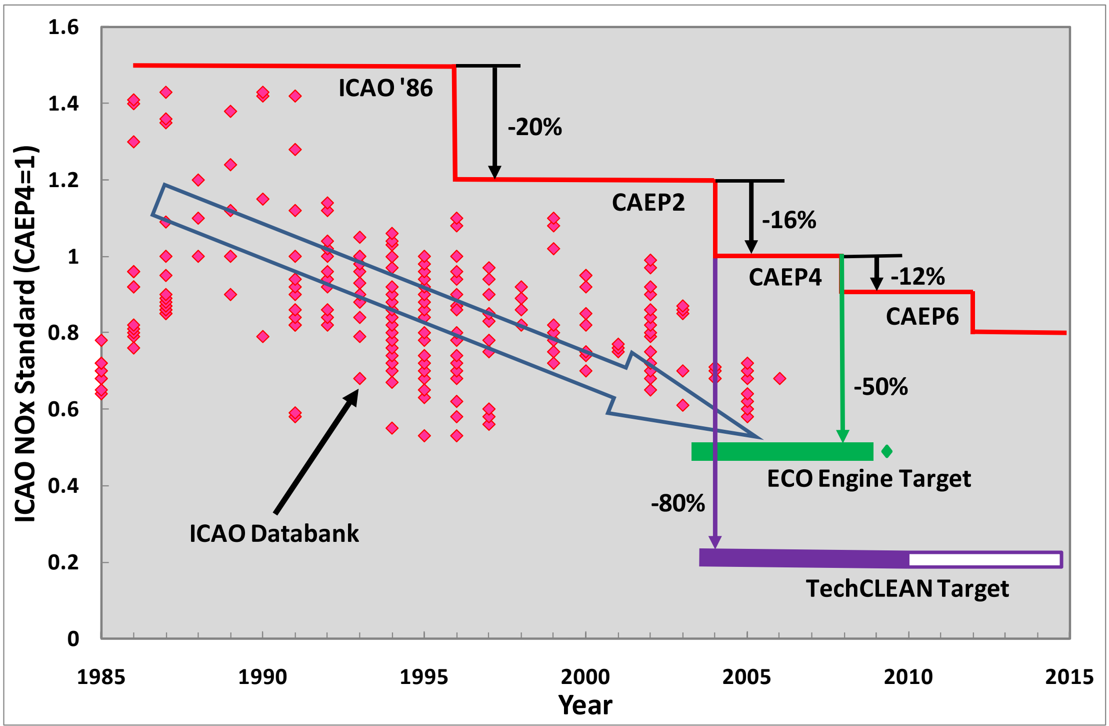
5.125 *Airport-generated Emissions*

Airport activities and operations such as air traffic movements, ground support equipment (GSE), motor vehicles, maintenance and catering activities etc, all generate air pollutant emissions.

5.126 Airport-generated air pollutants are very similar in nature to pollutants generated in urban areas, which include Carbon Monoxide (CO), Nitrogen Oxide (NO_x), Sulphur Oxide (SO_x), hydrocarbons (HCs) or Volatile Organic Compounds (VOCs) and particulate matter (particulates). According to an Airports Council International (ACI) 2009 Study, aircraft engines are usually the biggest source of both NO_x and other air pollutant emissions at an airport, with airport vehicles next. Off-airport emissions sources in the case of HKIA include nearby roads such as the North Lantau Highway, power stations, marine traffic and broader regional inputs from the PRD region.

5.127 The major air pollutant generated by airports is NO_x emissions from aircraft during landing and take-off (including climb-out, final approach and taxiing modes). All aircraft produced today are required to meet engine certification standards adopted by ICAO. The first standards for NO_x were adopted in 1981 and made more stringent in 1993, 1999 and 2004. Based on the reviewing work of the Organisation's Committee on Aviation Environmental Protection, the medium and long-term technology goals for NO_x are developed. Relative to midterm goals (2016), the group estimated a 45% reduction from the current standards set in 2004. As for the long term goal (2026), it estimated that a reduction of some 60% would be attainable under specific pressure ratio conditions. Figure 5.46 illustrates historical and expected future improvements in aircraft NO_x emission standards.

Figure 5.46 : ICAO NO_x Criteria Including Target Values for Research and Development



Note: ICAO – International Civil Aviation Organization
CAEP – Committee on Aviation Environmental Protection
NOx – A generic term for Nitric Oxide and Nitrogen Dioxide
Source: Japan Aerospace Exploration Agency, 2008

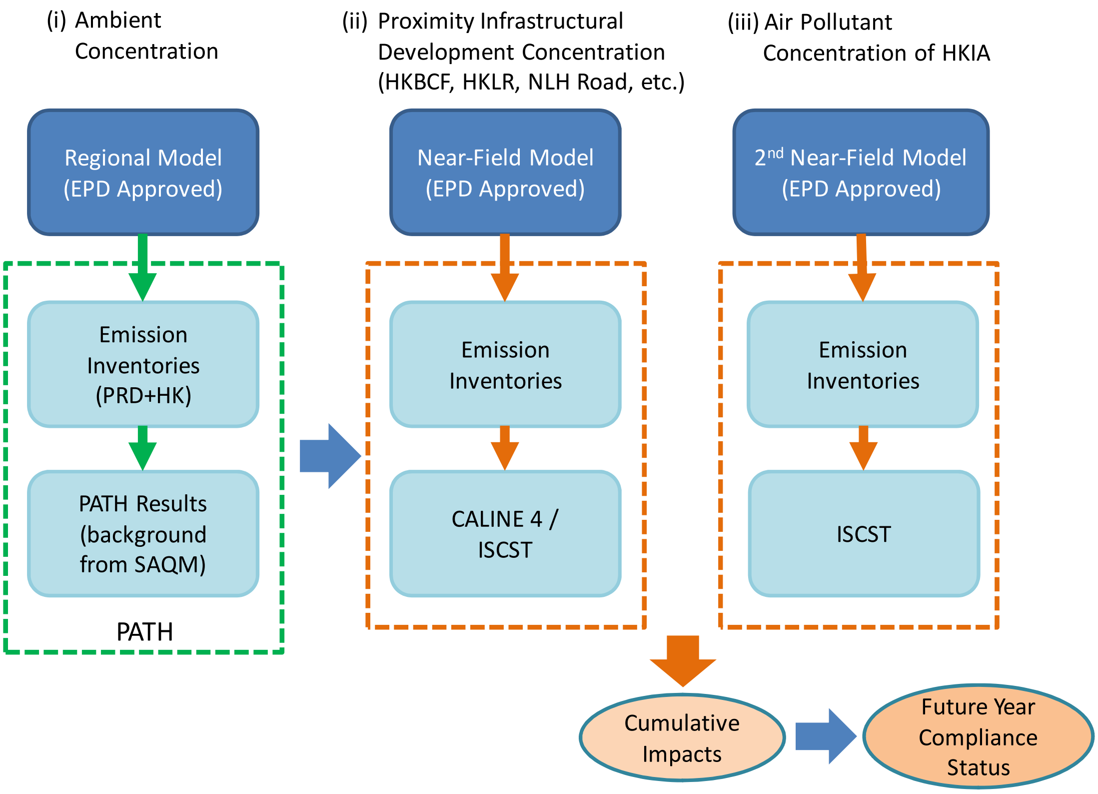
Approach used to assess air quality impact of HKIA

5.128 EPD provides clear guidance on acceptable methodologies and modelling tools for completing air emissions inventories and dispersion models. The principles of these have been adopted in this preliminary work and in the context of the interim review have allowed:

- Estimation of ambient pollutant concentrations from local emissions sources including power plant emissions, vehicular emissions and regional sources from PRD which are determined by using a regional air quality prediction model developed by EPD – the “Pollutants in the Atmosphere and their Transport over Hong Kong” (PATH) model.
- Estimation of proximity infrastructural development pollutant concentrations from vehicular emissions sources from North Lantau Highway (NLH), Hong Kong Boundary Crossing Facilities (HKBCF, Hong Kong Link Road (HKLR), Tuen Mun – Chek Lap Kok Link (TMCLKL) and local roads inside Tung Chung and the airport island which are determined by using a near field model accepted by EPD – the “California Line Source Dispersion Model Version 4” (CALINE 4) model.
- Estimation of project pollutant concentrations of emissions sources related to airport operators including landing and take-off ratios, and emissions from ground support equipment, auxiliary power units (APU), car parks, engine testing, fuel tanks, fire training, catering and helicopters established by a near field model also accepted by EPD – the “Industrial Source Complex Dispersion Model IV Short Term” (ISCST) model.

5.129 The way in which these modelling components combine to give a cumulative impact based on different input criteria is illustrated in Figure 5.47 below.

Figure 5.47 : Cumulative Impact based on Different Input Criteria



Source: SAQM stands for "Multi-species photochemical air quality model" – used for Pollutants Transport & Chemistry Modelling

5.130 The preliminary analysis has referred to the assumptions and methodologies in the recent EIA reports of HKSAR government's infrastructural projects near HKIA, but with air traffic movements scaled up to 620,000 ATMs per year to roughly simulate airport emissions from a three-runway system at design capacity. This is intended to give an early indication of how future "scaled up" airport emissions may affect nearby Air Sensitive Receivers (ASRs).

5.131 *Results and Compliance Status*

The preliminary analysis predicted that only the Midfield area on the airport island would experience concentration of NO_2 exceeding the limits (24-Hour NO_2 and/or Annual NO_2) in 2030, according to the current AQO criteria. However, as the ASRs locating in the Midfield area would all be commercial buildings, their air conditioning and mechanical ventilation designs are expected to be able to include appropriate gas filters to satisfy indoor air quality requirements for the buildings' occupied interior spaces. The projected cases where NO_2 exceeded the allowable limits at on-airport commercial buildings are not of major significance under the Air Pollution Control Ordinance. The preliminary analysis did not predict any breach of the current AQOs at the off-airport ASRs representing residential areas.

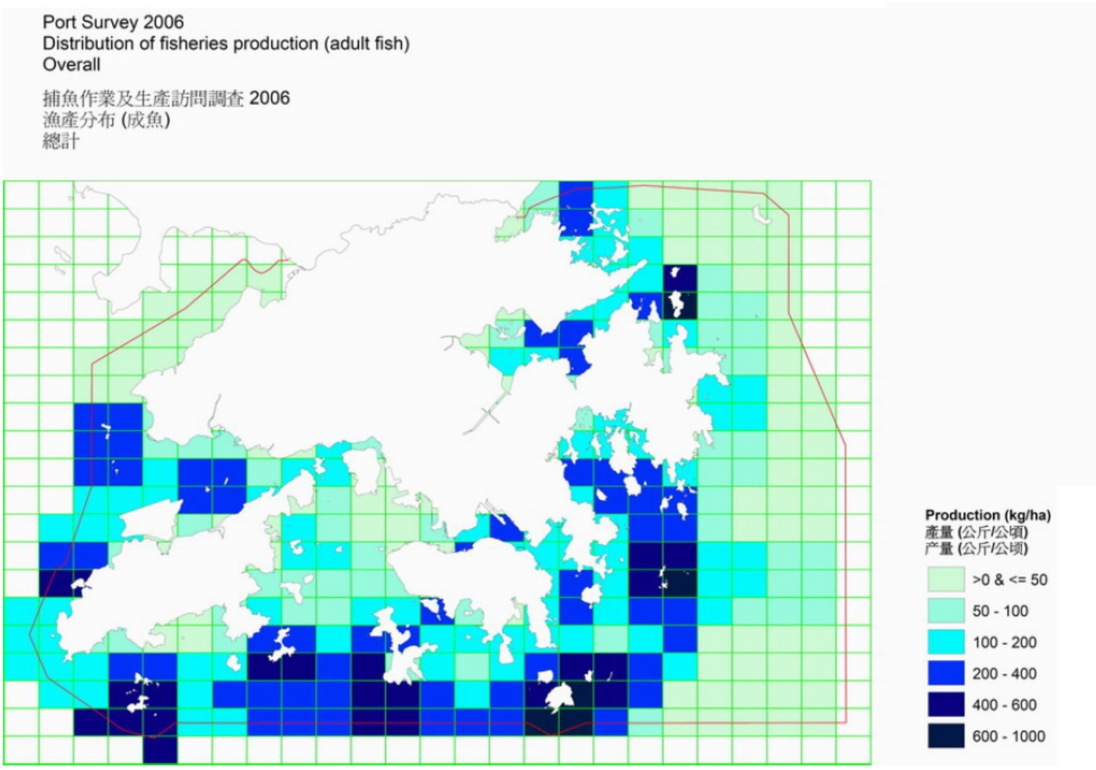
5.132 If Option 2 (three-runway system) is to be taken forward to the EIA stage, the airport emissions inventory and dispersion modelling exercise to be conducted for the three-runway airport layout at maximum operating conditions will adhere fully to the clear EPD guidance on acceptable methodologies and modelling tools for completing air emissions inventories and dispersion models. Future assessments will also make use of the best available information and assumptions for potential emissions reductions. It will also project the worst-case air pollutant levels at nearby ASRs against the prevailing AQOs that are expected to be in effect by 2030.

Preliminary Assessment on Fisheries

5.133 The scoping exercise identifies issues requiring a thorough assessment at both the construction and operations stages. Reclamation and permanent loss of marine area may affect fisheries' resources and fishing operations within the project area and in adjacent waters. The assessment was conducted by reviewing existing information related to culture and capture fisheries (such as the Ma Wan Fish Culture Zone) and capture fisheries (in the North Western Water Control Zone). For example, the 2006 Port Survey (AFCD, 2006), which identified levels of fisheries production and fishing activity within Hong Kong waters, found that the waters north and north-west of HKIA support a 'medium' value of fisheries production (medium-low fisheries production and fishing activities) within the survey grids affected by the Option 2 new land area (see Figure 5.48). The permanent loss in fisheries production is preliminarily estimated to be around 0.08% of Hong Kong's yearly production (58,700-117,400 kg loss).

5.134 If Option 2 is taken forward, the impact on fisheries will be considered in full accordance with statutory requirements in subsequent studies, including appropriate measures to reduce impact on fisheries to acceptable levels. Means for formalising compensation for capture and culture fisheries that may be impacted by new reclamation and/or construction works are clearly prescribed and these are likely to be applicable.

Figure 5.48 : Distribution of Fisheries Production (adult fish)



Source: Agriculture, Fisheries and Conservation Department, 2006

Preliminary Assessment on Marine Ecology

5.135 The scoping exercise identified likely impact on marine ecology, principally from marine work required for new land formation at the construction stage and from the permanent loss of sea bed and marine habitat thereafter.

5.136 The areas examined included the North Western Water Control Zone (WCZ), North Western Supplementary WCZ, Deep Bay WCZ and Western Buffer WCZ as designated under the Water Pollution Control Ordinance (WPCO). Sensitive areas that could be impacted by the project include coral sites within the WCZs, the Sha Chau and Lung Kwu Chau Marine Park, intertidal habitat zones of horseshoe crabs, coastal seagrass beds and the artificial reefs deployed in the Airport Marine Exclusion Zone (MEZ). A desktop literature review has established the conditions of the physical environment and the general ecological profile for impact assessment. In the desktop study process, no significant information gap was identified for a focused quantitative assessment at this preliminary stage.

5.137 It should be noted that much of the footprint of the proposed reclamation has been subject to substantial human disturbance in the past and is not known to be of particularly significant ecological value.

Preliminary Assessment on Chinese White Dolphins

5.138 Chinese White Dolphins (CWD), or Indo-Pacific Humpback dolphins (*Sousa chinensis*), can be found from southern China and northern Australia in the east to South Africa in the west. The local population size in Hong Kong waters is estimated to be about 100-200 individuals depending on the time of year[62], with CWDs in Hong Kong being largely located within north and west Lantau waters. In the wider Pearl River Estuary, it is estimated that there are at least 2,500 CWDs[63].

5.139 The potential impact on CWDs includes the reduction of habitat, disruption of breeding and calving areas, and disturbance of CWD activities including feeding and socialising. These disturbances could be generated during both the construction and operational phases. Potential impact can be alleviated by minimising the extent and duration of disturbance and by avoiding or minimising direct impact on known important dolphin habitat areas —identified through long-term analysis of CWD distribution and abundance patterns.

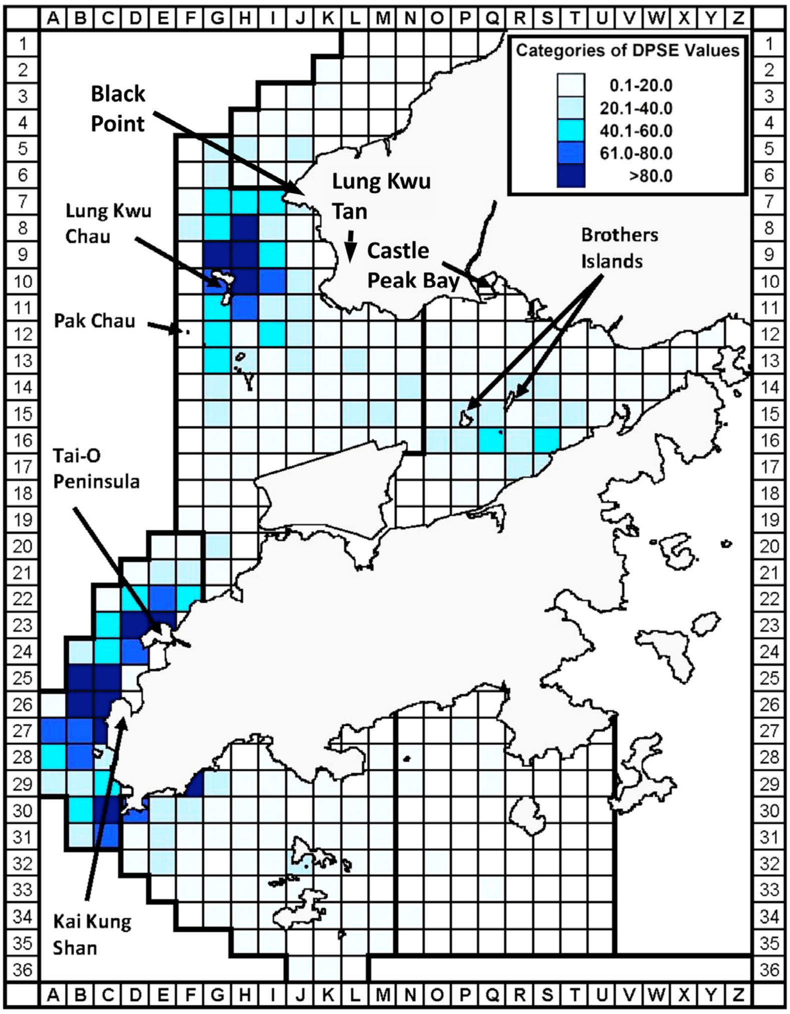
5.140 The Agriculture, Fisheries and Conservation Department's (AFCD) current database on CWDs in north Lantau waters and in the Pearl River Delta has been reviewed, particularly the distribution range and abundance in the proposed area of airport expansion. With over 13 years of monitoring, dolphin behaviour, seasonal use and abundance in north Lantau waters is relatively well understood. This preliminary work has referred to the database in considering the risks posed to CWDs from both the marine work required for reclamation — in particular the short-term elevation in suspended solid concentrations from reclamation activities and potential impact from actual construction activities – as well as from permanent loss of habitat as a result of new land formation.

5.141 The CWD distribution and abundance surveys have identified that CWDs are widely distributed throughout northwest, northeast, west and southwest Lantau, while they are rarely observed in the Deep Bay, southeast Lantau and Lamma areas. CWD sightings (and the areas of highest abundance) are common in the waters east of Lung Kwu Chau, between Lung Kwu Chau and Black Point, near Pak Chau, around the Brothers Islands and throughout the west Lantau area. Abundance is especially high along the stretch of waters between the Tai O Peninsula and Kai Kung Shan. CWDs are much less frequently observed in waters off Castle Peak Bay, Lung Kwu Tan, north of the HKIA platform and in northeast Lantau waters. Specifically around the existing airport platform, moderate to low abundance is evident extending several kilometres to the north and northwest, with slightly higher abundance noticed off the northeast corner of the airport platform (see Figure 5.49).

[62] Agriculture, Fisheries and Conservation Department 2007 Study

[63] Chen, T., S.K. Hung, Y.S. Qiu, X.P. Jia, and T.A. Jefferson. 2010 Distribution, abundance, and individual movements of Indo-Pacific humpback dolphins (Sousa chinesis) in the Pearl River Estuary, China. Mammalia 74: 117-125.

Figure 5.49 : Chinese White Dolphins Sightings



Note: Density of Chinese white dolphins with corrected survey effort per square kilometres in waters around Lantau Island, using data collected during 2002-2009. DPSE = no. of dolphins per 100 units of survey effort.

Source: Agriculture, Fisheries and Conservation Department

5.142 In recent years, studies have identified that the period between April to August is more important for calving, and mother-calf pairings may be more sensitive when they are subject to environmental stress such as underwater noise, increased marine activities and marine-based construction activities. Surveys show that areas in west Lantau have the highest number of newborn calf sightings. Specific areas identified as having higher densities of newborn calves include areas east and west of Lung Kwu Chau, near Tai O, Peaked Hill and around the tip of Fan Lau[64].

5.143 In broad terms, the overall impacts of airport expansion on CWDs depend on both the total size of the reclamation and its proximity to areas of known importance to CWDs. This preliminary work has considered only the existing database of CWD information, without conducting additional survey work. A thorough assessment of the overall

[64] Hung, S. K. (2008). Monitoring of marine mammals in Hong Kong waters – data collection. Final report submitted to the Agriculture, Fisheries and Conservation Department, Hong Kong.

environmental acceptability of Option 2 (three-runway layout) will be completed in subsequent studies.

5.144 Formation of new land will result in the permanent loss of CWD habitat. Airport expansion to the north would overlay a marine area of known low CWD abundance; nonetheless, land formation activities would require mitigation. Over time, numerous measures have been developed to minimise the immediate effects of marine construction activities on CWDs. With the proposed scale of reclamation required, there is also likely to be a need to compensate for the permanent loss of marine habitat or to find other ways to mitigate this loss. An important aspect to consider is that the Third Runway layout, while in an area of relatively low CWD abundance, may have the effect of interfering with CWD travelling "corridors". These are the routes that CWDs are thought to take when passing between areas of very high abundance, for example, between the Tai O Peninsula and Kai Kung Shan and the Lung Kwu Chau and Black Point high use areas. Further comprehensive assessments on such aspects will be completed in subsequent studies.

5.145 *Mitigation Measures*

There are a number of well-established mitigation measures, adjusted methodologies and working controls in Hong Kong to mitigate the impact of construction on dolphins. All options for minimising the impact of significant reclamation on CWDs and all other possible mitigation measures will be explored and developed, should the three-runway option be taken forward to the EIA stage after the public consultation.

5.146 An initial summary of measures that have often been recommended and deployed to minimise impact on marine mammals during marine works in Hong Kong is outlined below:

- Mitigation Principles

  In considering the application of mitigation measures intended to offset environmental impact, the principles of "avoid, minimise, mitigate and compensate" are of particular relevance.

  Avoidance

  Every effort should be taken to avoid, as far as possible, any impact at all.

  Minimisation

  Every effort should be taken to minimise impact where possible, for example by minimising reclamation size or reducing the duration of work.

- Mitigation Measures

  There are a range of effective mitigation measures in relatively standard use in marine based projects in Hong Kong and these include:

- Bubble Curtains

  Piling is not recommended as the construction method for land formation as it would generate underwater noise with high energy at frequencies which CWDs are sensitive to. Preliminary engineering feasibility assessments have identified that marine piling is not required for any of the options put forward. In case piling work is ultimately required, a bubble curtain is recommended to reduce underwater noise. Bubble curtains anchored to the sea bottom around piles could effectively absorb sound generated from pile driving.

- Dolphin Exclusion Zone

  A monitored exclusion zone of up to several hundred metres in size could be set up around dredging sites to reduce the chances of any adverse impact on CWDs. The work site is generally closely monitored for at least 30 minutes prior to the start of dredging, and if dolphins are sighted, dredging is delayed until CWDs have left the exclusion zone.

- Silt Curtains

  To avoid the spread of suspended solids which are re-suspended back into the water column during dredging and filling operations, silt curtains could be used around work areas wherever feasible. Regular inspection of the effectiveness of silt curtains would be required. A water quality monitoring programme, usually implemented in association with such marine work, would help to ensure that water quality in the vicinity of the work site meets the required standards.

- Dolphin Monitoring

  Monitoring the density and behaviour of CWDs before, during and after the period of construction work is likely to be recommended through the EIA process. This would help check if the other mitigation measures employed have been effective in reducing disturbance to CWDs and will also spot any longer- term change in behaviour.

  It is recommended that CWDs be monitored in three phases: pre-disturbance (i.e. baseline phase), disturbance (i.e. construction phase), and post-disturbance (i.e. operational phase). Survey techniques should be held constant from phase to phase with survey equipment and personnel ideally being the same as well. Any apparent differences in density between survey phases should be statistically analysed for trends.

<u>Compensation</u>

From a CWD conservation point of view, establishing designated Marine Park areas has historically been pursued as further compensation, generally as part of a suite of mitigation measures for any project.

5.147 As these measures have been identified from the review of current studies only, their relevance and applicability to the current project will be further evaluated, taking into account the design of the project and findings of the detailed EIAs to be undertaken in subsequent studies after the public consultation.

Preliminary Assessment on Noise

5.148 Although construction noise is expected to arise from land formation activities, it is not expected to be a major issue as the reclamation area is distant from nearby Noise Sensitive Receivers. This aspect will be studied in line with statutory requirements during subsequent studies.

5.149 Residential communities near the airport and its flight paths are subject to varying degrees of aircraft noise. Because operation of the Third Runway is likely to require new and amended arrival and departure flight paths, preliminary assessments of aircraft noise have been completed to determine its likely impact.

5.150 Moving HKIA from Kai Tak to Chek Lap Kok in 1998 had the major benefit of removing intrusive aircraft noise from over 350,000 residents living under or near Kai Tak's flight paths. Flight paths of HKIA's two-runway operation are mainly over water, creating less impact on residents and enabling 24-hour airport operation.

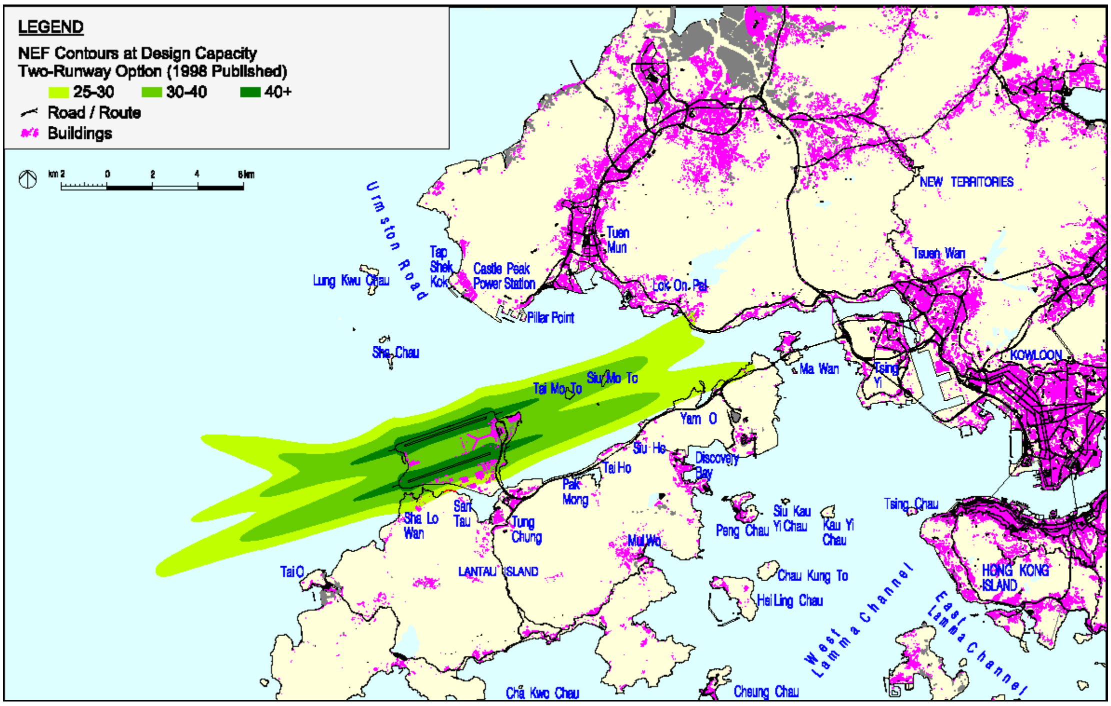
5.151 In Hong Kong, aircraft noise evaluation is conducted in accordance with guidelines established by the International Civil Aviation Organisation (ICAO) and the US Federal Aviation Administration (FAA). The FAA's Integrated Noise Model (INM) is an internationally accepted tool for assessing airport noise exposure, which is used to generate Noise Exposure Forecast (NEF) contours around the airport and its flight paths.

5.152 The INM combines accepted mathematical methods for the calculation of aircraft noise with an extensive database of aircraft acoustic and performance information. It estimates noise exposure by factoring in the duration of flyovers, peak noise levels, tonal characteristics, and the number of aircraft movements during both daytime and night-time periods. It penalises night-time flights; one night-time flight is equivalent to 16 daytime flights (of the same aircraft type). Based on these factors, a NEF — a composite index figure representing the cumulative aircraft noise exposure level per day (averaged over a year) — can be calculated.

5.153 NEF is a tool for land use planning, primarily used to define areas where the construction of certain types of building is "acceptable" or "unacceptable". Contours are defined for 25, 30 and 40 NEF levels. According to the Hong Kong Planning Standards and Guidelines (HKPSG), all land uses are considered acceptable if they fall outside the 25 NEF contour. It is noteworthy that these standards apply to buildings that rely on open-window ventilation. Land uses that do not rely on open-window ventilation—for example, those that utilise air conditioning — are permitted to be developed within the 25 NEF contour.

5.154 The most recent NEF contours for HKIA (see Figure 5.50) were published in 1998. These NEF contours represent a projection of the existing two-runway airport layout at design capacity.

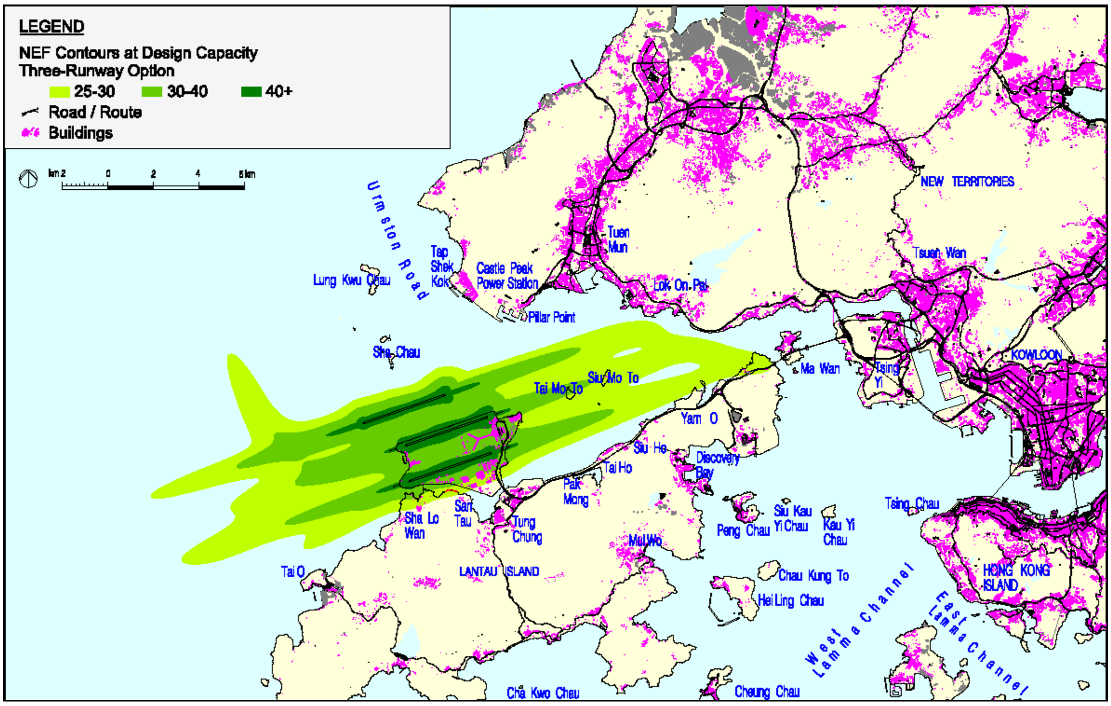
Figure 5.50 : Projection of Two-Runway NEF Contours for HKIA at Design Capacity (Published in 1998)



5.155 The NEF forecast will be formally updated as part of the future EIA based on updated flight path design, aircraft operational forecast, runway utilisation plan and practical assumptions of night-time noise mitigation measures for a three-runway system.

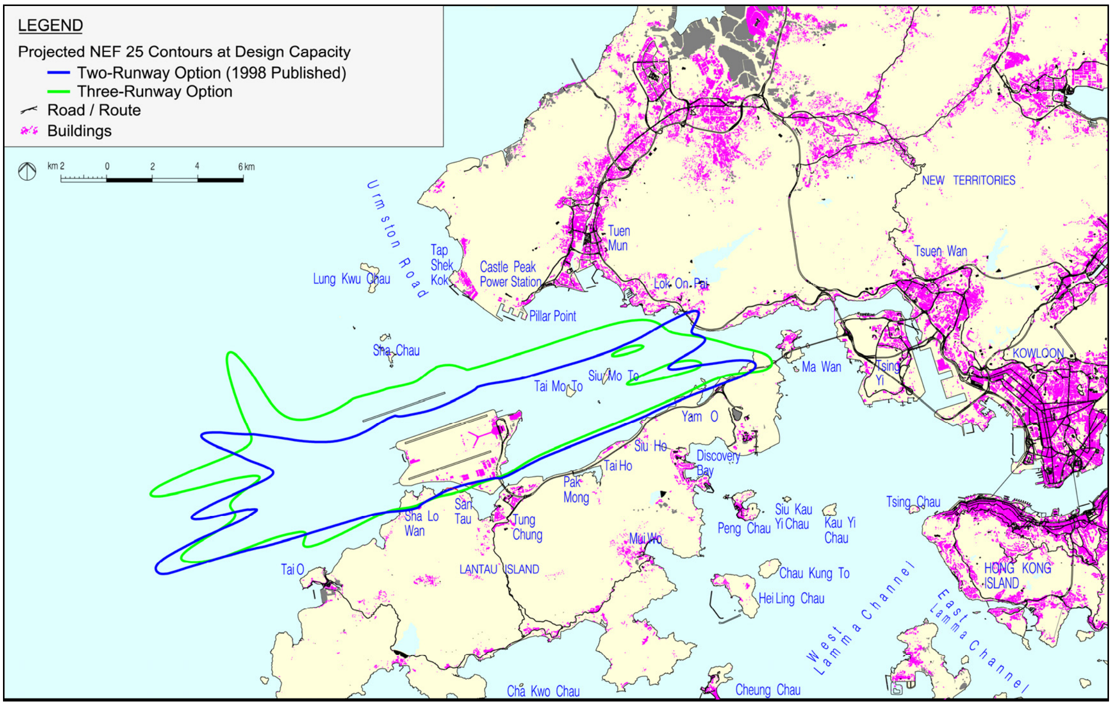
5.156 Due to the importance of the impact of aircraft noise, projections of preliminary noise contours have been completed. More information on the preliminary NEF contour forecast is in Appendix 4. The assessment has proportionally increased existing flight operating patterns to the projected annual aircraft movements of 620,000 at the design capacity of the three-runway system (see Figure 5.51).

Figure 5.51 : Preliminary Projection of Three-Runway NEF Contours for HKIA at Design Capacity



5.157 The preliminary NEF contour forecast for the three-runway option at design capacity is very similar to the contours published in 1998 for the two-runway option at design capacity (see Figure 5.52).

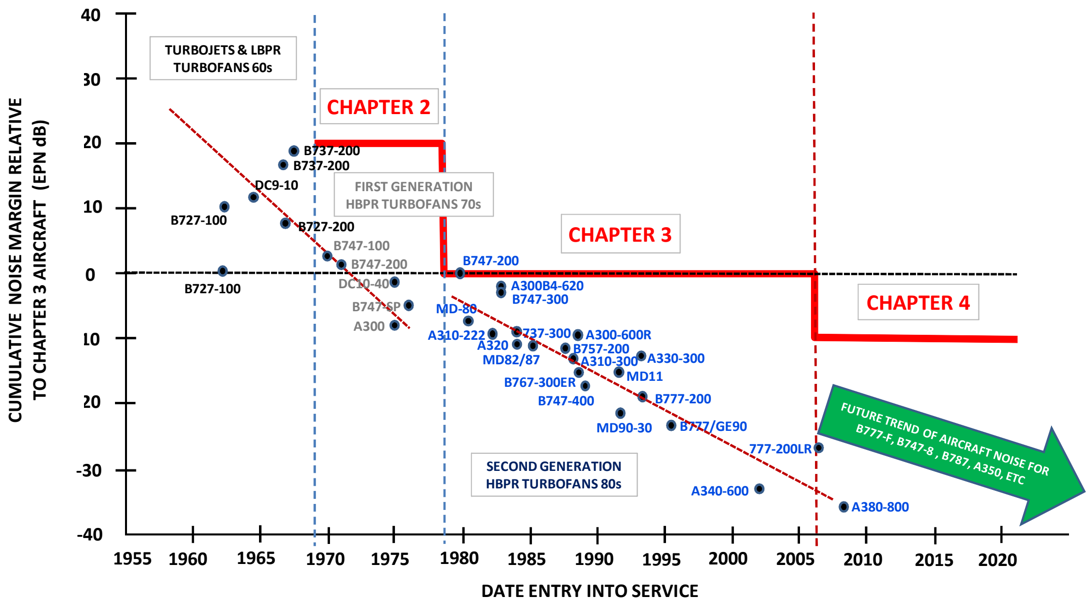
Figure 5.52 : NEF 25 Contour Comparison between the Three-Runway Option and the Two-Runway Option



This is the result of:

a) Improvements in aircraft and engine technology over the past decades, resulting in quieter, more efficient aircraft engines and airframes have reduced aircraft noise dramatically over time, and this trend is expected to continue. Figure 5.53 indicates the noise levels of commercial aircraft coming into operation over the last 50 years. The red line in Figure 5.53 shows the stepped ICAO aircraft noise certification requirements that have resulted in aircraft noise reduction over time. The Chapter 2 aircraft noise standard was introduced in 1969, but most Chapter 2 aircraft have now been phased out. All aircraft operating into Hong Kong are at least Chapter 3 compliant, and the ICAO requires all new aircraft types applying for type certification (from 1 January 2006 onwards) to be Chapter 4 compliant. Chapter 4 compliant aircraft are at least 10 decibels quieter than Chapter 3 – compliant ones, based on a cumulative measurement over the three phases of flight (approach, takeoff under full power, and overflight) tested at certification. Accepted acoustic standards are that a 10 decibel reduction is perceived as a roughly 50% decrease in noise volume. It is worth noting that many certified Chapter 3 aircraft comply with the Chapter 4 aircraft noise standard.

Figure 5.53 : Quieter Aircraft Entering Service over Time



Source: Pratt & Whitney & ICAO

b) The airline industry consensus is that all Chapter 3 noise standard-certified aircraft will be phased out in 20 years' time. By 2030, all night-time flight operations at HKIA will utilise new-generation aircraft (for example, B787, A350, B747-8F and B777F), which are expected to be at least as quiet if not significantly quieter than the most stringent current Chapter 4-certified aircraft noise level standard. New aircraft such as the B777 and A380 have already achieved this standard.

c) Changes to current night-time arrival and departure procedures, along with the development of new arrival flight paths:
   - Under current noise abatement procedures implemented by the Civil Aviation Department (CAD) since October 1998, about 90% of night-time flight operations (between 0000 – 0700 hours) are required to use Runway 07 direction for both arrivals and departures (i.e. landings from the southwest and takeoffs to the northeast, with north-easterly departures turning south via the West Lamma Channel). This arrangement avoids night-time flights over Sha Tin, Tsuen Wan and Sham Tseng;
   - CAD indicates that under the three-runway option, alternate runway direction usage (between Runway 07 direction, west to east, and Runway 25 direction, east to west) will be possible from an ATC operations point of view. As departures are noisier than arrivals, this will allow more departures to leave to the west during periods with more departures and vice versa when there are more arrivals; and
   - To continue minimising night-time flights over Sha Tin, Tsuen Wan and Sham Tseng. CAD has indicated that since alternate runway direction usage will allow increased arrivals from the east, new arrival flight paths (via the West Lamma Channel) can be explored for night-time flight operations that will allow the majority of night-time departures and suitably equipped arriving aircraft to take place over water, hence minimising flights over populated areas.

d) The South Runway will be assigned to standby mode where possible during the night-time period from 23:00 to 06:59 in order to minimise the aircraft noise impact along North Lantau shoreline. This assumption is made on the basis of significant tapering of forecast demand during 23:00-08:00 which could be adequately met by the remaining two runways during 23:00-00:59 and even by a single runway in mixed mode during 01:00-08:00 when routine maintenance of the three runways will be carried out in turn. The increase of HKIA's runways to three will provide the flexibility to minimise the use of the First Runway during 23:00-08:00, crucial to reducing aircraft noise impact along the North Lantau shoreline. This would be impossible under the two-runway option.

Preliminary Assessment on Water Quality and Hydrodynamics

5.158 The scale of the reclamation proposed in Option 2 – 650 hectares – has the potential to significantly impact water quality during the several years required for land formation work. During the operational phase, an aspect of significance is the potential change to the hydrodynamics and water flow patterns around any new land mass. Should tidal flows and water circulation be reduced, there could be implications on water quality, for example due to inadequate flushing of pollutants from embayed areas. The significant size of the new land area can potentially influence broader water flow patterns in Hong Kong waters.

5.159 *Water Flow Patterns*

Preliminary work has included some early assessment based on hydrodynamic and water quality models, both to give an indication of the overall acceptability of any changes to tidal flows and hydrodynamics caused by the new land area, and to assist in the qualitative environmental comparison of the three-runway layout options. 3-D hydrodynamics models (Delft Hydraulics) have been used in the preliminary assessment of options, covering both wet and dry seasons with 10 vertical model layers using a grid size of 200m x 200m.

5.160 Modelling results suggest that the reclamation proposed in Option 2 will not significantly impact large-scale tidal flows, although some local scale changes were identified around the individual footprints (for example, small increases in flow speed at the western end of the Third Runway). Flushing capacity in major flow channels such as Urmston Road to Ma Wan Channel, was not shown to change significantly and impact on the airport channel was low. No substantive impact on broader Hong Kong waters was shown. These vital parameters will be assessed fully in accordance with statutory requirements in subsequent studies.

5.161 *Water Quality*

Dredging and filling phases of marine construction may adversely impact on water quality by resulting in increased Suspended Solid (SS) concentrations in the water column, which can directly influence marine ecology. SS re-deposition can affect ecologically sensitive receivers (i.e. corals, sea grasses and certain other marine flora and fauna).

5.162 Preliminary water quality modelling work has been undertaken using a Delft3D-WAQ model, focusing on SS suspension and sediment plumes that could be expected from dredging work associated with land formation. This represents a worst-case scenario in terms of the number and types of dredging equipment that could be anticipated and based on time series plots covering complete spring-neap cycles focusing on selected water sensitive receivers (WSRs), such as the Sha Chau and Lung Kwu Chau Marine Park and coastal areas near Tai Ho Wan and Sha Lo Wan.

5.163 The early water quality modelling indicated that the Option 2 preferred layout would have the least impact on WSRs. It is projected that SS levels are marginally exceeded at certain WSRs but these can probably be reduced to acceptable levels with the adoption of well-tried and tested mitigation measures. This preliminary analysis will be reviewed and assessed fully in accordance with statutory requirements in subsequent studies.

5.164 *Dredging of Soft Sediment*

During the construction of HKIA, a "dredged reclamation" approach was adopted requiring the removal and disposal of soft marine mud layers prior to infilling with firmer reclamation material on the underlying firm sand of the deeper sea bed. The preliminary water quality monitoring work summarised above has estimated sediment plumes based on the assumption of a dredged reclamation approach as a worst-case. However, because of the environmental impact of soft sediment dredging, the preferred reclamation approach now practised in Hong Kong is "drained reclamation", a methodology that leaves the soft sediment of the surface layers in place. A surcharge/de-watering method to stabilise the *in-situ* softer material above the deeper firm sandy layer is implemented to stabilise and firm the soft surface layers prior to reclaiming above the stabilised seabed material.

5.165 *Contaminated Mud Pits*

A further potential challenge arises when land reclamation is considered over the area of contaminated mud pits (CMPs) to the north of the existing airport island (see Figure 5.31). These CMPs are managed by the Civil Engineering and Development Department (CEDD), and began operation in late 1992. They are the Government's permanent solution for the disposal of contaminated soft marine mud. The marine mud was taken from the inner harbour and other areas to make way for earlier reclamations in Hong Kong. The CMPs hold contaminated material that is contained ("capped") under a layer (about two metres) of clean material at seabed level. In considering the viability of forming new land over the CMPs, the presumption is that the contained contaminated material must remain in place because these facilities are a permanent solution and removing materials prior to building over the pits is not a realistic option.

5.166 If interface or encroachment into the CMPs is required, the contaminated material and water from the CMPs must be contained during the process of land formation. The drained reclamation approach now preferred in Hong Kong would not be possible, mainly because the surcharge/dewatering methodology, by its nature, squeezes interstitial water from the soft material as an integral part of the consolidation process – this is not acceptable given the nature of the material contained in the CMPs. The preliminary engineering feasibility for airport development has therefore investigated various ground stabilisation and construction methodologies that are able to:

- Sufficiently firm the soft material in the CMPs in-situ, and
- Ensure there is no leaching of material or interstitial water from contained material within the CMPs to surrounding waters.

5.167 One methodology that appears capable of achieving this after detailed consideration of several possible alternatives is Deep Cement Mixing (DCM).

5.168 Areas of reclamation outside of the CMPs are expected to use the drained reclamation approach wherever possible, so as to minimise the extent of soft sediment dredging prior to land formation. For areas outside the CMPs but beneath the runway, the marine sediment will be treated with DCM in order to meet the more stringent performance criterion. Sloping seawalls are proposed to be erected on a non-dredged formation or over DCM treated CMPs. The engineering method for land formation will be further studied during the EIA phase.

5.169 Future engineering and environmental trials of DCM will be done to quantify the potential for additional water quality impact from the methodology, and to determine its acceptability for firming the area of CMPs falling within the Option 2 airport footprint. Should DCM be used above CMPs, it is expected to provide an effective and permanent cap for the contained contaminated material once reclamation is completed.

Other Environmental Aspects

5.170 It is recognised that some of the environmental aspects identified in Figure 5.44 have not been elaborated upon in this section, although most were considered in the qualitative comparison of available expansion options (see Appendix 3 for details). All the aspects identified and associated potential impacts will be considered fully in accordance with statutory requirements in subsequent studies.

Statutory Environmental Impact Assessment Process

5.171 It is recognised that the scoping of environmental aspects and the preliminary assessments being carried out do not replace the statutory EIA process prescribed in the EIA Ordinance. Should HKIA move forward with the three-runway development plan, a formal EIA will be completed in accordance with the criteria and stipulations detailed in the statutory process.