Republic of the Philippines
Department of Transportation and Communications (DOTC)

JICA's Information Collection Survey for New Manila International Airport in The Republic of the Philippines

Final Report

May 2016

Japan International Cooperation Agency (JICA)

Japan Airport Consultants, Inc. (JAC)
Almec Corporation (ALMEC)
Oriental Consultants Global Co., Ltd. (OCG)

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1USD＝123.38Yen

1USD＝45.157PHP

1PHP = 2.732 Yen

June 2015

Summary

1. Background

1.1 General

In and around Metro Manila, there are five operational airports; namely Ninoy Aquino International Airport (NAIA), Clark International Airport (CRK), Plaridel Airport, Sangley Point Air Base (SANGLEY) and Subic International Airport.

NAIA is located approx. 10 km from the business center of Metro Manila, and is a gateway airport in the Philippines. NAIA handled approx. 34 million passengers consisting of 18 million domestic and 16 million international passengers in 2014. Also NAIA handled approx. 266 thousand aircraft movements consisting of 143 thousand domestic and 94 thousand international flights.

CRK is located approx. 90 km to the northwest from the center of Metro Manila in the province of Pampanga. CRK handled 1.5 million passengers per annum in 2012, however, currently is handling less than 1 million passengers per annum, due to the fact that Emirate and Air Asia stopped their operations in CRK. As for the aircraft movements, CRK handled 26 thousand aircraft movements consisting of 1 thousand domestic and 6 thousand international flights and 20 thousand of general aviation in 2014.

Plaridel airport is serving mainly general aviation, located in the province of Bulacan and approx. 35 km to the northwest from the center of Metro Manila.

SANGLEY is located in the northern portion of Cavite peninsular and approx. 15 km to the southwest from Metro Manila. SANGLEY is being operated by the Philippines Navy and Air Force, however, SANGLEY is also accommodating some general aviation aircraft for the purpose of mitigating NAIA's capacity constraint.

Subic International Airport is located in Olongapo city approx. 80 km. Once, Federal Express utilized Subic International Airport as a cargo hub airport.

Figure 1-1 Locations of Airports and Airfields in and around Metro Manila

1.2 Airport Capacity Constraints

NAIA handled more than 34 million passengers and 260 thousand aircraft movements per annum including general aviation in 2014, and it seems already to have reached the capacity limit. The trend of the air passenger movements in NAIA is upward in due course of high economic growth rate in the Philippines. Also high popularity of LCC airlines pushes runway capacity limitation as well, and this trend would be continuing in the short-term. Expansion of NAIA's property seems difficult. Mitigation measures are necessary as soon as possible in order to accommodate the vigorous air traffic demand.

The Government of the Philippines had declared in 1994 to utilize CRK as a premier international gateway airport in the Philippines so that air traffic demand in the National Capital Region (NCR) would be handled by NAIA and CRK. However CRK is not fully utilized currently, the reasons behind the underutilization include lack of high speed railway access and unpredictable travel time to/from Metro Manila.

1.3 Alternative Solutions Examined

In the wake of airport capacity constraints, following alternative solutions have been examined;

i) Upgrading CRK to a Gateway Airport; and
ii) Capacity enhancement of NAIA

1) Upgrading CRK

There exists a large scale development plan named "Clark Green City", which is a new project converting the area into a new urban area. When "Clark Green City" development is realized, Metro Clark is also coming out in the future, and CRK is expected to accommodate the future air traffic demand induced from Metro Clark and northern Luzon area.

Passenger terminal building of CRK was expanded in 2013 with a capacity to accommodate 4.5 million passengers per annum, and also there is a plan to build a new budget terminal building with 15 million passenger capacity as well.

CRK airport property area is approx. 2,340 ha, sufficient for developing airport facilities of a gateway airport, and therefore, CRK has a large potential to accommodate the passenger and cargo demand spilled over from NAIA, on condition that travel time would significantly become predictable.

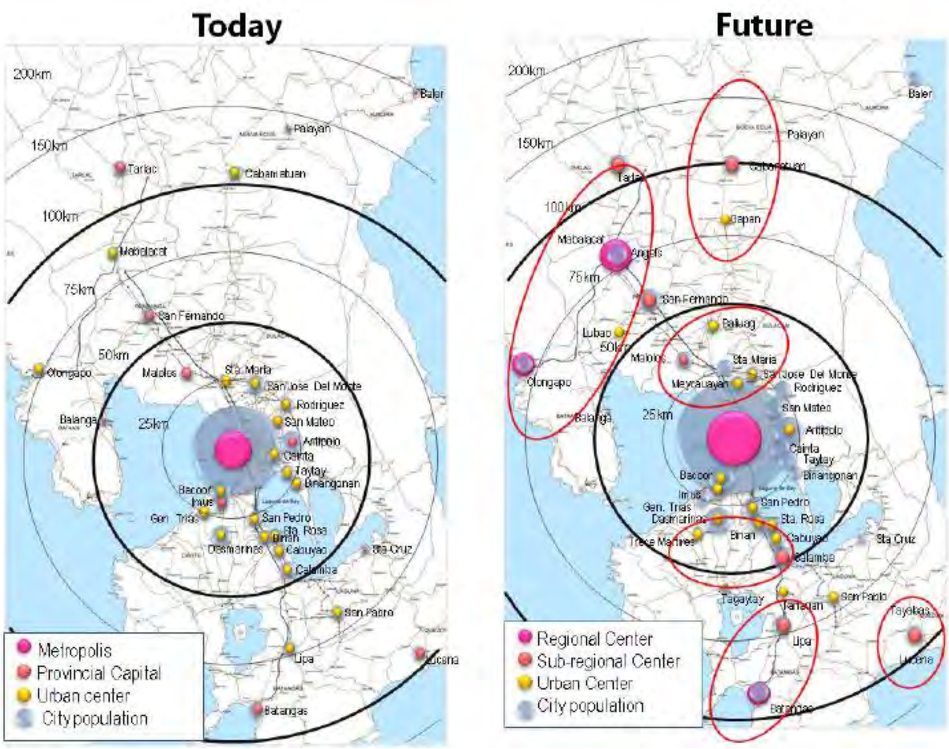


Figure 1-2 Current and Future Direction of Urbanization around Metro Manila

2) Capacity enhancement of NAIA

NAIA has been experiencing its runway capacity limitations during peak hours. General aviation (GA) is also being accommodated at NAIA. Because of the significant difference in the aircraft speed between the commercial and GA aircraft as well as wider separation space between large and GA aircraft, mixed operations of GA and commercial jet aircraft give adverse influence for maximization of runway capacity.

Although NAIA's runway capacity has nearly reached its limit, there are some spaces to accommodate flights in the early morning and late evening because of insufficient air navigation and aeronautical ground lights facilities at local airports. In case these deficiencies at local airports are improved, the vacant slots during early morning and late evening could be utilized.

There is possibility for international direct flights between foreign airports and local airports in the Philippines, because of the attractiveness of local areas such as Cebu and Bohol in Visaya, among others, after development of local airports.

Financial incentive may somehow induce airlines to move to CRK instead of NAIA operation, but it is likely not to attract many airlines to move to CRK if this incentive measure is applied alone. Some other measures such as ease of taxation in case of the airlines utilization of CRK instead of NAIA, or in case of new airline's entrance to the market etc., it may make synergy influence.

1.4 Roadmap for Development of New Manila International Airport

Alternative solutions should be realized immediately, otherwise NAIA would face capacity constraint in the near future. Although those measures could be undertaken, the air traffic demand of Greater Capital Region (GCR) in the Philippines would overwhelm NAIA's airport capacity sooner or later. Realistically, CRK is a position to accommodate over spilled air traffic demand of NAIA, and in this context, CRK should be develop in the short-term.

"Roadmap Study" in 2013 showed necessity of New Manila International airport (NMIA) to cater for increasing air traffic demand of GCR. Until opening of NMIA, NAIA will continue to be the main gateway airport of the Philippine, while CRK will accommodate relatively smaller air traffic until Metro Clark generates demand.　Following table shows image for development of the airport system for GCR. To cater for the vigorous air traffic demand for GCR, NMIA needs to be developed at an appropriate location near Metro Manila.

Table 1-1 Image of Roadmap for Development for Airports in GCR Area

Airport	Immediate-term	Short-term	Medium-term	Long-term
NMIA	Decision making by the Government. Project formulation such as EIA/ECC, ICC approval.	Design & construct revetment/reclamation and access bridge.	Site development and construction of airport facilities and related service/facilities.	Inaugurate NMIA
NAIA	Improve airport capacity.	Continue improvements as required	Partially transfer some domestic operation to other airport.	Close NAIA, or remain NAIA as it is.
CRK	Improve airport capacity.	Continue improvements as appropriate to attract overflowing airlines and passengers/cargo from NAIA	Continue improvements as appropriate to attract overflowing airlines and passengers/cargo from NAIA, and also generated by Metro	Continue improvements as appropriate to cater the passengers generated by Metro Clark.

			Clark.	
Sangley or Other Airport	Improve airport to decongest NAIA	Improve airport to decongest NAIA	Improve airport to decongest NAIA	

1.5 Need to Scrutinize Site for New Gateway International Airport

Terms of Reference issued by JICA indicated the candidate sites of NMIA as shown below.

i) Angat-Pandi-Bustos located to the north of Metro Manila;
ii) Obando, located to the north of Metro Manila;
iii) Northern Portion of Manila Bay;
iv) Central Portion of Manila Bay;
v) Sangley Point Option 1 located offshore Cavite Peninsular
vi) Sangley Point Option 2, located parallel to the existing runway at Sangley Point;
vii) San Nicholas Shoals located to the south of Sangley;
viii) Western side of Laguna de Bay; and
ix) Rizal-Talim Island located in the central part of Laguna de Bay

Each of the above-listed candidate sites of NMIA has its advantages and disadvantages in terms of social and environment issues, characteristic of soil conditions, topography, and so forth. Site selection for large scale airport nearby Metro Manila requires evaluation from many aspects such as airspace availability, obstacle restriction, weather conditions, social and environment consideration, accessibility, proximity of demand area, land use, topography of sites, construction cost consideration, construction years required etc., and therefore careful scrutiny of the sites should be required.

2. Long-term Traffic Demand Forecast

2.1 Basic Approach for Forecast

The air traffic demand at NMIA has been calculated through the processes shown in Figure 2-1.

- ✓ The base year of forecast has been set at 2014.
- ✓ Under the assumption that the commencement of service at NMIA is 2025, air traffic demand has been forecasted for the years 2020, 2025, 2030, 2035, 2040, 2045 and 2050.

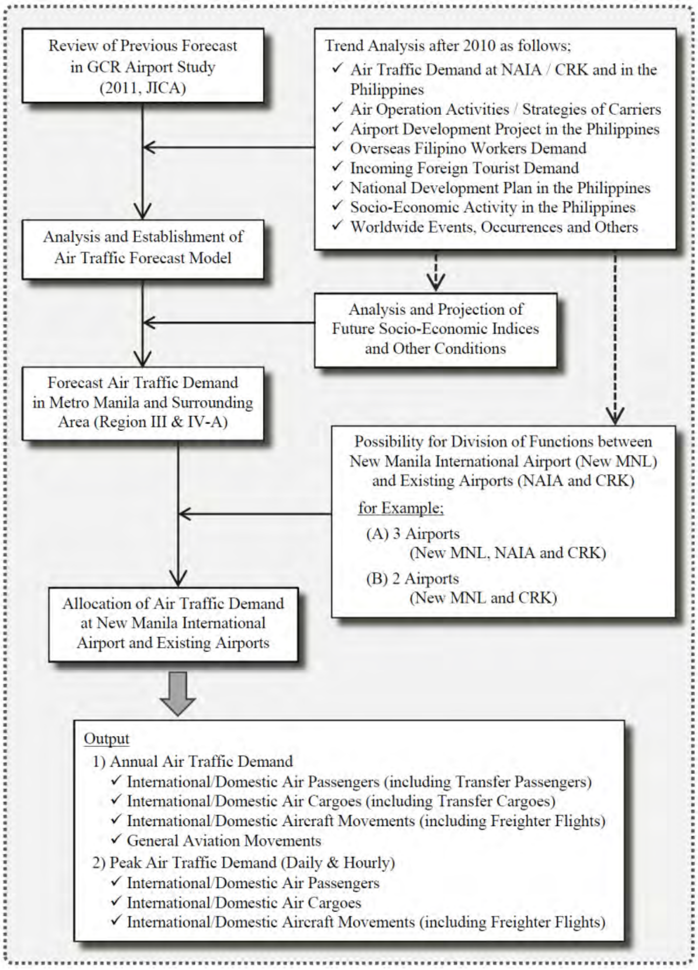


Figure 2-1 Flow Chart for Air Traffic Demand Forecast

2.2 Forecast Model and Forecast Case

2.2.1 Analysis and Establishment of Forecasting Model

1) Analysis of Forecasting Models

Various multiple regression models have been analyzed based on the combinations of independent and dependent variables with various analysis periods as shown in Figure 2-2. Then the forecast models to calculate future air traffic demand have been selected by comparison for precision of analysis from the statistical view point.

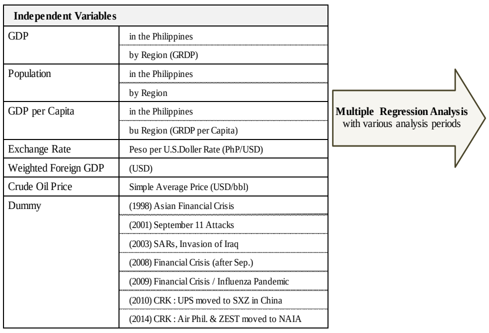


Figure 2-2 Outline of Multiple Regression Analysis

2) Forecasting Models for Air Traffic Demand at NAIA

The forecasting models for air traffic demand at NAIA were analyzed as Table 2-1.

Table 2-1 Forecasting Models for Air Traffic Demand at NAIA

Category	Formula	Remarks
Domestic Passengers	DPAX(NAIA) = 0.00363 x GDP - 8054.8	r2= 0.9404
International Passengers	IPAX(NAIA) = 0.00234 x GDP - 1067.3	r2= 0.9740
Domestic Cargoes	DCGO(NAIA) = 0.0409 x GDP - 129310.7	r2= 0.9491
International Cargoes	ICGO(NAIA) = 0.0422 x GDP - 51884.9	r2= 0.6946
Where	DPAX(NAIA): Annual Domestic Passengers at NAIA ('000) IPAX(NAIA): Annual International Passengers at NAIA ('000) DCGO(NAIA): Annual Domestic Cargoes at NAIA (tons) ICGO(NAIA): Annual International Cargoes at NAIA (tons) GDP: Gross Domestic Product in the Philippines (million pesos) r2: Coefficient of Determination	

Source: JICA Survey Team

3) Forecasting Models for Air Traffic Demand at CRK

The forecasting models for air traffic demand at CRK were analyzed as Table 2-2.

Table 2-2 Forecast Model for Air Traffic Demand at CRK

Category	Formula	Remarks
Domestic Passengers	DPAX(CRK) = 0.00002 x GDP + 193.1 x DMY(a) - 70.3	r2= 0.9484
International Passengers	IPAX(CRK) = 0.00031 x GDP - 1403.0	r2= 0.8841
Domestic Cargoes	DCGO(CRK) = 0.00081 x GDP - 1204.6 x DMY(b) - 4006.1 x DMY(c) - 548.8	r2= 0.8467
International Cargoes	ICGO(CRK) = 0.01647 x GDP - 98496.8 x DMY(d) + 26999.4	r2= 0.9436
Where	DPAX(CRK): Annual Domestic Passengers at NAIA ('000)	
	IPAX(CRK): Annual International Passengers at NAIA ('000)	
	DCGO(CRK): Annual Domestic Cargoes at NAIA (tons)	
	ICGO(CRK): Annual International Cargoes at NAIA (tons)	
	GDP: Gross Domestic Product in the Philippines (million pesos)	
	DMY(a): Dummy Variable for Operating of Airphil Express and Zestair	before 2014= 1
	DMY(b): Dummy Variable for Financial Crisis	2008 = 1
	DMY(c): Dummy Variable for Withdrawing of UPS	after 2009= 1
	DMY(d): Dummy Variable for Withdrawing of UPS	after 2009 = 1
	r2: Coefficient of Determination	

Source: JICA Survey Team

4) Forecasting Models for Air Traffic Demand of Entire GCR

Several forecasting models for the air traffic demand of the entire GCR (total of NAIA and CRK) were analyzed and it was found out that forecasting the total of NAIA and CRK would produce lower level of correlation than separately forecasting NAIA and CRK. Therefore, the air traffic demand of NAIA plus CRK has been regarded as the air traffic demand of GCR.

2.2.2 Forecasting Cases in This Study

The air traffic demand of NMIA has been estimated for following cases in this Study.

1) Trend Forecast as the Base Case

Air traffic demand at NAIA has been estimated by forecasting models obtained through regression analyses of the past airport traffic record. The models thus obtained reflect the past trend of the airport traffic at NAIA and CRK, and future airport traffic demand forecast by these models is to be regarded as the basis and to be called as the "Base Case". It should be noted that the Base Case forecast is based on an assumption of non-capacity-constrained NAIA.

2) Future Traffic Distribution

NAIA is a capacity constrained airport and its capacity will be saturated sooner or later. It will not be possible to develop NMIA before the capacity saturation of NAIA. After the forthcoming capacity saturation, the over-spilled traffic would only be able to use CRK until completion of NMIA, and a significant volume of traffic would be accommodated at CRK, offering much more improved air network and flight frequencies than current level. The airport access, being regarded as one of the major causes of underutilization, will progressively be improved by construction of the skyway and other road system in Metro Manila as well as the proposed railway development. Therefore, even after completion of NMIA, the air passengers and cargo to/from CRK catchment area but now using NAIA could continue to use CRK. After estimating the Base Case forecast, possible future traffic distribution between NMIA and CRK has been examined based on the origin/destination of the NAIA users for reference purpose only.

2.2.3 Projection of Socio-Economic Framework

Based on the future growth rates of GDP in the Philippines forecasted by various organizations (see Table 2-3), the future GDP in the Philippines has been estimated as Table 2-4. Sensitivity analyses were made for + 1.0% of GDP growth rate as a High Case and - 1.0% of GDP growth rate as a Low Case respectively.

Table 2-3 Comparison of GDP Growth Rate by Various Organizations

Year	Assumption of 2011 GCR Study (Medium Case)	Actual Growth Rate (NSCB)	Recent Forecast by Various Organizations					
			NEDA		IMF	World Bank	ADB	SCB
			Low	High				
2011	5.0 %	3.66 %	-	-	-	-	-	-
2012	5.3 %	6.80 %	-	-	-	-	-	-
2013	5.0 %	7.18 %	-	-	-	-	-	-
2014	5.0 %	6.10 %	6.5 %	7.5 %	6.24 %	6.0 %	-	-
2015	5.0 %	-	7.0 %	8.0 %	6.27 %	6.5 %	6.4 %	5.7 %

Source: JICA Survey Team

Table 2-4 Assumed Future GDP in the Philippines

	Year	GDP in the Philippines [constnat price at 2000] (PhP Million)					
		Low Case (Med.-1%)		Medium Case		High Case (Med.+1%)	
		Value	Change	Value	Change	Value	Change
Actual	2010	5,701,539	7.63%	5,701,539	7.63%	5,701,539	7.63%
	2011	5,910,201	3.66%	5,910,201	3.66%	5,910,201	3.66%
	2012	6,312,174	6.80%	6,312,174	6.80%	6,312,174	6.80%
	2013	6,765,459	7.18%	6,765,459	7.18%	6,765,459	7.18%
	2014	7,177,872	6.10%	7,177,872	6.10%	7,177,872	6.10%
Forecast	2020	9,082,298	4.00%	9,619,035	5.00%	10,181,949	6.00%
	2025	10,528,873	3.00%	11,703,027	4.00%	12,995,033	5.00%
	2030	12,205,849	3.00%	14,238,522	4.00%	16,585,321	5.00%
	2035	13,476,244	2.00%	16,506,349	3.00%	20,178,579	4.00%
	2040	14,878,862	2.00%	19,135,382	3.00%	24,550,327	4.00%
	2045	16,427,466	2.00%	22,183,153	3.00%	29,869,227	4.00%
	2050	18,137,250	2.00%	25,716,354	3.00%	36,340,482	4.00%

Source: JICA Survey Team

2.2.4 Air Traffic Demand Forecast

Future domestic and international air traffic demand (passengers and cargoes) at NAIA and CRK in Base Case has been estimated by the forecast models based on the projected future socio-economic framework, and the demand in GCR has been calculated as a total of demands at NAIA and CRK. Result of the air traffic demand forecast is summarized hereunder.

1) Air Passengers in GCR

Domestic and international air passenger demand in GCR (total of NAIA and CRK) has been estimated as shown in Table 2-5 and Figure 2-3. The total passengers in GCR will increase to 79,789 thousand in 2030 consisting 43,918 thousand domestic and 35,931 thousand international passengers, and that will be over 110 million passengers in 2040.

Table 2-5 Air Passenger Demand Forecast in GCR (Base Case)

	Year	Domestic Passengers			International Passengers			Total		
		GCR	NAIA	CRK	GCR	NAIA	CRK	GCR	NAIA	CRK
Forecast ('000)	2020	27,033	26,887	146	23,432	21,900	1,532	50,465	48,788	1,677
	2025	34,650	34,458	193	29,044	26,877	2,167	63,694	61,334	2,360
	2030	43,918	43,668	250	35,871	32,931	2,941	79,789	76,599	3,190
	2035	52,207	51,906	300	41,978	38,346	3,633	94,185	90,252	3,933
	2040	61,816	61,456	360	49,058	44,623	4,435	110,874	106,079	4,794
	2045	72,956	72,528	428	57,265	51,900	5,365	130,221	124,428	5,793
	2050	85,870	85,362	507	66,779	60,337	6,442	152,649	145,699	6,950
Growth Rate	'20 -'25	5.1%	5.1%	5.7%	4.4%	4.2%	7.2%	4.8%	4.7%	7.1%
	'25 -'30	4.9%	4.9%	5.3%	4.3%	4.1%	6.3%	4.6%	4.5%	6.2%
	'30 -'35	3.5%	3.5%	3.8%	3.2%	3.1%	4.3%	3.4%	3.3%	4.3%
	'35 -'40	3.4%	3.4%	3.7%	3.2%	3.1%	4.1%	3.3%	3.3%	4.0%
	'40 -'45	3.4%	3.4%	3.5%	3.1%	3.1%	3.9%	3.3%	3.2%	3.9%
	'45 -'50	3.3%	3.3%	3.5%	3.1%	3.1%	3.7%	3.2%	3.2%	3.7%
Share by Airport	2020	100.0%	99.5%	0.5%	100.0%	93.5%	6.5%	100.0%	96.7%	3.3%
	2025	100.0%	99.4%	0.6%	100.0%	92.5%	7.5%	100.0%	96.3%	3.7%
	2030	100.0%	99.4%	0.6%	100.0%	91.8%	8.2%	100.0%	96.0%	4.0%
	2035	100.0%	99.4%	0.6%	100.0%	91.3%	8.7%	100.0%	95.8%	4.2%
	2040	100.0%	99.4%	0.6%	100.0%	91.0%	9.0%	100.0%	95.7%	4.3%
	2045	100.0%	99.4%	0.6%	100.0%	90.6%	9.4%	100.0%	95.6%	4.4%
	2050	100.0%	99.4%	0.6%	100.0%	90.4%	9.6%	100.0%	95.4%	4.6%

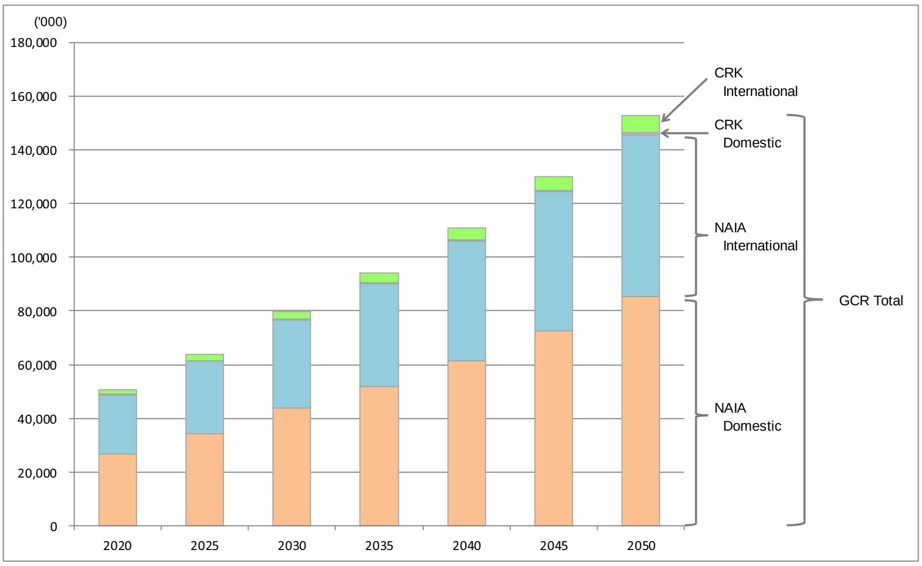


Figure 2-3 Air Passenger Demand in GCR by Airport (Base Case)

2) Air Passengers at NAIA

As for the Base Case (Table 2-6), the total passengers will increase to 76,599 thousand consisting 43,668 thousand domestic passengers and 32,931 thousand international passengers in 2030. And that will be over 100 million passengers in 2040.

Table 2-6 Air Passenger Demand Forecast at NAIA (Base Case)

	Year	Passengers ('000)							
		Domestic		International				Total	
		Passengers	Growth Rate	Passengers	Growth Rate	(Foreigner)	(Filipino)	Passengers	Growth Rate
Actual	2010	14,755	–	12,381	–	(6,266)	(6,115)	27,136	–
	2011	16,687	13.09%	12,969	4.76%	(6,449)	(6,520)	29,657	9.29%
	2012	17,739	6.30%	14,140	9.02%	(6,999)	(7,141)	31,879	7.49%
	2013	17,689	-0.28%	15,177	7.34%	(7,490)	(7,687)	32,867	3.10%
	2014	18,020	1.87%	16,072	5.89%	(7,965)	(8,106)	34,091	3.73%
Forecast	2020	26,887	6.90%	21,900	5.29%	(10,768)	(11,133)	48,788	6.16%
	2025	34,458	5.09%	26,877	4.18%	(13,164)	(13,712)	61,334	4.68%
	2030	43,668	4.85%	32,931	4.15%	(16,082)	(16,848)	76,599	4.55%
	2035	51,906	3.52%	38,346	3.09%	(18,693)	(19,652)	90,252	3.33%
	2040	61,456	3.44%	44,623	3.08%	(21,721)	(22,902)	106,079	3.28%
	2045	72,528	3.37%	51,900	3.07%	(25,231)	(26,669)	124,428	3.24%
	2050	85,362	3.31%	60,337	3.06%	(29,302)	(31,035)	145,699	3.21%

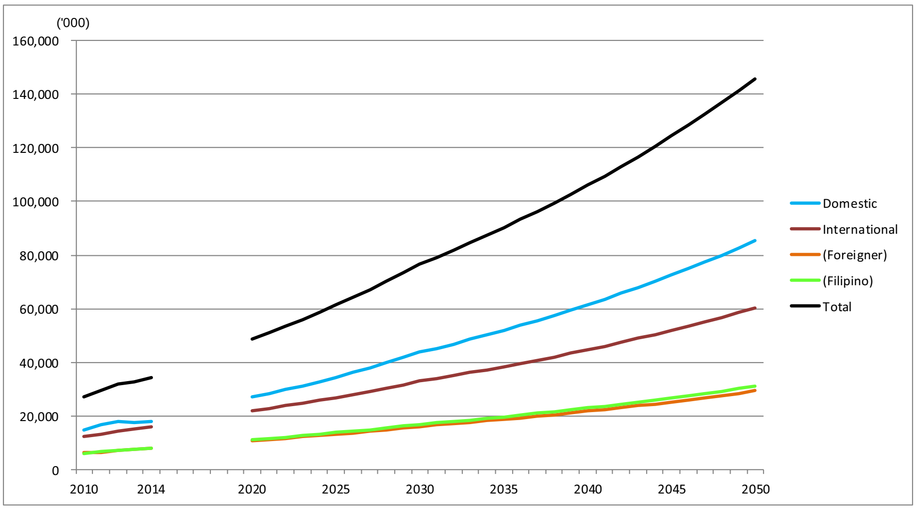


Figure 2-4 Air Passenger Demand at NAIA (Base Case)

3) Air Passengers at CRK

The total passengers at CRK will increase to 3,190 thousand in 2030 consisting 250 thousand domestic and 2,941 thousand international passengers (Table 2-7).

Table 2-7 Air Passenger Demand Forecast at CRK (Base Case)

	Year	Passengers ('000)							
		Domestic		International				Total	
		Passengers	Growth Rate	Passengers	Growth Rate	(Foreigner)	(Filipino)	Passengers	Growth Rate
Actual	2010	47	—	608	—	(308)	(300)	654	—
	2011	42	-9.47%	725	19.31%	(361)	(364)	767	17.27%
	2012	300	613.32%	1,015	40.04%	(503)	(513)	1,316	71.51%
	2013	215	-28.38%	985	-2.94%	(486)	(499)	1,201	-8.75%
	2014	91	-57.73%	787	-20.15%	(390)	(397)	878	-26.89%
Forecast	2020	146	8.18%	1,532	11.74%	(753)	(779)	1,677	11.40%
	2025	193	5.73%	2,167	7.19%	(1,062)	(1,106)	2,360	7.07%
	2030	250	5.32%	2,941	6.29%	(1,436)	(1,505)	3,190	6.22%
	2035	300	3.78%	3,633	4.32%	(1,771)	(1,862)	3,933	4.28%
	2040	360	3.65%	4,435	4.07%	(2,159)	(2,276)	4,794	4.04%
	2045	428	3.55%	5,365	3.88%	(2,608)	(2,757)	5,793	3.86%
	2050	507	3.46%	6,442	3.73%	(3,129)	(3,314)	6,950	3.71%

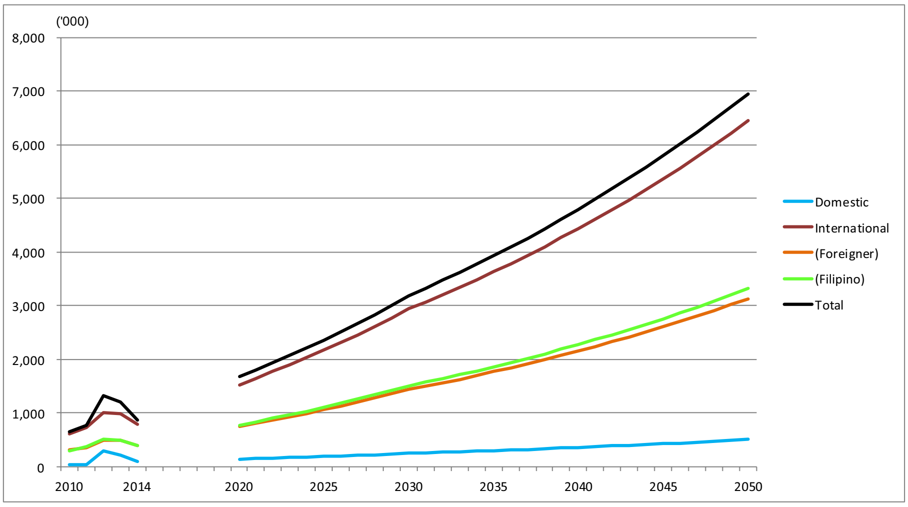


Figure 2-5 Air Passenger Demand at CRK (Base Case)

4) Air Cargoes in GCR

Domestic and international air cargo demand in GCR (total of NAIA and CRK) has been estimated as shown in Table 2-8.

The total cargoes in GCR will increase to 1,277,139 tons in 2030 consisting 460,723 tons of domestic and 816,416 tons of international cargoes that will be over 2 million tons in 2045.

Table 2-8 Air Cargo Demand Forecast in GCR (Base Case)

		Domestic Cargoes			International Cargoes			Total		
	Year	GCR	NAIA	CRK	GCR	NAIA	CRK	GCR	NAIA	CRK
Forecast (tons)	2020	267,817	264,553	3,264	545,178	458,277	86,901	812,995	722,831	90,165
	2025	354,843	349,885	4,958	667,542	546,323	121,218	1,022,385	896,209	126,176
	2030	460,723	453,704	7,019	816,416	653,445	162,971	1,277,139	1,107,149	169,989
	2035	555,426	546,563	8,862	949,573	749,258	200,315	1,504,999	1,295,821	209,177
	2040	665,212	654,213	10,999	1,103,939	860,331	243,608	1,769,151	1,514,544	254,607
	2045	792,484	779,008	13,476	1,282,892	989,096	293,796	2,075,376	1,768,104	307,273
	2050	940,028	923,679	16,348	1,490,347	1,138,369	351,978	2,430,375	2,062,049	368,326
Growth Rate	'20 -'25	5.8%	5.8%	8.7%	4.1%	3.6%	6.9%	4.7%	4.4%	7.0%
	'25 -'30	5.4%	5.3%	7.2%	4.1%	3.6%	6.1%	4.6%	4.3%	6.1%
	'30 -'35	3.8%	3.8%	4.8%	3.1%	2.8%	4.2%	3.3%	3.2%	4.2%
	'35 -'40	3.7%	3.7%	4.4%	3.1%	2.8%	4.0%	3.3%	3.2%	4.0%
	'40 -'45	3.6%	3.6%	4.1%	3.1%	2.8%	3.8%	3.2%	3.1%	3.8%
	'45 -'50	3.5%	3.5%	3.9%	3.0%	2.9%	3.7%	3.2%	3.1%	3.7%
Share by Airport	2020	100.0%	98.8%	1.2%	100.0%	84.1%	15.9%	100.0%	88.9%	11.1%
	2025	100.0%	98.6%	1.4%	100.0%	81.8%	18.2%	100.0%	87.7%	12.3%
	2030	100.0%	98.5%	1.5%	100.0%	80.0%	20.0%	100.0%	86.7%	13.3%
	2035	100.0%	98.4%	1.6%	100.0%	78.9%	21.1%	100.0%	86.1%	13.9%
	2040	100.0%	98.3%	1.7%	100.0%	77.9%	22.1%	100.0%	85.6%	14.4%
	2045	100.0%	98.3%	1.7%	100.0%	77.1%	22.9%	100.0%	85.2%	14.8%
	2050	100.0%	98.3%	1.7%	100.0%	76.4%	23.6%	100.0%	84.8%	15.2%

5) Air Cargoes at NAIA

Domestic and international air cargo demand at NAIA has been estimated as shown in Table 2-9.

The total cargoes will increase to 1,107,149 tons consisting 453,704 tons of domestic cargoes and 653,445 tons of international cargoes in 2030.

Table 2-9 Air Cargo Demand Forecast at NAIA (Base Case)

	Year	Cargoes (tons)									
		Domestic				International				Total	
		Cargoes	Growth Rate	(Unload)	(Load)	Cargoes	Growth Rate	(Inbound)	(Outbound)	Cargoes	Growth Rate
Actual	2010	117,467	–	(62,763)	(54,704)	306,361	–	(142,751)	(163,610)	423,828	–
	2011	119,872	2.05%	(57,862)	(62,010)	290,505	-5.18%	(139,901)	(150,604)	410,377	-3.17%
	2012	149,080	24.37%	(71,403)	(77,677)	311,055	7.07%	(148,822)	(162,233)	460,135	12.12%
	2013	164,201	10.14%	(80,408)	(83,794)	293,116	-5.77%	(142,930)	(150,186)	457,317	-0.61%
	2014	164,597	0.24%	(83,720)	(80,876)	355,141	21.16%	(173,753)	(181,389)	519,738	13.65%
Forecast	2020	264,553	8.23%	(132,277)	(132,277)	458,277	4.34%	(229,139)	(229,139)	722,831	5.65%
	2025	349,885	5.75%	(174,943)	(174,943)	546,323	3.58%	(273,162)	(273,162)	896,209	4.39%
	2030	453,704	5.33%	(226,852)	(226,852)	653,445	3.65%	(326,723)	(326,723)	1,107,149	4.32%
	2035	546,563	3.79%	(273,282)	(273,282)	749,258	2.77%	(374,629)	(374,629)	1,295,821	3.20%
	2040	654,213	3.66%	(327,106)	(327,106)	860,331	2.80%	(430,166)	(430,166)	1,514,544	3.17%
	2045	779,008	3.55%	(389,504)	(389,504)	989,096	2.83%	(494,548)	(494,548)	1,768,104	3.14%
	2050	923,679	3.47%	(461,840)	(461,840)	1,138,369	2.85%	(569,185)	(569,185)	2,062,049	3.12%

6) Air Cargoes at CRK

Domestic and international air cargo demand at CRK has been estimated as shown in Table 2-10. The total cargoes will increase to 169,989 tons in 2030 consisting 7,019 tons of domestic and 162,971 tons of international cargoes.

Table 2-10 Air Cargo Demand Forecast at CRK (Base Case)

	Year	Cargoes (tons)									
		Domestic				International				Total	
		Cargoes	Growth Rate	(Unload)	(Load)	Cargoes	Growth Rate	(Inbound)	(Outbound)	Cargoes	Growth Rate
Actual	2010	648	–	(322)	(326)	45,090	–	(23,447)	(21,643)	45,738	–
	2011	0	–	(0)	(0)	41,284	-8.44%	(21,095)	(20,189)	41,284	-9.74%
	2012	0	–	(0)	(0)	41,621	0.82%	(21,821)	(19,800)	41,621	0.82%
	2013	2,582	–	(1,586)	(996)	41,476	-0.35%	(21,836)	(19,640)	44,057	5.85%
	2014	1,280	-50.44%	(750)	(529)	46,702	12.60%	(25,229)	(21,473)	47,981	8.91%
Forecast	2020	3,264	16.89%	(1,632)	(1,632)	86,901	10.90%	(43,450)	(43,450)	90,165	11.09%
	2025	4,958	8.72%	(2,479)	(2,479)	121,218	6.88%	(60,609)	(60,609)	126,176	6.95%
	2030	7,019	7.20%	(3,509)	(3,509)	162,971	6.10%	(81,485)	(81,485)	169,989	6.14%
	2035	8,862	4.77%	(4,431)	(4,431)	200,315	4.21%	(100,158)	(100,158)	209,177	4.24%
	2040	10,999	4.42%	(5,500)	(5,500)	243,608	3.99%	(121,804)	(121,804)	254,607	4.01%
	2045	13,476	4.15%	(6,738)	(6,738)	293,796	3.82%	(146,898)	(146,898)	307,273	3.83%
	2050	16,348	3.94%	(8,174)	(8,174)	351,978	3.68%	(175,989)	(175,989)	368,326	3.69%

2.3 Peak-day and Peak-hour Air Traffic Demand and Annual Aircraft Movement Forecast

2.3.1 Basic Approach for Calculation

1) Method of Calculation

The peak-day and peak-hour air traffic demands at NAIA and CRK have been calculated in accordance with the flow chart shown Figure 2-6. And annual aircraft movement forecasts were calculated based on those results.

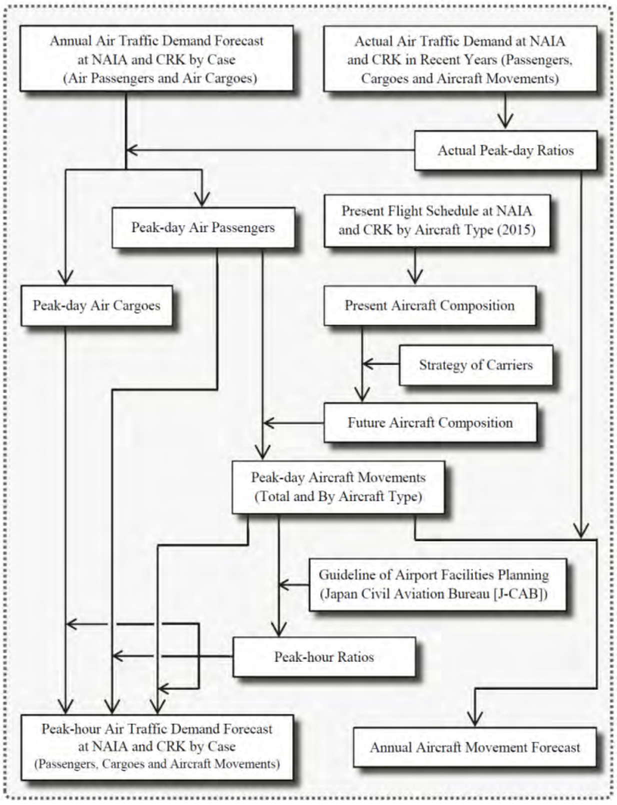


Figure 2-6 Flow Chart for Calculation of Peak-day and Peak-hour Air traffic Demand

2) Precondition of Calculation

a) Peak-day Ratio

Future peak-day ratio at NAIA and CRK has been adopted same as average of recent peak-day ratio at NAIA shown in Table2-11.

Table 2-11 Future Peak-day Ratio

	Domestic	International
Air Passengers	1 / 309	1 / 326
Air Cargoes	1 / 319	1 / 348
Aircraft Movements	1 / 334	1 / 346

b) Peak-hour Ratio

Peak hour air traffic demand has been forecasted using peak-hour coefficients calculated according to guideline for airport facilities planning of Japan Civil Aviation Bureau (JCAB).

c) Aircraft Composition

The aircraft types operating at NAIA and CRK are categorized into five groups as shown in Table 2-12, and the aircraft compositions at NAIA and CRK have been estimated based on present aircraft compositions considering for increase in size of aircraft as shown in Table 2-13 and Table 2-14.

Table 2-12 Aircraft Category in This Study

Category	Seat	Aircraft
LJ1	420	B747, B777-300
LJ2	350	A330, A340, B777-200
MJ	280	A300, A310, B767, B787
SJ	180	A320, A321, B737, MD90
TP / RJ	70	DHC8, ATR72, MRJ70/90

Source: JICA Survey Team

Table 2-13 Future Aircraft Composition at NAIA

Aircraft Type		Domestic Flights					International Flights				
Type	Seat	2015	2020	2025	2030	2035 -	2015	2020	2025	2030	2035 -
LJ1	420						15%	13%	11%	10%	8%
LJ2	350	2%	5%	7%	8%	10%	15%	17%	21%	23%	25%
MJ	280		10%	17%	23%	30%	12%	17%	21%	25%	30%
SJ	180	83%	69%	63%	56%	50%	58%	53%	47%	42%	36%
TP / RJ	70	16%	16%	14%	12%	10%					

Source: JICA Survey Team

Table 2-14 Future Aircraft Composition at CRK

Aircraft Type		Domestic Flights					International Flights				
Type	Seat	2015	2020	2025	2030	2035 -	2015	2020	2025	2030	2035 -
LJ1	420							17%	6%	13%	11%
LJ2	350		5%	7%	8%	10%		17%	18%	22%	26%
MJ	280		10%	17%	23%	30%	12%	8%	18%	26%	33%
SJ	180	100%	69%	63%	56%	50%	88%	58%	59%	39%	30%
TP / RJ	70		16%	14%	12%	10%					

Source: JICA Survey Team

d) Load Factor

Average load factors were estimated as follows;

i) Average Load Factor of Domestic Flights = 85%, and,

ii) Average Load Factor of International Flights = 75%.

e) Cargo Freighter Movements

Cargo freighter movements at NMIA has been calculated using 1.0% of ratio to total passenger aircraft movements based on estimation in 2011 GCR Airport Study due to no available recent data.

f) General Aviation Movements

The aircraft movements of general aviation (GA) in 2014 were approximately 30 thousand at NAIA and approximately 20 thousand at CRK.
It has been assumed that GA traffic demand at NAIA and CRK would be same operate at 2014 level of 30 thousand and 20 thousand respectively in this study.

2.3.2 Peak-day and Peak-hour Air Traffic Demand and Annual Aircraft Movements

According to the basic approach, peak-day and peak-hour air traffic demand forecasts (including annual aircraft movements) at NAIA have been calculated as well as CRK and GCR

In the study for long-term facility requirement of NMIA, the numerical values for planning (development target) will be selected or adopted from these calculations.

Table 2-15 Peak-day and Peak-hour Air Traffic Demand at NAIA [Base Case]

	Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
		Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
Annual Traffic	2020	26,887	21,900	48,788	264,553	458,277	722,830	189,044	119,716	3,090	311,850	30,000	341,850
	2025	34,458	26,877	61,334	349,885	546,323	896,208	227,120	144,628	3,720	375,468	30,000	405,468
	2030	43,668	32,931	76,599	453,704	653,445	1,107,149	271,876	173,692	4,460	450,028	30,000	480,028
	2035	51,906	38,346	90,252	546,563	749,258	1,295,821	305,276	199,296	5,050	509,622	30,000	539,622
	2040	61,456	44,623	106,079	654,213	860,331	1,514,544	362,056	231,128	5,930	599,114	30,000	629,114
	2045	72,528	51,900	124,428	779,008	989,096	1,768,104	426,852	269,188	6,960	703,000	30,000	733,000
	2050	85,362	60,337	145,699	923,679	1,138,369	2,062,048	502,336	312,092	8,140	822,568	30,000	852,568
Peak-day Traffic	2020	87,014	67,179	154,193	829	1,317	2,146	566	346	10	922	-	-
	2025	111,513	82,443	193,956	1,097	1,570	2,667	680	418	10	1,108	-	-
	2030	141,321	101,014	242,335	1,422	1,878	3,300	814	502	14	1,330	-	-
	2035	167,981	117,625	285,606	1,713	2,153	3,866	914	576	14	1,504	-	-
	2040	198,888	136,881	335,769	2,051	2,472	4,523	1,084	668	18	1,770	-	-
	2045	234,717	159,203	393,920	2,442	2,842	5,284	1,278	778	20	2,076	-	-
	2050	276,254	185,082	461,336	2,896	3,271	6,167	1,504	902	24	2,430	-	-
Peak-hour Traffic	2020	6,593	7,862	14,455	63	154	217	43	40	2	85	-	-
	2025	8,229	9,606	17,835	81	183	264	50	49	2	101	-	-
	2030	10,201	11,727	21,928	103	218	321	59	58	2	119	-	-
	2035	11,975	13,624	25,599	122	249	371	65	67	2	134	-	-
	2040	13,951	15,820	29,771	144	286	430	76	77	2	155	-	-
	2045	16,245	18,364	34,609	169	328	497	88	90	2	180	-	-
	2050	18,904	21,315	40,219	198	377	575	103	104	2	209	-	-

Table 2-16 Aircraft Movements by Aircraft Type at NAIA [Base Case]

	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
Year	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
Annual Traffic													
2020		9,352	18,704	130,928	30,060	189,044	15,916	20,760	20,068	62,972		119,716	3,090
2025		15,364	38,076	142,284	31,396	227,120	16,608	29,756	30,448	67,816		144,628	3,720
2030		22,712	63,460	152,972	32,732	271,876	17,300	39,444	44,288	72,660		173,692	4,460
2035		30,728	91,516	152,304	30,728	305,276	15,916	50,516	60,204	72,660		199,296	5,050
2040		36,072	108,884	181,028	36,072	362,056	18,684	58,128	69,200	85,116		231,128	5,930
2045		42,752	128,256	213,092	42,752	426,852	22,144	68,508	80,272	98,264		269,188	6,960
2050		50,100	150,968	251,168	50,100	502,336	26,296	80,272	93,420	112,104		312,092	8,140
Peak-day Traffic													
2020		28	56	392	90	566	46	60	58	182		346	10
2025		46	114	426	94	680	48	86	88	196		418	10
2030		68	190	458	98	814	50	114	128	210		502	14
2035		92	274	456	92	914	46	146	174	210		576	14
2040		108	326	542	108	1,084	54	168	200	246		668	18
2045		128	384	638	128	1,278	64	198	232	284		778	20
2050		150	452	752	150	1,504	76	232	270	324		902	24
Peak-hour Traffic													
2020		4	6	26	8	44	6	8	8	20		42	2
2025		4	10	30	8	52	6	12	12	20		50	2
2030		6	14	32	8	60	6	14	16	24		60	2
2035		8	20	30	8	66	6	18	22	22		68	2
2040		8	24	38	8	78	8	20	24	26		78	2
2045		10	28	42	10	90	8	24	28	30		90	2
2050		12	32	48	12	104	10	28	32	34		104	2

Table 2-17 Annual Air Traffic Demand at CRK [Base Case]

Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
	Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
2020	146	1,532	1,677	3,264	86,901	90,165	1,336	8,304	100	9,740	20,000	29,740
2025	193	2,167	2,360	4,958	121,218	126,176	1,336	11,764	130	13,230	20,000	33,230
2030	250	2,941	3,190	7,019	162,971	169,990	2,004	15,916	180	18,100	20,000	38,100
2035	300	3,633	3,933	8,862	200,315	209,177	2,004	18,684	210	20,898	20,000	40,898
2040	360	4,435	4,794	10,999	243,608	254,607	2,672	22,836	260	25,768	20,000	45,768
2045	428	5,365	5,793	13,476	293,796	307,272	2,672	27,680	300	30,652	20,000	50,652
2050	507	6,442	6,950	16,348	351,978	368,326	3,340	33,908	370	37,618	20,000	57,618

Table 2-18 Annual Aircraft Movements by Aircraft Type at CRK [Base Case]

Year	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
2020				1,336		1,336	1,384	1,384	692	4,844		8,304	100
2025				1,336		1,336	692	2,076	2,076	6,920		11,764	130
2030			668	1,336		2,004	2,076	3,460	4,152	6,228		15,916	180
2035			668	1,336		2,004	2,076	4,844	6,228	5,536		18,684	210
2040			668	2,004		2,672	2,076	5,536	6,920	8,304		22,836	260
2045			668	2,004		2,672	2,076	6,920	8,996	9,688		27,680	300
2050		668	1,336	668	668	3,340	2,768	8,996	10,380	11,764		33,908	370

Table 2-19 Annual Air Traffic Demand in GCR [Base Case]

Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
	Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
2020	27,033	23,432	50,465	267,817	545,178	812,995	190,380	128,020	3,190	321,590	50,000	371,590
2025	34,650	29,044	63,694	354,843	667,541	1,022,384	228,456	156,392	3,850	388,698	50,000	438,698
2030	43,918	35,871	79,789	460,723	816,416	1,277,139	273,880	189,608	4,640	468,128	50,000	518,128
2035	52,207	41,978	94,185	555,425	949,573	1,504,998	307,280	217,980	5,260	530,520	50,000	580,520
2040	61,816	49,058	110,874	665,212	1,103,939	1,769,151	364,728	253,964	6,190	624,882	50,000	674,882
2045	72,956	57,265	130,221	792,484	1,282,892	2,075,376	429,524	296,868	7,260	733,652	50,000	783,652
2050	85,870	66,779	152,649	940,027	1,490,347	2,430,374	505,676	346,000	8,510	860,186	50,000	910,186

Table 2-20 Annual Aircraft Movements by Aircraft Type in GCR [Base Case]

Year	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
2020		9,352	18,704	132,264	30,060	190,380	17,300	22,144	20,760	67,816		128,020	3,190
2025		15,364	38,076	143,620	31,396	228,456	17,300	31,832	32,524	74,736		156,392	3,850
2030		22,712	64,128	154,308	32,732	273,880	19,376	42,904	48,440	78,888		189,608	4,640
2035		30,728	92,184	153,640	30,728	307,280	17,992	55,360	66,432	78,196		217,980	5,260
2040		36,072	109,552	183,032	36,072	364,728	20,760	63,664	76,120	93,420		253,964	6,190
2045		42,752	128,924	215,096	42,752	429,524	24,220	75,428	89,268	107,952		296,868	7,260
2050		50,768	152,304	251,836	50,768	505,676	29,064	89,268	103,800	123,868		346,000	8,510

2.4 Trial Traffic Distribution between NMIA and CRK

CRK has two main runways and a newly expanded passenger terminal building capable of accommodating four million passengers annually, but still being underutilized, possibly because:

- ✓ Convenient and reliable access to/from Metro Manila is lacking;
- ✓ Currently no metropolis exists near CRK and CRK's inherent air traffic demand is not enough to attract more airlines to come;
- ✓ As a result CRK in terms of the air network and frequency of the flight services compared with NAIA is less competitive.

However, NAIA is capacity constrained gateway airport and is now reaching its capacity limit. Once saturated, the over spilled air traffic demand would need to be accommodated at CRK or otherwise the demand would not be realized. In addition, Bases Conversion and Development Authority (BCDA) is planning to implement its ambitious plan of Clark Green City Development Project.

These two factors, together with ongoing efforts to improve traffic conditions inside Metro Manila, could be driving forces to increase the air traffic demand at CRK. Based on several simple assumptions, the future traffic distribution scenario is discussed hereunder.

2.4.1 Basic Considerations

1) NAIA'S Capacity Limit

The air traffic demand forecasts discussed above are based on an assumption that no restriction on the capacity of NAIA would not exist. Practically the runway capacity of NAIA is limited while the airport traffic demand has been increasing and definitely NAIA's runway capacity would be saturated sooner or later. In 2011 GCR Airport Study, the runway capacity of NAIA has been estimated to be 250,000 movements annually (GA to be transferred to other airports), based on an assumption that airport facilities and staffing at local airports would be improved and the hours of domestic operations at NAIA would be expanded. In the 2011 GCR Airport Study the assumed capacity limit of 250,000 aircraft movements was translated to annual passenger volume of 35 MPPA based on then average number of 140 passengers per flight. Assuming that the size of aircraft fleet would be expanded as shown in Table 2-13 above, the average numbers of domestic and international passengers per flight would have increased to 142 and 190 respectively; an average of about 166. Then the assumed capacity limit of 250,000 movements could be translated to 41.5 MPPA.

2) Clark Green City Development Project

Meanwhile Bases Conversion and Development Authority (BCDA) is now implementing the Clark Green City Development Plan. According to the information of Invest Philippines, "recently approved by the National Economic Development Authority (NEDA), the Clark Green City Project is envisioned to become the Philippines most modern and the first technologically-integrated city with a mix of residential, commercial, agro-industrial, institutional and information technology developments at the same time having a green, sustainable and intelligent community for its residents, workers and business establishments. The 9,450-hectare Clark Green City is located within the Clark Special Economic Zone (CSEZ) and at the heart of the bustling urban centers and major infrastructures in the Central Luzon Region. The development is focused on two (2) key elements; 1) on the areas natural resources and ecosystems as the defining factors of development; and 2) on smart urban development. The development is generally mixed-use and is structured into five (5) districts defined by their main functions, namely Government District; Central Business District; Academic District; Agri-Forestry Research and Development District; and Wellness, Recreation and Eco-tourism District". The Clark Green City Development will be implemented in phases; the first phase was scheduled to be implemented during a period from 2014 to 2019. Although the project implementation seems to be a little bit delayed, its implementation would have significant impact on the air traffic demand at CRK.

3) Measures for Improving Attractiveness of CRK

In order to attract the over spilled traffic from NAIA to utilize CRK, several measures would need to be implemented such as improvement of the airport access, introduction of incentives, etc. According to the result of transport survey, about 20% of NAIA users are to/from Regions I, II, III and CAR and they would be happy to utilize CRK if CRK can offer adequate level of services. This issue is to be further examined in the second half of this Survey.

2.4.2 Traffic Distribution Scenario and Results

Bearing the capacity constraint of NAIA and implementation of the Clark Green City Development Project as well as the measures for improving attractiveness of CRK, following traffic distribution scenario has been prepared:

i) According to the Base Case forecast, the passenger movements at NAIA would exceed 41.5 MPPA in 2018, reaching its capacity limit. Until such time and thereafter, several measures for improving attractiveness of CRK would be implemented. Then utilization of CRK could be the choice for the over spilled passenger and airlines. If this happens, due to the availability of wider network and increased frequency, CRK would become capable of offering better opportunity to its users of more destinations and flight frequency.

ii) GA currently operating at NAIA should be transferred to Sangley or any other airports as soon as possible.

iii) In around 2028 when the first phase NMIA development is completed, NAIA would be closed down and majority of the over spilled traffic would be accommodated at NMIA together with those being accommodated by NAIA.

iv) However, 22% of the international and 15% of the domestic passengers at NAIA of the Base Case forecast would continue to utilize CRK as they would be to/from Regions I, II, III and CAR.

Results of the assumed traffic distribution scenario are shown in Tables 2-21 and 2-22 as well as Figures 2-7 and 2-8.

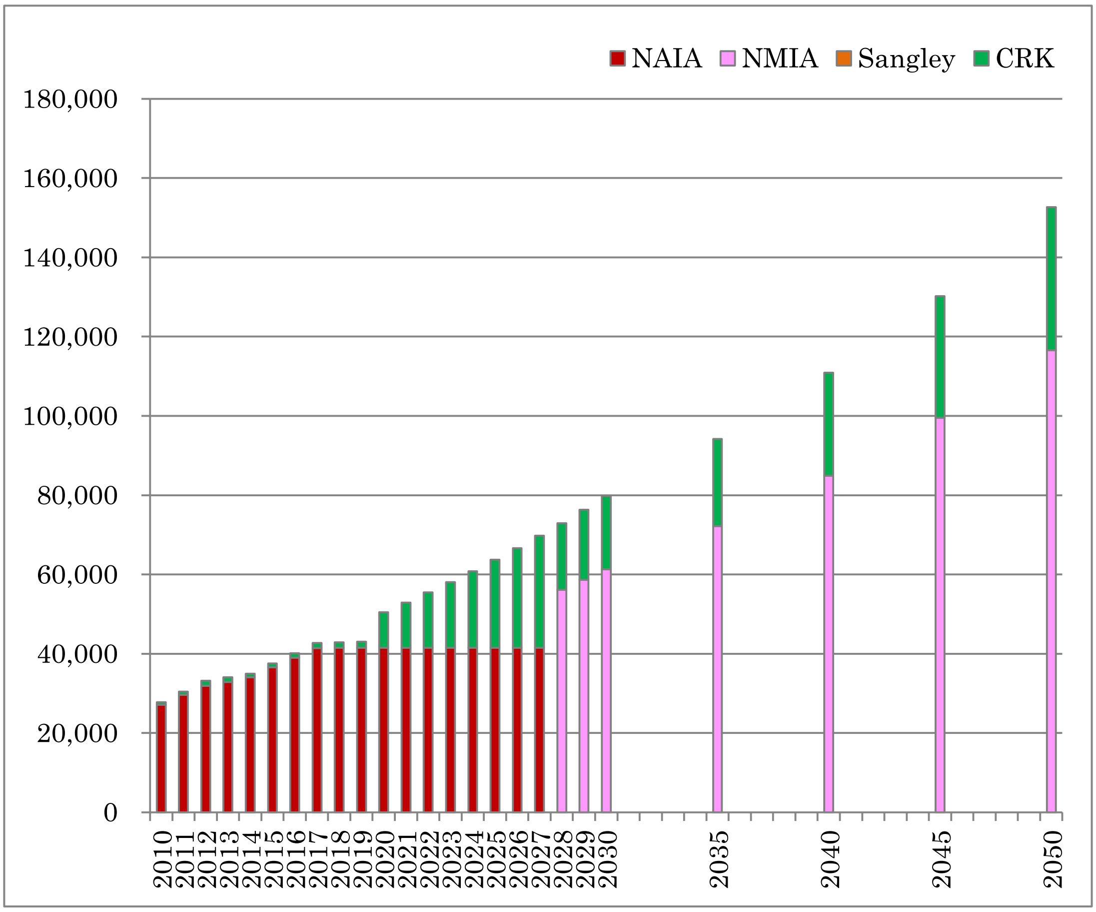


Figure 2-7 Assumed Distribution of Total Passengers

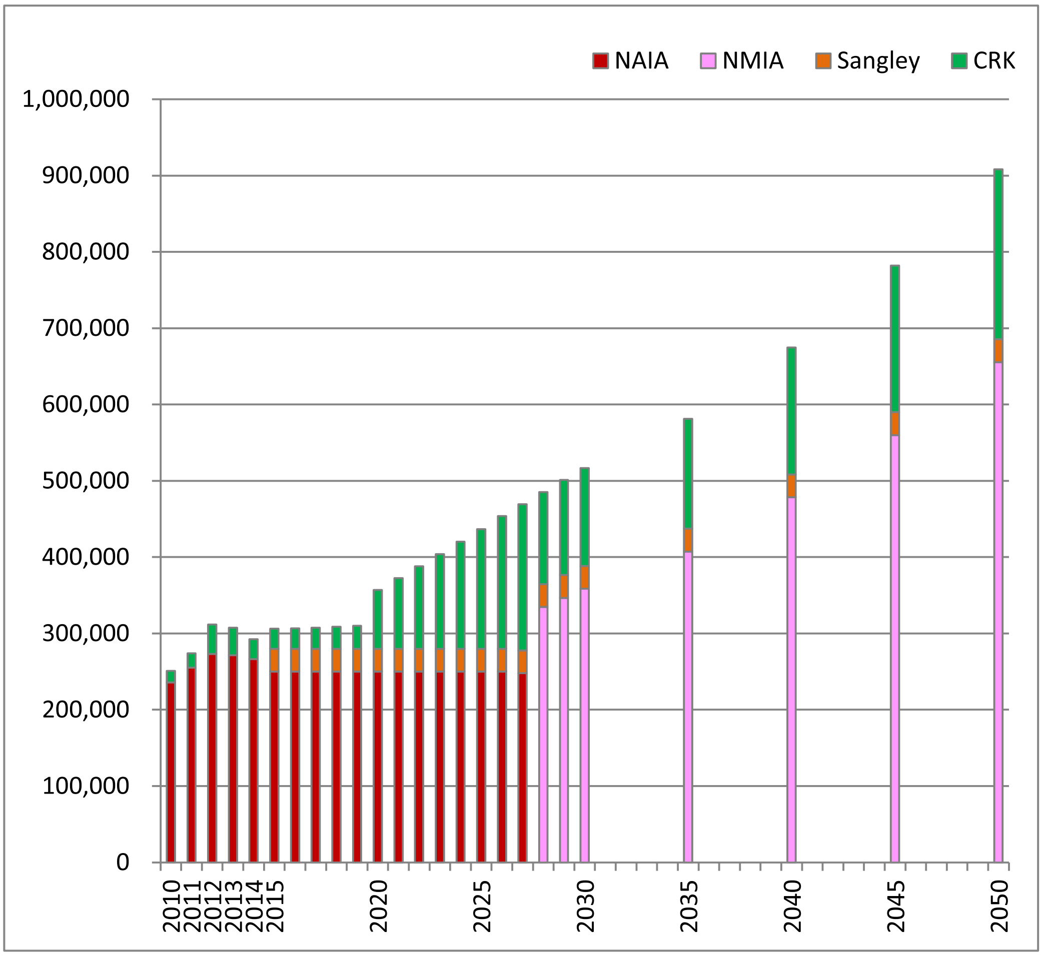


Figure 2-8 Assumed Distribution of Total Flights including GA

Table 2-21 Assumed Traffic Distribution Scenario (Passenger Movements: '1000)

	Year	Air Traffic Demand Forecast in Base Case						Moved Air Passenger Demand from NAIA to Other Airports			Assumed Distribution of Air Passenger Demand												
		NAIA			CRK						NAIA			NMIA			Sangley	CRK			GCR		
		Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	Domestic	International	Total	Domestic	International	Total
Actual	2010	14,755	12,381	27,136	47	608	654				14,755	12,381	27,136					47	608	654	14,802	12,988	27,790
	2011	16,687	12,969	29,657	42	725	767				16,687	12,969	29,657					42	725	767	16,729	13,695	30,424
	2012	17,739	14,140	31,879	300	1,015	1,316				17,739	14,140	31,879					300	1,015	1,316	18,039	15,155	33,195
	2013	17,689	15,177	32,867	215	985	1,201				17,689	15,177	32,867					215	985	1,201	17,905	16,163	34,067
	2014	18,020	16,072	34,091	91	787	878				18,020	16,072	34,091					91	787	878	18,110	16,858	34,969
Forecast	2015	19,498	17,043	36,541	100	911	1,011				19,498	17,043	36,541					100	911	1,011	19,598	17,954	37,552
	2016	20,975	18,015	38,990	109	1,035	1,144				20,975	18,015	38,990					109	1,035	1,144	21,085	19,050	40,134
	2017	22,453	18,986	41,439	118	1,159	1,278				22,453	18,986	41,439					118	1,159	1,278	22,572	20,145	42,717
	2018	23,931	19,958	43,889	128	1,283	1,411	1,303	1,086	2,389	22,629	18,871	41,500					128	1,283	1,411	22,756	20,155	42,911
	2019	25,409	20,929	46,338	137	1,407	1,544	2,653	2,185	4,838	22,756	18,744	41,500					137	1,407	1,544	22,893	20,151	43,044
	2020	26,887	21,900	48,788	146	1,532	1,677	4,817	2,471	7,288	22,071	19,429	41,500					4,962	4,003	8,965	27,033	23,432	50,465
	2021	28,285	22,819	51,104	154	1,649	1,803	6,327	3,277	9,604	21,958	19,542	41,500					6,481	4,926	11,408	28,439	24,468	52,908
	2022	29,739	23,775	53,513	163	1,771	1,934	7,907	4,106	12,013	21,831	19,669	41,500					8,071	5,877	13,948	29,902	25,546	55,448
	2023	31,250	24,768	56,019	173	1,898	2,071	9,559	4,959	14,519	21,691	19,809	41,500					9,732	6,857	16,589	31,423	26,666	58,089
	2024	32,823	25,802	58,624	182	2,030	2,212	11,284	5,841	17,124	21,539	19,961	41,500					11,466	7,871	19,337	33,005	27,832	60,837
	2025	34,458	26,877	61,334	193	2,167	2,360	13,081	6,753	19,834	21,377	20,123	41,500					13,273	8,921	22,194	34,650	29,044	63,694
	2026	36,158	27,994	64,152	203	2,310	2,513	14,971	7,681	22,652	21,187	20,313	41,500					15,174	9,991	25,166	36,361	30,304	66,666
	2027	37,927	29,157	67,083	214	2,459	2,673	16,942	8,641	25,583	20,985	20,515	41,500					17,156	11,100	28,256	38,141	31,615	69,756
	2028	39,766	30,366	70,132	225	2,613	2,839	8,970	5,057	14,026				30,796	25,309	56,105		9,195	7,670	16,865	39,991	32,979	72,970
	2029	41,679	31,623	73,302	237	2,774	3,011	9,397	5,264	14,660				32,282	26,359	58,641		9,634	8,038	17,671	41,916	34,397	76,313
	2030	43,668	32,931	76,599	250	2,941	3,190	9,837	5,483	15,320				33,831	27,448	61,279		10,087	8,423	18,510	43,918	35,871	79,789
	2035	51,906	38,346	90,252	300	3,633	3,933	11,700	6,350	18,050				40,206	31,995	72,201		12,001	9,983	21,984	52,207	41,978	94,185
	2040	61,456	44,623	106,079	360	4,435	4,794	13,817	7,399	21,216				47,639	37,224	84,864		14,177	11,834	26,010	61,816	49,058	110,874
	2045	72,528	51,900	124,428	428	5,365	5,793	16,267	8,619	24,886				56,261	43,282	99,542		16,695	13,983	30,678	72,956	57,265	130,221
	2050	85,362	60,337	145,699	507	6,442	6,950	19,109	10,031	29,140				66,254	50,306	116,559		19,616	16,474	36,090	85,870	66,779	152,649

Table 2-22 Assumed Traffic Distribution Scenario (Aircraft Movements including Freighters)

	Year	Assumed Distribution of Aircraft Movements																		
		NAIA				NMIA				Sangley			CRK				GCR			
		Domestic	Int'l (*)	GA	Total	Domestic	Int'l (*)	GA	Total	Domestic	GA	Total	Domestic	Int'l (*)	GA	Total	Domestic	Int'l (*)	GA	Total
Actual	2010	132,786	67,321	35,887	235,994								744	5,332	9,054	15,130	133,530	72,653	44,941	251,124
	2011	145,353	72,390	37,411	255,154								609	6,971	11,209	18,789	145,962	79,361	48,620	273,943
	2012	155,832	79,685	37,561	273,078								3,501	9,313	25,854	38,668	159,333	88,998	63,415	311,746
	2013	149,421	87,629	34,416	271,466								1,916	8,420	25,833	36,169	151,337	96,049	60,249	307,635
	2014	142,693	93,748	29,819	266,260								936	5,715	19,560	26,211	143,629	99,463	49,379	292,471
Forecast	2015	149,438	100,562		250,000						30,000	30,000	767	5,376	20,000	26,143	150,205	105,938	50,000	306,143
	2016	149,991	100,009		250,000						30,000	30,000	820	6,031	20,000	26,851	150,811	106,040	50,000	306,851
	2017	150,488	99,512		250,000						30,000	30,000	872	6,678	20,000	27,550	151,360	106,190	50,000	307,550
	2018	151,129	98,871		250,000						30,000	30,000	977	7,712	20,000	28,689	152,106	106,583	50,000	308,689
	2019	151,750	98,250		250,000						30,000	30,000	1,088	8,812	20,000	29,900	152,838	107,062	50,000	309,900
	2020	147,179	102,821		250,000						30,000	30,000	34,825	22,292	20,000	77,117	182,004	125,113	50,000	357,117
	2021	145,855	104,145		250,000						30,000	30,000	45,001	27,443	20,000	92,444	190,856	131,588	50,000	372,444
	2022	144,482	105,518		250,000						30,000	30,000	55,389	32,692	20,000	108,081	199,871	138,210	50,000	388,081
	2023	143,065	106,935		250,000						30,000	30,000	65,958	38,036	20,000	123,994	209,023	144,971	50,000	403,994
	2024	141,608	108,392		250,000						30,000	30,000	76,676	43,472	20,000	140,148	218,284	151,864	50,000	420,148
	2025	140,113	109,887		250,000						30,000	30,000	87,514	49,002	20,000	156,516	227,627	158,889	50,000	436,516
	2026	138,427	111,573		250,000						30,000	30,000	99,075	54,842	20,000	173,917	237,502	166,415	50,000	453,917
	2027	135,545	112,351		247,896						30,000	30,000	110,815	60,789	20,000	191,604	246,360	173,140	50,000	469,500
	2028					196,609	138,092		334,701		30,000	30,000	58,703	41,848	20,000	120,551	255,312	179,940	50,000	485,252
	2029					203,526	143,104		346,630		30,000	30,000	60,738	43,636	20,000	124,374	264,264	186,740	50,000	501,004
	2030					210,462	148,090		358,552		30,000	30,000	62,750	45,446	20,000	128,196	273,212	193,536	50,000	516,748
	2035					236,646	170,679		407,325		30,000	30,000	70,634	53,253	20,000	143,887	307,280	223,932	50,000	581,212
	2040					280,569	197,917		478,486		30,000	30,000	83,491	62,919	20,000	166,410	364,060	260,836	50,000	674,896
	2045					331,234	228,810		560,044		30,000	30,000	98,290	73,924	20,000	192,214	429,524	302,734	50,000	782,258
	2050					389,645	265,999		655,644		30,000	30,000	115,363	87,107	20,000	222,470	505,008	353,106	50,000	908,114

3. Basic Requirement for NMIA Development

3.1 Planning Parameters

1) Target Year

To conduct facility requirement examination, following target year has been considered.

i) Short-term Year 2030 demand (5 years after opening of NMIA)
ii) Medium-term Year 2035 demand (10 years after opening of NMIA)
iii) Long-term Year 2045 demand (20 years after opening of NMIA)

2) Design Aircraft and Aerodrome Reference Code

Airbus A380 and Boeing B747-8 have been selected as design aircraft for facility requirement. The ICAO aerodrome reference code number and letter for these aircraft are Code 4F.

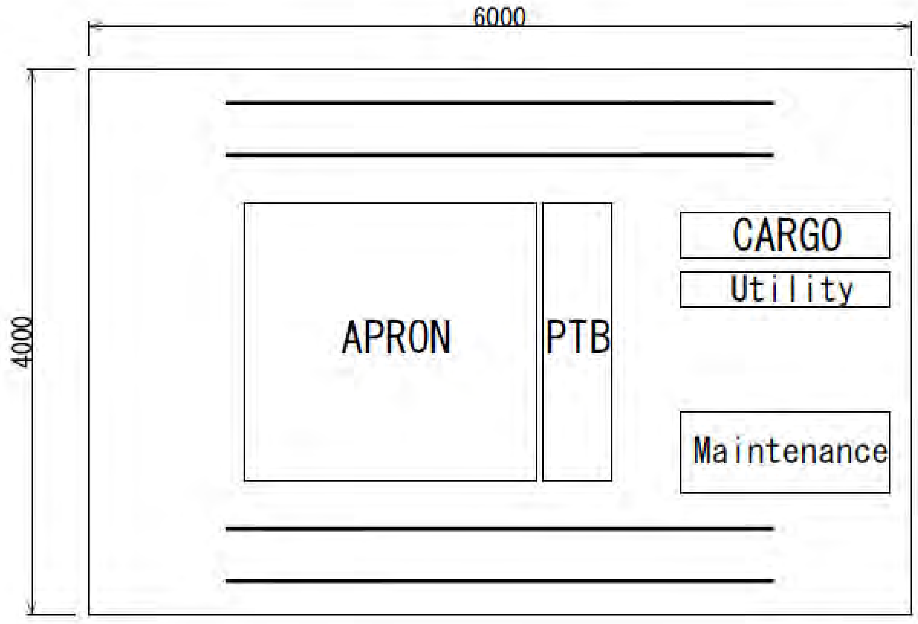
3) Imaginary Development Concept of NMIA

NMIA is likely to be built on a platform prepared by reclamation. The cost of reclamation would be excessive and it is necessary to minimize the platform size. At the same time, the platform should enable development of necessary facilities to meet the demand while ensuring safe and efficient operations as the world-class international gateway airport. NMIA on its opening day will need to be provided with two open parallel runways (4000-m long 60-m wide) capable of accommodating approximately 110 aircraft movements during a peak-hour. In between the runways, there should be an ample area for development of the taxiway system, aircraft parking aprons and the landside facilities. Result of the preliminary facility planning showed that the runways should be spaced by approximately 1635 m. The taxiway system, aircraft parking aprons as well as the landside facilities capable of accommodating the forecast airport traffic demand of 2030 to 2035 may be developed between the open parallel runways. In order to develop this size of international gateway airport, the platform will need to be approximately 6km by 2.5km (1500ha) on the opening day.

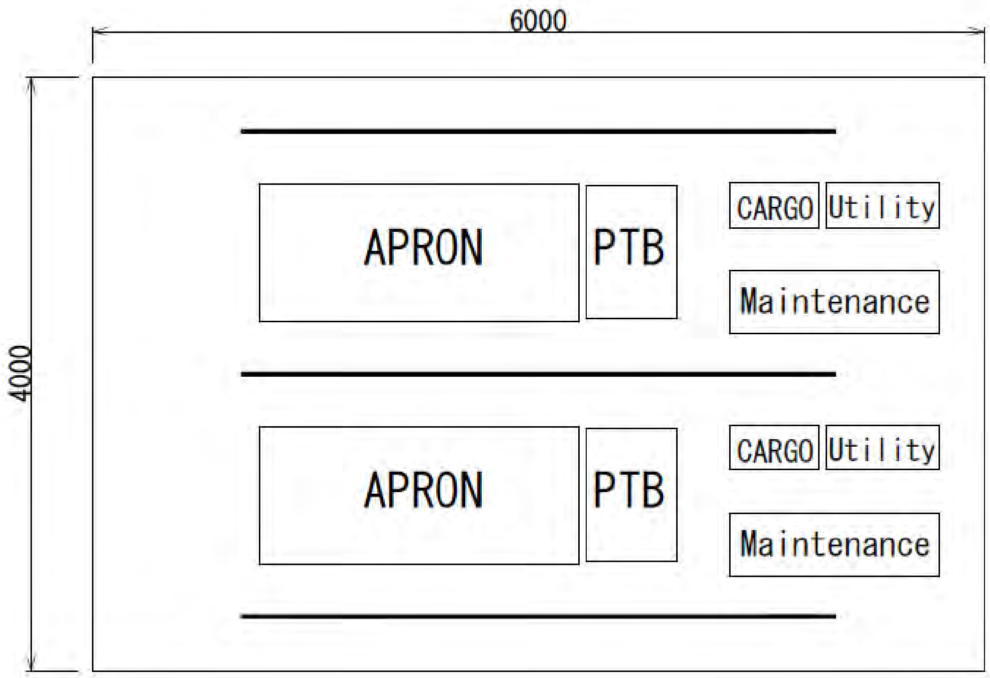
Figure 3-1 Imaginary Concept of NMIA Development on Opening Day

Ultimately the platform size will need to be approximately 6 km by 4 km (2400 ha) for development of widely spaced two sets of close parallel runways or three open parallel runways.

Figure 3-2 shows imaginary concepts of ultimate phase of NMIA development.



Ultimate Phase Option 1: Widely Spaced Two Sets of Close Parallel Runways



Ultimate Phase Option 2: Three Open Parallel Runways

Figure 5.2.1-2 Imaginary Concepts of Ultimate Phase of NMIA Development

3.2 Preliminary Construction Cost Estimate

Preliminary construction cost estimate in short-term development related to airport facilities for NMIA has been made. It should be noted that the construction cost was undertaken on referenced airport layout plan, and should be subject to review for next stage.

Table 3-1 Preliminary Construction Cost Estimate for Airport Facilities in Short-term

No.	Item	Amount (Million USD)	Amount (Billion PHP)
1	Civil Works	707	31.9
2	Building Works	2,689	121.4
3	Utility Works	646	29.2
4	Air Navigation Facilities	159	7.2
Total		4,200	189.7

4. Initial Screening of Alternative Sites

The terms of Reference issued by JICA defined following nine airport sites for alternative new airport sites as listed below.

i) Angat-Pandi-Bustos located to the north of Metro Manila in the province of Bulacan in Region III;
ii) Obando located to the north of Metro Manila in the province of Bulacan in Region III;
iii) Northern Portion of Manila Bay;
iv) Central Portion of Manila Bay;
v) Sangley Point Option 1 located offshore Cavite Peninsular
vi) Sangley Point Option 2 located parallel to the existing runway at Sangley Point;
vii) San Nicholas Shoals located to the south of Sangley;
viii) Western side of Laguna de Bay; and
ix) Rizal-Talim Island located in the central part of Laguna de Bay

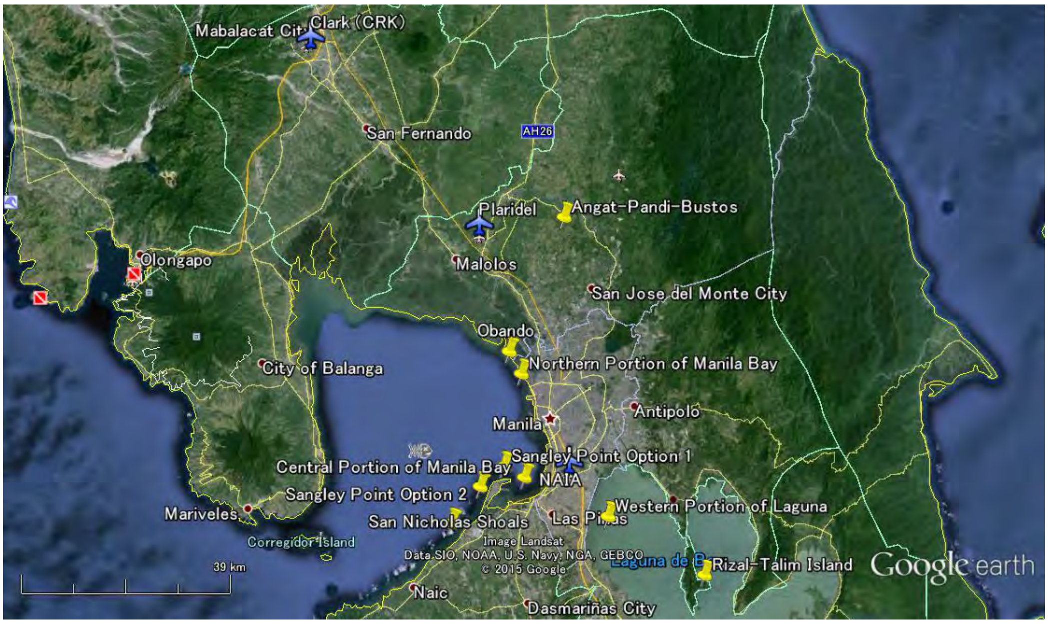


Figure4-1 Location of Existing Airports and Alternative New Airport Sites

In these alternative airport sites, their places are not located properly to play the expected role of NMIA as the gateway international airport for NCR and Southern Luzon. These sites are to be eliminated through initial screening. Qualitative assessment of the nine alternative new sites has been conducted based on the initial screening criteria. The criteria are categorized into five as list below.

1) Criteria related to Air

   a) Navigation Risks; A site should be free from any significant physical obstruction such as mountain ranges and manmade structures.

   b) Risk of Aircraft Crash and Noise Problems; The expected aircraft flight paths preferably should not overlap with urbanized areas and dangerous facilities.

   c) Runway Usability; Runways can preferably be oriented to prevailing wind direction.

2) Criteria related to Social Issues

   a) Land Availability; A site should be able to offer adequate space for airport development with less negative environment and social impacts.

   b) Resettlement and compensation; Anticipated magnitude of resettlement and required compensation.

3) Criteria related the Natural Environment

   a) Impact on Ecosystem; A site should be developed without significant irreversible impacts on the natural environment.

b) Natural Hazard Risks; A site should be less vulnerable to flooding, tsunami and other natural hazards.

4) Criteria related to Economics

a) Accessibility; Proximity to NCR and Region IV-A as well as connectivity with the existing and planned expressways and rail link.

b) Integrated Urban Development Opportunity; A site should offer integrated urban development opportunities for enhancement of the airport function and cost recovery.

5) Criteria related to the Cost; A site should not be associated with unreasonably high cost implication such as a need to totally excavate a rocky mountain.

The summary of the qualitative evaluation of the alternative new airport sites is shown below.

Table 4-1 Summary of Qualitative Evaluation of Alternative Sites

1. Angat-Pandi-Bustos This alternative site is not properly located to play its expected role to fundamentally resolve the serious capacity constraint of NAIA. Development of NMIA in this site would cause competition with CRK, rather than addressing the capacity constraint issue of NAIA. There are other disadvantages associated with this site, such as limited expansibility, risk of natural hazards and less opportunity of integrated urban development. Although the construction cost could be less than those for the other sites, this advantage does not offset the fundamental disadvantage of this alternative site in terms of the accessibility. Therefore, this site is not an appropriate option to consider development of NMIA.
2. Obando This alternative site has several disadvantages such as risk of flooding, limited possibility of urban development and expected high cost for stabilization of sub-surface soils. There is no significant advantage offsetting these disadvantages. Therefore, this site is not an appropriate option to consider development NMIA.
3. Northern Portion of Manila Bay This alternative site has several disadvantages such as aircraft crash and noise issues, limited possibility of urban development and expected high cost for stabilization of sub-surface soils and access development. There is no significant advantage offsetting these disadvantages. Therefore, this site is not an appropriate option to consider development of NMIA.
4. Central Portion of Manila Bay This alternative site has several disadvantages such as high risk of bird strikes. Proximity to LPPCHEA should be taken into account when preparing an airport layout and development plan. On the other hand, this alternative site can offer several significant advantages such as very good accessibility. Therefore, this site should be subjected to detail examination.

5. Sangley Point Option 1 This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of examination. Therefore, this site should be subjected to detail examination.
6. Sangley Point Option 2 This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of examination. Therefore, this site should be subjected to detail examination.
7. San Nicholas Shoals As majority of the aircraft departure and arrival paths near the runways can be located on Manila Bay, no significant problems related to aircraft crash and noise is anticipated. Fairly good condition of sub-surface soils is anticipated. As no significant disadvantage is recognized, this site should be subjected to detail examination.
8. West Portion of Laguna de Bay Although significant negative environment and social impacts as well as high cost implication are anticipated, this alternative site is very much conveniently located to serve NCR and Region IV-A, offering very favorable accessibility both by road and rail. Therefore, this site should be subjected to detail examination.
9. Rizal-Talim Island This alternative site is surrounding by high mountains on both sides which would infringe obstacle limitation surfaces. Removal thereof is not practicable due to anticipated high cost, environment and social negative impacts. Access from NCR and Region IV-A to this site is very much inconvenient. This alternative site is not a place for development of a gateway airport.

5. Preliminary Examination of Prospective New Airport Sites

5.1 Prospective New Airport Sites

As a result of the initial screening, following five sites have been chosen as the prospective new airport sites for development of NMIA;

i) Sangley Point Option 1 located offshore Cavite Peninsular;
ii) Sangley Point Option 2 located parallel to the existing runway at Sangley Point;
iii) Central Portion of Manila Bay;
iv) San Nicholas Shoals located to the south of Sangley; and
v) Western side of Laguna de Bay

5.2 Items for Examination of Prospective New Airport Sites

5.2.1 Items for Detail Examination

Detail examination of the prospective new airport sites are to be conducted with respect to the following items:

a) Airspace Utilization and Aircraft Operations
b) Environment and Social Consideration
c) Risk of Natural Hazard
d) Reclamation for Platform Development
e) Airport Access Traffic and Network
f) Surrounding Land Use and Urban Planning
g) Preliminary Cost Estimate for NMIA Development

5.3 Examination on Airspace Utilization and Aircraft Operations

The Survey Team has carried out an aeronautical feasibility study focused on the fundamental question as to whether the five prospective sites for NMIA could meet basic airport planning requirements in terms of airspace/air traffic and obstacle/terrain feasibilities for the intended airport role. Following two alternatives ultimate phase development concepts have been examined:

a) Ultimate Phase Option 1: Two sets of widely spaced close parallel runways; and
b) Ultimate Phase Option 2: Three open parallel runways.

5.3.1 Airspaces and Instrument Flight Procedures for Ultimate Phase Option 1

1) Methodology

A series of analyses were performed on each prospective site location for the new airport to evaluate feasibility of establish Instrument Flight Procedures (IFPs) within Manila Terminal Control Area (TMA). IFPs, such as Instrument Approach Procedures (IAPs) and Standard Instrument Departures (SIDs) for each prospective site were developed to confirm whether the appropriate IFPs would be able to accommodate within Manila TMA and to identify relative challenges that each of the prospective site would face. This qualitative analysis included evaluation of terrain elevations as well as man-made artificial obstacles around the site by using flight procedure design software. For feasibility evaluation purpose, the Survey Team developed protected area templates for each prospective site representing typical IFP layout for airport operation with four parallel runways configuration.

2) Airspace/Air Traffic Feasibility Evaluation

All of the prospective sites will inevitably require major airspace redesign of the Manila TMA in order for them to work effectively from an airspace / air traffic control standpoint. Since the existing Intensive Military Training Areas, Corridors, and Flight Training Areas would be reallocated within the extent of new TMA by succeeding development phase of airspace redesign, those airspaces were ignored in the evaluation. Meanwhile, the existing Prohibited, Restricted and Danger Areas that have been established for security or other reasons associated with the nature or activities at the ground surface of those specific areas were considered in the evaluation. The Survey Team developed the following three criteria to evaluate airspace/air traffic feasibility of the prospective sites.

Table 5.3.1-1 Comparative Criteria for Airspace/ Air Traffic Evaluation

Comparative Criterion		Metric
A-1	Preservation of existing airspace	Vertical separation or lateral separation between IFPs and existing airspace are certainly preserved or not.
A-2	Airspace availability for arrival routes	Sufficient extent of airspace is available to accommodate with omni-directional arrival routes to all IAFs or not.
A-3	Airspace availability for holding stacks	Sufficient extent of airspace is available to accommodate with holding procedures on all IAFs or not.

In addition to the comparative criteria in above, the Survey Team assessed feasibility of independent runway operation between the new airport and existing NAIA. The results of the preliminary evaluation showed that no prospective site would be feasible for the independent runway operation due to close distance between each prospective site and existing NAIA. Since all prospective sites resulted in infeasible for independent runway operation, this criterion was not incorporated into the comparative criteria in above.

3) Obstacle/ Terrain Feasibility Evaluation

In order to determine all potential airspace hazards in terms of obstacles and terrain, the Survey Team utilized data sets of digital obstacles and terrain files. The Survey Team developed the following four criteria to evaluate obstacle/terrain feasibility of the prospective sites.

Table 5.3.1-2 Comparative Criteria for Obstacle/ Terrain Evaluation

Comparative Criterion		Metric
O-1	ILS Approach Design	Minimum Decision Height (DH=200ft) can be obtained or not.
O-2	Initial/Intermediate Approach Design	Adequate descent gradient of approach segments; i.e., 3° on the final, 5.2% on the intermediate, and less than 8.0% on the initial, can be maintained or not.
O-3	Missed Approach Design	Adequate climb gradient; ideally 2.5% but acceptable up to 5.0% can be maintained or not.
O-4	Departure Design	Adequate climb gradient; ideally 3.3% but acceptable up to 5.0% can be maintained or not.

4) Assessment Results

Results of the assessment are summarized in Table 5.3.1-3. The Survey Team came up with three favorable prospective sites for new NAIA; Central Portion of Manila Bay, Western Side of Laguna de Bay and Sangley Point Option 1 as these sites would not cause significant conflict with the existing prohibited/restricted airspaces. The other two sites; Sangley Point Option 2 and San Nicholas Shoals would require removal or relaxing of the height restriction of RP-P1: MALACANANG; the prohibited airspace established around the official residence of the President of the Republic of the Philippines. Successful negotiation/coordination with relevant authorities to remove/relax the restriction of RP-P1 in a timely manner is considered very much unlikely. Therefore, it can be concluded that, from the airspace and obstacle restriction viewpoint, Sangley Point Option 2 and San Nicholas Shoals sites are not appropriate options for development of NMIA.

Table 5.3.1-3 Summary of Assessment Results for Prospective Sites (Ultimate Phase Option 1)

Sites Name	Brief Assessment Result Description
Central Portion of Manila Bay Less Challenging	This site location exhibits the most favorable assessment result to accommodate all IFPs in Manila TMA without major conflict with the existing airspaces. The airport has a good runway orientation and certain distance from adjacent TMAs that helps make flexible air traffic flows. The arrival routes from south, however, require a careful IFP design to resolve conflicts with an existing restricted airspace (RP-R73).
Western side of Laguna de Bay	This site location also exhibits favorable assessment result to accommodate all IFPs in Manila TMA without major conflicts with the existing airspaces. Its north/south runway orientation, however, will make a slight conflict between initial approach segments and an existing airspace (RP-R72).
Sangley Point Option 1	While this site location exhibits favorable assessment result in terms of conflict with the existing airspaces, existence of an oil terminal facility near RWY02R threshold could be a potential hazard for neighboring area in case of aircraft crash into the terminal. Coordination with authorities concerned would be required.
San Nicholas Shoals	While this site will be a good distance from Metro Manila region, its northeast/southwest runway orientation will cause some significant challenges on modifying vertical limit of some prohibited areas including RP-P1. This site will also require careful IFP design to work out terrain penetrations.
Sangley Point Option 2 More Challenging	This site will be the most challenging one due to proximate location to Metro Manila and its runway orientation. IAPs for this site will conflict with some prohibited/restricted airspaces including RP-P1. Limited extent of airspace to the west side of the airport will be only available due to a restricted airspace and an adjacent TMA, and it will make air traffic flow inefficient.

5) Feasibility of Independent Operation with NAIA

JICA Study Team assessed feasibility of independent runway operation between the new airport and existing NAIA. NAIA has primary runway 06/24 and secondary runway 13/31. RWY 13/31 does not meet relevant ICAO requirements in terms of the strip width, separation distance between runway and parallel taxiway centerlines for instrument runway. Operability of RWY 31 is very much limited as approach is allowed only during daytime under VMC. Unless independent operations between NAIA RWY 06/24 and NMIA is achievable, NAIA is considered to be closed down for redevelopment and fund raising for NMIA development.

The results of the preliminary evaluation showed that no prospective site would be feasible for the independent runway operation due to close distance between each prospective site and existing NAIA. A summary table of the assessment results appears in Table 5.3.1-4.

Table 5.3.1-4 Assessment Results of Independent Runway Operation

Site Name / Operation	Sangley Point Option 1	Sangley Point Option 2	Central Portion of Manila Bay	San Nicholas Shoals	Western side of Laguna de Bay
East Wind Operation	**Infeasible**	**Infeasible**	**Infeasible**	**Infeasible**	**Infeasible**
West Wind Operation	**Feasible**	**Infeasible**	**Infeasible**	**Feasible**	**Infeasible**
Overall Result	**Infeasible**	**Infeasible**	**Infeasible**	**Infeasible**	**Infeasible**

5.3.2 Airspaces and Instrument Flight Procedures for Ultimate Phase Option 2

This Subsection deals with the examination of the airspaces and instrument flight procedures for the Ultimate Phase Option 2: Three Open Parallel Runways. The same methodology in Subsection 5.3.1 or modified herein was adopted to evaluate feasibility of IFPs on each prospective site. FAA ORDER 7110.65R applied to the simultaneous independent operations on three parallel runways in the United States has also been taken into account. In case of the Ultimate Phase Option 2: Three Open Parallel Runways, the Survey Team came up with two potential prospective sites for NMIAs: Western Portion of Laguna de Bay and Sangley Point Option 1 in terms of the airspace and air traffic preference. The other three sites would cause significant conflict with several prohibited/restricted airspaces including RP-P1, and be concluded as not appropriate for development of NMIA. The results of evaluation on each prospective site are outlined in the Table 5.3.2-1 below. It should be noted that the Ultimate Phase Option 2 requires wider airspace than the Option 1 and the simultaneous operation with NAIA would not be practicable.

Table 5.3.2-1 Summary of Assessment Results for Prospective Sites (Ultimate Phase Option 2)

Sites Name	Brief Assessment Result Description
Western side of Laguna de Bay Less Challenging	This site location exhibits the most favorable assessment result to accommodate all IFPs in Manila TMA without major conflicts with the existing airspace. Although an existing restricted airspace will conflict with the IAPs from the south, the relevant authority seems optimistic about changing of this airspace.
Sangley Point Option 1	While this site location exhibits most favorable assessment result in terms of conflict with the existing airspaces, existence of an oil terminal facility near RWY02R threshold could be a potential hazard for neighboring area in case of aircraft crash into the terminal. Coordination with authorities concerned would be required. In addition, this site location will require removal of an antenna that penetrates the ILS-OAS. This issue could be resolved through further examination on the runway location.
San Nicholas Shoals	While this site will be a good distance from Metro Manila region, its northeast/southwest runway orientation will provide some challenges on modifying vertical limit of RP-P1. This site will also require careful IFP design to work out terrain penetrations.
Central Portion of Manila Bay	The airport has a good runway orientation and certain distance from adjacent TMAs that will help make flexible air traffic flows. This site, however, will require challenges to resolve conflict with two existing airspace including RP-P1 due to proximate location to Metro Manila region.
Sangley Point Option 2 More Challenging	This site will be the most challenging one due to neighboring location to Metro Manila. IAPs for this site will conflict with a prohibited airspace and two restricted airspace including RP-P1. Limited extent of airspace at the west side of the airport will be only available due to a restricted airspace and an adjacent TMA, and it will make air traffic flow inefficient.

5.4 Environmental and Social Consideration

5.4.1 Project Description

Subject of environmental consideration survey are focusing on following five airport alternative sites.

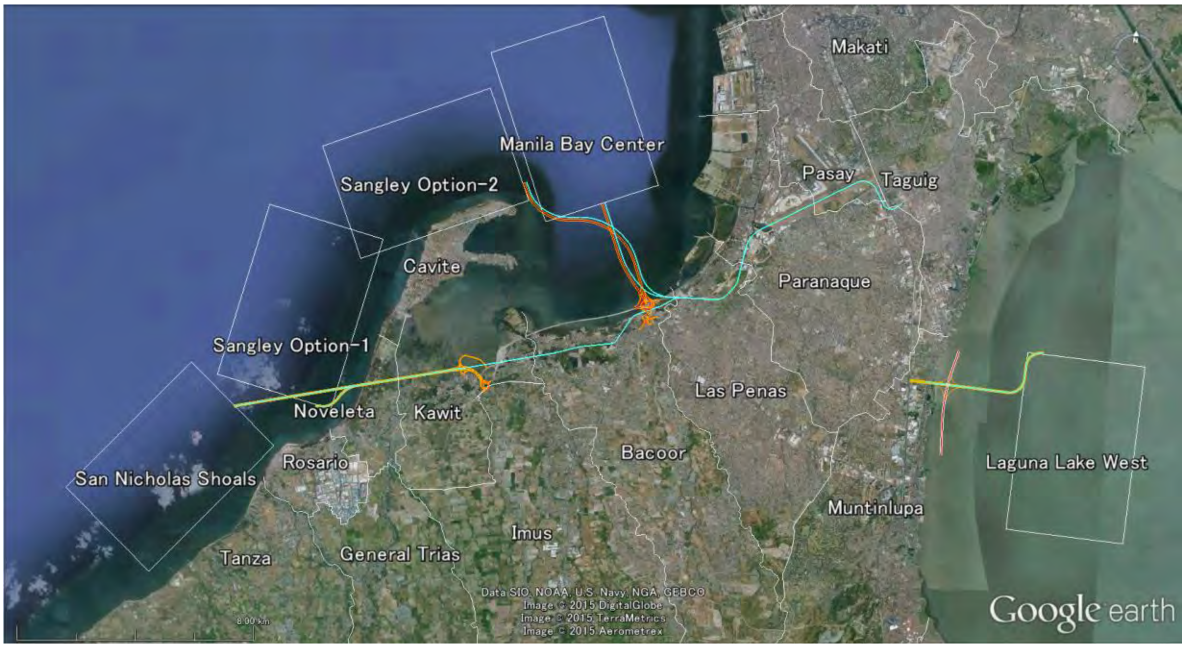


Figure 5.4-1 Location of Subject Airport Sites and Access Road

Major components of each alternatives are：

- Airfield (2,400 hectare),
- Access road including interchange area and access railroad, and
- Sand excavation.

5.4.2 Land Acquisition and Resettlement

All the alternatives are involved with reclamation project; and therefore, the land acquisition and resettlement will occur only along the access routes. The results are shown in Figure 5.4-2 and Figure 5.4-3. Estimated numbers of resettlement people are shown in Figure 5.4-4.

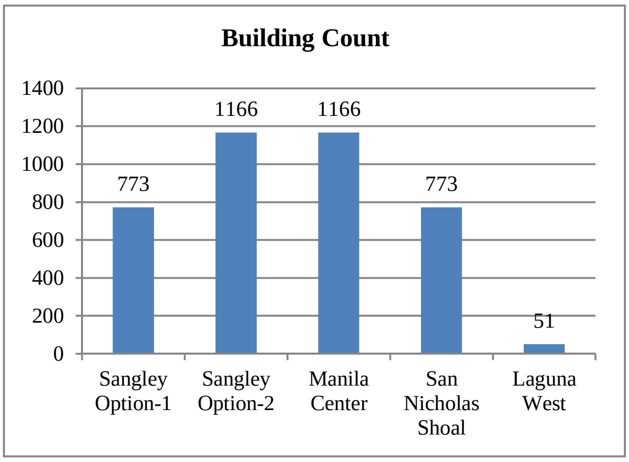


Figure 5.4-2 Number of Houses Interfering

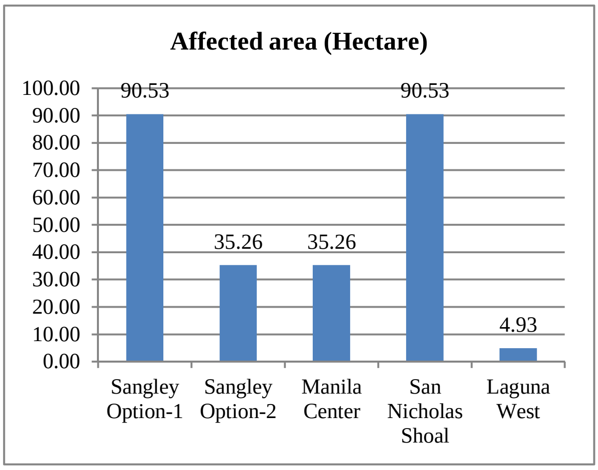


Figure 5.4-3 Affected Land Area

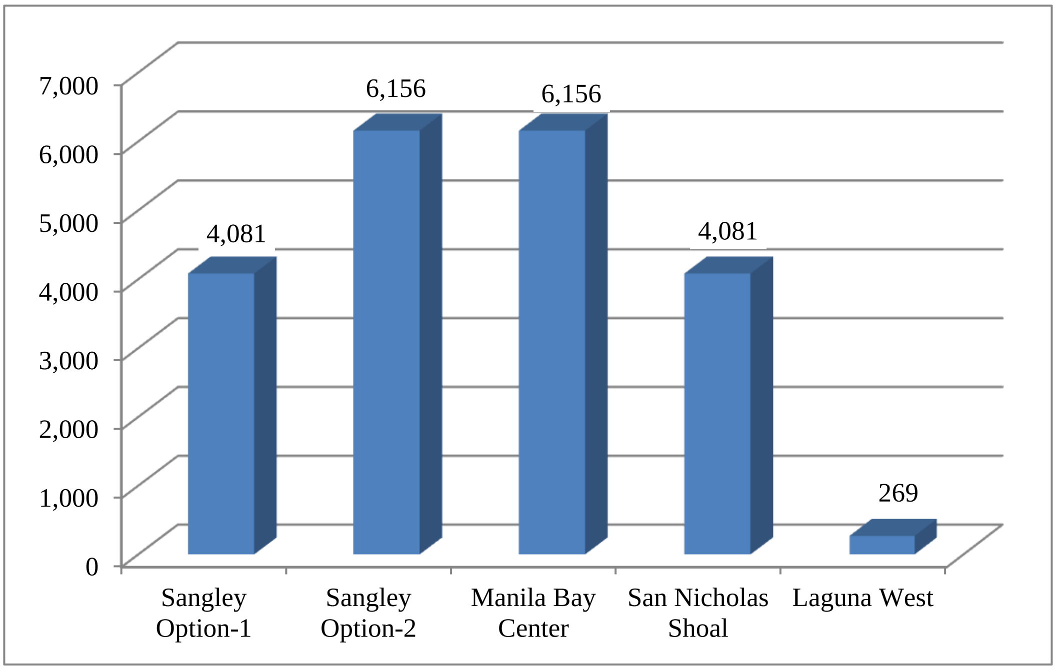


Figure 58.4-4 Comparison of Project Affected People (Resettlement only)

5.4.3 Impacts on Fish Folks and Industry

5.4.3.1 Sand Quarry

One of the biggest impact expected on fishery is of sand quarry works at offshore area for the reclamation material. Although the exact quarry site is not determined yet, the size will be more than 10,000 hectare. The sand excavation works will completely change the subjected sea bottom environment which is presently being rich sources of fish production and thus important livelihood resources for fisher folks. According to interviews done by JICA survey team, the fishery income of fisherman in Rosario is not low; and therefore, financial impact will be significant (Table 5.4-1). The tentative locations of sand quarries are shown in Figure 5.4-5.

- Income during lean season (Oct – February) : Php. 300 - 400 per fishing night
- Squid season (March - May) : Php. 5,000 - 10,000 per fishing night
- Shrimp and crab season (June - September) : Php. 10,000 - 20,000 per fishing night

The number of fisherman is shown in Table 5.4-1. The most significant impacts by sand quarry works will be on fisher folks of Rosario and Tanza (and possibly of Naic).

Table 5.4-1 Number of Fisher Folks

City/Municipality	Number of Fisherman in LGU	Significant impact expected by sand quarry
Cavite City	3,528	-
Kawit	1,840	-
Noveleta	240	-
Rosario	3,606	✔
City of Bacoor	723	-
Tanza	2,449	✔
Maragondon	443	✔
Naic	4,778	✔
Ternate	899	✔

Source: Province of Cavite 2013

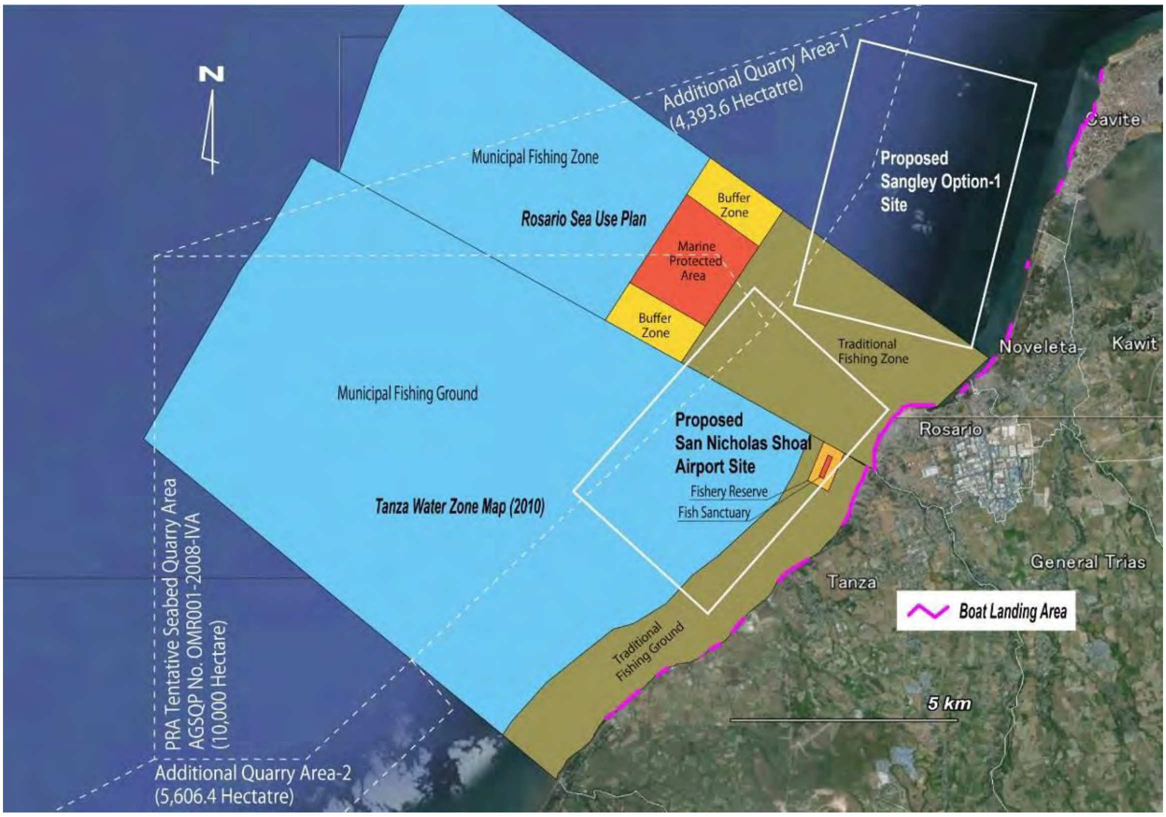


Figure 5.4-5 Tentative Location of Sand Quarry

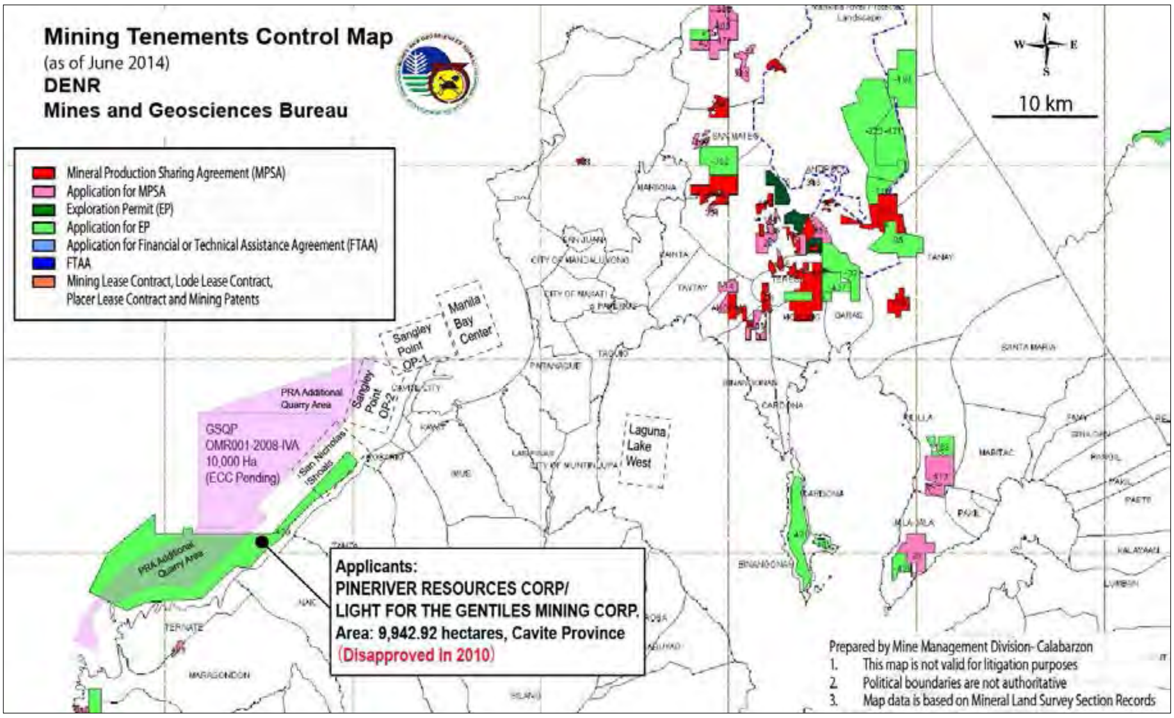
[Banning Sand Quarry in Manila Bay by DENR]

Presently, the sand excavation works is halted as DENR Secretary Jose Atienza Jr. ordered the PRA to stop its quarrying activities in Rosario and Tanza, upon receiving a petition from Rosario Mayor Jose Ricafrente Jr. in 2008, and the excavation is not resumed as of today (December 2015). The Secretary of DENR is now expecting PRA to receive ECC from DENR through submission of EIS before resuming the sand excavation in the Government Seabed Quarry Permit (GSQP) area. As soon as EIA report becomes available, the social impacts on the fisher folks should be reviewed thoroughly.

The Related law and regulations are listed below.

- Tanza Municipal Ordinance: No 11-95 prohibits the dredging, excavation, hauling of sand within Municipal fishery area in Tanza, Cavite Province.
- Fisheries Code of 1998: a permit to quarry is not issued to projects within a marine habitat

DENR is receiving other application for mining in the proximity areas as shown in Figure 5.4-6. An application of seabed quarry at offshore area of Tanza, Naic, and Ternate has not been approved up to now (December 2015).



Source： DENR (modified by JICA Study Team)

Figure 5.4-6 Mining Tenements Control Map of Vicinity Areas

5.4.3.2 Reclamation

There are distinctive differences in fishery practices among five alternative sites. Sea water area of Sangley Option-1, Option-2, and San Nicholas Shoal are used mainly for open water fishing. Manila Bay Center site is used as mussel and oyster culturing together with fish lift nets. Laguna Lake site is used as fish pens which are installed by business investors who rent the area from LLDA (Figure 5.4-7).

Fishing gears and perpetual loss of the fishing ground as income source of the fisherman need to be compensated. The estimation of the compensation is calculated and presented in Figure 5.4-8 together with land and resettlement cost.

For those who use open sea as fishing ground, a new reclaimed airport structure will be a large obstacle which must be detoured every morning and evening in addition to loss of fishing ground.

Figure 5.4-7 Fishing Gear Installations

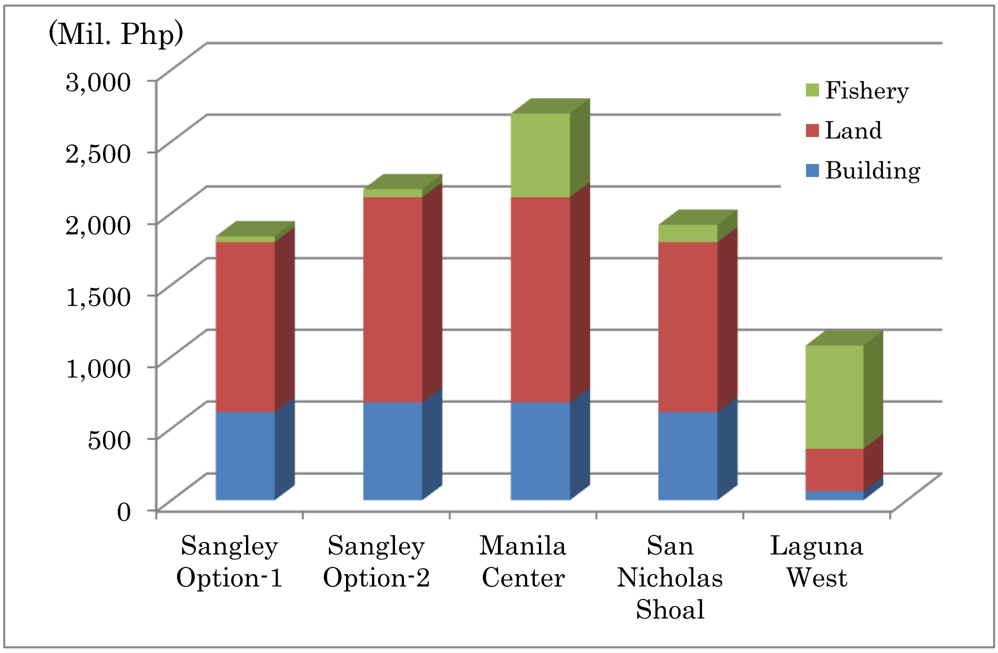


Figure 5.4-8 Estimation of Land and Building Cost

5.4.3.3 Impacts on Tourism

There are tourism businesses along the shore behind the proposed sites. The numbers are: three in Noveleta, one in Rosario, and eight in Tanza. It is expected that the many of the tourism business will be difficult as they are at present due to their open sea environment will be lost, the reclamation works over the years, and the sea water becoming half-closed water environment. The quality of sea water and the view will totally be changed due to less-circulated water body remaining behind the new airport.

5.4.3.4 Impacts on Natural Environment

There is no protected area or endangered species in and around the site except Ramsar Site (LPPCHEA). Location of LPPCHEA is shown in Figure 5.4-9.

Table 5.4-2 Outline of LPPCHEA

Name	Las Peñas – Parañaque Critical Habitat and Ecotourism Area (LPPCHEA)
Official Date of designation to Ramsar Site	March 15, 2013
Legal Background as a Critical Habitat	*Presidential Proclamation No. 1412 (2007), *Presidential Proclamation No. 1412-A (2008)
Managing Body	Manila Bay Critical Habitat Management Council, Chaired by Department of Energy and Natural Resources (DENR)
Area	175-hectare coastal wetland area
Importance	LPPCHEA lies along the East Asian – Australasian Flyway. The number of wild birds in the area could peak at around 5,000 heads per day.
Major Important Species	*Philippine Duck (Anas luzonica): breeding site *Black-Winged Stilts (Himantopus himantopus) : stopping over

Ocean side view of LLPCHEA

Lagoon side of LLPCHEA

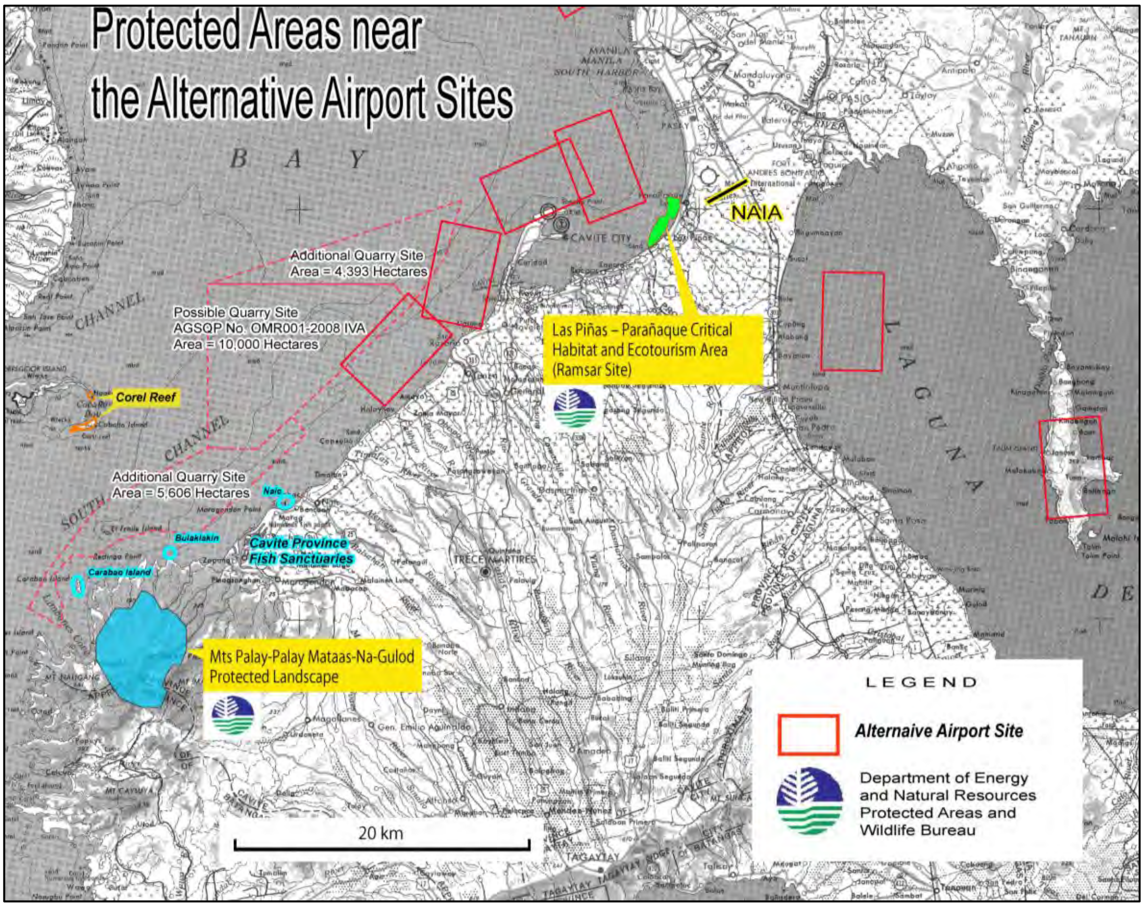


Figure 5.4-9 Protected Areas near Airport Alternative Sites

5.4.4 Erosion and Accretion

5.4.4.1 Unbalancing of demand and supply balance of sand

Direction of littoral drift along the shore is to the northeast at the Rosario area which is closest to Sangley Option-1 (Figure 5.4.10). As the south corner of the reclaimed airport blocks sand movement at Binakayan, Rosario City, accretion will occur at the western section; on the other hand, the eastern coastal area will be eroded as the sand supply from the west will be stopped. Accretion at the western side of the airport will easily clog the navigation channel for fishery boats.

Source: JICA Study Team

Figure 5.4-10 Recent Littoral Drift at the Southern Corner of Sangley Option-1 Site

5.4.4.2 Shallowing Bacoor Bay

Construction of airport at Manila Bay Center may shallow the area's seabed in the long-term. Figure 5.4-11 shows how Manila Bay Center airport site could disturb sediments from Ilong-Ilong River and Paranaque River running down the underwater slope. Since the areas such as Las Peñas, Parañaque, Bacoor, Noveleta, Kawit, and Imus are officially designated flood prone areas, shallowing of the rivers' estuary areas could aggravate flooding at upstream areas.

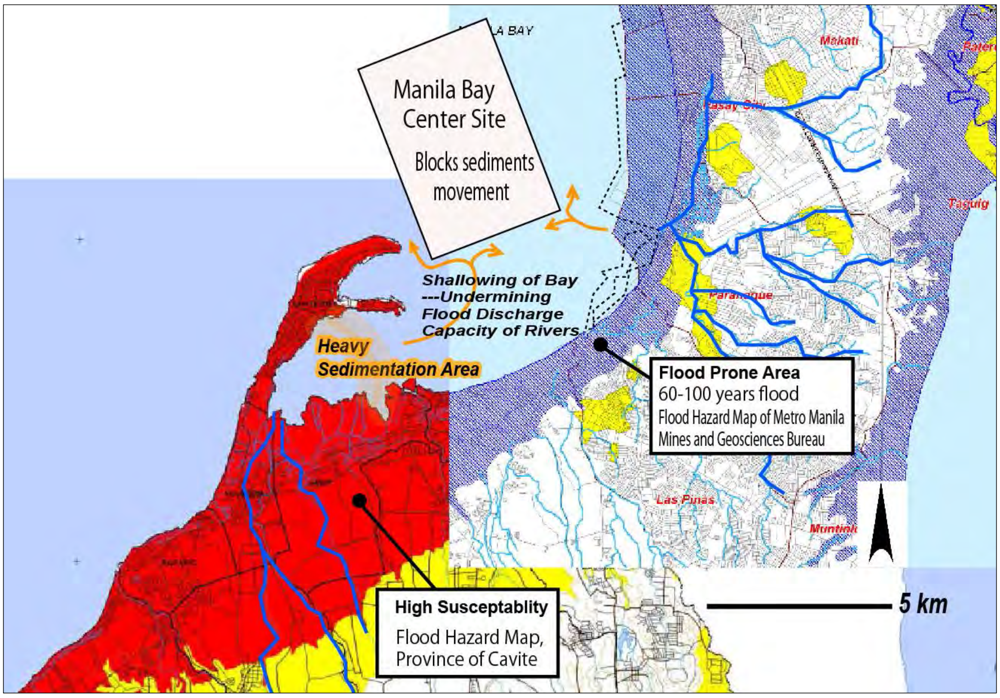


Figure 5.4-11 Shallowing Elements of Bacoor Bay

5.4.5 Sludge from Pasig River

There is a fear that new airport at offshore area of Manila Bay may block heavily polluted sludge coming from Pasig River, and deteriorate seabed of offshore area of Parañaque, Las Peñas, Bacoor, and Kawit. However, according to the bathymetry map and vector of effluent from Pasig River, shown in Figure 5.4-12, stagnation of the sludge by the new airport is not likely to occur. Sludge from Pasig River is not moving in to the offshore area of Parañaque City, suggesting that there is no major southward longshore current existing.

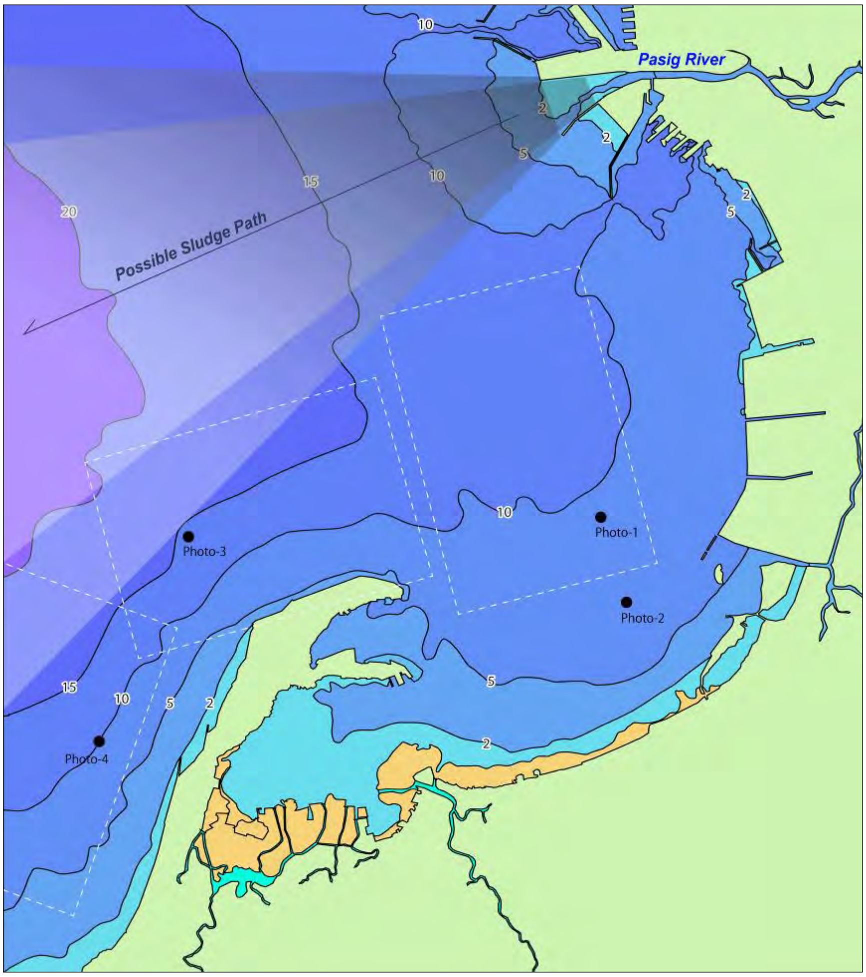


Figure 5.4-12 Possible Sludge Movement based on Bathymetry and Vector of Effluent

5.4.6 Mitigation Measures

The mitigation measures, described in Table 5.4-3 are proposed based on results of field survey and reviewing water quality and offshore current at the alternative sites. The significant impacts are expected as the scale of resettlement by rail road and access road. Other significant impacts are fishery ground loss by excavation and reclamation.

Table 5.4-3 Mitigation Measures for Environmental and Social Impacts of Alternative Sites

Type of Impact	Description of Expected Significant Impact	Possible Mitigation Measures	Corresponding Alternative site				
			Sangley OP1	Sangley OP2	Manila Bay Center	San Nicholas Shoal	Laguna West
1. Resettlement	- Access road and the interchanges, and railroad require resettlement for the land	- Alternation of the routes to the offshore area. - Redesigning of interchange locations	✔	✔	✔	✔	-
2. Water quality degradation & Sedimentation (during operation)	- Water surface of Bacoor Bay and nearby areas are susceptible to red tide already due to weak current. Reclaimed land will obstruct the weak littoral current and forms less-interchangeable waterbody. Thereby it aggravates the surrounding sea's water quality. - It also blocks littoral drift of sediment. It may cause the downstream area (northern part) be eroded; on the other hand, the western part will be accreted and clog rivers' outlets.	- Modification of airport boundary to secure water exchange - Installation of sewerage treatment plant at estuaries of rivers. - Water pollution control at the pollution sources (factories and domestic) - Periodical excavation is required, or setting-off the proposed airport location toward offshore direction	✔	✔	✔	-	-
3. Water quality degradation (During construction)	- Turbid plume emerges at the excavation site and reclamation area. Since settling speed is slow since bottom surface is covered by clay; and the plume may reach remote areas without proper mitigation measure. High pH in at the construction site may affect living environment of the surroundings.	- Avoid using clamshell dredger - Usage of water screens	✔	✔	✔	✔	✔
4. Narrowing of estuary	- Ilong-Ilong River has high sediment load, and the estuary is ever enlarging, making Bacoor Bay shallower. Reclamation of offshore area of Cavite Peninsula will block sediment proliferation away to the estuary. - Narrowed estuary will affect flood flow of the river	- Periodical excavation of the sediment near the new airport area and estuary channels. - Opening of channel to west side of Cavite Peninsula for another outlet of Ilong-Ilong River			✔		

Type of Impact	Description of Expected Significant Impact	Possible Mitigation Measures	Corresponding Alternative site				
			Sangley OP1	Sangley OP2	Manila Bay Center	San Nicholas Shoal	Laguna West
	and may aggravate flooding the flood prone upstream area.						
5. Livelihood (Airport construction on Fishery)	- Fisherman will lose 2,400 ha of municipal fishing ground - Fisherman who moor their boats behind the new airport will have to travel extra mileages for going outside of the airport costing more fuel and time - Intensity of fishing gear is higher at Manila Bay Center site and Laguna Lake site	- Monetary compensation, providing motorized boats - Creation of mooring facilities or land for fishing industries as compensation	✔	✔	✔	✔	✔
6. Livelihood (Seabed quarry on Fishery)	- Seabed quarry at the PRA proposed site will devastate impacts on Rosario and Tanza's (and may Naic, Ternate also) fishery resources. Severe damage on income source of fisher folks is expected.	- Compensation based on thorough survey and consultation with fisherman and LGU. - Support for alternative employment	✔	✔	✔	✔	
7. Livelihood (Tourism)	- Offshore reclamation will eliminate tourism assets (beach environment with view) of the area, causing the tourism industry less attractive.	- Compensation - Providing priority opportunities at new airport site	✔			✔	
8. Biodiversity	- There are fish sanctuaries in Rosario, Tanza and Muntinlupa, Laguna Lake. Tanza fish sanctuary will be totally lost by reclamation while the one in Muntinlupa will be behind the airport.	- Providing artificial fish reef near the airport area. Offshore structure may very well be good fish sanctuary with some modifications.				✔	✔
9. Resilience against flooding (Laguna Lake)	- Losing flood capacity of Laguna Lake for flood control purpose by replacing more than 36 million cum of waterbody by structure	- Excavation of the same amount of sediments from the Lake - Resettlement of people who live on low laying area - Create new discharge channel by using part of Ninoy Aquino International Airport, or by other routes.					✔

5.5 Assessment on Natural Disaster Risks

Natural disaster hazards which are expected in the study area are assessed as follows;

- ***Seismic Hazards***: There is no known active or potentially active fault cutting through all five sites although the West Valley Fault is considered a near source earthquake generator to Western Portion of Laguna de Bay and the site could experience excessively high peak ground acceleration if a magnitude 7.2 design earthquake occurs along the adjacent West Valley Fault. The other sites will experience relatively lower peak ground accelerations than Western Portion of Laguna de Bay. This site should be designed to be resilient to the expected earthquake especially for foundation, airport facilities and structure of access transport systems such as roads and railways.

  All sites are susceptible to settlement and liquefaction. Although the reclaimed areas themselves would be flat, the stability of the (submarine) slopes along the edges of the reclaimed areas is a concern.

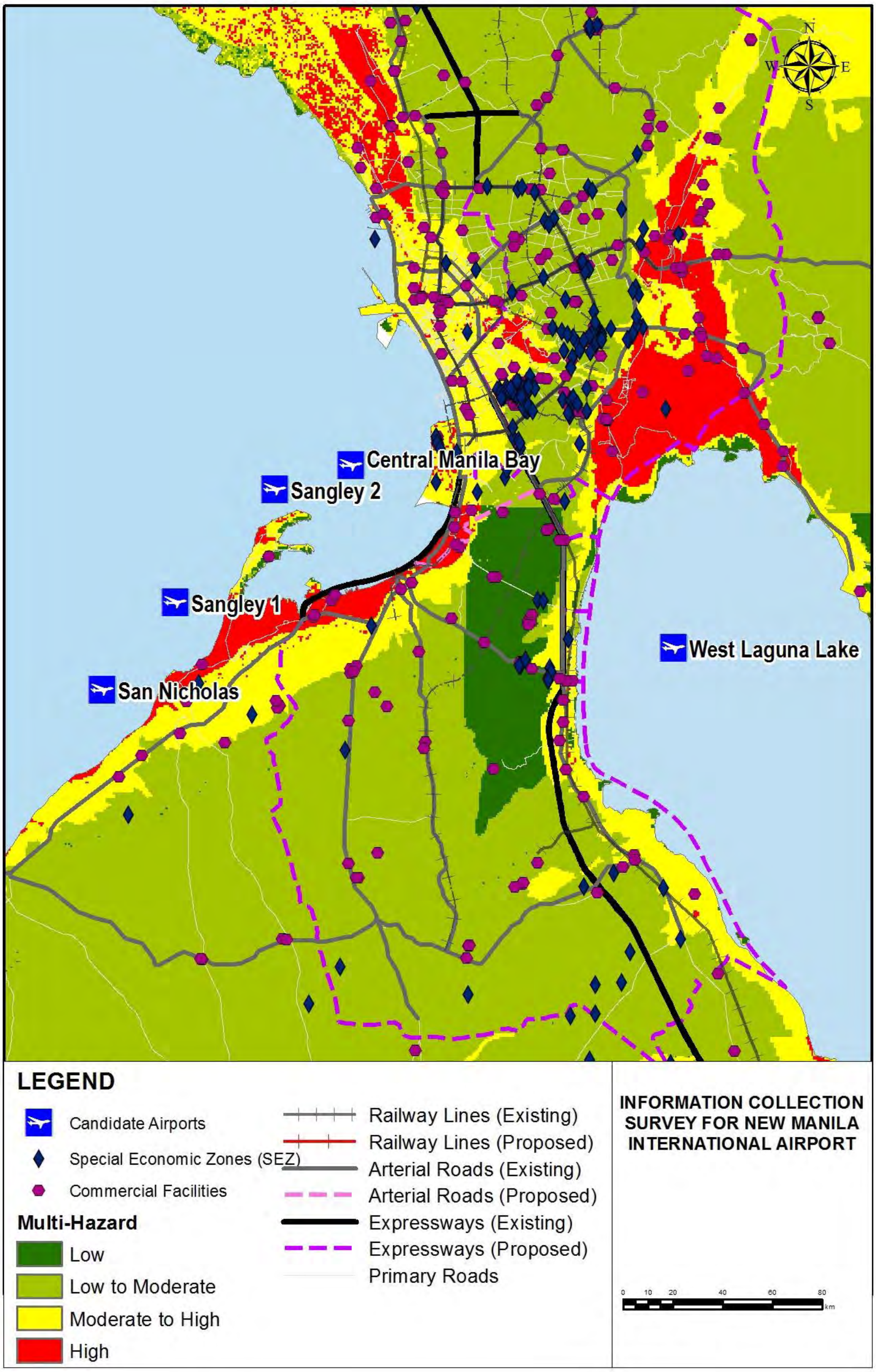
  Manila Bay is highly susceptible to tsunamis. The Manila Trench is considered a local source of tsunamis. Laguna Lake is not prone to tsunamis but should be checked against seiches.

- ***Coastal Hazards***: The reclaimed areas might interfere with longshore currents which distributes sediments along the coast. This can lead to coastal erosion and aggradation. Manila Bay is prone to tsunamis and storm surges.

- ***Fluvial Hazards***: Laguna Lake is used as a temporary storage for floodwaters. The lake coastal areas were submerged for about one month during Typhoon Ondoy and Habagat. Whether perceived or real, communities along the coastal areas of Sites 3 to 5 are expected to raise the issue of flooding.

- ***Volcanic Hazards***: All sites experienced ash fall during the 1991 Pinatubo eruption which can be considered a century eruption. It does not happen often.

- ***Vulnerability***: Figure 5.5-1 shows a multi-hazard map which is overlapped areas of several hazards (flood, landslide, liquefaction and tsunami) and overlaid with existing road network, location of Special Economic Zone (SEZ) and commercial facilities. The red colored area shows the highest hazard level areas where several hazards have high risk. Vulnerability of airport access roads and economic demands distribution are identified by this map.



Source: Prepared by JICA Survey Team based on data from NAMRIA

Figure 5.5-1 Industrial and Commercial Facilities and Multi-hazard Map

Table 5.5-1 summarizes the possible geohazard by the prospective airport sites. Types of the geohazard not applicable to the sites are coded as yellow (A) while those that are applicable or need further evaluation are in green (B).

It is recommended that further studies be conducted in the consequent study stage on the selected sites. The study should include geology, detailed seismic hazard assessment, geohazard (non-seismic) assessment, geotechnical engineering (bearing capacity, settlement and liquefaction) and coastal engineering. It is also recommended that a survey on the possible sources of fill material and armor rock be conducted. However, the damages caused by the expected disasters can be reduced and adopted by applying appropriate measures. Those measures should be investigated to construct a new airport resilient to the natural disasters.

Table 5.5-1 Summary of Geohazard Identification

	Site No. 1 Sangley Option 1	Site No. 2 Sangley Option 2	Site No. 3 Central Portion of Manila Bay	Site No. 4 San Nicolas Shoals	Site No. 5 West Laguna
seismic hazards					
ground motion	B	B	B	B	B
liquefaction	B	B	B	B	B
settlement	B	B	B	B	B
EQ-induced (submarine) landslides	B	B	B	B	B
tsunamis	B	B	B	B	A
seiche	A	A	A	A	B
coastal hazards					
coastal erosion	B	B	B	B	B
aggradation	B	B	B	B	B
storm surge	B	B	B	B	B
coastal flooding	B	B	B	B	B
scouring	B	B	B	B	B

	Site No. 1 Sangley Option 1	Site No. 2 Sangley Option 2	Site No. 3 Central Portion of Manila Bay	Site No. 4 San Nicolas Shoals	Site No. 5 West Laguna
subsidence	B	B	B	B	B
fluvial hazards					
inundation	A	A	B	B	B
volcanic hazards					
ashfall	B	B	B	B	B
slope instabilities					
submarine landslides	B	B	B	B	B

Source: JICA Survey Team

5.6 Examination on Seawall and Reclamation for Airport Platform Development

5.6.1 Assumed Elevations of Seawall and Reclamation

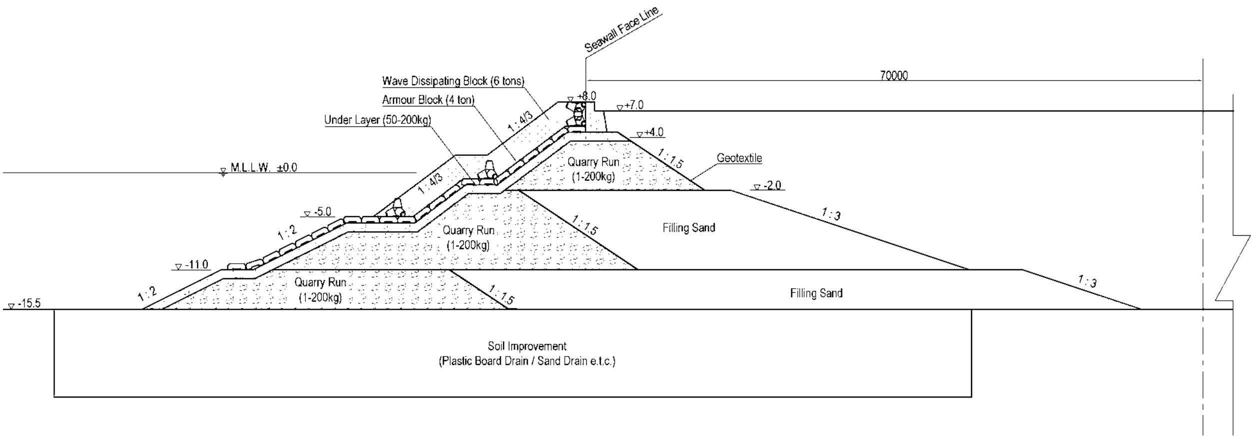
At Manila bay area, the elevation of reclamation area is +7.00 m, which is determined by evaluating its hydraulic performance restricting the wave overtopping the structure, such as Historical tsunami and/or storm surge and Local Sea level rise. The seawall's crown crest (1.00 m) is designed (Seawall elevation +8.00m) would be sufficient to keep the overtopping volume within acceptable limit (0.02 m^3/m/sec).

At Western Laguna Lake (LGL) area, the elevation of reclamation area is estimated +8.00 m, which is determined based on the new road construction datum line (Laguna Lake Dike Road PPP Project) and Future local subsidence (0.02m/year x 60years). The seawall's crown crest is designed (Seawall elevation +9.00 m).

5.6.2 Preliminary Concept Design of Seawall and Reclamation

5.6.2.1 Sewall

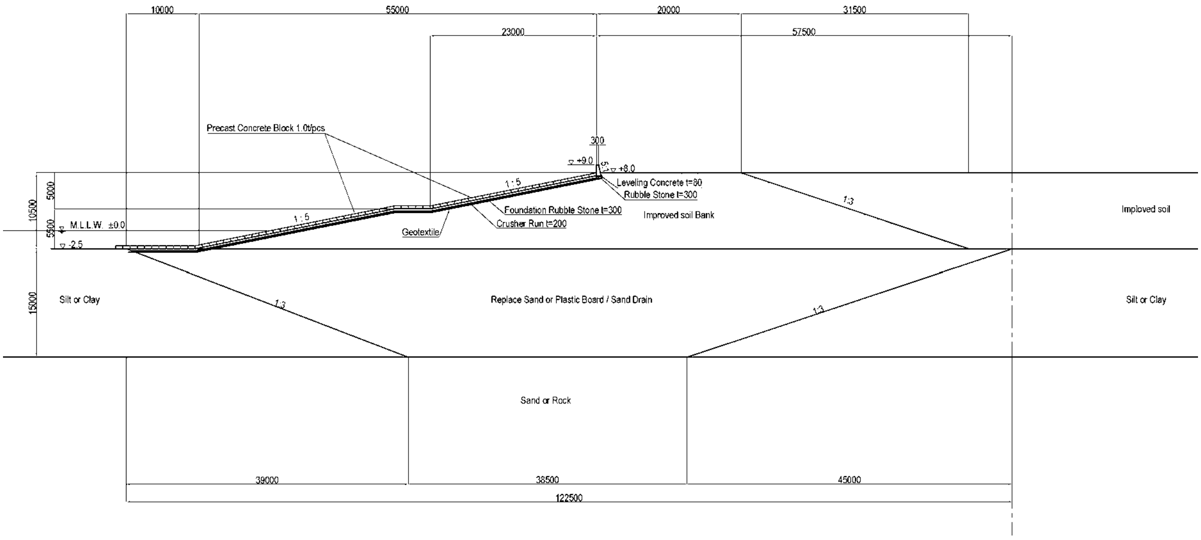
At Manila bay area, sloping seawall covered by wave-dissipating blocks will be used to dissipate the wave energy and restrict the volume of wave overtopping to the landward side. The minimum required weight of each wave dissipating blocks for candidate sites are calculated based on the Hudson's equation.



Source: Survey Team

Figure 5.6-1 Recommended Typical Section of Seawall in Manila Bay

Western Laguna Lake, site is located in the large freshwater lake and wave condition here is relatively calm. Therefore, countermeasures for wave run-up and/or overtopping are relatively low.



Source: Survey Team

Figure 5.6-2 Recommended Typical Section of Seawall in Laguna Lake

5.6.2.2 Reclamation

1) General Features

The average water depth for reclamation of Sangley Point (1), (2) and Manila Bay Center (MBC) are approximately -10m while -7m at San Nicolas Shoal (SNS) and -2.5 m at Laguna Lake West (LGL). The planned reclamation heights for the prospective sites at area are respectively +7m at Manila Bay and +8m at Laguna Lake West. Availability of Reclamation Materials

a) Reclamation at Manila Bay area

According to the Pre-FS carried out by PRA, it is concluded that sandy soil adequate for the land reclamation can be available at San Nicolas Shoal and its quantity can be sufficient for the whole reclamation.

b) Reclamation at Laguna De Bay

Based on the meeting with LLDA, cement mixing method with dredged soil deposited at the bottom of Laguna Lake is considered in this survey.

2) Consolidation Settlement

Estimated consolidation settlement of clay layer at each site is calculated, it is realized that as 80% consolidation time for one loading would take more than 10 months. Vertical drain method to accelerate the consolidation settlement shall be necessary.

3) Liquefaction

In the Liquefaction Susceptibility/Hazard Maps covering five (5) prospective sites suggest high possibility of liquefaction occurrence during earthquake with certain magnitude. The materials to be reclaimed are assumedly sourced from sea sand which has mostly probably the characteristic that will be fallen into the range of possibility of liquefaction.

4) Soil Improvement

a) Acceleration of Consolidation Settlement

The vertical drain is classified into two types (Prefabricated Vertical Drain method; PVD / Sand Drain method). Taking the effectiveness of the method, economy, past experience and efficiency into consideration, PVD is recommendable to be preferable method.

PVD is further fractionated materially to two (2) types such as plastic drain type (PD) and fiber drain type (FD). FD seems preferable method because of its flexibility and sturdiness against induced energy given by Dynamic Compaction Method (DCM) to be technically suggested as countermeasure for liquefaction particularly for sand fill of reclamation.

b) Liquefaction Prevention

Principles of the countermeasure are considered Four (4) types countermeasure techniques (Sand Compaction Pile; SCP / Dynamic Compaction Method: DCM / Vibrating bar with Suck-Up-Water / Grave Drain), taking the effectiveness of the method, economy, past experience and efficiency into consideration, DCM seems to be most preferable method.

5.6.3 Rough Estimate of Construction Cost

Result of rough cost estimation of seawall and reclamation at each prospective site is shown in followed tables.

Table 5.6-1 Summary of Cost of Seawall and Reclamation for 1,500 ha at Each Prospective Site

Unit; Million USD

No	Description	SG1	SG2	MBC	SNS	LGL
1	Revetment	1,218	1,429	1,485	1,112	2,704
2	Reclamation	3,529	3,847	4,437	2,950	13,767
3	Soil Improvement					
3.1	PVD	428	528	1,910	348	303
3.2	DCM	541	550	546	533	
	Total	5,716	6,354	8,379	4,942	16,774

Source: Survey Team

Table 5.6-2 Summary of Cost of Seawall and Reclamation for 2,400 ha at Each Prospective Site

Unit; Million USD

No	Description	SG1	SG2	MBC	SNS	LGL
1	Revetment	1,409	1,652	1,717	1,286	3,127
2	Reclamation	5,564	6,066	6,997	4,652	21,709
3	Soil Improvement					
3.1	PVD	675	833	1,004	548	478
3.2	DCM	853	867	861	840	
	Total	8,501	9,418	10,580	7,326	25,314

Source: Survey Team

5.7 Airport Access Traffic and Network

The airport access facilities described in this section are considered based on the existing and planned roadway/railway network in Metro Manila, for the purpose of comparison of the candidate sites for New Manila Airport in view of accessibility to/from city center and economic efficiency of construction.

Looking at the projected future travel demand at the New Manila Airport, the travel demand seems too large and it would not be able to be catered only with the existing and planned roadway/railway network. Therefore, holistic study for the urban transport network in Metro Manila would be necessary. Once the project site would be selected, the Airport Access Facilities should be reviewed together with a further study for roadway/railway network in Metro Manila.

Airport Access Road should have good accessibility from city center and neighboring provinces, and it would depend on the strength of road network, consisting of expressways, arterial roads, distributer roads and local roads. For better accessibility and connectivity in the existing and planned roadway network in Metro Manila, the routes of proposed Airport Access Roads are considered to be connected with upper hierarchy level roadways (e.g.: existing/proposed expressways or existing/proposed major roads).

Airport Access Rail should also have good accessibility to the railway network in Metro Manila. However, the current railway network in Metro Manila does not have enough capacity to fully cover the travel demand generated in Metro Manila and all the existing lines are currently seriously congested. Even if the Airport Access Rail have good connectivity to the existing railway network, passengers to/from NMIA, who normally have big baggage, would not be able to utilize the existing railway lines. Therefore, upgrading of passenger capacity of the existing railways is necessary to fully utilize the Airport Access Railway.

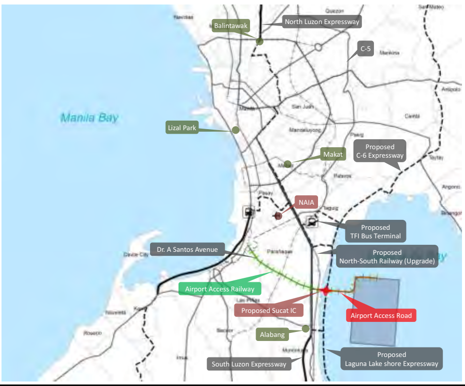
The Airport Access Rail proposed in this study has been identified as a possible shortest railway route in the future rail system and should therefore be understood to be indicative plan. Therefore, a comprehensive study should be carried out during the forthcoming feasibility study for development of the rail system for the specific site chosen.

The proposed Airport Access Road and Rail for each candidate site of New Manila Airport is summarized in Table 5.7-1

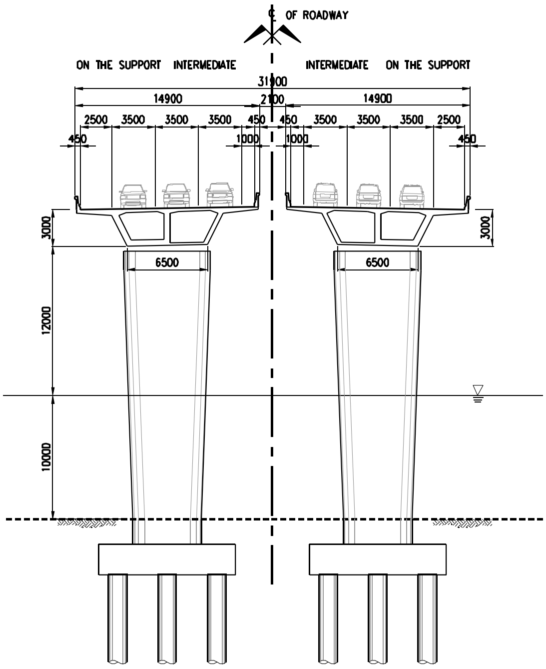
Figure 5.7-1 Existing and Planned Road/Railway Network in Metro Manila

Table 5.7-1 Examination of Prospective New Airport Sites on Airport Access

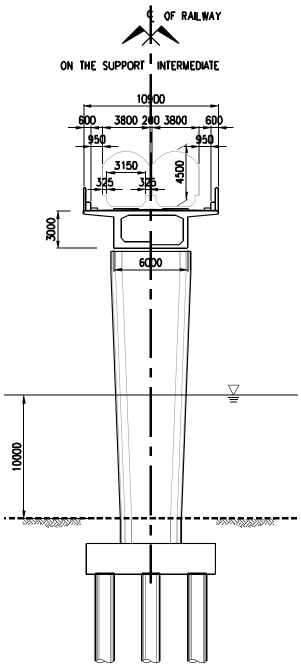
	Accessibility	Economic Efficiency
Sangley Point Option 1  	• Access Road will be connected with CAVITEX and CALAX. • Access Rail will be connected with LRT Line 1, Mega Manila Subway line and North-South Railway as well as the proposed FTI Bus Terminal. • Rizal Park: 32.5km (47min) • Makati: 32.5km (35min) • NLEX: 48.5km (49min) • SLEX: 30.5km (55min)	(Access Road) • Embankment: 5 km • Viaduct: 5 km • Interchange: 2 (Access Rail) • Viaduct: 18 km • Underground: 9 km • Station: 7 • Access Road: Php 26.5 bln. • Access Rail: Php 53.8 bln. • Total: Php 80.3 bln.
Sangley Point Option 2  	• Access Road will be connected with CAVITEX and Aguinaldo Blvd. • Access Rail will be connected with LRT Line 1, Mega Manila Subway line and North-South Railway as well as the proposed FTI Bus Terminal. • Rizal Park: 24.5km (39min) • Makati: 24.5km (27min) • NLEX: 40.5km (41min) • SLEX: 22.5km (47min)	(Access Road) • Embankment: 1.5 km • Viaduct: 7.5 km • Interchange: 2 (Access Rail) • Viaduct: 11 km • Underground: 9 km • Station: 4 • Access Road: Php 31.9 bln. • Access Rail: Php 43.8 bln. • Total: Php 75.7 bln.
Central Portion of Manila Bay  	• Access Road will be connected with CAVITEX and Aguinaldo Blvd. • Access Rail will be connected with LRT Line 1, Mega Manila Subway line and North-South Railway as well as the proposed FTI Bus Terminal. • Rizal Park: 20.5km (35min) • Makati: 20.5km (23min) • NLEX: 36.5km (37min) • SLEX: 18.5km (43min)	(Access Road) • Embankment: 1.5 km • Viaduct: 3.5 km • Interchange: 2 (Access Rail) • Viaduct: 7 km • Underground: 9 km • Station: 4 • Access Road: Php 20.9 bln. • Access Rail: Php 39.3 bln. • Total: Php 60.2 bln.

	Accessibility	**Economic Efficiency**
San Nicholas Shoals  	• Access Road will be connected with CAVITEX and CALAX. • Access Rail will be connected with LRT Line 1, Mega Manila Subway line and North-South Railway as well as the proposed FTI Bus Terminal.	(Access Road) • Embankment: 5 km • Viaduct: 5 km • Interchange: 2 (Access Rail) • Viaduct: 18 km • Underground: 9 km • Station: 7
	• Rizal Park: 32.5km (47min) • Makati: 32.5km (35min) • NLEX: 48.5km (49min) • SLEX: 30.5km (55min)	• Access Road: Php 26.5 bln. • Access Rail: Php 53.8 bln. • Total: Php 80.3 bln.
Western Portion of Laguna de Bay  	• Access Road will be connected with CAVITEX and CALAX. • Access Rail will be connected with LRT Line 1, Mega Manila Subway line and North-South Railway as well as the proposed FTI Bus Terminal.	(Access Road) • Embankment: 5 km • Viaduct: 4 km • Interchange: 1 (Access Rail) • Viaduct: 14 km • Underground: 1 km • Station: 5
	• Rizal Park: 31.5km (36min) • Makati: 25.5km (28min) • NLEX: 41.5km (42min) • SLEX: 17.0km (18min)	• Access Road: Php 22.7 bln. • Access Rail: Php 26.6 bln. • Total: Php 49.3 bln.

The following figures show the possible structural dimensions for roadway and railway viaduct.



Typical Cross Section
(Viaduct for 6-lane Roadway)



Typical Cross Section
(Viaduct for Railway)

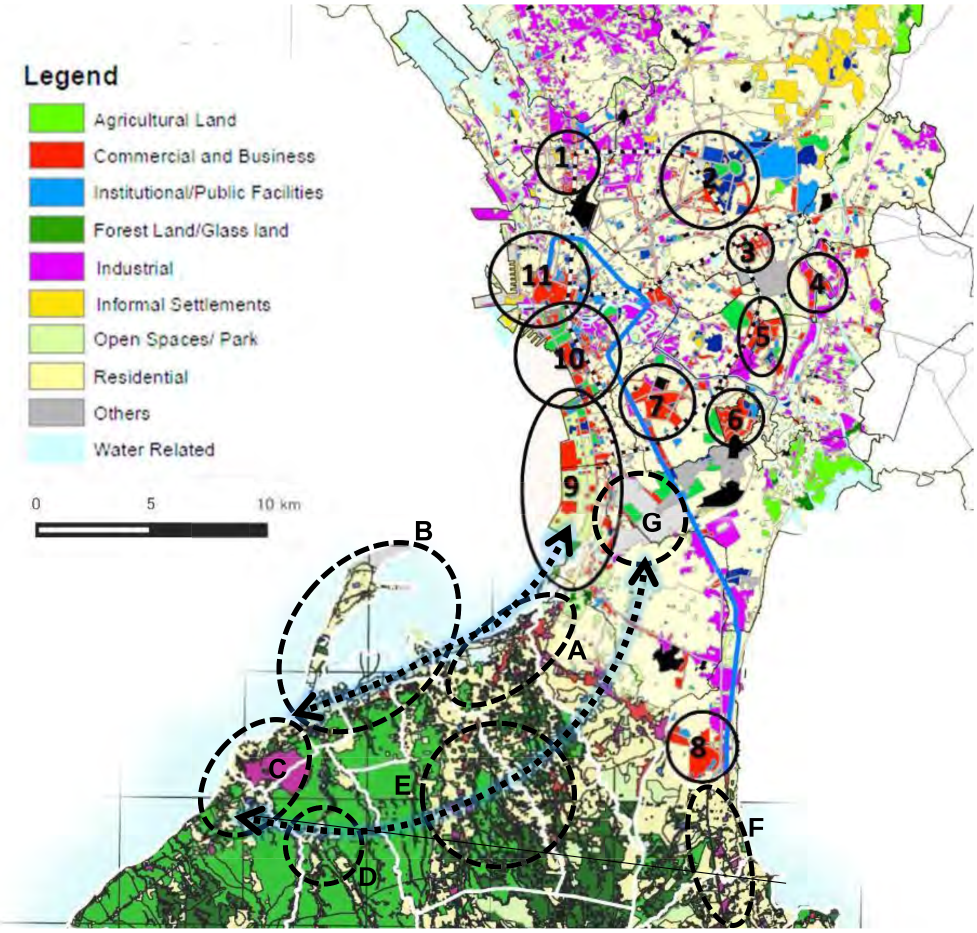
Figure 5.7-2 Airport Access Road and Rail Development Concept

5.8 Examination on Surrounding Land Use and Urban Development

1) Regional Context

According to the geographical context, NMIA is supposed to mainly accommodate the needs of south Metro Manila (MM), Cavite and Laguna Provinces. While north of MM includes undeveloped areas, south of MM becomes highly populated area towards the border of MM and the rapid urbanization extends to the north of Cavite and Laguna Province. Therefore, efficient land use needs to be promoted in these areas. However, formation of urban areas in the north of Cavite and Laguna province are not well organized due to the lack of coordination among Local Government Units (LGUs). In these new urban areas, regional transport system also needs to be improved to enhance the connectivity among LGUs towards sustainable urban growth.

As Figure 5.8-1 and Table 5.8-1 show, everal emerging Central Business Districts (CBDs) are identified in the north of Cavite and Laguna Province. Unfortunately, currently they're not fully functioned as CBDs due to the lack of connections with the existing CBDs in MM. Among future CBDs, current NAIA is expected to be an anchor to connect the existing and future CBDs due to its prime location. Therefore, early transition from NAIA to NMIA is desirable.



Source: JICA CBD Study and NAMRIA, 2005

Figure 5.8-1 Land Use and CBDs in MM, Cavite and Laguna Province

Table5.8-1 List of Identified CBDs in MM, Cavite and Laguna Province

No.	Identified CBD by CBD Study	No.	Future CBD identified by NMIA Study
1	Monument Area (Caloocan)	A	Sothern Manila Bay Area (Las Pniãs, Bacoor)
2	Quezon Circle Area (Quezon City)	B	Cavite and Bacoor Bay Area (Cavite, Novelta, Kawit)
3	Cubao (Quezon City)	C	Rosario-Tanza Coastal Area (Rosario, Tanza)
4	Eastwood City (Quezon City)	D	General Trias Area (General Trias)
5	Ortigas Center (Pasig)	E	Bacoor Imus Area (Bacoor, Imus)
6	Bonifacio Global City (Taguig)	F	Southern Muntinlupa and San Pedro Area (Muntinlupa, San Pedro)
7	Makati CBD (Makati)		
8	Alabang Center (Muntinlupa)	G	Current NAIA Area (Post relocation to NMIA) (Pasay, Paranãque)
9	Manila Bay Area (Pasay)		
10	Port Area (Manila)		
11	Central Manila (Manila)		

2) Central Manila Bay

Vicinity of Central Manila Bay site extends along the coast in the cities of Manila, Pasay and Paranãque. The area has been intensively developed since the early stage of urbanization of Manila (see Figure 5.8-2). The area encompasses old city center, port area, tourist area including historic sites, and reclaimed lands where mega developments are in progress.

Source: JICA Study Team

Figure 5.8-2 Concept Plan of Central Manila Bay

The proposed layout of Central Portion of Manila Bay was prepared mainly considering the following:

i) RP-P1:Malacanang should not be protruded by the obstacle assessment surfaces for the instrument flight procedures of aircraft approaching/departing NMIA;
ii) Horizontal and vertical limitation on the surrounding cities should be minimized and adequate distances between NMIA and the coastal areas should be provided;
iii) Any tall structures located in the Port of Manila, other than those in the anchorage area, should not infringe the obstacle limitation surfaces of NMIA.

In this case, a part of NMIA physically overlaps the Manila Port Zone. Some of the ship routes and anchorages are located under the approach/take-off climb surfaces, resulting in strict height limitation as depicted in Figure 5.8-3. The red line on the said Figure shows the boundary of Manila Port Zone and the squares are the anchorages with identifications of designated areas and numbers. Height limitations are also shown by yellow figures. According to officials of the Philippine Port Authority (PPA), the mast heights sometimes exceed 60 m above sea level. Should such height limitation be enforced, some of the anchorages located in areas B, C and Q would not be usable, resulting in significant reduction of the handling capacity of the Port of Manila. JICA Survey Team had several discussions with officials of PPA, and during the meeting held on 25 January 2016 attended by representatives of PPA, DOTC and the Survey Team, PPA expressed its opinion that such reduction of the handling capacity should not be acceptable for PPA. Therefore, Central Portion of Manila Bay site is to be regarded as less feasible from surrounding land use viewpoint.

Figure 5.8-3 Anchorages and Ship Routes located under Approach/Transitional/Horizontal Surfaces

Alternative runway orientation of 09/27 to avoid the height limitation on the port zone would result in another problem; significant negative impact on the land use of Cavite City as well as the coastal area of Metro Manila along CAVITEX. Conflict between the instrument flight procedure and RP-R76 is another issue inherent to the alternative Runway 09/27. In conclusion this site is to be regarded less feasible.

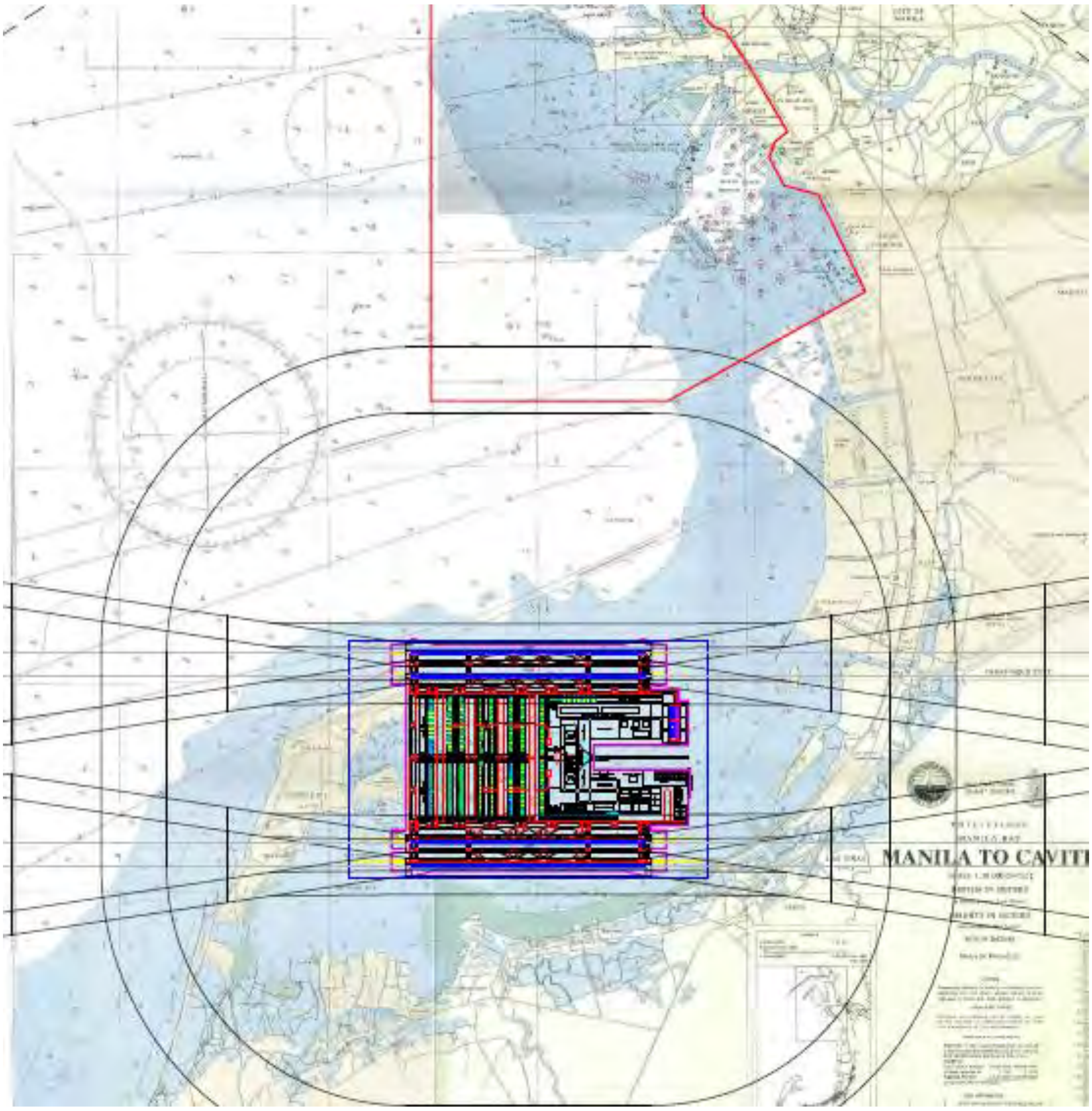
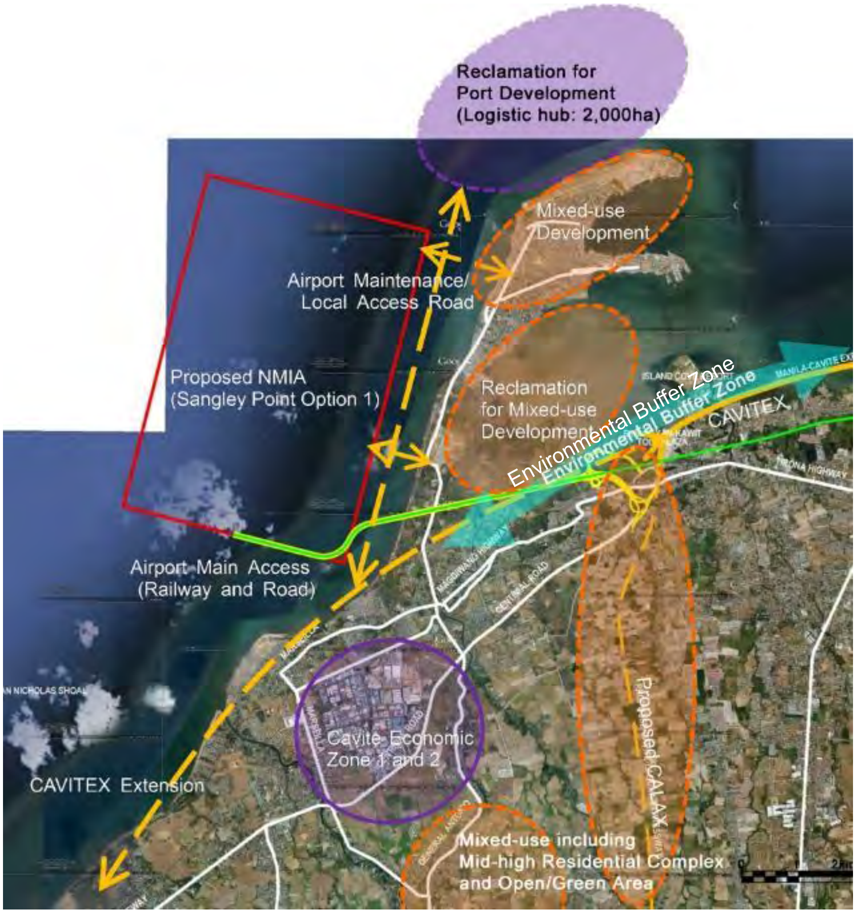


Figure 5.8-4 Alternative Location of Central Portion of Manila Bay Site
(Avoiding Overlapping and Height Restriction Problems)

3) Sangley Point Options 1 and 2

Sangley Point 1 is in the offshore of Cavite City and Noveleta while Sangley Point 2 is in Cavite City. Since the scale of NMIA is so large that other municipalities such as Imus, Bacoor, Las Pinãs, Paranãque, among others, will also be directly and indirectly affected. Since currently large-scale (2,000ha) port development has been planned according to the provincial development physical framework plan to construct an international logistic hub, proposed access should be considered for the integration with the proposed port development as well as the existing industrial areas (Cavite Economic Zone 1 and 2) designated by the Philippine Economic Zone Authority (PEZA) in order to maximize the benefits by the airport development. In response to such needs, local access shown in Figures 5.8-5 and 5.8-6 has been proposed in addition to the proposed airport main access. The local access also provides the benefits for both local community and NMIA since it mitigates the traffic congestion and serves as the maintenance access for the airport service vehicular as well.

In order to maximize the benefit of the development of NMIA and logistic hub, further reclamation is desirable in Baccor Bay. On the other hand, current reclamation projects along Manila Bay need to be revised to enhance environmental integration as a buffer zone of coastal area.



Source: JICA Study Team

Figure 5.8-5 Concept Plan of Sangley Point Option 1

Source: JICA Study Team

Figure 5.8-6 Concept Plan of Sangley Point Option 2

4) San Nicholas Shoal

San Nicholas Shoal site is located offshore of the municipalities of Rosario and Tanza. While Rosario is highly developed, developed areas in Tanza are sporadic. Since there are no noteworthy projects within the immediate influenced area by NMIA except for some industrial areas, development of NMIA and relevant infrastructure may not provide the significant positive impacts comparing to the other candidate sites. In order to foster a new CBD as shown in Figure 5.8-2, integration of these municipalities and NMIA needs to be enhanced.

In order to enhance the integration and maximize the benefits of the development of NMIA, the access for the local community and the existing industrial areas as well as for the maintenance should be considered as shown in Figure 5.8-7 in addition to the main access. Extension of CAVITEX is desirable not only for the better local access but also for the better regional access to the western coastal area in Cavite province including some major resort areas. Since large scale residential development is not identified in the vicinity of San Nicholas Shoals due to its fragmented and relatively small-scale land ownership, consolidated and efficient land use needs to be promoted to accommodate the influx of population from MM. Therefore, large scale residential and mixed-use development is desirable along major roads such as Emilio Aguinald Highway and proposed CALAX as illustrated in Figure 5.8-7.

Source: JICA Study Team

Figure 5.8-7 Concept Plan of San Nicholas Shoals

5) Western Laguna Lake

Western Laguna Lake area is located along main urban and transport corridors connecting the north and south as well as the east and west of Metro Manila. As Laguna Lakeshore Expressway Project involves development of flood free urban land, integration with the development of NMIA will stimulate the multiplier effects on socio-economic especially in terms of urban development. In order to enhance the linkage with the emerging CBD in Alabang, local access including maintenance access for the airport service vehicular is desirable to be developed in addition to the airport main access as shown in Figure 5.8-8.

Source: JICA Study Team

Figure 5.8-8 Concept Plan of Western Laguna Lake

5.9 Summary Result of Detail Examination

In summary following are the key findings based on the technical examination on the five prospective new airport sites.

a) Sangley Point Option 1 is feasible option as:

i) The instrument flight procedures can be established without conflict with the existing major restricted/prohibited airspaces for both the Ultimate Phase Options 1 and 2. Coordination with relevant authorities regarding risks of aircraft crash into the PETRON oil terminal in Rosario might be required.

ii) Although number of the involuntary resettlement is significant, the other sites also would require significant number of the involuntary resettlement except for Western Portion of Laguna de Bay. As Western Portion of Laguna de Bay site would require excessive level of the cost for the platform development, it is considered less feasible option and cannot be an alternative to Sangley Point Option 1, subject to the proposed confirmation based on the actual boring data in the next feasibility study stage.

iii) Sangley Point Option 1 can be regarded feasible in terms of the risk of natural hazard and the airport accessibility as well as surrounding land use and urban development as it offers at least a similar level of feasibility to the other sites.

iv) The cost for the platform and access road development as well as land acquisition and compensation of Sangley Point Option 1 is the second lowest after San Nicholas Shoals. In order for San Nicholas Shoals to be an alternative to Sangley Point Option 1, the conflict issue between the instrument flight procedures and RP-P1 must be resolved.

b) Sangley Point Option 2 is less feasible option as:

i) The instrument flight procedures for both Ultimate Phase Options 1 and 2 would conflict with RP-P1, RP-P74, RP-P75 and RP-P76. Coordination to remove or relax these airspace limitations could be very difficult, subject to decision by the Government of the Philippines.

ii) The required cost for platform and access road development as well as and acquisition and compensation is more than Sangley Point Option 1.

iii) No significant advantage has been recognized from the other examination aspects compared with Sangley Point Option 1.

c) Although there are several advantages for development of NMIA at the Central Portion of Manila Bay, this site is less feasible option as the expected reduction of the handling capacity of the Port of Manila mainly due to the height limitation for safe aircraft operations should not be acceptable for the Philippine Port Authority. Alternative runway orientation of 09/27 to avoid the height limitation on the port zone would result in another problem;

significant negative impact on the land use of Cavite City as well as the coastal area of Metro Manila along CAVITEX. Conflict between the instrument flight procedure and RP-R76 is another issue inherent to the alternative Runway 09/27. In conclusion this site is to be regarded less feasible.

d) San Nicholas Shoals is less feasible option unless the conflict between its instrument flight procedures and RP-P1 is successfully coordinated as:

i) The instrument flight procedures would conflict with RP-P1 for both the Ultimate Phase Options 1 and 2. Coordination to remove or relax the airspace limitations could be very difficult, subject to decision by the Government of the Philippines.
ii) This site would require significant number of involuntary resettlement for development of the access road.
iii) San Nicholas Shoals can be regarded feasible in terms of the risk of natural hazard and the cost implication.
iv) From the airport accessibility as well as surrounding land use and urban development viewpoints, this site is moderate to less feasible level.
v) However, the cost for platform and access road development as well as land acquisition and compensation of this site is the least among five prospective new airport sites.

e) Western Portion of Laguna de Bay is less feasible, subject to the proposed confirmation based on the actual boring data in the next feasibility study stage, as:

i) Although the instrument flight procedures for Western Portion of Laguna de Bay would penetrate RP-R73: Barbados Airstrip, this airspace is for skydiving, aerobatic flying, ultra-light and aero-model operations and successful coordination could be expected. For both the Ultimate Phase Options 1 and 2, overlapping with RP-P1 can be avoided.
ii) This site would offer the least number of involuntary resettlement.
iii) A risk of excessively high peak ground acceleration could be anticipated in case of magnitude-7.2 earthquake to be caused by West Valley Fault.
iv) From the airport accessibility as well as surrounding land use and urban development viewpoints, this site is feasible.
v) However, the cost for platform development of this site is excessively large due to the poor sub-soil condition and non-availability of proper reclamation materials.

Above-mentioned result of the examination for new airport sites is summarized in Table 5.9-1.

Table 5.9-1 Summary of the Results of Detail Examination

Item	Sangley Point Option 1	Sangley Point Option 2	Central Portion of Manila Bay	San Nicholas Shoals	Western Portion of Laguna
Airspace Utilization and Aircraft Operations	Possible for both options.	Very difficult for both options. Conflict with RP-P1, RP-R73, RP-R75.	Possible for option1 only. Control of surrounding developments required.	Very difficult for both options. Conflict with RP-P1.	Possible for both options. Conflict with RP-R73 could be coordinated.
Environmental and Social Considerations	Significant Involuntary resettlement 4,100 people	Significant Involuntary resettlement 6,200 people	Significant Involuntary resettlement 6,200 people	Significant Involuntary resettlement 4,100 people	Less Involuntary resettlement 300 people
Risk of Natural Hazard	Feasible	Feasible	Moderate Migrant birds could be cause of bird strike.	Feasible	Less feasible Excessively high peak ground acceleration anticipated
Reclamation for Platform Development	Feasible	Feasible	Feasible	Feasible	Not Feasible Stabilization of dredged fill material and lake bed.
Airport Access: Travel time from Makati	Moderate About 35 min.	Feasible About 27 min.	Feasible About 23 min.	Moderate About 35 min.	Very good as connectable with LLED and PNR. About 28 min.
Surrounding Land Use and Urban Development	Feasible	Feasible	Conflict with port zone not acceptable for PPA	Less Feasible	Feasible
Cost for Opening Day *2	Million US$ 10,860	Million US$ 11,645	Million US$ 13,482	Million US$ 10,065	Million US$ 22,146 *4
Overall	Feasible	Less feasible	Less feasible *3	Less feasible *1	Less feasible *4

Notes for Table 5.9-1

*1: In case of San Nicholas Shoals site, if the airspace utilization issue is successfully coordinated, overall rating should be regarded as Feasible.

*2: The "Cost for Opening Day" includes costs for the platform development (approximately 1500 ha), access road, land acquisition for the access road construction, compensation (for ultimate phase 2400 ha) as well as the airport facilities for the opening day but exclude the costs for the engineering, contingencies, taxes and duties and other incidental costs. See Table 5.9-2.

*3: A part of PPA port zone would overlap the airport property. The ships anchored in the port zone would infringe the obstacle limitation surfaces of NMIA. The handling capacity of the Port of Manila would be significantly restricted by the overlapping and height limitation, which should not be acceptable for PPA.

*4: The cost estimate and hence overall examination result for this site should be reviewed based on actual boring data to be conducted in the next master plan and feasibility study.

Table 5.9-2 Breakdown of Preliminary Construction Costs

(Million US$)

Items	Sangley Option 1	Sangley Option 2	Central Manila Bay	San Nicholas Shoals	Western Laguna
A. Platform Development (1500 ha)	**5,716**	**6,354**	**8,379**	**4,942**	**16,774**
Seawall	1,218	1,429	1,485	1,112	2,704
Reclamation	3,529	3,847	4,437	2,950	13,767
Acceleration of Consolidation Settlement	428	528	1,910	348	303
Liquefaction Prevention	541	550	546	533	0
B. Airport Access Development (Opening Day)	**588**	**705**	**464**	**588**	**504**
Expressway	588	705	464	588	504
Rail	0	0	0	0	0
C. Land Acquisition and Compensation (2400 ha)	**41**	**48**	**48**	**42**	**24**
D. Subtotal (A+B+C)	**6,344**	**7,107**	**8,890**	**5,573**	**17,301**
E. Airport Facilities Development (Opening Day)	**4,200**	**4,200**	**4,200**	**4,200**	**4,200**
Airfield/Landside Civil Facilities	707	707	707	707	707
Buildings	2,689	2,689	2,689	2,689	2,689
Utilities	646	646	646	646	646
CNS/ATM & AGL	159	159	159	159	159
F. General Requirement	**315**	**338**	**391**	**292**	**644**
G. Total for Opening Day (D+E+F)	**10,860**	**11,645**	**13,482**	**10,065**	**22,146**

Reference: Platform Development (2400 ha)	8,501	9,418	10,580	7,326	25,314

Note. Cost estimate was done based on the platform size of 1500ha and airport facilities on the opening day. However the cost of compensation for affected fisherfolk was estimated for the required platform size of 2400ha for the long-term. The cost does not include engineering, contingencies, taxes and duties and other incidental costs.

6. PRELIMINARY ECONOMIC AND FINANCIAL ANALYSIS

6.1 Basic Approach

Based on the objective of the Survey, a preliminary economic analysis and financial analysis for NMIA development project has been carried out to grasp any problem and viewpoint related to the approximate amount of project costs, project finance, operating expenditures/revenues, economic effects and others that should be considered in the future study such as Full Feasibility Study (FS) based on the following conditions:

a) The analysis has been carried out for the site of Sangley Point Option 1 that was rated as feasible in the Survey and the results of this analysis are not to be used to compare with other sites,

b) The preliminary construction cost estimated in Section 5 has been adopted as the basis in this analysis,

c) The operating costs and expenditures at NMIA have been estimated based on the present financial data of NAIA, and no modification (including establishment of new fees/charges) has been considered for improvement of the profitability,

d) The economic benefits have been estimated based on the forecast calculated in Section 2 including traffic distribution between NMIA and CRK,

e) Various parameters for the analysis such as the time value, access time and foreign visitors' average expenditure, etc. have been estimated based on the existing statistical data and information.

6.2 Total Project Cost and General Project Implementation Schedule

The total project cost for initial phase development of NMIA was estimated based on the following preliminary assumptions as shown in Table 6.2-1 and general project implementation schedule was prepared as shown in Figure 6.2-1.

i) The cost for development of NMIA would be financed by a foreign soft loan and own fund of the Government of the Philippines;

ii) The annual maintenance, replacement and operation cost would 1.0% of the total construction cost in the first five years, to be increased to 2.0% from sixth to tenth years and further to 3.0% thereafter.

iii) The consulting service cost would be 8% of the total construction cost;

iv) Physical contingencies of the construction and consulting service costs would be 10% and 5% respectively;

v) The price escalation rates of foreign and local portions would be 2.0% and 3.5% respectively;

vi) The interest rates of the foreign soft loan would be 0.1% for the construction works and 0.01% for the consulting services;

vii) Rate of VAT and import tax would be 12% and 5% respectively;

viii) Cost for the Project Management Unit (PMU) would be 2% of the total construction, consulting services and land acquisition and compensation costs;

ix) A front end fee of 0.2% of the foreign soft loan amount would be payable by the borrower;

x) The foreign soft loan would cover 100% of the eligible portion which would not include the land acquisition and compensation cost, the cost of PMU, taxes and duties; and

xi) Exchange rate used for computation is US$=PHP 45.157.

Table 6.2-1 Estimated Total Project Cost for Initial Phase Development of NMIA

Item		Project Cost		
		FC	LC	Total
A. ELIGIBLE PORTION				
Ⅰ)	Procurement / Construction	6,126	421,511	15,460
	Division 1: General Requirements	95	9,980	316
	Division 2: Platform Development	2,285	154,888	5,715
	Division 3: Airport Access	206	17,250	588
	Division 4: Airport Civil Facilities	107	27,139	708
	Package 5: Building Works	1,479	54,685	2,690
	Package 6: Utilities	355	13,096	645
	Package 7: CNS/ATM and AGL	95	2,845	158
	Base Cost	4,622	279,883	10,820
	Price Escalation	947	103,309	3,235
	Physical Contingency	557	38,319	1,405
Ⅱ)	Consulting services	741	16,106	1,098
	Base Cost	606	11,741	866
	Price Escalation	100	3,598	180
	Physical Contingency	35	767	52
Total (Ⅰ + Ⅱ)		6,867	437,617	16,558
B. NON ELIGIBLE PORTION		0	0	0
a	Procurement / Construction	0	0	0
	Base Cost	0	0	0
	Price Escalation	0	0	0
	Physical Contingency	0	0	0
b	Land Acquisition	0	2,296	51
	Base Cost	0	1,806	40
	Price Escalation	0	281	6
	Physical Contingency	0	209	5
c	Administration Cost	0	15,000	332
d	VAT	0	52,790	1,169
e	Import Tax	0	15,505	343
Total (a+b+c+d+e)		0	85,591	1,895
TOTAL (A+B)		6,867	523,208	18,454
C. Interest During Construction (IDC)		74	0	74
	Interest during Construction (Const.)	73	0	73
	Interest during Construction (Consul.)	1	0	1
D. Front-End Fee		33	0	33
GRAND TOTAL (A+B+C+D)		6,974	523,208	18,561
E. Foreign Soft Loan Finance Portion incl. IDC (A+C+D)		6,974	437,617	16,665

Source: JICA Survey Team

The project implementation schedule has been estimated as shown in Figure 6.2-1 based on the following assumptions:

i) Current JICA Data Collection Survey is to be completed by early 2016, followed by implementation of the Full Feasibility Study (FS) for one and a half years.

ii) EIA is to be carried out simultaneously with the FS. EIA is to be finalized based on the result of FS and submitted to DENR/EMB in 2018 for approval and issuance of ECC.

iii) The period from 2018 to 2019 is for various financial arrangements including securing a foreign soft loan.

iv) In the first half of 2019, necessary approval of PRA on the reclamation project will be secured and the engineering consultants will be selected for the design, tender documentation as well as the detail environmental and social examination.

v) Selection of the contractors will be commenced in 2020 and to be completed by 2024 step by step starting from the platform development as well as the airport access road and bridge, followed by the airport airside and landside civil works, the building and utility works, the CNS/ATM and aeronautical ground lights.

vi) The contractors' mobilization and preparatory works will be started in 2021.

vii) The platform development works will be commenced in 2022 and to be completed in five years.

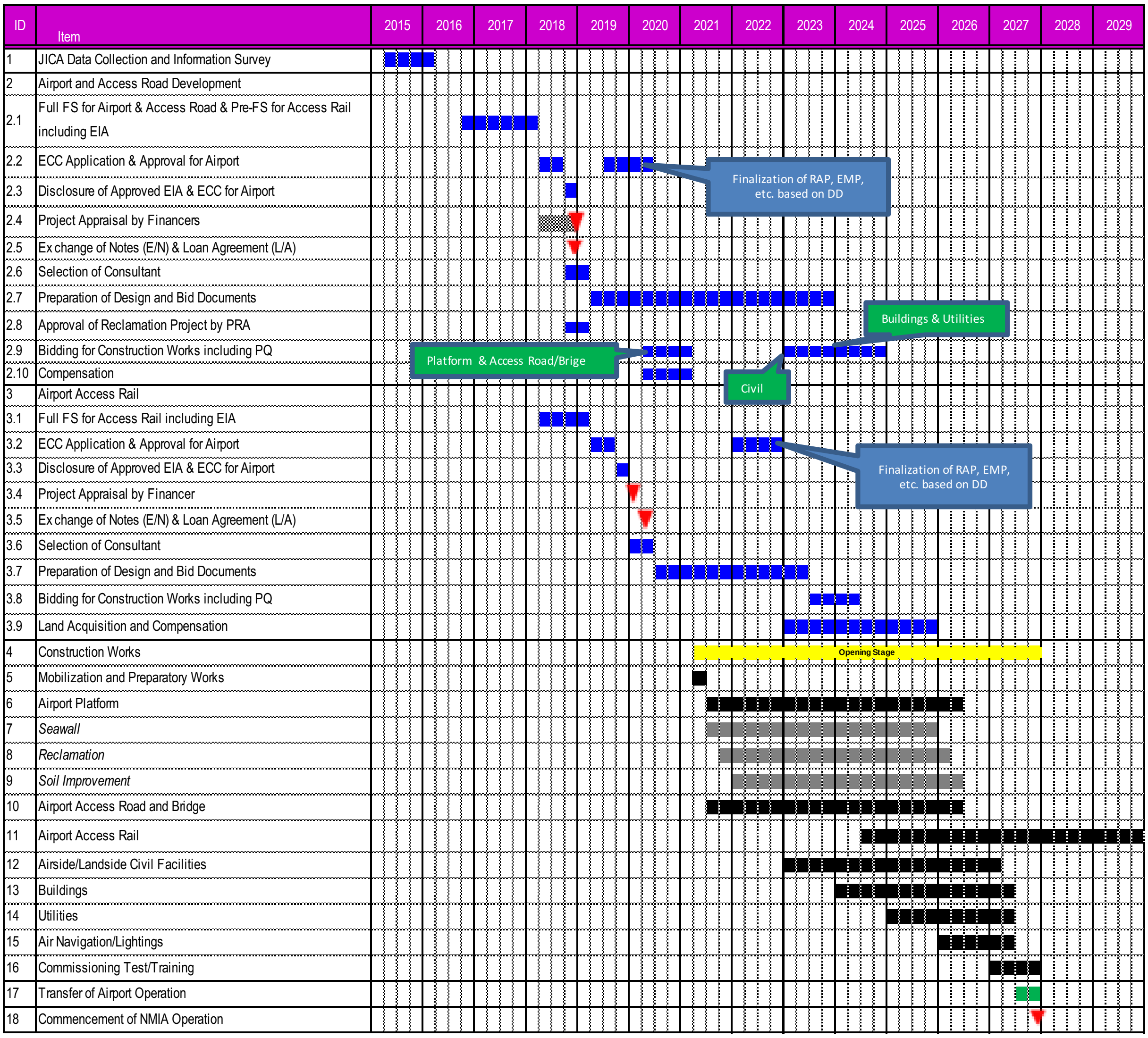
viii) Construction of 3-lane each airport access road will be developed simultaneously with the platform development.

ix) Approximately two years after commencement of the platform development, the works for airport facilities development will be commenced and to be completed in four years, followed by a half year familiarization as well as preparation for transfer of the airport operation.

x) New Manila International Airport will be opened in 2028.

xi) An airport access rail development will continue until sometime after inauguration of NMIA.

A general project implementation schedule is shown in Figure 6.2-1.



Source: JICA Survey Team

Figure 6.2-1 General Project Implementation Schedule for Initial Development of NMIA

6.3 Economic Analysis

6.3.1 With Project Case and Without Project Case

The expected return of the Project should be evaluated as incremental benefits attributable to improvement of the facilities.

i) With Project Case

The airport capacity of NMIA will be same as air traffic demand in 2030 (76,599,000 of total air passengers). Therefore, the capacity of GCR will be 89,099,000 passengers (including the capacity of CRK as 12,500,000).

ii) Without Project Case

Capacity limit of the existing NAIA is set at 41,500,000 of total air passengers, and the capacity of GCR is 54,000,000 passengers (including the capacity of CRK as 12,500,000). And it is assumed that thereafter in the air passenger traffic would not increase any more.

The relationship between With Project Case and Without Project Case are shown in below figures.

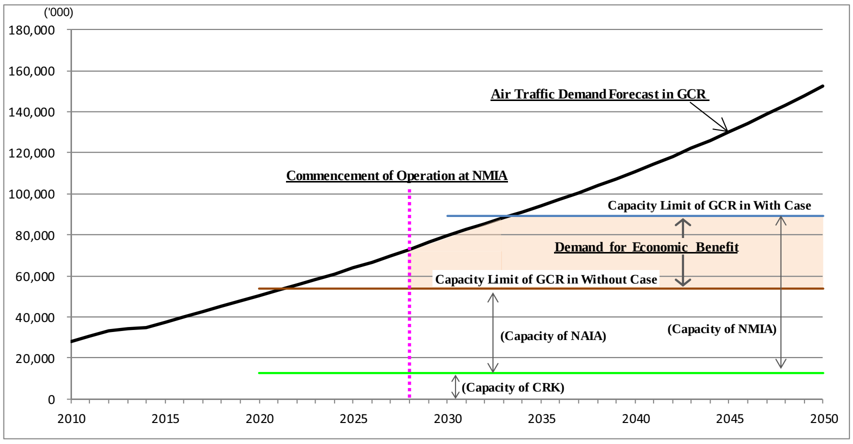


Figure 6.3-1 Air Passenger Traffic Demand for Benefits Estimate

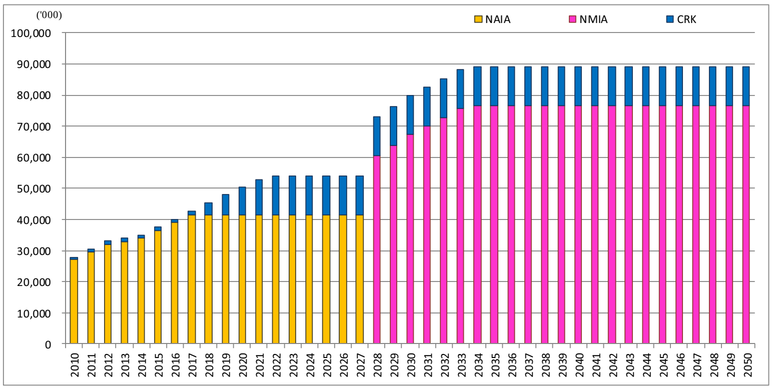


Figure 6.3-2 Air Passenger Traffic Demand in GCR by Airport (With Project Case)

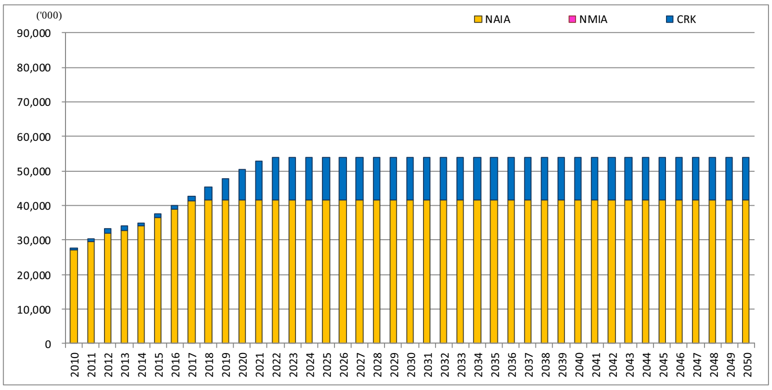


Figure 6.3-3 Air Passenger Traffic Demand in GCR by Airport (Without Project Case)

6.3.2 Preconditions of Analysis

- ✓ Standard Price: Constant price as of 2015 in Philippines Peso (PhP).
- ✓ Commencement of Service at NMIA: Assumed in 2028.

- ✓ Project Evaluation Period: From 2017 as beginning year of the Project to 2057 as thirtieth (30th) year after commencement of operations at NMIA (2028).
- ✓ Social Discount Rate: Adopted as 15.0%

6.3.3 Economic Costs and Benefits

1) Economic Cost

The project implementation cost was adopted as shown in Table 6.3-1 (excluding the price escalation, interest during construction and taxes).

Table 6.3-1 Project Implementation Costs for Economic Analysis

(PhP Million)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Eligible Portion		3,446	3,786	4,006	37,726	74,263	80,486	104,852	144,776	101,414	38,251	527	593,533
Construction Cost					30,082	63,250	67,609	88,044	122,123	85,535	31,955		488,599
Consulting Services		3,270	3,589	3,792	3,832	3,092	4,097	5,084	6,071	4,022	1,764	493	39,106
Contingency		176	198	214	3,811	7,921	8,779	11,725	16,582	11,856	4,532	34	65,828
Non-Eligible Portion	1,502	444	824	831	883	1,779	1,981	2,643	3,725	2,661	1,021	14	18,308
Construction Cost		361	722	722									1,806
Adminnistration Cost		83	101	109	883	1,779	1,981	2,643	3,725	2,661	1,021	14	15,000
Others	1,502												1,502
Total Project Cost	1,502	3,890	4,610	4,838	38,609	76,042	82,467	107,495	148,501	104,075	39,272	542	611,841

Source: JICA Survey Team

The operation and maintenance costs were calculated by referring to actual expenditures of MIAA, difference of facility scale between NAIA and NMIA, and estimated construction cost of NMIA.

2) Economic Benefits

i) Saved loss of airport revenues payable by air passengers and air lines

The aeronautical revenues were calculated based on present aeronautical tariff at NAIA.
The non-aeronautical revenues were estimated based on present income statement of MIAA and difference of the airport facilities area between NAIA and NMIA.

ii) Saved loss of travel opportunities for domestic passengers due to travel cancellation

The benefits were calculated using average expenditure of domestic travelers in the Philippines (PhP 1,622 per traveler; DoT).

iii) Saved loss of consumption by international passengers due to travel cancellation

The benefits were calculated using average expenditure of foreign visitors to the Philippines (PhP 39,102 per traveler; DoT).

iv) Saved loss of domestic and international cargo trade opportunities due to transport cancellation

The benefits were calculated using average commodity value per tonnage of domestic air cargo in the Philippines (PhP 10,200 per ton; PSA) and average trade value per tonnage of international air cargo at NAIA (PhP 4,683,600 per ton; PSA).

v) Loss of airport access time due to difference of airport locations

The losses due to access time were calculated using average access time of each airport (based on actual records) and assumed time values of air passengers/cargoes (based on evaluation in MUCEP, actual air cargo tariff, PSA Statistics and IMF date; see below).

- ✓ Air Passenger: (Domestic) PhP 115.8/hr. (International) PhP 1,534.8/hr.
- ✓ Air Cargo: (Domestic) PhP 47.9/hr./ton (International) PhP 635.3/hr./hr.

vi) Sale of the existing NAIA property

The land of existing NAIA will be freed up for other economic uses. The economic benefit is calculated as sale of the existing NAIA property (land) by commercial land unit price as approximately PhP 38,700 Million.

6.3.4 Result of Economic Analysis

The result of Economic Analysis for NMIA Development Project is summarized in Table 6.3-2. And sensitivity analysis of the EIRR on negative side is made as shown in Table 6.3-3.

Table 6.3-2 Result of Economic Analysis

Indicators	Calculation
Economic Internal Rate of Return (EIRR)	13.4 %
Economic Net Present Value (ENPV)	PhP - 23,815 million
Benefit Cost Ratio (BCR)	0.85

Source: JICA Survey Team

Table 6.3-3 Result of Sensitivity Analysis for EIRR

Case		Benefits		
		- 20%	- 10%	+/- 0%
Costs	+ 20%	9.3%	10.6%	11.7%
	+ 10%	10.0%	11.3%	12.5%
	+/- 0%	10.8%	12.2%	13.4%

Source: JICA Survey Team

As shown Table 6.3-2, EIRR was calculated as 13.4 % and that is lower than the Social Discount Rate (SDR) adopted by NEDA in the Philippines (15%).

6.4 Financial Analysis

6.4.1 With Project Case and Without Project Case

The expected return of the Project should be evaluated as incremental revenues attributable to improvement of the facilities.

i) With Project Case

The airport capacity of NMIA will be same as air traffic demand in 2030 (76,599,000 of total air passengers).

ii) Without Project Case

The capacity limit of the existing NAIA has been set at 41,500,000 of total air passengers, and it is assumed that thereafter in the air passenger traffic would not increase any more at NAIA.

Air passenger traffic demand in MNL (NAIA and NMIA) is adopted for 2 cases as follows.

a) Base Case

Air passenger demands in NAIA and NMIA calculated using trend models are used to analyze.

b) Traffic Distribution Case

Air passenger demands in NAIA and NMIA estimated under the scenario for traffic distribution between NMIA and CRK are used to analyze.

The relationship between With Project Case and Without Project Case are shown in below figures.

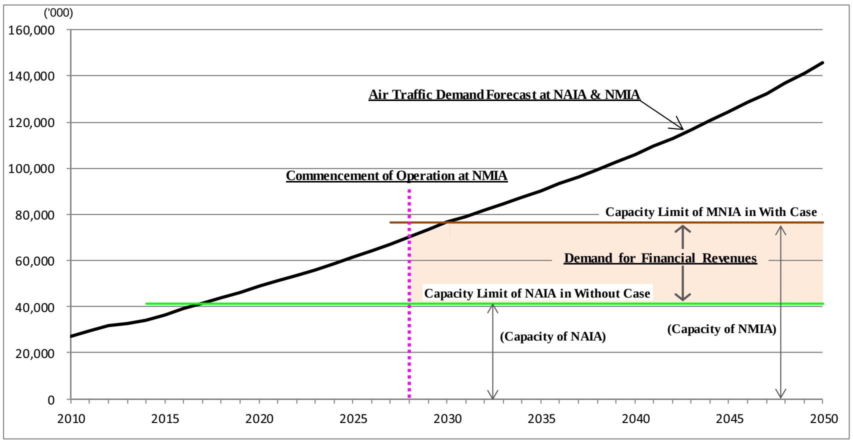


Figure 6.4-1 Air Passenger Traffic Demand for Financial Revenues

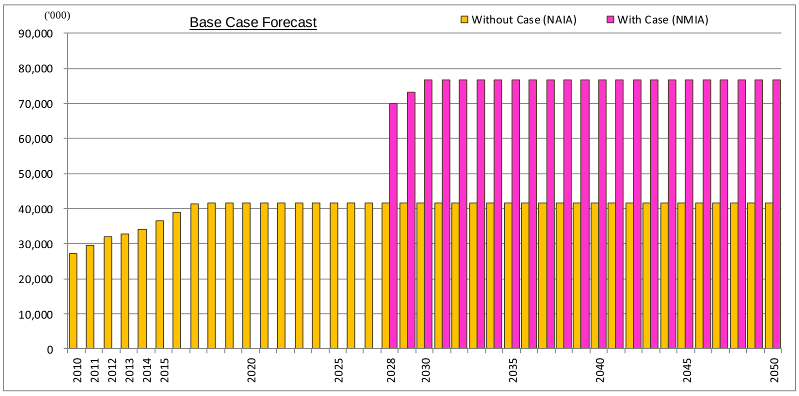


Figure 6.4-2 Air Passenger Traffic Demand at NAIA and NMIA (Base Case)

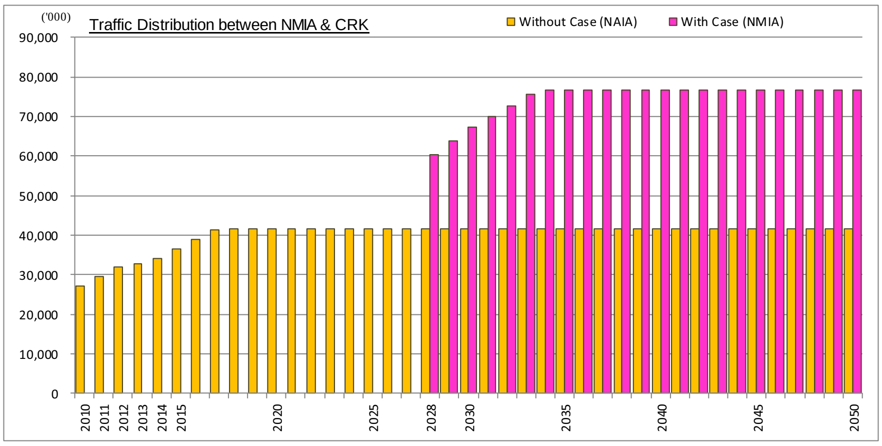


Figure 6.4-3 Air Passenger Traffic Demand at NAIA and NMIA (Traffic Distribution Case)

6.4.2 Preconditions of Analysis

The precondition of Financial Analysis is on equal terms with Economic Analysis.

6.4.3 Expenditures and Revenues

1) Expenditures

The project implementation cost is adopted as shown in Table 6.4-1 (excluding the price escalation and interest during construction).

Table 6.3-1 Project Implementation Costs for Financial Analysis

(PhP Million)

	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Total
Eligible Portion		3,446	3,786	4,006	37,726	74,263	80,486	104,852	144,776	101,414	38,251	527	593,533
Construction Cost					30,082	63,250	67,609	88,044	122,123	85,535	31,955		488,599
Consulting Services		3,270	3,589	3,792	3,832	3,092	4,097	5,084	6,071	4,022	1,764	493	39,106
Contingency		176	198	214	3,811	7,921	8,779	11,725	16,582	11,856	4,532	34	65,828
Non-Eligible Portion	1,502	761	1,232	1,269	5,043	10,062	11,307	14,943	20,639	14,416	5,361	67	86,603
Construction Cost		361	722	722									1,806
Administration Cost		83	101	109	883	1,779	1,981	2,643	3,725	2,661	1,021	14	15,000
Tax		317	408	437	4,161	8,283	9,326	12,301	16,913	11,755	4,341	53	68,295
Others	1,502												1,502
Total Project Cost	1,502	4,207	5,018	5,275	42,769	84,325	91,793	119,795	165,414	115,830	43,613	594	680,136

Source: JICA Survey Team

As for operating and maintenance expenses, the same operation, maintenance and replacement expenses estimated in Economic Analysis are used in this analysis.

2) Revenues

Both of aeronautical revenues and non-aeronautical revenues estimated in Economic Analysis are used in this study. And the land sale of existing NAIA is included as extraordinary income. The sales price was calculated as approximately PhP 38,700 Million.

6.4.4 Result of Financial Analysis

The result of Financial Analysis for NMIA Development Project is summarized in Table 6.4-2.

Table 6.4-2 Result of Financial Analysis

Indicators	Base Case	Traffic Distribution Case
Financial Internal Rate of Return (FIRR)	- 5.8 %	- 12.2 %
Financial Net Present Value (FNPV)	PhP - 157,839 million	PhP - 162,800 million
Benefit Cost Ratio (BCR)	0.10	0.07

Source: JICA Survey Team

As shown Table 6.4-2, FIRR were estimated as -5.8% in Base Case and -12.2% in Traffic Distribution Case. Major reasons behind incalculable is the enormous amount of construction cost (especially cost of platform development) against small amount of operating revenue.

7. IMPLEMENTATION ARRANGEMENT

The realization of the new NAIA will span about 10 years – wherein the implementing arrangements would need to change in accordance with its development phases or stages.
The 1st phase is the pre-construction period that covers site selection, planning and design of the new airport facilities. The 2nd phase focuses on site development works, followed by construction of the aerodrome facilities. The 3rd phase is the operations and maintenance of the completed facility.

Organizing for Phase 1: The recommendations of the 2011 JICA "Study on Airport Strategy for GCR" on implementation arrangement focused on phase 1 activities. The key points of its recommendations are summarized hereunder:

- Establishment of a joint organization, which essentially places the concurrent development of MNL and CRK under one umbrella (which it referred to as GCRA Special Task Force);
- Adoption and execution of a TDR regime that will re-allocate traffic from MNL to CRK;
- Implementation of a "capacity-based" development scheme for NAIA, which would start in 2012 and ends in 2020;
- Extensive privatization of NAIA and DMIA operations;
- Creation of a GCR Airport Authority – either by legislation or executive action - that will merge MIAA and CIAC.

The last two items are more relevant to phase 3 activities - but assumed a situation where the existing NAIA would remain in conjunction with CRK. This was the Base Case scenario mentioned earlier. Hence, it omitted the construction of a new airport facility. Implicitly, it conceded that the responsibilities for all capital improvement projects for MNL and CRK shall remain with the appropriate SOEs, i.e., by MIAA for MNL and by CIAC for CRK. The site selection can be handled by the aforementioned Task Force (assuming that this Task Force has been created). Considering precedents, however, such a decision would ultimately end up at the NEDA-ICC and the Office of the President.

Organizing for Phase 2: Once a decision is made on the preferred site, a Project Management Office should be organized to handle the construction of NMIA on this preferred site. Such a PMO can be formed in three ways:

i) By MIAA (if site is within NCR) under its charter (EO No. 778 s1982), is responsible for the development and management of the country's premier gateway airport within NCR;

ii) By CAAP (if site is outside NCR), which is responsible for all other airports outside NCR and Cebu.

iii) By DOTC, as it is wont to do under the current administration.

The 3rd option is more appropriate under the following circumstances:

- Site development would entail inter-agency collaboration (road works by DPWH, reclamation by PRA);
- Funding would rely on ODA and/or GAA that is beyond the financial capability of NAIA or CAAP, which are two corporate entities that are independent but attached to DOTC;

The development of new NAIA can be divided into two phases: site development (cost ~Php90 billion) and airport facility construction (cost ~Php189 billion). The second maybe considered for PPP, but the first stage should follow traditional mode of implementation - via direct government funding. The reasons for eschewing the PPP modality for the site development works are as follows:

- Site development will entail reclamation works on site classifiable as in the public domain and outside the commerce of man, i.e., cannot be titled by private entities;
- A project with long gestation period without intermediate cash flows will face difficulty in financial closing;
- The construction will involve substantial geotechnical works with its attendant uncertainties;
- To avoid the cascade effect of construction delays that might subject the project to long-drawn legal challenges;
- The social and environmental obstacles present risks that can be handled better by the public sector;
- Financial viability of new NAIA (as presented in Section 10.5) will not pass the private Sector's ROI hurdle rate, especially with the addition of site development cost.

When the site is almost ready, a PPP approach should be considered for the 2nd stage of construction. This is a natural progression to what DOTC is currently implementing for the existing NAIA.

Organizing for Phase 3: The recommendation of the 2011 "Study on Airport Strategy for GCR" for a single airport authority, however, needs further review. Efficiency considerations do not favor a monopoly provider. An environment of friendly competition between new NAIA and Clark can be more beneficial to the country. Organizing separate but cooperating bodies is all the more advisable, in the event that the privatization of existing NAIA pans out.

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Abbreviation	Full Text
A	
AAGR	Average Annual Growth Rate
ABN	Aerodrome Beacon
ACC	Airport Consultative Committee
ACC	Area Control Center
ACI	Airports Council International
ACN	Aircraft Classification Number
ADB	Asian Develoopment Bank
ADS/B	Automatic Dependent Surveillance/Broadcast
ADRM	Airport Development Reference Manual
AFTN	Aeronautical Fixed Telecommunication Network
AGL	Aeronautical(Airfield) Ground Lights(lighting)
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
ALOS	Advanced land observing satellite
AMHS	Aeronautical Message Handling System
ANF	Air Navigation Facilities
ANS	Air Navigation Service
APCH	Approach
APM	Automated People Mover
APP	Approach Control
APV	Approach procedures with vertical guidance
AR	Authorization required
ARP	Aerodrome Reference Point
AR5	Fifth Assessment Report
ASEAN	Association of South East Asian Nations
ASTER	Advanced spaceborne thermal emission and reflection radiometer
ATC	Air Traffic Control
ATFM	Air Traffic Flow Monitoring
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Services
ATZ	Aerodrome Traffic Zone
AUSAid	Australian Agency for International Development
AWOS	Automatic Weather Observation System
B	
B-C	Benefit Cost Ratio
Baro VNAV	Barometric vertical navigation
BCDA	Bases Conversion and Development Authority
BFAR	Bureau of Fisheries and Aquatic Resources
BIR	Bureau of Internal Revenue
BOI	Bureau of Immigration
BOT	Build-operate-and-Transfer
Brgy	Barangay (Smallest unit of policital administration)
C	
CAA	Civil Aviation Authority
CAAP	Civil Aviation Authority of the Philippines
CALAX	Cavite-Laguna Expressway
CAT	Category
CAVITEX	Manila-Cavite Expressway
CBD	Central Business District
CC	Congregatory Species
Cgo	Cargo
CIAC	Clark International Airport Cooperation
CIQ	Customs, Immigration and Quarantine
CLUP	Comprehensive Land Use Plan
CNS	Communications, Navigation and Surveillance Systems
CNS/ATM	Communications, Navigation and Surveillance Systems for Air Traffic Management
COD	Chemical Oxygen Demand
CPA	Conservation Priority Area
CPI	Consumer Price Index
CR	Critically Endangered Species
CRK	Clark International Airport

Abbreviation	Full Text
CSCAND	Collective Strengthening on Community Awareness on Natural Disasters
CSEZ	Clark Special Economic Zone
CT	Cargo Terminal
CTR	Control zone
C-5	Circumferential Road 5
D	
DAM	Daily Aircraft Movements
DAO	Department Administrative Order
DCM	Dynamic Consolidation Method
DEM	Digital elevation model
DENR	Department of Environment and Natural Resources
DH, DA/H	Decision Height, Decision altitude/height
DLT	Design Low Tide Level
DME	Distance Measuring Equipment
DO	Dissolved Oxygen
DOM	Domestic
DOTC	Department of Transportation and Communications
DPWH	Department of Public Works and Highways
DVOR	Dopler Very High Frequency Omni Directional Radio-Range
DMY	Dummy Variable
DoT	Department of Tourism
E	
ECC	Environmental Compliance Certificate
EDSA	Epifanio Delos Santos Avenue
EIA	Environmental Impact Assesments
EIRR	Economic Internal Rate of Return
EIS	Environmental Impact Statements
EMB	Environmental Management Bureau
EN	Endangered Species
ENPV	Economic Net Present Value
EO	Executive Order
F	
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FAP	Final approach point
FD	Fiber Drain
FedEx	Federal Express
FIRR	Financial Internal Rate of Return
FL	Flight level
FLO	Apron Flood Lights
FMS	Flight Management System
FNPV	Financial Net Present Value
ft	Feet
FTI	Food Terminal Incorporated
G	
GA	General Aviation
GBAS	Ground Based Augmentation System
GCR	Greater Capital Region
GCR Airport Study	The Study on the Airport Strategy for the Greater Capital Region in the Republic of the Philippines" (November 2011, JICA)
GCRA	Greater Capital Region Airport
GDP	Gross Domestic Product
GNSS	Global Navigation Satellite System
GOJ	Government of Japan
GOP	Government of the Republic of the Philippines
GP	Glide path
GRDP	Gross Regional Domestic Product
GRP	Gross Regional Product
GSLR	Global Sea Level Rise
GSQP	Government Seabed Quarry Permit
GTC	Ground Transportation Center
H	
HHWL	Highest High Water Level
HWL	High Water Level

Abbreviation	Full Text
I	
IAF	Initial Approach Fix
IAP	Instrument Approach Procedures
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICT	International Cargo Terminal
IEE	Initial Environmental Examination
IF	Intermediate Fix
IFP	Instrument flight procedure
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMF	International Monetary Fund
IPCC	Intergovernmental Pannel on Climate Change
IRR	Implementing Rules and Regulations
IUCN	International Union for Conservation of Nature
J	
JAXA	Japan aerospace exploration agency
JCAB	Japan Civil Aviation Bureau
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
K	
KBA	Key Biodiversity Areas
KIAC	Kansai International Airport Corporation
KIAS	Knot indicated airspeed
KOICA	Korea International Cooperation Agency
L	
LAHSO	Land and Hold Short Operations
LC	Legacy Carrier
LCC	Low Cost Carriers
LDA	Localizer-type directional aid
LDBDL	Laguna De Bay Datum
LGU	Local Government Units
LJ1	Over 400 seater Large Jet Aircraft
LJ2	350 seater Large Jet Aircraft
LLDA	Laguna Lake Development Authority
LLED (P)	Laguna Lakeshore Expressway Dike (Project)
LLWL	Lowest Low Water Level
LLZ/LOC	Localizer
LMO	Lake Management Office
LPPCHEA	Las Peñas-Parañaque Critical Habitat and Ecotourism Area
LRT	Light Rail Transit
LWL	Low Water Level
M	
MA	Missed approach
MAPt	Missed approach point
MCIAA	Mactan-Cebu International Airport Authority
MENRO	Municipal Environmental and Natural Resources Officer
MET	Meteorological
METAR	Met Airport Report
MGB	Mines and Geosciences Bureau
MHHW	Mean Higher High Water Level
MHW	Mean High Water Level
MIA	Manila International Airport
MIAA	Manila International Airport Authority
MICT	Manila International Container Terminal
MJ	Medium Jet Aircraft
MLIT	Ministry of Land, Infrastructure, Transportation and Tourism
MLLW	Mean Lower Low Level
MLW	Mean Low Water Level
MLS	Microwave landing system
MMDA	Metropolitan Manila Development Authority
MMEIRS	Metro Manila Earthquake Impact Reduction Study
MOC	Minimum obstacle clearance
MPA	Million Passengers per Annum

Abbreviation	Full Text
MPN	Most Probable Number
MRO	Maintenance, Repair and Overhaul
MRT	Metro Rail Transit
MSL	Mean Sea Level
MSSR	Monopulse Secondary Surveillance Radar
MT	Metric Tons
MTL	Mean Tide Level
MTOW	Maximum Take-Off Weight
MWL	Mean Water Level
N	
NAIA	Ninoy Aquino International Airport
NAMRIA	National Mapping and Resource Information Authority
NASA	National aeronautics and space administration
NCR	National Capital Region
NDB	Non-Directional Radio Beacon
NDCC	National Disaster Coordination Council
NEDA	National Economic and Development Authority
NIPAS	National Integrated Protected Area System
NLEx	North Luzon Expressway
NM	Nautical mile
NMIA	New Manila International Airports
NM	Nautical Mile(1852m)
NOTAM	Notice To Airman
NPA	Non-precision approach
NPV	Net Present Value
NSCB	National Statistic Coordination Board
NSO	National Statistics Office
NTZ	No transgression zone
O	
OAA	Obstacle assessment area
OAS	Obstacle assessment surface
OCA/H	Obstacle Clearance Altitude/Height
OCD	Office of Civil Defence
OD	Origin-Destination
ODA	Official Development Assistance
OFW	Overseas Filipino Workers
OIS	Obstacle identification surface
OLS	Obstacle Limitation Surfaces
OPR	Outbound Philippine Residents
OSV	Overseas Visitors
P	
PA	Precision approach
PAGASA	Philippine Atmospheric Geophysical and Astronomical Services Administration
PALS	Precision Approach Lighting System
PANS	Procedures for Air Navigation Services
PANS/OPS	PANS-Aircraft Operations
PAP	Project-Affected-People
PAPI	Precision Approach Path Indicator
PAR	Philippoines Area of Responsibility
Pax	Passenger
PBN	Performance Based Navigation
PCA	Positive Control Area
PCN	Pavement Classification Number
PCU	Passenger Car Unit
PD	Presidential Decree
PDM	2-way Peak Day Movement
PDPFP	Provincial Development and Physical Framework Plan
PFDA	Philippine Fisheries Development Authority
PGA	Peak Ground Acceleration
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PHP	Phillipines Peso
PNR	Philippine National Railways
PPA	Philippine Port Authority
PPP	Public Private Partnership
PRA	Philippine Reclamation Authority

Abbreviation	Full Text
PSA	Philippine Statistics Authority
PSR	Primary Surveillance Radar
PTB	Passenger Terminal Building
PVD	Prefabricated Vertical Drain Method
R	
R	Correlation Coefficient
r2	Coefficient of Determination
RA	Republic Act
REDL	Runway Edge Light
REL	Runway Edge Lights
RENL	Runway End Light
RESA	Runway End Safety Area
RET	Rapid Exit Taxiway
RNAV	Area Navigation
RNP	Required Navigation Performance
ROT	Runway Occupancy Time
RR	Restricted-Range Species
Rp	Return Period
RTHL	Runway Threshold Light
RTIL	Runway Threshold Identification Lights
RVR	Runway Visual Range
RWY	Runway
S	
SALS	Simple Approach Lighting System
SARPs	Standards and Recommended Practices
SBAS	Satellite-based augmentation system
SCB	Standard Chartered Bank
SCF	Standard Conversion Factor
SCP	Sand Compaction Pile
SD	Sand Drain
SID	Standard Instrument Departure
SJ	Small Jet Aircraft
SLEx	South Luzon Expressway
SLR	Sea Level Rise
SMB	Sverdrup-Munk-Bretschneider
SOIR	Simultaneous operations on parallel or near-parallel instrument runways
SPT	Standard Penetration Test
STAR	Standard Terminal Arrival Route
SZX	Shenzhen Baoan International Airport
T	
TCA	Terminal Control Area
TDR	Traffic Distribution Rules
TEL	Taxiway Edge Lights
THRL	Threshold Lights
THSD	Trailing Suction Hopper Dradger
TMA	Terminal Manoeuvring Area, same as Terminal Control Area (TCA)
TOC	Total Organic Carbon
TRACON	Terminal Radar Approach Control
TP / RJ	Turboprop / Regional Jet
TSS	Total Suspended Solids
TWR	Control Tower
U	
UNDP	United Nations Development Program
UPS	United Parcel Services
V	
VAT	Value Added Tax
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VNAV	Vertical navigation
VOR	Very High Frequency Omni Directional Radio-Range
VSAT	Very Small Aperture Terminal
VU	Vulnerable Species

Abbreviation	Full Text
W	
WB	World Bank
WDIL	Wind Direction Indicator Lights

SECTION 1

INTRODUCTION

SECTION 1: INTRODUCTION

1.1 Objective of the Survey

The objective of JICA's Information Collection Survey for New Manila International Airport (hereinafter referred to as "the Survey") is to:

i) Carefully review the previous study titled "Roadmap for Transport Infrastructure Development for Metro Manila and its Surrounding Areas (Region III & Region IV-A) and its Supplemental Report No. 1 New NAIA Project, dated March 2014 (hereinafter referred to as the "Roadmap Study");

ii) Conduct additional surveys and data collection on the natural conditions, environmental and social consideration matters, urban planning, etc. on candidate sites for development of the proposed New International Airport in Metro Manila (hereinafter referred to as the "New Manila International Airport or NMIA"); and

iii) Provide the Government of the Philippines with data and information necessary for the Government to examine and make judgment for development of the NMIA.

1.2 Survey Team Organization

Staff members of this Survey consist of 19 personnel as listed in Table 1.2-1.

Table 1.2-1 List of Survey Team Members

Assignment	Name	Firm
Team Leader/Airport Planner	Teruo HANADA	JAC
Deputy Team Leader/Airport Planner 2	Nobuyoshi ONO	JAC
Urban Transport Planner	Shizuo IWATA	ALMEC
Air Traffic Forecast	Azuma FURUSE	JAC
Topography Survey and Geotechnical Investigation	Suguru HIBI	OCG
Survey on Water Quality, Sediment, etc.	Toshitsugu SHIMODAIRA	OCG
Environmental and Social Consideration	Norikazu YAMAZAKI	OCG
Airspace Utilization and Operation Procedures	Hidehisa YOSHIDA	JAC
Reclamation Planner 1	Toshiyuki INOUE	OCG
Reclamation Planner 2	Jun YAMAUCHI	OCG
Airport Facility Planner	Takao YAMAGUCHI	OCG
Risk Assessment of Natural Disasters	Yuko SAKAI	ALMEC
Economic and Financial Analysis and Project Implementation Scheme	Rene Santiago	ALMEC
Airport Access Traffic Survey	Chika WATANABE	ALMEC
Airport Access Traffic Forecast	Takanori ODA	ALMEC

Assignment	Name	Firm
Urban Development Planner	Ayako NAKAGAWA	ALMEC
Airport Access Facility Planner 1	Hiroyuki MORIMOTO	OCG
Airport Access Facility Planner 2	Kiminori MATSUMOTO	OCG
Coordinator/Airport Facility Planner	Mayo MIYOSHI	JAC

1.3 Scope of Work

Scope of the work consists of the following:

No. Work Item

100. Discussion on Inception Report
110. Data and Information Gathering on Airports in and around Metro Manila
120. Surveys and Data Collection
130. Air Traffic and Airport Access Traffic Demand Forecast
140. Estimate of Facility Requirements and Construction Cost
150. Initial Screening of New Airport Sites
160. Examination of Detailed Criteria
170. Discussion on Interim Report
180. Data Collection and Examination of Alternative New Airport Sites
180-1. Impacts on Natural and Social Environment
180-2. Land Preparation by Construction of Seawalls and Reclamation
180-3. Airport Access
180-4. Surrounding Land Use and Urban Planning
180-5. Airspace Utilization
180-6. Preliminary Project Cost Estimate and Examination of EIRR and FIRR
180-7. Preliminary Examination of Project Implementation Scheme
190. Examination on Airport Capacity Enhancement Measures
200. Discussion on Draft Final Report
210. Submission of Final Report

Figure 1.3-1 shows the work flow of this Survey.

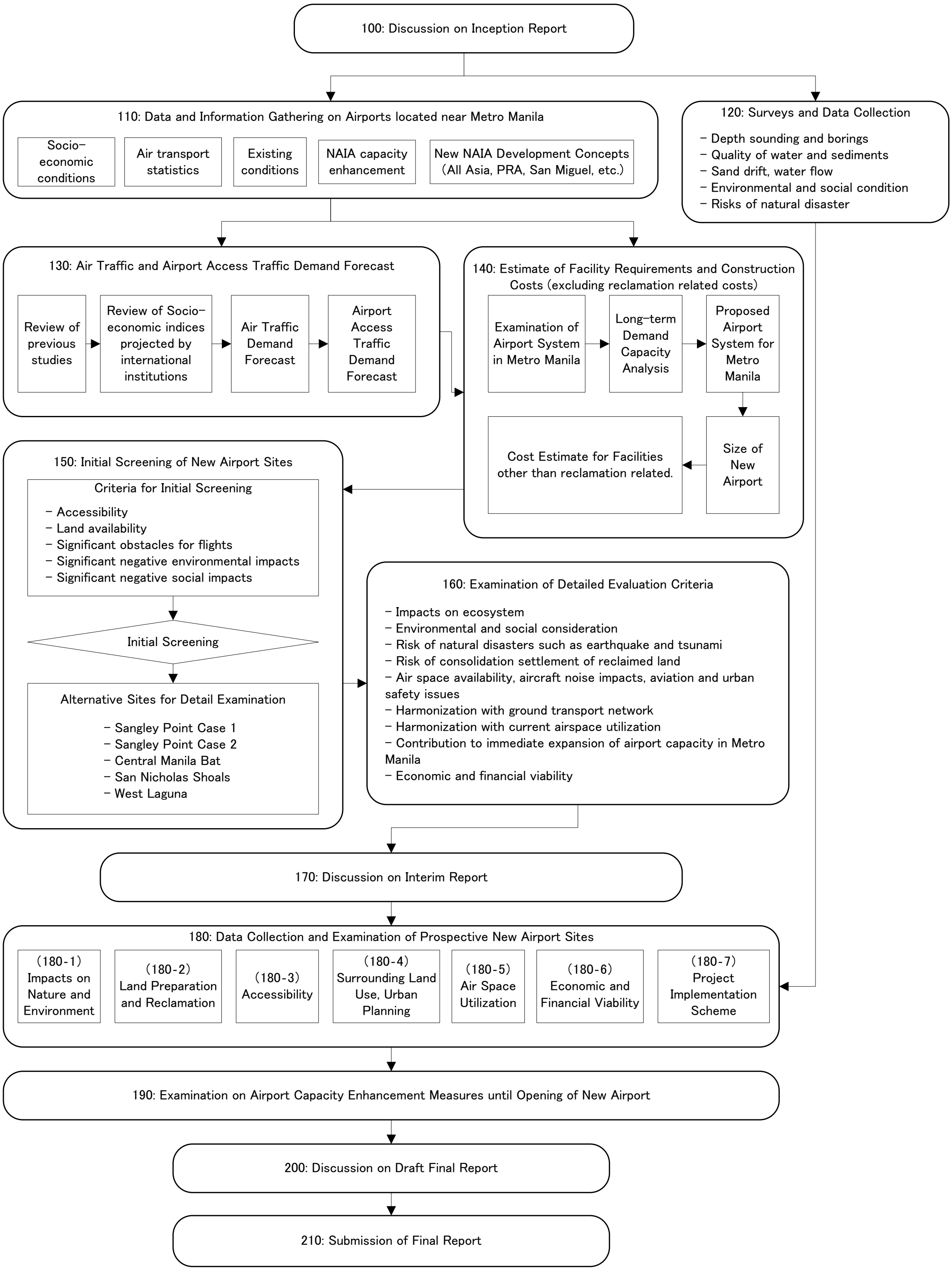


Figure 1.3-1 Work Flow of the Survey

1.4 Work Schedule and Scope of Interim Report

The Survey was commenced late in January 2015 and completed in May 2016. Originally, it was planned that, during the first half of the Survey, data and information gathering including the field survey works (geotechnical/bathymetric/water quality/environmental/social, etc.) would be carried out while simultaneously conducting the initial screening of the alternative new airport sites and examination of the detail evaluation criteria. However DOTC requested JICA to provide data and information necessary to fill out relevant forms for examination by Investment Coordination Committee (ICC) of National Economic Development Authority (NEDA). In response to the request from DOTC, a preliminary examination of the prospective new airport sites has been carried out in the first half of the Survey before the filed survey works are completed. Nevertheless, it should be clearly understood that the objective of the Survey is data and information gathering for determination of the new airport site, to be followed by a comprehensive mater planning and feasibility study as the next step. Therefore results of the preliminary examination of the prospective new airport site are for site examination purpose but not for judgment of the economic and financial viability of the project.

This Final Report deals with the results of the entire information collection as well as the preliminary examination of the prospective new airport sites.

SECTION 2

BACKGROUND

SECTION 2: BACKGROUND

2.1 Existing Conditions of Airports in Metro Manila

2.1.1 Summary Description of Airport System in Metro Manila

There are five (5) operational airports in and around Metro Manila. Ninoy Aquino International Airport (hereinafter referred to as "NAIA") is the gateway airport in the Philippines mainly due to its distance from/to business center of Metro Manila. Currently, NAIA is handling approx. 34 million passengers per annum in 2014 both international and domestic flights, and majority of NAIA passengers are from/to Metro Manila and southern portion of Luzon.

Meanwhile, Clark International Airport (hereinafter referred to as "CRK") is currently utilized by mainly low cost carrier (LCC) airlines. Its location is the province of Pampanga approx. 90 km to the northwest from the center of Metro Manila. CRK handled 1.5 million passengers per annum in 2012, however, currently is handling less than 1 million passengers per annum, due to the fact that Emirate and Air Asia stopped their operations in CRK. There is no high speed access railway and insufficient road access to CRK only is available at present and that is inducing unpredictable travel time, hence CRK gives less airlines' and passenger's attraction.

Plaridel airport is serving mainly general aviation activities, located in the province of Bulacan and approx. 35 km to the northwest from the center of Metro Manila. Plaridel airport is classified community airport by CAAP with 900-m long runway, and Visual Flight Rules (VFR) operation is undertaken.

Sangley Point Air Base (hereinafter referred to as "SANGLEY") is located in the northern portion of Cavite peninsula, and approx. 15 km to the southwest from Metro Manila. SANGLEY is operated by the Philippines Navy and Air Force. SANGLY is also accommodating some general aviation aircraft for the purpose of mitigating NAIA's capacity constraint.

Subic International Airport is located in Olongapo city approx. 80 km. Once, Federal Express utilized Subic International Airport as a cargo hub airport.

Locations of above-mentioned airports and airfield are shown in Figure 2.1.1-1.

Figure 2.1.1-1 Locations of Airports and Airfields in and around Metro Manila

2.1.2 Ninoy Aquino International Airport (NAIA)

1) General

NAIA, located approx. 10 km from the business center of Metro Manila, is being operated by Manila International Airport Authority (MIAA). Overall property area of NAIA is approx. 645 ha and is being surrounded by residential area. The reference point of NAIA is 14° 30' 35.788" North and 121° 00' 49.892" East, and its elevation is 22.8 m. The layout of NAIA is shown below.

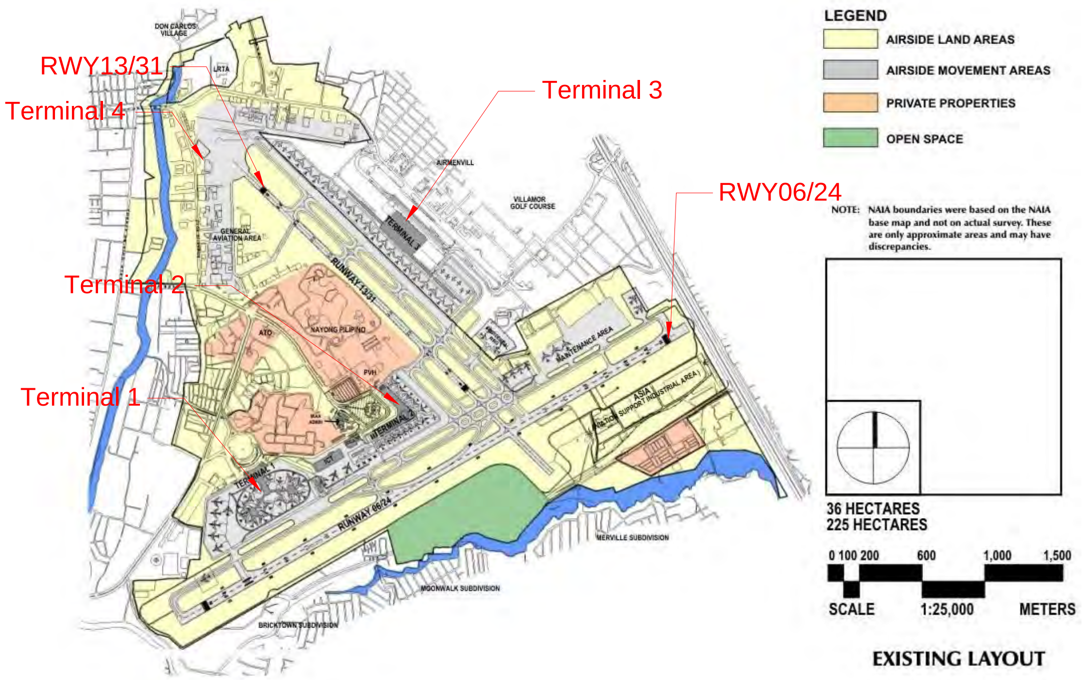


Figure 2.1.2-1 Layout of NAIA

Source: GCR report

a) Runway

Runway system of NAIA is so called V shape runway system. The main runway orientation is 06/24, while the other is 13/31. The extended runway centerline of RWY 13/31 crosses RWY 06/24 at approx. 1,200 m from the RWY 24 threshold. RWY 06/24 is 3,410 m in length and 60 m in width with a 3,529 m x 300 m runway strip and 13/31 runway is 1,998 m in length and 45 m in width with 2,130 m x 100 m runway strip.

Code E class aircraft such as Boeing 777-300 are using RWY 06/24. Majority of the domestic flights, using small jet, turbo-prop aircraft and general aviation, mainly use RWY 13/31.

b) Taxiways

Single parallel taxiway with six (6) stub taxiways and two (2) rapid exit taxiways is provided for RWY 06/24. The distance between 06/24 runway centerline and its parallel taxiway centerline is 152.5 m, and it does not suffice ICAO requirement of 182.5m for Code E aircraft and 190 m for Code F aircraft. Width of parallel taxiway for 06/24 runway is 20 m.

Runway 13/31 is also provided with a single parallel taxiway. The distance between 13/31 runway centerline and its parallel taxiway is 107.5 m, and it meets requirement for Non-instrument runway 4E. The width of parallel taxiway for 13/31 runway is 23 m.

c) Passenger Terminal Buildings

Four (4) separate passenger terminal buildings exist in NAIA at present and their locations are shown in Figure 2.1.2-1.

Based on report of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in Japan, air passenger traffic by each terminal building is shown in Figure 2.1.2-2.

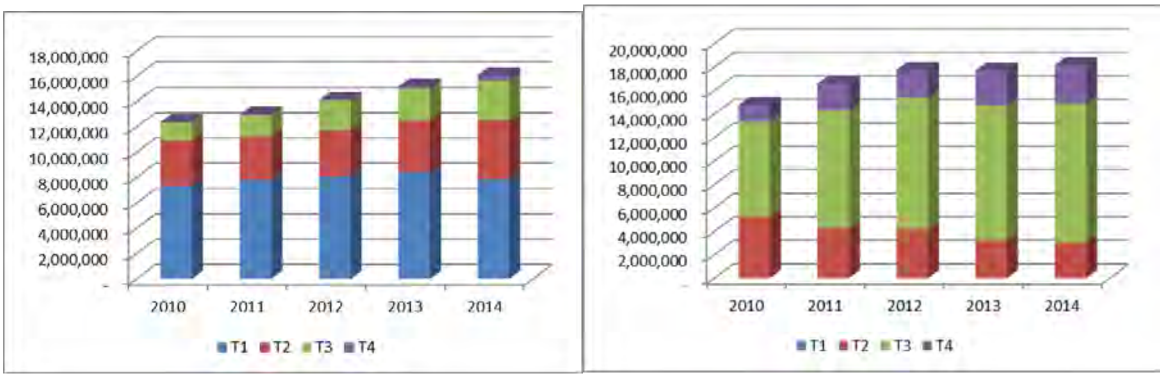


Figure 2.1.2-2 Number of Passenger at NAIA by Terminal Building

Source: MLIT report

Terminal 1, dedicated for international flight and approx. 105,000 m2 of floor space, is handling around 7 million passengers per annum in 2014 accounting for about 50 % of the international passengers. Currently 23 airlines are utilizing Terminal 1.

Terminal 2 has been operational since 1995. The construction of Terminal 2 was funded by Japanese government. The floor space is approx. 73,000 m2, and Philippine Airlines and Air Phil Express occupy Terminal 2. Terminal 2 was originally designed for domestic use only, however, PAL is utilizing both international and domestic flight. Design capacity of Terminal 2 is approx. 9 million passengers per annum for domestic use, and now Terminal 2 is handling around 7 million passengers for both international and domestic.

Aiming at international flight use, Terminal 3 was constructed in 2002 under BOT scheme, and is handling both of international and domestic flights at present consisting of approx. 12 million domestic and 2 million international passengers respectively. The floor space of Terminal 3 is approx. 180,000 m2, and design passenger capacity for international use was 13 million per annum. Eight airlines for international flight and two airlines for domestic flight are operating.

Terminal 4 is the oldest terminal in NAIA. LCC airlines are currently operating in terminal 4, and carrying approx. 3 million passengers per annum. The floor space of terminal 4 is approx. 3,300 m2.

2) Current Air Passenger Movements

NAIA is the largest airport in the Philippines and handles over 40% of domestic air passenger/cargo demand and over 80% of international air passenger/cargo demand of nationwide air traffic demand in the Philippines. NAIA plays an important role as the international/domestic hub airport and international gateway in the Philippines.

As of February 2014, 7 domestic airlines and 35 foreign airlines are in service at NAIA as shown in Table 2.1.2-1, and 32 domestic scheduled air routes and 36 international scheduled air routes are operated at NAIA as shown in Table 2.1.2-2.

Table 2.1.2-1 Number of Airlines at NAIA in February 2014

Airline		Country	Airline		Country
AirAsia Zest	Z2	Philippines	Garuda Indonesia	GA	Indonesia
Cebu Pacific Air	5J	Philippines	Jetstar Asia	3K	Singapore
PAL Express	2P	Philippines	Malaysia Airlines	MH	Malaysia
Philippine Airlines	PR	Philippines	Royal Brunei Airlines	BI	Burunei
Philippines AirAsia	PQ	Philippines	Singapore Airlines	SQ	Singapore
Skyjet	M8	Philippines	Thai Airways International	TG	Thailand
Tigerair Philippines (Seair)	DG	Philippines	Tigerair Singapore	TR	Singapore
Seair (Tigerair Philippines)	XO	Philippines	Vietnam Airlines	VN	Vietnam
AHK Air Hong Kong	LD	Hong Kong	Emirates	EK	UAE
Air China	CA	China	Etihad Airways	EY	UAE
Air Macau	NX	Macau	Gulf Air	GF	Bahrain
ANA	NH	Japan	Kuwait Airways	KU	Kwait
Asiana Airlines	OZ	Korea	Oman Air	WY	Oman
Cathay Pacific	CX	Hong Kong	Qatar Airways	QR	Qatar
China Airlines	CI	Taiwan	Saudia	SV	Saudi Arabia
China Southern Airlines	CZ	China	Air Niugini	PX	Papua New Guinea
Dragonair	KA	Hong Kong	Qantas	QF	Australia
EVA Air	BR	Taiwan	Delta Air Lines	DL	USA
JAL	JL	Japan	United Airlines	UA	USA
Jeju Air	7C	Korea	Air France	AF	France
Korean Air	KE	Korea	KLM	KL	Netherlands
Xiamen Airlines	MF	China			

Source: JICA Survey Team

Table 2.1.2-2 Air Routes at NAIA in February 2014

Destination		Country	Destination		Country	Destination		Country
Bacolod	BCD	Philippines	San Jose	SJI	Philippines	Kota Kinabalu	BKI	Malaysia
Basco	BSO		Surigao	SUG		Bangkok	BKK	Thailand
Butuan	BXU		Tacloban	TAC		Bandar Seri Begawan	BWN	Brunei
Cotabato	CBO		Tagbilaran	TAG		Jakarta	CGK	Indonesia
Cebu City	CEB		Tuguegarao	TUG		Phuket	HKT	Thailand
Cagayan De Oro	CGY		Busuanga	USU		Kuala Lumpur	KUL	Malaysia
Catarman	CRM		Virac	VRC		Ho Chi Minh City	SGH	Vietnam
Calbayog	CYP		Naga	WNP		Singapore	SIN	Singapore
Cauayan	CYZ		Zamboanga	ZAM		Abu Dhabi	AUH	UAE
Dumaguete	DGT		Guangzhou	CAN	China	Bahrain	BAH	Bahrain
Dipolog	DPL		Fukuoka	FUK	Japan	Dammam	DMM	Saudi Arabia
Davao	DVO		Hong Kong	HKG	Hong Kong	Doha	DOH	Qatar
General Santos City	GES		Tokyo	HND	Japan	Dubai	DXB	UAE
Iloilo	ILO		Seoul	ICN	Korea	Muscat	MCT	Oman
Kalibo	KLO		Osaka	KIX	Japan	Riyadh	RUH	Saudi Arabia
Laoag	LAO		Macau	MFM	Macau	Darwin	DRW	Australia
Legaspi	LGP		Nagoya	NGO	Japan	Guam	GUM	Guam
Masbate	MBT		Tokyo	NRT	Japan	Port Moresby	POM	Papua New Guinea
Caticlan	MPH		Beijing	PEK	China	Sydney	SYD	Australia
Ozamis City	OZC		Busan	PUS	Korea	Los Angeles	LAX	USA
Pagadian	PAG		Shanghai	PVG	China	San Francisco	SFO	USA
Puerto Princesa	PPS		Taipei	TPE	Taiwan	Vancouver	YVR	Canada
Roxas City	RXS		Xiamen	XMN	China			

Source: JICA Survey Team

The air traffic record at NAIA is shown in Table 2.1.2-3.

NAIA handled approximately 34 million air passengers consisting of 18 million domestic and 16 million international air passengers respectively in 2014. In the last 10 years, the domestic air passenger traffic increased by 10.3% annually and international air passenger traffic increased by 6.7% annually.

The continued economic growth of the Philippines has contributed to the increase in air passenger demand, together with the expansion of LCCs' operations in the Philippines.

Table 2.1.2-3 Air Traffic Demand Record at NAIA

Year	Passenger ('000)				Cargo (tons)				Aircraft Movement (flights)			
	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total
1991	3,074	4,529	205	7,809	74,565	179,680	18,471	272,716	43,133	26,143	56,578	125,854
1992	3,281	5,236	229	8,746	70,455	193,915	12,065	276,435	47,572	30,359	64,133	142,064
1993	3,531	5,671	216	9,418	79,275	212,152	13,137	304,564	45,217	32,989	59,180	137,386
1994	3,945	6,116	262	10,323	61,848	231,992	6,664	300,504	48,635	35,702	65,002	149,339
1995	4,329	6,560	304	11,193	80,009	274,849	9,782	364,640	55,096	37,311	72,640	165,047
1996	4,986	7,297	345	12,628	100,890	293,323	7,795	402,008	62,653	43,805	74,314	180,772
1997	6,137	7,726	283	14,146	107,020	377,775	8,336	493,131	72,331	49,274	76,278	197,883
1998	5,337	6,817	320	12,474	86,521	291,246	10,801	388,568	65,187	41,453	73,163	179,803
1999	5,742	7,019	251	13,011	80,663	290,414	6,445	377,521	63,714	41,207	61,336	166,257
2000	5,968	7,130	348	13,446	117,951	272,740	7,922	398,612	64,987	39,083	64,126	168,196
2001	5,401	6,531	262	12,194	120,839	235,908	8,484	365,231	73,473	42,096	57,019	172,588
2002	5,282	7,466	239	12,988	116,298	265,902	5,564	387,764	71,111	44,112	53,789	169,012
2003	5,791	7,126	221	13,139	116,924	255,249	2,596	374,770	73,952	42,300	43,456	159,708
2004	6,741	8,416	272	15,429	122,245	299,243	2,182	423,671	75,786	42,385	39,854	158,025
2005	6,972	9,222	292	16,485	116,077	296,090	2,107	414,274	83,273	47,746	40,312	171,331
2006	8,159	9,767	304	18,229	109,817	300,427	2,515	412,759	84,698	48,980	38,235	171,913
2007	9,707	10,725	262	20,694	92,620	295,634	1,872	390,125	92,648	54,643	41,506	188,797
2008	10,720	11,273	259	22,253	89,651	263,397	2,101	355,149	101,927	60,525	42,794	205,246
2009	12,680	11,203	225	24,109	97,129	237,923	2,387	337,440	121,310	64,356	37,122	222,788
2010	14,755	12,381	204	27,340	117,467	306,361	1,528	425,357	132,786	67,321	35,887	235,994
2011	16,687	12,969	227	29,883	119,872	290,505	1,521	411,898	145,353	72,390	37,411	255,154
2012	17,739	14,140	243	32,122	149,080	311,055	1,415	461,550	155,832	79,685	37,561	273,078
2013	17,689	15,177	250	33,117	164,201	293,116	978	458,296	149,421	87,629	34,416	271,466
2014	18,020	16,072	184	34,275	164,597	355,141	297	520,035	142,693	93,748	29,819	266,260

source : JICA Survey Team (based on data from CAAP and MIAA)

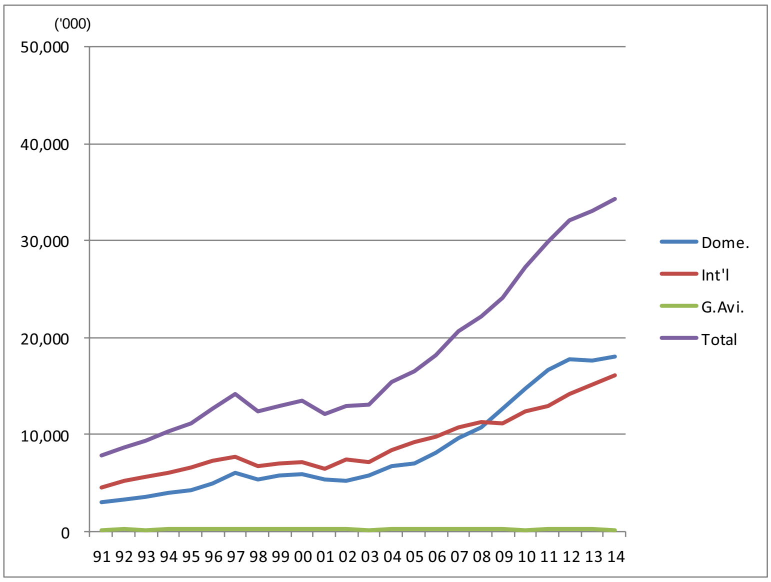


Figure 2.1.2-3 Actual Air Passenger Traffic Record at NAIA

NAIA handled approximately 266 thousand aircraft movements consisting 143 thousand domestic and 94 thousand international flights respectively in 2014. In the last 10 years, the domestic flights increased by 6.5% annually and international flights increased by 8.3% annually. In 2013 and 2014, the domestic aircraft movements decreased by over 4.0% annually.

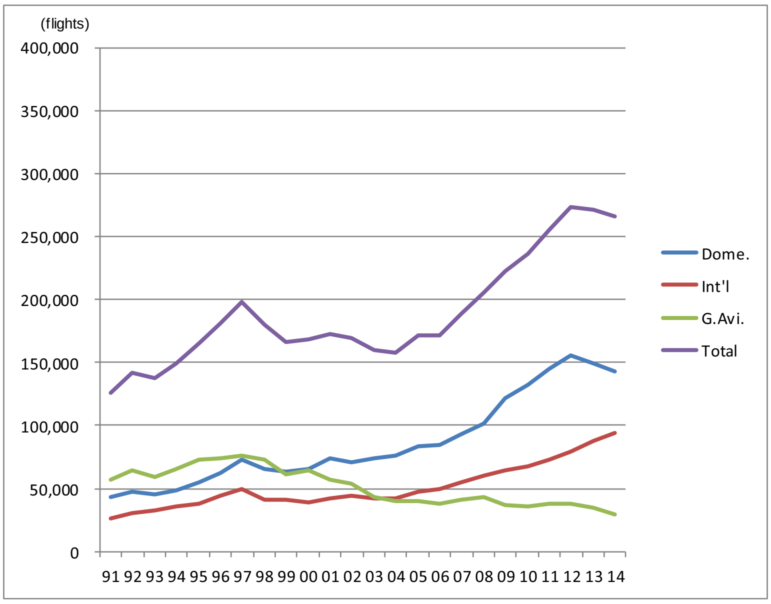


Figure 2.1.2-4 Actual Aircraft Movements Record at NAIA

As for the general aviation traffic demand, NAIA handled approximately 200 air passengers, 300 tons of air cargoes and 30 thousand flights in 2014. In the last 10 years, the air passenger traffic, air cargo traffic and aircraft movements decreased by 3.8%, 18.1% and 2.9% annually respectively.

2.1.3 Clark International Airport (CRK)

1) General

Clark International Airport (CRK), former Diosdado Macapagal International Airport, is located in the province of Pampanga approx. 90 km north-west from Metro Manila. North Luzon Expressway (NLEX) is a major access means at present. CRK is being operated by Clark International Airport Corporation (CIAC), and overall property area of CRK is about 2,340 ha. The reference point of CRK is 15° 11' 09.5607 North and 120° 33' 37.1658 East, and its elevation is 147.6 m. The layout of CRK is shown in Figure 2.1.3-1.

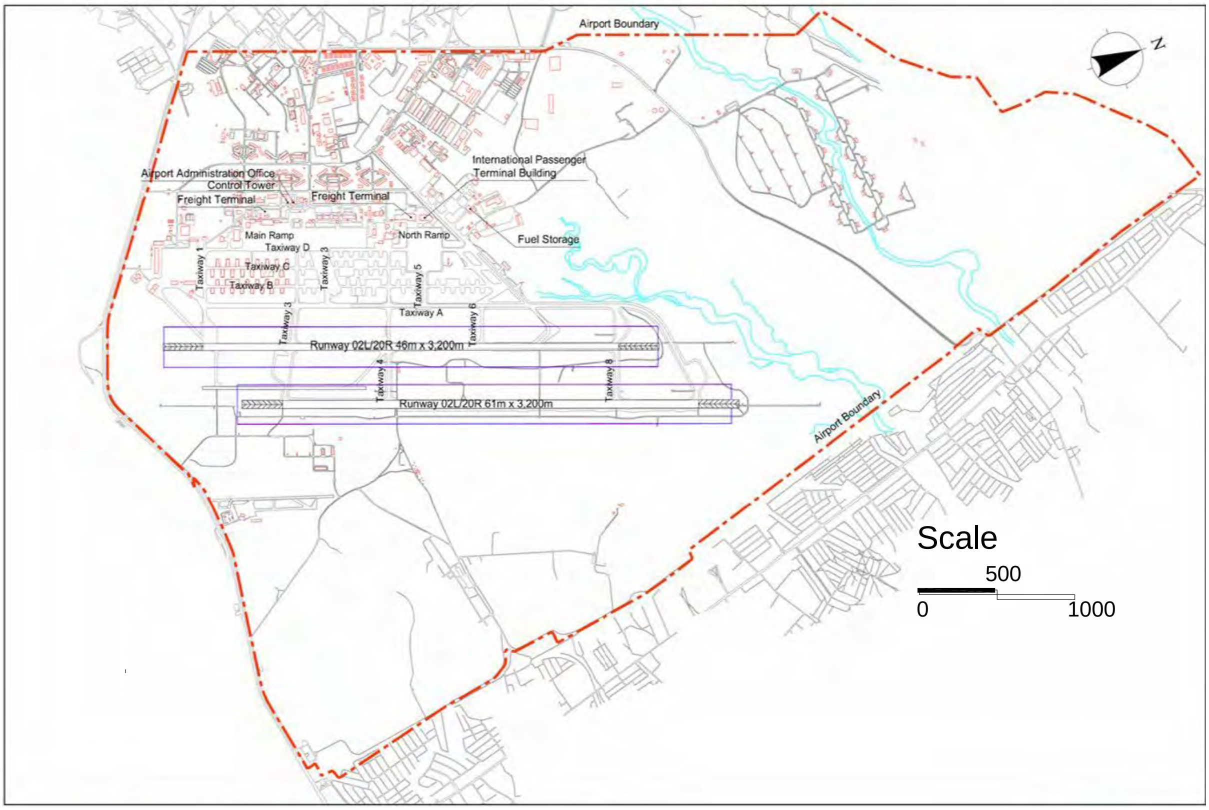


Figure 2.1.3-1 Layout of CRK

Source: GCR report

a) Runway

Runway system of CRK is close parallel runway system, and the orientation of the runways is 02/20. Runway 02R/20L is 3,200 m in length and 61 m in width with precision approach category. The other runway 02L/20R is 3,200 m in length and 45 m in width with non-precision approach category. 3,800 m x 300 m of runway strips for both runways are provided. The distance between the runways is 425 m.

b) Passenger Terminal Building

Expansion of passenger terminal building at CRK was carried out in 2013, and the floor space of the passenger terminal building increased to approx. 20,000 m2. The design capacity of the passenger terminal building is 4.5 million passengers per annum. Cebu Pacific Air, Air Asia, Tiger Air, Jin Air, Asiana Airlines, Quatar Airways, Cathay Pacific and Dragonair are operating international flight. Cebu Pacific Air is also operating domestic flights.

Figure 2.1.3-2 Clark International Airport Passenger Terminal Building

2) Current Air Passenger Movements

In 1995, during the Ramos administration, CRK was announced as next premier international gateway airport in the Philippines and some development projects were implemented for CRK after that. After 2003, United Parcel Service (UPS) started its Asian hub operation at CRK and many Philippine-registered airlines and foreign airlines, such as Cebu Pacific Air, Spirit of Manila Airlines, Seair, Air Asia, Jin Air, Asiana Airlines, Emirates and others, started operation of scheduled domestic and international flights.

However, UPS moved to Shenzhen Airport, China in 2010 and some other airlines moved to NAIA in 2014.

As of February 2014, 2 domestic airlines and 7 foreign airlines are in service at CRK as shown Table 2.1.3-1, and 1 domestic scheduled air routes and 6 international scheduled air routes are operating at CRK as shown Table 2.1.3-2.

Table 2.1.3-1 Number of Airlines at CRK in February 2014

Airline		Registration Country
Cebu Pacific Air	5J	Philippines
Tigerair Philippines (Se	DG (XO)	
Asiana Airlines	OZ	Korea
Dragonair	KA	Hong Kong
Jin Air	LJ	Korea
AirAsia	AK	Malaysia
Tigerair Singapore	TR	Singapore
Qatar Airways	QR	Qatar

source : JICA Survey Team

Table 2.1.3-2 Air Routes at CRK in February 2014

Destination		Country
Cebu City	CEB	Philippines
Hong Kong	HKG	Hong Kong
Seoul	ICN	Korea
Macau	MFM	Macau
Kuala Lumpur	KUL	Malaysia
Singapore	SIN	Singapore
Doha	DOH	Qatar

source : JICA Survey Team

The air traffic record at CRK is shown in Table 2.1.3-3.

CRK handled approximately 998 thousand air passengers consisting of 91 thousand domestic air passengers, 787 thousand international air passengers and 121 thousand passengers by general aviation in 2014. In the last 5 years, the domestic air passenger traffic increased by 24.2% annually, international air passenger traffic increased by 7.0% annually and air passengers by general aviation increased by 37.9% annually.

International air passenger demand accounted for approx. 80% of the total air passenger demand at CRK and domestic air passengers are less than the passengers by general aviation.

Table 2.1.3-3 Air Traffic Demand Record at CRK

Year	Passenger ('000)				Cargo (tons)				Aircraft Movement (flights)			
	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total
2001	2	2	8	12	69	37,342	259	37,671	60	3,278	1,741	5,079
2002	9	1	17	27	323	55,889	393	56,606	296	2,564	3,801	6,661
2003	6	8	30	44	2,335	83,648	350	86,333	3,040	85	5,862	8,987
2004	9	50	39	98	3,130	105,031	311	108,472	3,030	453	5,681	9,164
2005	8	219	36	263	3,907	107,211	260	111,377	728	2,157	4,968	7,853
2006	17	464	34	515	3,774	124,981	285	129,039	716	4,053	4,331	9,100
2007	43	490	22	555	3,533	125,124	156	128,812	1,162	3,954	3,455	8,571
2008	40	490	24	553	2,780	127,008	193	129,980	1,146	4,070	3,922	9,138
2009	31	559	24	614	3,639	128,439	256	132,334	1,114	5,141	3,984	10,239
2010	47	608	52	706	648	45,090	386	46,124	744	5,332	9,054	15,130
2011	42	725	68	835	0	41,284	456	41,740	609	6,971	11,209	18,789
2012	300	1,015	167	1,483	0	41,621	974	42,595	3,501	9,313	25,854	38,668
2013	215	985	188	1,388	2,582	41,476	734	44,792	1,916	8,420	25,833	36,169
2014	91	787	121	998	1,280	46,702	195	48,176	936	5,715	19,560	26,211

source : JICA Survey Team (based on data from CAAP and CIAC)

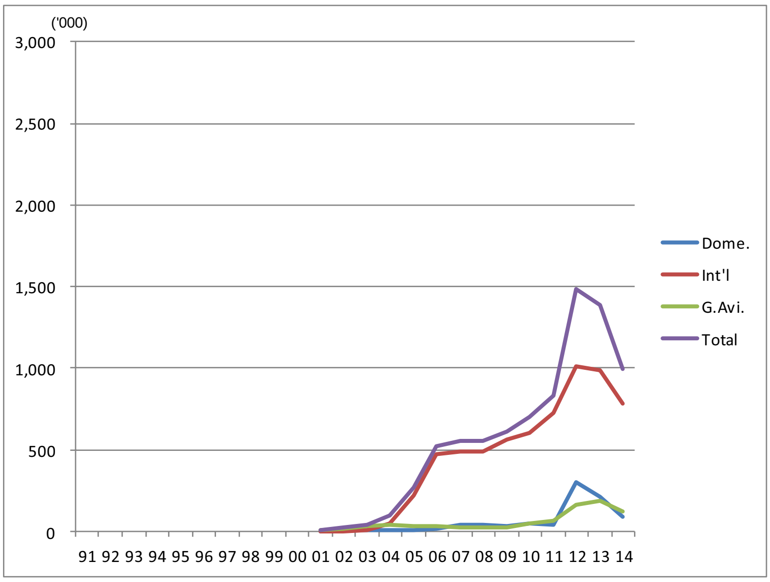


Figure 2.1.3-3 Actual Air Passenger Traffic Record at CRK

CRK handled 48 thousand tons of air cargoes consisting 1 thousand tons of domestic air cargoes and 47 thousand tons of international air cargoes in 2014. In the last 5 years, the domestic air cargo traffic decreased by 18.9% annually and international air cargo traffic increased by 18.3% annually. The international air cargo demand decreased sharply in 2010 when UPS moved out to Shenzhen Airport.

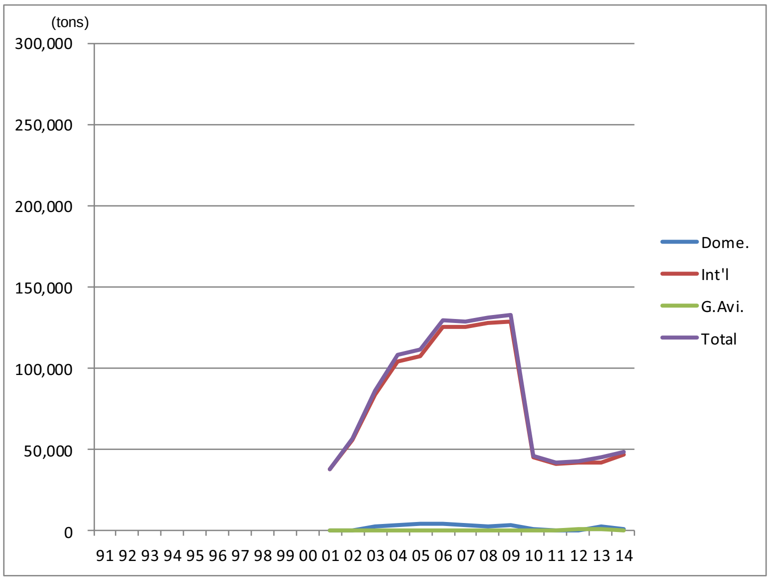


Figure 2.1.3-4 Actual Air Cargo Traffic Record at CRK

CRK handled 26 thousand aircraft movements consisting 1 thousand domestic flights, 6 thousand international flights and 20 thousand flights of general aviation in 2014. In the last 5 years, the domestic flights decreased by 11.0% annually and international flights decreased by 10.3%

annually. The domestic and international flights decreased sharply in 2014 when Air Asia moved to NAIA and Emirates stopped its operation at CRK.

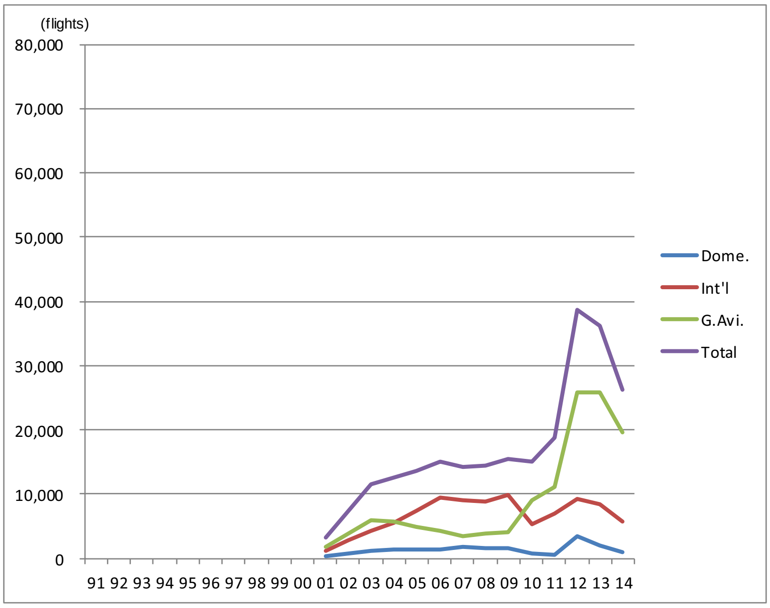


Figure 2.1.3-5 Actual Aircraft Movements Record at CRK

2.1.4 Other Airport and Air Field

1) SANGLEY

SANGLEY is located at Cavite peninsula about 15 km south west of center of Metro Manila. SANGLEY is operated by PAF and PN. Some of the general aviation is also operating at SANGLEY from 2013.

The elevation at the reference point is 2.4 m, and the runway orientation is 07/25. Length of the runway is 1,829 m, but RWY 07 threshold is displaced by around 600 m due to water puddle during and after heavy rain. Visual Flight Rule (VFR) operation is being adopted.

The layout of SANGLEY is shown in Figure 2.1.4-1.

Figure 2.1.4-1 Layout of SANGLEY

2) Plaridel Airport

Plaridel airport is categorized one of community airports by CAAP, where is located in Bulacan province approx. 35 km north west from Metro Manila. General Aviation and flight training school activity are mainly operated at Plaridel airport. Administrator of Plaridel airport is CAAP. The reference point of Plaridel airport is 14^{o} 52' 29.5445 North and 120^{o} 51' 11.1410 East, and its elevation is 6.2 m. VFR operation is being adopted. Orientation of the runway is 17/35, and its size is 900 m in length and 30 m in width. There exists river to the north and east of the airport. The layout of Plaridel airport is shown in Figure 2.1.4-2.

Figure 2.1.4-2 Layout of Plaridel Airport

3) Subic International Airport

Subic International Airport is located in Olongapo city approx. 80 km in straight line away from Metro Manila in North-West direction. The reference point of Subic International Airport is 14^{o} 47' 40.016 North and 120^{o} 16' 16.917 East, and its elevation is 19.503 m. Once, Federal Express utilized Subic International Airport as a cargo hub airport, however, Federal Express stopped its cargo operation, and moved to China in 2009. Orientation of the runway is 07/25, and its size is 2,744 m in length and 45 m width.

Figure 2.1.4-3 Layout of Subic International Airport

2.1.5 Airport Capacity Constraints

NAIA is the busiest airport in the Philippines, which handled more than 34 million passengers and 260,000 aircraft movements per annum including general aviation in 2014, and it seems already to have reached the capacity limit. The trend of the air passenger movement in NAIA is upward in due course of high economic growth rate in the Philippines. Also, popularity of LCC airlines in the Philippines pushes runway capacity limitation as well, and this trend would be continuing in short-term. NAIA is surrounded by residential area, and it is very difficult to expand airport property area. Mitigation measures are necessary as soon as possible in order to accommodate the vigorous air traffic demand. In the wake of these situations, some of the general aviation was transferred to SANGLEY in 2013, however, airport capacity constraints are still issues for NAIA.

Government of the Philippines (GOP) had declared in 1994 to utilize CRK as a premier international gateway airport in the Philippines so that air traffic demand in National Capital Region would be handled by NAIA and CRK. Currently, CRK is handling only approx. 1 million passengers per annum, and its number is far behind when compared to that of NAIA, reasons behind the underutilization include lack of high speed railway access and unpredictable travel time to/from Metro Manila.

ATM system development project funded by JICA is ongoing in the Philippines in order to enhance more efficient air traffic management. According to GCR report, approach control function will be integrated into a new Manila ATM center, aiming that each of ATS should have advanced automation functions, exchange those data, and so forth to realize collaborative air traffic management. It is expected that distance between flying aircraft could be reduced, and this would somehow give more traffic volume at NAIA. However, this could not completely solve capacity constraint issue at NAIA.

2.2 Alternative Solutions Examined

The capacity of NAIA is assumed approx. 35 million passengers per annum and 250,000 aircraft movements (except for GA) and it would reach the capacity limitation in the near future or already reached based on the historical air traffic data. In order to accommodate the air traffic demand in the region, alternative solutions have been examined;

i) Upgrading CRK to Gateway Airport; and
ii) Capacity enhancement of NAIA

2.2.1 Upgrading CRK to Gateway Airport

1) General

At present, CRK is accommodating very limited air passenger traffic, and one of the reasons is no high speed railway access and unpredictable travel time from Metro Manila. Meanwhile, there exists a large scale development plan named "Clark Green City", which is new project converting the area into a new urban area. Summary of "Clark Green City" project is as follows.

"*The newest project in Central Luzon is the conversion of Sacobia area into a new urban area, half the size of Metro Manila. BCDA is in the final stages of master planning the 35,000 hectare Sacobia otherwise dubbed as Clark Green City located at the Clark Special Economic Zone. It is expected to be launched next year. Clark Green City will generate billions in investments and generate thousands of jobs. This will also provide the catalyst for the economic development of surrounding local government units. The state-owned Bases Conversion and Development Authority (BCDA) is investing more funds to convert the more than 35,000 hectares of the Sacobia to generate thousands of jobs for the people of Central Luzon region. The agency has so far invested P33.8 billion in line with its mandate to convert the former US military Clark Air Base into productive area and at the same time create employment and investment opportunities. Building a "Green City" at the 36,000 hectare portion of the Clark Special Economic Zone in Pampanga will approximately cost P200 billion. The green metropolis would be a mix of industrial, institutional and commercial areas, which would apply green technologies by adapting a Green Building System, Renewable energy from sustaining sources will be used by all facilities and buildings in Clark Green City that is half the size of Metro Manila.* "

Source: Web site

Based on the above development plan, when Metro Clark is realized in the future, CRK is expected to accommodate the future air traffic demand induced from Metro Clark and northern Luzon area.

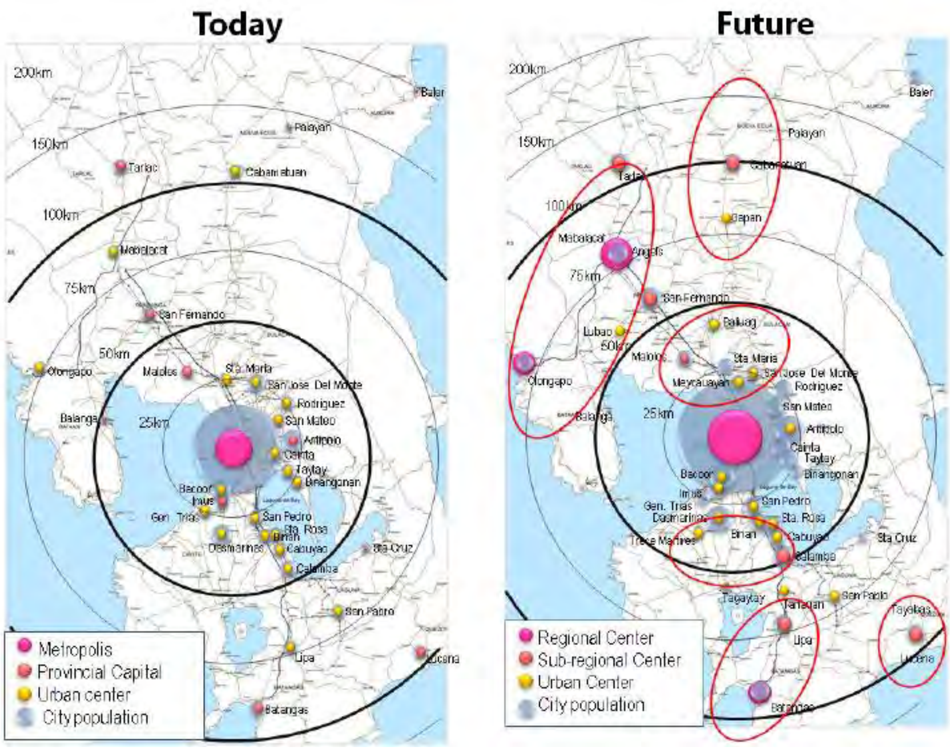


Figure 2.2.1-1 Current and Future Direction of Urbanization around Metro Manila

Source: Roadmap Study

2) Master Planning of CRK

In 2014, ADPi updated the Master Plan of CRK as prepared by KOICA in view of CRK as the main gateway for Northern and Central Luzon, serving Regiions I, II, III and CAR. The master plan is divided into four phases, with an ultimate capacity of 80 million passengers per annum.

Figure 2.2.1-2 Land Use Plan for CRK

Source: CIAC

3) Expansion of Passenger Terminal Building

Passenger terminal building was expanded in 2013 and completed 2014 with a capacity to accommodate 4.5 million passengers per annum. According to Clark International Airport Corporation (CIAC) presentation material obtained by MLIT, the floor space was increased by 73 %, and additional check in counter and baggage claim carousel were also added.

A new passenger terminal building is aiming to improve the connectivity of CRK as a main gateway to Northern and Central Luzon, and its plan has submitted to NEDA for approval. The project will be implemented in two phases with an ultimate capacity of 80 million passengers per annum.

4) Possibility of Gateway Airport

CRK airport property area is approx. 2,340 ha, and it is sufficient space for developing airport facilities for gateway airport, and therefore, CRK has a large potential to accommodate the passenger spilled over from NAIA, on condition that travel time would significantly become predictable.

2.2.2 Capacity Enhancement of NAIA

1) Transfer of General Aviation at NAIA

NAIA is facing runway capacity limitations during peak hours. The share of runway usage by Domestic/International/General Aviation at NAIA is shown below as well as domestic flight runway usage rate by aircraft category. Majority of aircraft operating NAIA for domestic flight is small jet aircraft, due to the high share of LCC airlines. As for general aviation, the share of runway usage rate is declining, one of the reasons is that some of general aviation was transferred from NAIA to SANGLEY in 2013.

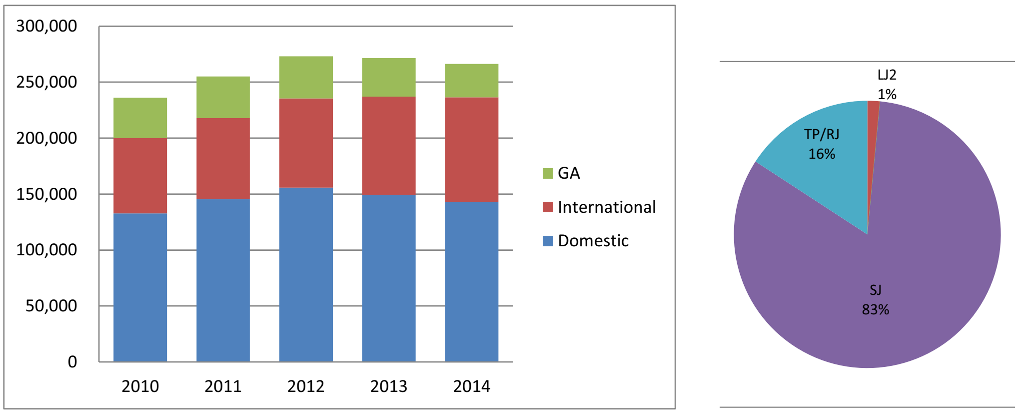


Figure 2.2.2-1 GA Share of RWY Usage and Domestic Flight Runway Usage by Category
Source: JICA Survey Team and Data from CAAP, MIAA and CIAC

In terms of runway capacity, the speed of general aviation and other commercial jet aircraft is significantly different, and therefore, mixed operation of general aviation and commercial jet aircraft give adverse influence for maximization of runway capacity. In case the slot allotted to general aviation at NAIA is given to commercial airlines, it contributes to increase of slot for commercial airline as well as maximization of runway capacity.

2) Extension of Operation Hour for Local Airports

Peak departure time of domestic flight in 2014 at NAIA is at 06:00-06:59 based on the following figure obtained from CAAP by MLIT. There are more than 10 departures from 05:00 to 16:00, however, it seems to have somewhat the space for departures in the evening until late evening. This departure flight pattern is relative to insufficient navigation and aeronautical ground lights facilities at local airports.

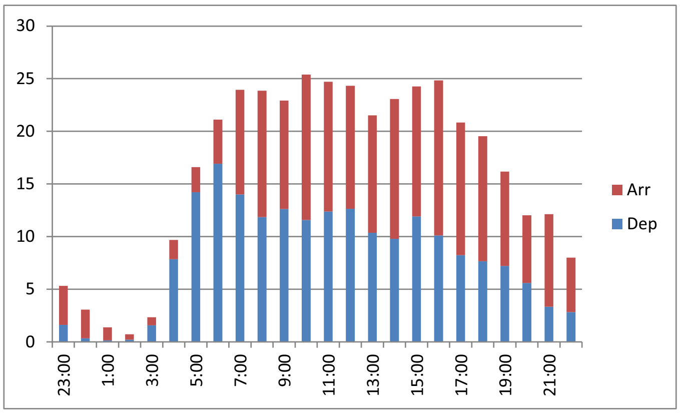


Figure 2.2.2-2 Number of Domestic Departure Flight

Source: Manila Control Tower-Monthly Traffic Count 2014

Bacolod Airport and Iloilo Airport are equipped with full Aeronautical Ground Lighting and Navigation facilities, and therefore, the operation hours at both airports are from 5:00 to 21:00 as shown below. In case other class I airports extend its operation hours from early morning to late at night after developing the lighting and other facilities, it can be expected to alleviate departure flight concentration and is useful for runway utilization at NAIA.

Following table shows existing operation hours and navigation and aeronautical facilities at main local airport.

Table 2.2.2-1 Operation Hour and Conditions of AGL and Navigation Facilities at Class I Airport

		Bacolod	Butuan Principal	Cagayan De Oro	Cotabato	Daniez Romualde (Tacloban)	Dipolo	Dumaguete	Iloilo	Legazpi	Naga	Pagadian	Roxas	San Jose	Tagbilaran	Tuguegarao
	Operation Hour	5-21	8-16	5-18	7-16	5-18	7-17	6-18	5-21	7-16	6-17	7.5-15.5	5-15	7-18	6-18	8-16
											8-16 (Mon)					
	AGL															
1	Precision Approach Lighting System (PALS)	○							○							
2	Simple Approach Lighting System (SALS)	○	○			○			○	○						
3	Precision Approach Path Indicator (PAPI)	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
4	Runway Edge Lights (REL)	○	○	○	○	○	○	○	○	○	○		○		○	○
5	Runway Threshold Lights (RTHL)	○							○							
6	Runway End Lihgts (REDL)	○							○							
7	Taxiway Edge Lights (TEL)	○	○	○	○	○	○	○	○		○		○		○	
8	Aerodrome Beacon (ABN)	○							○							
9	Wind Direction Indicator Lights (WDIL)	○	○		○	○	○	○	○							
10	Apron Flood Light (FLO)	○	○				○		○							
11	RunwayThreshould Identification Lights (RTIL)	○			○	○		○	○							
	NAV															
1	VOR	○	○	○	○	○		○	○	○	○		○	○		
2	DME	○	○	○	○	○			○	○	○		○	○		○
3	ILS	○							○							
4	NDB											○				

Source: AIP and GCR report

3) International Direct Flight to/from Major Local Airports

Central portion of the Philippines such as Visaya area, and/or other local areas are attracting many tourists. Considering the capacity limitation at NAIA and in case of existence of sufficient air traffic demand to local area, there is possibility for international airlines to connect international direct flight to/from local airports. Following table shows that regional distribution number of foreigners' traveler and its share in 2011.

The share of Visaya area of Region 6, 7 and 8 accounted for more than 30 %. The biggest share of Visaya area is Region 7 where relatively large economic city of Cebu is located. Region 6, where Kalibo international airport, Bacolod airport and Iloilo airport are located, accounted for approx. 10% share, and Region 6 might have a potential of international direct flight. It is noted that Bacolod airport and Iloilo airport are developed in compliance with ICAO requirements, and it is possible to accommodate international flight from the view of airport facility. In Region 5, there is no international airport, however, around 14 % of foreign travelers visited there, and it might have international direct flight, after airport facility development for international flight.

Table 2.2.2-2 Regional Distribution Number of Foreigner' Traveler and Its Share in 2011

Area	Number	Share	Area	Number	Share
NCR	1,704,600	34.7%	Region 7	1,030,294	21.0%
CAR	85,085	1.7%	Region 8	24,050	0.5%
Region 1	21,832	0.4%	Region 9	5,566	0.1%
Region 2	33,737	0.7%	Region 10	86,089	1.8%
Region 3	147,170	3.0%	Region 11	59,859	1.2%
Region 4	498,655	10.2%	Region 12	3,990	0.1%
Region 5	675,387	13.8%	Region 13	38,056	0.8%
Region 6	494,175	10.1%			

Source: Department of Tourism

Record of Gross Regional Domestic Product (GRDP) is shown below. Based on GRDP data, that of NCR, and Region 4A accounted for more than 50 %. It is apparent of RGDP concentration to Metro Manila area. Meanwhile, Regions 6, 10 and 11 achieved relatively higher GRDP value. In view of GRDP, relatively higher GRDP area may have a potential of business opportunity in the region. It is noted that Cagayan De Oro airport is located in Region 10, and General Santos airport, Davao airport are in Region 11, and these airports may have international direct flight potential.

Table 2.2.2-3 Gross Regional Domestic Product in the Region Past 5 years

(Php Billion at constant price in 2000)

	NCR	CAR	1	2	3	4A	4B	5	6	7	8	9	10	11	12	ARMM	13
2010	2,038	120	180	100	511	1,009	102	114	227	341	151	117	211	217	151	48	65
Share	35.7%	2.1%	3.2%	1.8%	9.0%	17.7%	1.8%	2.0%	4.0%	6.0%	2.6%	2.1%	3.7%	3.8%	2.6%	0.8%	1.1%
2011	2,103	122	184	105	547	1,026	105	116	241	364	154	117	223	225	159	47	70
Share	35.6%	2.1%	3.1%	1.8%	9.3%	17.4%	1.8%	2.0%	4.1%	6.2%	2.6%	2.0%	3.8%	3.8%	2.7%	0.8%	1.2%
2012	2,251	123	194	114	582	1,101	110	124	260	398	144	132	239	242	172	48	78
Share	35.7%	1.9%	3.1%	1.8%	9.2%	17.4%	1.7%	2.0%	4.1%	6.3%	2.3%	2.1%	3.8%	3.8%	2.7%	0.8%	1.2%
2013	2,455	130	209	122	608	1,175	112	136	271	428	152	138	253	258	186	50	84
Share	36.3%	1.9%	3.1%	1.8%	9.0%	17.4%	1.7%	2.0%	4.0%	6.3%	2.2%	2.0%	3.7%	3.8%	2.7%	0.7%	1.2%
2014	2,617	134	220	130	645	1,238	116	144	287	462	153	146	269	274	200	51	91
Share	36.5%	1.9%	3.1%	1.8%	9.0%	17.2%	1.6%	2.0%	4.0%	6.4%	2.1%	2.0%	3.7%	3.8%	2.8%	0.7%	1.3%

Source: National Statistics Coordination Board

4) Incentive Policy Making

Incentive policy making is one of the solutions of decongestion of NAIA, and might be attracting airlines from the view of financial aspect for airlines. Most of the airlines prefer utilizing NAIA to CRK. However, there is a development plan of Metro Clark such as "Clark Green City", and it would generate more users for CRK based on economic activity from its development. The cause of insufficient utilization of CRK is from unpredictable travel time due to lack of access system especially within Metro Manila, but with procurement of highway in Metro Manila currently underway, it is possible to improve its accessibility to CRK.

Meanwhile, financial incentive is to offer to airlines reducing airport facility cost such as landing charges, parking charges, aerobridge charges, passenger service charges, aircraft navigation charges, etc., and it may somehow induce airlines to consider utilizing CRK instead of NAIA operation, but it is likely not to attract much to airlines to move to CRK if this incentive measure is applied alone. For instance, if the Government of Philippines makes ease of taxation in case of the airlines utilization of CRK instead of NAIA, or in case of new airline's entrance to the market etc., it may make synergy influence.

5) Utilization of SANGLEY

Existing SANGLEY is currently accommodating some of general aviation. In case all the general aviation and other turbo prop aircraft operations are transferred from NAIA to SANGLEY, the capacity constraints at NAIA could be somehow mitigated.

Examination of SANGLEY as the supplemental airport for NAIA is further described in Section 9 in this report.

2.2.3 Roadmap for Development of New Manila International Airport (NMIA)

Examination of alternative solutions should be realized immediately, otherwise NAIA would face capacity constraint in the near future. Although those measures could be undertaken, the air traffic demand of Greater Capital Region in the Philippines overwhelmed NAIA airport capacity soon or later based on past air traffic demand forecast analysis. Realistically, CRK is a position to accommodate over spilled air traffic demand of NAIA, in this context, CRK should develop further.

Roadmap for transportation infrastructure development for Metro Manila and Its Surrounding Areas (hereinafter referred to as "Roadmap Study") funded by JICA was conducted in 2013, and it showed that the necessity of New Manila International Airport (NMIA) to cater for increasing air traffic demand of GCR area. Until opening of NMIA, NAIA will continue to be main gateway airport of the Philippines because of the distance of gravity center of Metro Manila, while CRK will accommodate relatively small air traffic compared to its potential until Metro Clark generates demand. Following table shows image of airport system for GCR area. To cater the air traffic demand for GCR area, NMIA needs to develop appropriate location near Metro Manila.

Table 2.2.3-1 Image of Roadmap for Development for Airports in GCR Area

Airport	Immediate-term	Short-term	Medium-term	Long-term
NMIA	Decision making by the Government. Project formulation such as EIA/ECC, ICC approval.	Design & construct revetment/reclamation and access bridge.	Site development and construction of airport facilities and related service/facilities.	Inaugurate NMIA
NAIA	Improve airport capacity.	Continue improvements as required	Partialy transfer some domestic operation to other airport.	Close NAIA, or remain NAIA as it is.
CRK	Improve airport capacity.	Continue improvements as appropriate to attract overflowing airlines and passengers/cargo from NAIA	Continue improvements as appropriate to attract overflowing airlines and passengers/cargo from NAIA, and also generated by Metro Clark.	Continue improvements as appropriate to cater the passengers generated by Metro Clark.
Sangley or Other Airport	Improve airport to decongest NAIA	Improve airport to decongest NAIA	Improve airport to decongest NAIA	

2.3 Need to Scrutinize Site for New Gateway International Airport

Terms of Reference issued by JICA indicated the candidate site of NMIA as shown below.

i) Angat-Pandi-Bustos located to the north of Metro Manila;
ii) Obando, located to the north of Metro Manila;
iii) Northern Portion of Manila Bay;
iv) Central Portion of Manila Bay;
v) Sangley Point Option 1 located offshore Cavite Peninsular
vi) Sangley Point Option 2, located parallel to the existing runway at Sangley Point;
vii) San Nicholas Shoals located to the south of Sangley;
viii) Western side of Laguna de Bay; and
ix) Rizal-Talim Island located in the central part of Laguna de Bay

Above candidate sites of NMIA are including some difficulties in terms of social and environment issues, characteristic of soil conditions, topography, and so forth. Site selection for large scale airport nearby Metro Manila requires for evaluating from many aspects such as airspace availability, obstacle restriction, weather conditions, social and environment consideration, accessibility, proximity of demand area, land use, topography of sites, construction cost consideration, construction years required etc., and therefore, scrutinizing efforts should be required.

SECTION 3

LONG-TERM TRAFFIC DEMAND FORECAST

SECTION 3: LONG-TERM TRAFFIC DEMAND FORECAST

3.1 Basic Approach for Forecast

3.1.1. Precondition of Forecast

1) Base Year

The base year of forecast has been set at 2014.

2) Years of Forecast

Under an assumption that the commencement of operations at New Manila International Airport (NMIA) would be around 2025, air traffic demand has been forecasted for the years 2020, 2025, 2030, 2035, 2040, 2045 and 2050.

3.1.2. Method of Air Traffic Demand Forecast

The air traffic demand at NMIA has been calculated through the processes shown in Figure 3.1.2-1.

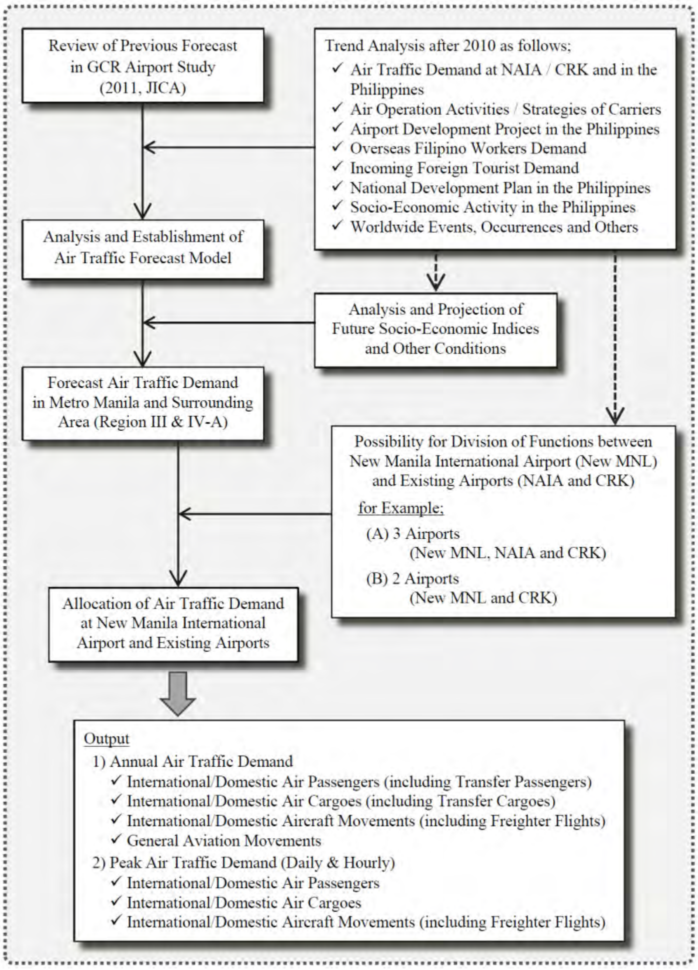


Figure 3.1.2-1 Flow Chart for Air Traffic Demand Forecast

3.2 Review of Previous Forecast

The outline of previous forecast for NAIA and CRK estimated in "The Study on the Airport Strategy for the Greater Capital Region in the Republic of the Philippines" (November 2011, JICA) (hereafter abbreviated to "2011 GCR Airport Study") is summarized as follows.

3.2.1. Precondition of Forecast in 2011 GCR Airport Study

1) Base Year

The base year of forecast was 2010.

2) Years of Forecast

The future airport traffic demand was forecast for the years 2015, 2020, 2025, 2030, 2035 and 2040.

3.2.2. Method of Forecast in 2011 GCR Airport Study

Regression models with air traffic demand records as dependent variables and socio-economic indicators (including some dummy variables for external events and occurrences in the world) as independent variables were developed for GCR (sum of NAIA and CRK) as well as NAIA and CRK separately as follows:

1) Forecasting Models for Air Traffic Demand in GCR (NAIA + CRK)

a) International Passengers

GCR-IPAX = 0.00996 x GDP - 1177.0 x DMY - 2491.5 [Formula-a1]
(24.8) (-3.8) (-5.2) R = 0.985

Where GCR-IPAX: Greater Capital Region Annual International Passengers ('000)
GDP: Gross Domestic Product (million pesos)
DMY: Crisis Dummy Variable (2003=1)
R: Correlation Coefficient ( ): t-value

Notes) The demand calculated through above Formula-a1 was divided into two airports of NAIA and CRK by applying the actual share (in 2010) of the total air passenger traffic volume of NAIA and CRK combined.

b) International Cargoes

GCR-ICGO = 0.2337 x GDP - 67120.0 x DMY - 40139.9 [Formula-a2]
(7.7) (-2.7) (1.4) R = 0.703

Where GCR-ICGO: Greater Capital Region Annual International Cargo (tons)
GDP: Gross Domestic Product (million pesos)

DMY: Crisis Dummy Variable (2003, 2008, 2009=1)

R: Correlation Coefficient ( ): t-value

Notes) The demand through above Formula-a2 was divided in two airports of NAIA and CRK by applying the actual share (in 2010) of the total air cargo traffic volume of NAIA and CRK combined.

2) Forecast Model for Air Traffic Demand at NAIA

a) International Passengers

The international air passenger demand was calculated by dividing the air passenger traffic demand at GCR forecasted through Formula-a1.

b) International Cargoes:

The international air cargo demand was calculated by dividing the air passenger traffic demand at GCR forecasted through Formula-a2.

c) Domestic Passengers:

DPAX-NAIA = 0.00548 x GDP + 175.0 x NAL

(43.9) (16.4) R = 0.998

Where DPAX-NAIA: Annual Domestic Passenger at NAIA ('000)

GDP: Gross Domestic Product (million pesos)

NAL: Number of Aircraft of LCC

R: Correlation Coefficient ( ): t-value

d) Domestic Cargoes:

The domestc air cargo traffic demand was calculated using 3.0% of annual growth rate assumed based on the average growth rate of air cargo for the past 14 yeares at NAIA.

3) Forecast Model for Air Traffic Model at CRK

a) International Passengers

The international air passenger demand was calculated by dividing the air passenger traffic demand at GCR forecasted through Formula-a1.

b) International Cargoes:

The international air cargo demand was calculated by dividing the air passenger traffic demand at GCR forecasted through Formula-a2.

c) Domestic Passengers:

DPAX-DMIA = 0.0018 x GRDP - 173.4

(5.6) (-4.9) R = 0.861

Where DPAX-DMIA: Annual Domestic Passenger ('000)

GRDP: Gross Regional Domestic Product in Region III (million pesos)

R: Correlation Coefficient ( ): t-value

d) Domestic Cargoes:

The domestc air cargo traffic demand was calculated using 2.25% of annual growth rate assumed based on the average growth rate of air cargo for the past 7 yeares at CRK.

4) Projection of the Socio-Economic Framework

a) Gross Domestic Product (GDP)

The future economic growth rates of the Philippines were assumed based on the forecasts by various organizations as Base Case (Medium Case). And sensitivity analyses were carried out for +1.0% of GDP as a High Case and -1.0% of GDP as a Low Case.

Table 3.2.2-1 Assumed Future Philippine GDP Growth Rate in 2011 GCR Study

Year	Growth Rate		
	Low Case	Medium Case	High Case
2011	4.0 %	5.0 %	6.0 %
2012	4.3 %	5.3 %	6.3 %
2013～2016	4.0 %	5.0 %	6.0 %
2017～2020	3.5 %	4.5 %	5.5 %
2021～2025	3.3 %	4.3 %	5.3 %
2026～2030	3.0 %	4.0 %	5.0 %
2031～2035	2.8 %	3.8 %	4.8 %
2036～2040	2.7 %	3.7 %	4.7 %

Source: 2011 GCR Airport Study

b) Future Trends of Low Cost Carriers (LCCs)

The future trends of LCCs in the Philippines were reviewed based on the fleet development plans of Cebu Pacific and other LCC airlines.

Table 3.2.2-2 Assumed Future Number of LCC Aircraft in 2011 GCR Airport Study

Year	Number of Aircraft
2010	32
2011	42
2012	47
2013	52
2014	53
2015~	+3/year

Source: 2011 GCR Airport Study

3.2.3. Result of Forecast in 2011 GCR Airport Study

1) Air Traffic Demand Forecast at NAIA

The result of air traffic demand at NAIA is shown in Table 3.2.3-1 and Table 3.2.3-2. The aircraft movement was forecasted based on the then flight schedule (in 2010) at NAIA and future trends in fleet development. As for the general aviation (GA) traffic demand, it was assumed that future GA flights at NAIA would remain at 2010 level of 36,000 annual movements.

Table 3.2.3-1 Air Passenger and Cargo Demand Forecast at NAIA in 2011 GCR Airport Study

Year	Passengers ('000)			Cargo (metric tons)		
	International	Domestic	Total	International	Domestic	Total
2010	12,381	14,755	27,136	306,361	117,467	423,828
2015	16,464	21,314	37,778	396,001	139,514	535,515
2020	21,172	26,658	47,830	499,345	165,699	665,044
2025	26,649	32,447	59,096	619,591	196,799	816,390
2030	32,901	38,683	71,584	756,831	233,735	990,566
2035	40,098	45,466	85,564	914,822	277,604	1,192,426
2040	48,526	52,959	101,485	1,099,822	329,706	1,429,528
Period	Average Annual Growth Rate			Average Annual Growth Rate		
2010-2020	5.5%	6.1%	5.0%	5.0%	3.5%	4.3%
2010-2030	5.0%	4.9%	4.7%	4.6%	3.5%	4.2%
2010-2040	4.7%	4.4%	4.5%	4.4%	3.5%	4.1%

Source: 2011 GCR Airport Study

Table 3.2.3-2 Aircraft Movement Forecast at NAIA in 2011 GCR Airport Study

Year	International Passenger Flights	Domestic Passenger Flights	Freighter Flights	General Aviation	Total
2010	65,567 (28%)	132,992 (56%)	1,986 (1%)	36,000 (15%)	236,545 (100%)
2015	88,687 (28%)	188,078 (60%)	2,768 (1%)	36,000 (12%)	315,533 (100%)
2020	116,022 (31%)	220,678 (59%)	3,367 (1%)	36,000 (10%)	376,067 (100%)
2025	146,106 (33%)	256,701 (58%)	4,028 (1%)	36,000 (8%)	442,835 (100%)
2030	180,458 (35%)	293,056 (57%)	4,735 (1%)	36,000 (7%)	514,249 (100%)
2035	219,849 (36%)	344,439 (57%)	5,643 (1%)	36,000 (6%)	605,931 (100%)
2040	265,953 (37%)	401,206 (57%)	6,672 (1%)	36,000 (5%)	709,831 (100%)

Source: 2011 GCR Airport Study

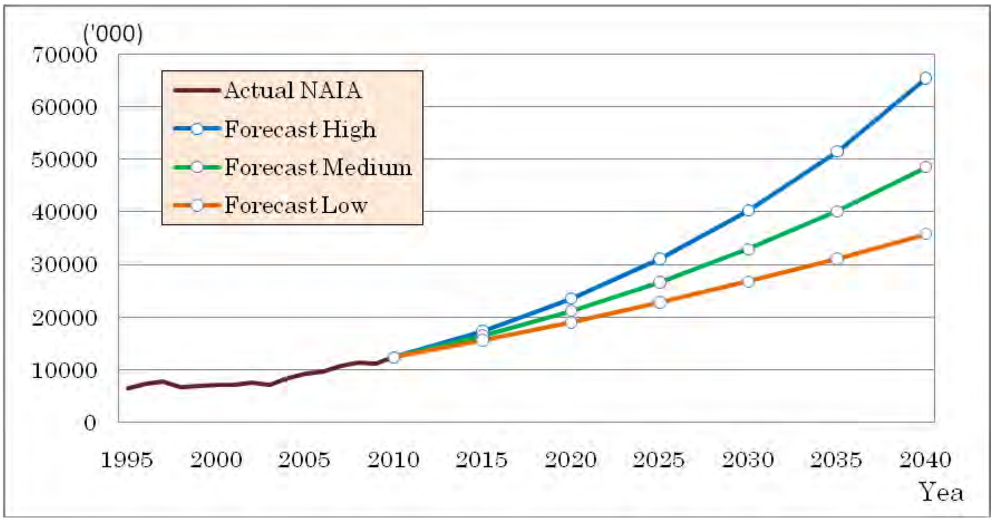


Figure 3.2.3-1 International Passenger Demand at NAIA

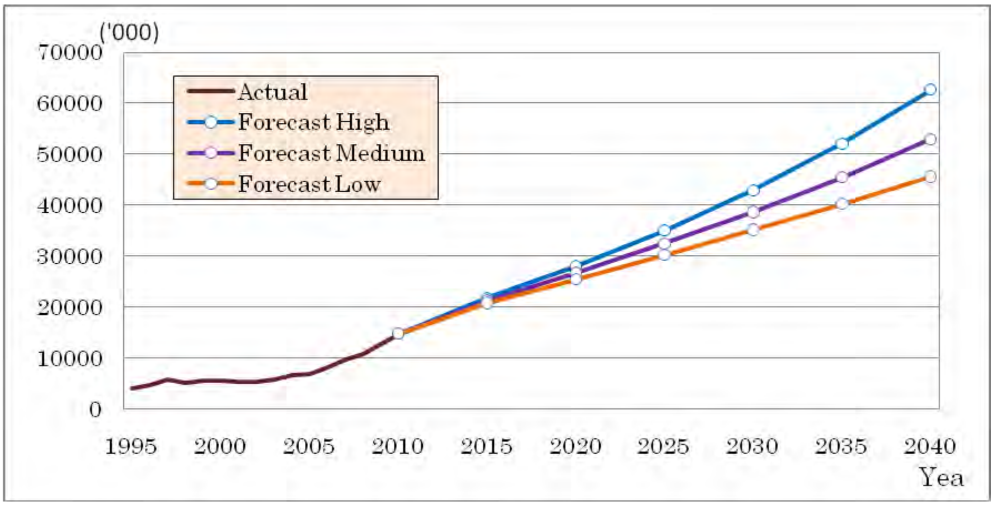


Figure 3.2.3-2 Domestic Passenger Demand at NAIA

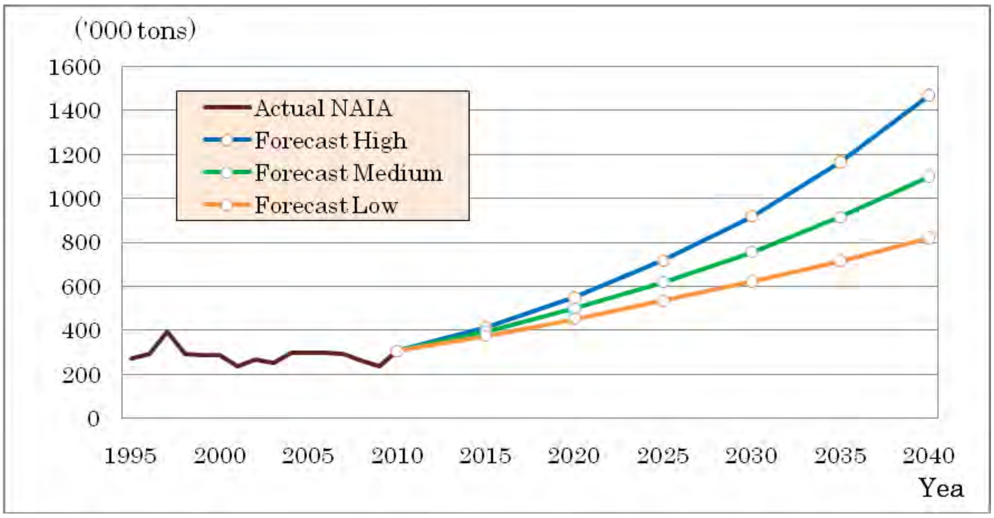


Figure 3.2.3-3 International Cargo Demand at NAIA

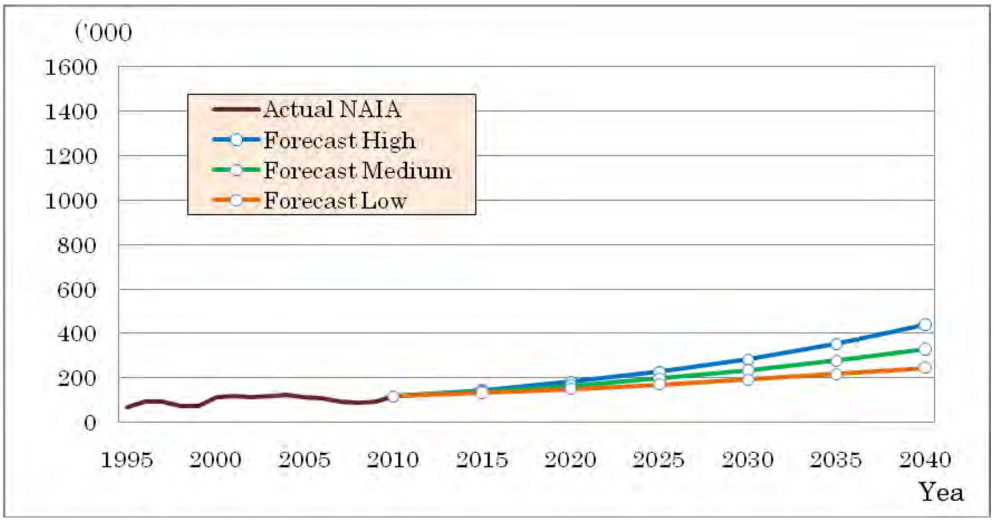


Figure 3.2.3-4 Domestic Cargo Demand at NAIA

2) Air Traffic Demand Forecast at CRK

The result of air traffic demand forecast at CRK is shown in Table 3.2.3-3 and Table 3.2.3-4. The aircraft movement was forecasted based on the then flight schedule (in 2010) at CRK and future trends in fleet development. As for the general aviation (GA) traffic demand, it was assumed that future GA flights at CRK would be approximately 4,600 per annum, equivalent to the annual average over the last 8 years.

Table 3.2.3-3 Air Passenger and Cargo Demand Forecast at CRK in 2011 GCR Airport Study

Year	Passengers ('000)			Cargo (metric tons)		
	International	Domestic	Total	International	Domestic	Total
2010	608	38	685	45,326	648	45,974
2015	808	109	917	48,263	737	49,000
2020	1,039	182	1,221	60,858	841	61,699
2025	1,308	267	1,575	75,513	961	76,474
2030	1,615	364	1,979	92,239	1,098	93,337
2035	1,968	475	2,444	111,495	1,256	112,750
2040	2,382	606	2,988	134,042	1,441	135,482
Period	Average Annual Growth Rate			Average Annual Growth Rate		
2010-2020	5.5%	14.7%	6.6%	5.0%	2.6%	3.0%
2010-2030	5.0%	10.9%	5.8%	4.6%	2.7%	3.6%
2010-2040	4.7%	9.0%	5.2%	4.4%	2.7%	3.7%

Source: 2011 GCR Airport Study

Table 3.2.3-4 Aircraft Movement Forecast at CRK in 2011 GCR Airport Study

Year	Passenger Flight			Freighter Flight			General Aviation	Total
	International	Domestic	Sub Total	International	Domestic	Sub Total		
2010	4,767	1,494	6,261 (53%)	751	130	881 (8%)	4,600 (39%)	11,741 (100%)
2015	11,596	1,931	13,527 (69%)	1,272	147	1,419 (7%)	4,600 (24%)	19,546 (100%)
2020	14,807	2,434	17,241 (72%)	2,010	168	2,178 (9%)	4,600 (19%)	24,019 (100%)
2025	19,073	3,021	22,094 (74%)	2,800	192	2,992 (10%)	4,600 (15%)	29,686 (100%)
2030	23,782	3,690	27,472 (76%)	3,635	220	3,855 (11%)	4,600 (13%)	35,926 (100%)
2035	29,668	4,460	34,128 (78%)	4,749	251	5,000 (11%)	4,600 (11%)	43,728 (100%)
2040	36,002	5,362	41,364 (79%)	6,052	288	6,340 (12%)	4,600 (9%)	52,304 (100%)

Source: 2011 GCR Airport Study

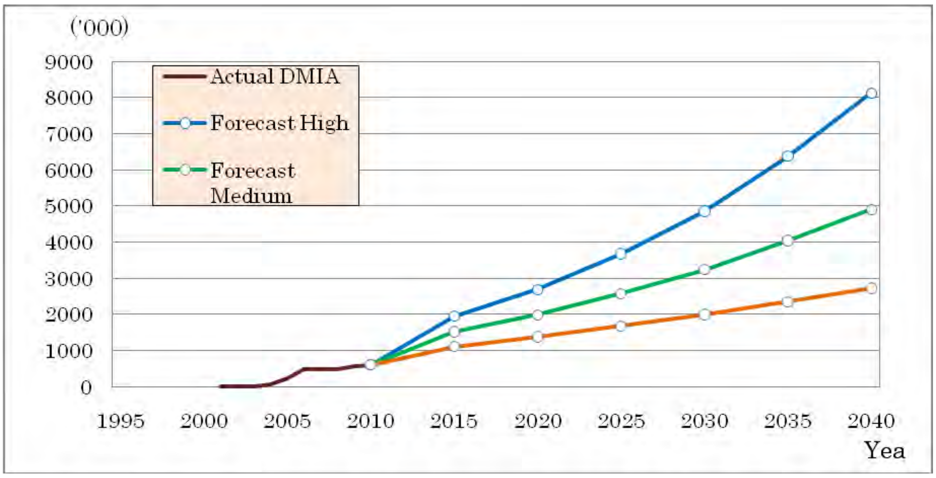


Figure 3.2.3-5 International Passenger Demand at CRK

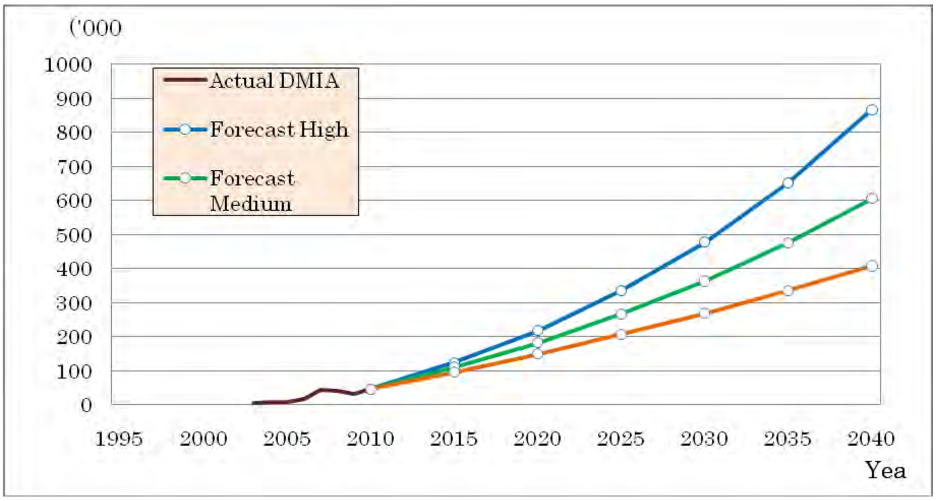


Figure 3.2.3-6 Domestic Passenger Demand at CRK

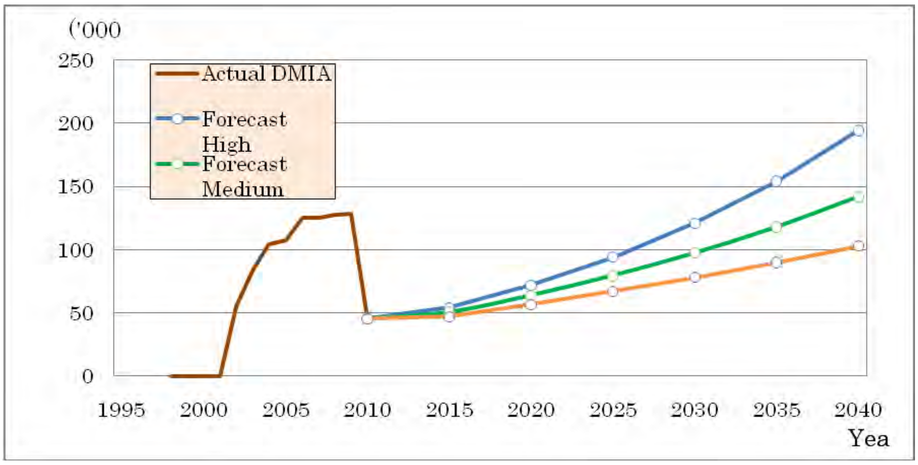


Figure 3.2.3-7 International Cargo Demand at CRK

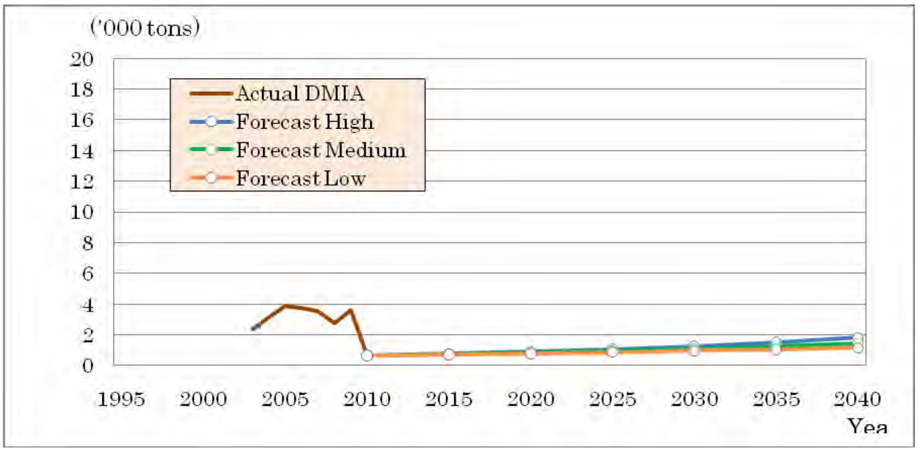


Figure 3.2.3-8 Domestic Cargo Demand at CRK

3) Consideration for the Air Traffic Demand Forecast in 2011 GCR Airport Study

The necessity to reevaluate the air traffic demand forecast has been considered from following viewpoints:

- ✓ When the forecast in 2011 GCR Airport Study was conducted, the accumulation of actual air traffic records at CRK was very much limited as most of the scheduled aircraft operations at CRK had started in around 2005. However, now actual records until 2014 are available in this study and it has been considered that the forecast by trend analysis is possible. Therefore, it is considered necessary to reanalyze the forecasting models by using the latest actual air traffic demand data.
- ✓ The actual growth rates of GDP in the Philippines after 2010 are available in this Study. Therefore, it is necessary to reevaluate the future Philippine GDP growth rates by referring to the recent forecast by various organizations.

3.3 Analysis and Establishment of Forecasting Models

3.3.1. Past Record of Air Traffic Demand

3.3.1.1. Air Traffic Demand in the Philippines

The air traffic record in the Philippines is shown in Table 3.3.1-1. The air passenger demand in 2014 was approximately 61 million consisting of 42 million domestic and 18 million international respectively. In the last 10 years, the domestic air passenger traffic increased by 11.2 % annually and international air passenger traffic increased by 7.1 % annually.

The air cargo demand in 2014 was approximately 824 thousand tons consisting 406 thousand tons of domestic and 417 thousand tons of international air cargoes. In the last 10 years, the domestic air cargo traffic increased by 4.0 % annually and international air cargo traffic decreased by 0.2 % annually.

The aircraft movement was approximately 817 thousand consisting 646 thousand domestic and 117 thousand international flights respectively in 2014. In the last 10 years, the domestic flights increased by 10.5 % annually and international flights increased by 8.0 % annually.

As for the general aviation traffic demand, the air passenger demand was approximately 348 thousand, the air cargo demand was 494 tons and the aircraft movement was 54 thousand in 2014. In the last 10 years, the air passenger traffic, air cargo traffic and aircraft movements decreased by 0.6 %, 15.1 % and 0.4 % annually respectively.

Table 3.3.1-1 Air Traffic Demand Record in the Philippines

Year	Passenger ('000)				Cargo (tons)				Aircraft Movement			
	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total
1991	7,761	4,587	225	12,573	148,705	180,258	19,905	348,868	225,312	26,929	60,228	312,469
1992	8,485	5,333	259	14,078	172,942	195,830	13,368	382,139	246,888	31,278	70,189	348,355
1993	9,030	5,845	246	15,121	177,675	212,892	14,677	405,244	210,927	34,497	65,313	310,737
1994	9,863	6,361	296	16,521	175,749	233,098	7,399	416,246	235,861	37,811	71,291	344,963
1995	10,549	6,877	352	17,778	185,470	281,686	11,115	478,270	247,295	39,876	81,527	368,698
1996	11,838	7,682	404	19,924	214,296	304,186	8,955	527,437	271,175	46,883	84,336	402,394
1997	14,235	8,239	343	22,817	280,572	389,857	9,906	680,335	294,717	52,672	89,540	436,929
1998	12,203	7,205	373	19,782	187,167	309,844	12,356	509,366	181,569	44,475	82,674	308,718
1999	12,560	7,469	295	20,323	193,576	309,604	7,436	510,616	236,438	45,193	69,908	351,539
2000	12,650	7,595	406	20,651	250,181	295,066	9,065	554,311	221,095	42,592	72,483	336,170
2001	12,056	7,045	317	19,418	247,890	300,870	10,080	558,840	234,039	49,000	66,917	349,956
2002	11,898	8,077	318	20,293	250,679	343,307	6,587	600,573	239,988	52,733	63,004	355,725
2003	12,351	7,644	276	20,271	243,463	360,810	3,325	607,598	241,580	52,410	58,583	352,573
2004	14,533	9,108	371	24,012	274,448	425,270	2,528	702,246	238,619	54,148	56,672	349,439
2005	15,278	9,987	366	25,631	292,691	421,601	2,933	717,225	226,198	62,106	52,752	341,056
2006	17,493	11,136	385	29,014	237,683	445,969	3,070	686,723	237,149	66,838	44,831	348,818
2007	21,846	12,572	357	34,775	301,969	440,864	2,760	745,594	350,923	72,652	51,897	475,472
2008	23,780	12,353	356	36,489	254,508	409,111	2,827	666,446	439,324	78,127	59,784	577,235
2009	28,381	12,203	302	40,885	234,195	381,172	3,324	618,691	478,345	82,311	47,782	608,438
2010	34,627	13,640	287	48,554	305,795	370,586	2,060	678,441	509,379	83,234	53,496	646,109
2011	37,406	14,992	367	52,765	314,316	347,259	2,323	663,898	608,880	93,810	56,087	758,777
2012	40,144	16,417	419	56,980	345,277	366,353	2,396	714,027	695,731	105,366	68,744	869,841
2013	40,990	17,588	532	59,110	338,192	349,926	2,036	690,153	700,778	114,266	70,569	885,613
2014	42,186	18,102	348	60,636	406,363	417,100	494	823,957	646,484	116,613	54,214	817,311

Source: JICA Survey Team (based on data of CAAP, MIAA, CRK, and others)

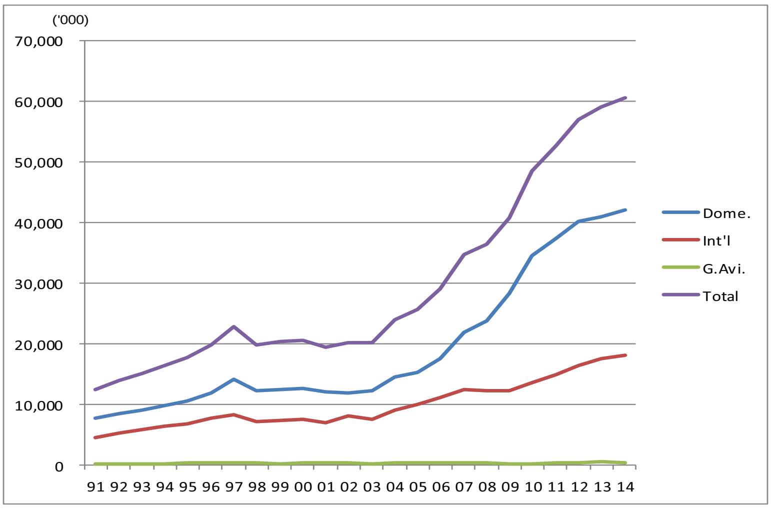


Figure 3.3.1-1 Actual Air Passenger Traffic Record in the Philippines

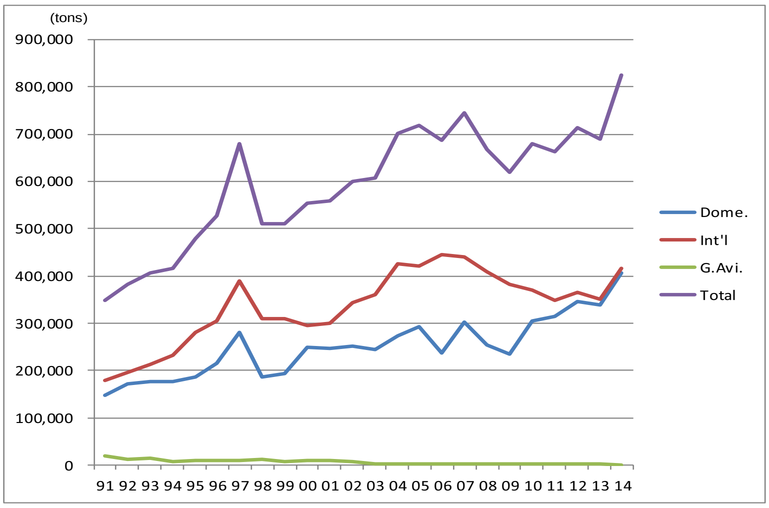


Figure 3.3.1-2 Actual Air Cargo Traffic Record in the Philippines

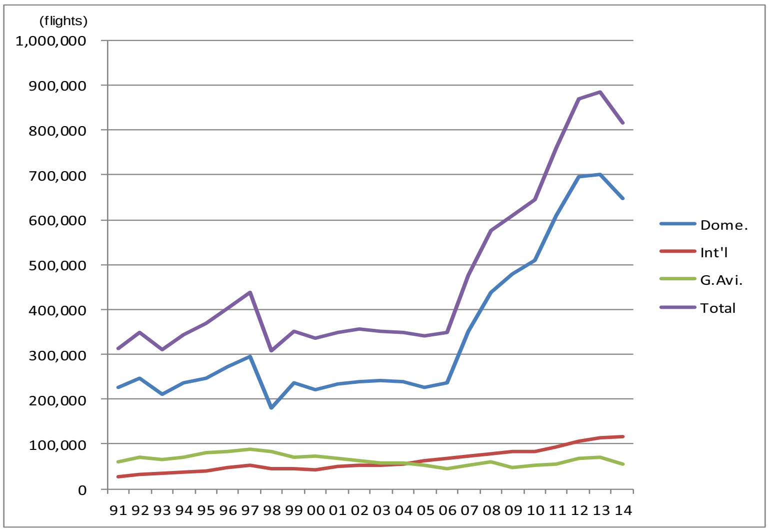


Figure 3.3.1-3 Actual Aircraft Movements Record in the Philippines

3.3.1.2. Air Traffic Demand in Metro Manila and Surrounding Area (GCR)

The air traffic record in GCR (total demand of NAIA and CRK) is shown in Table 3.3.1-2. The air passenger demand was approximately 32 million consisting of 18 million domestic air passengers and 17 million international air passengers in 2014. In the last 10 years, the domestic air passenger traffic increased by 10.4 % annually and international air passenger traffic increased by 7.1 % annually.

The air cargo demand was approximately 568 thousand tons consisting 166 thousand tons of domestic air cargoes and 402 thousand tons of international air cargoes in 2014. In the last 10 years, the domestic air cargo traffic increased by 2.8 % annually but the international air cargo traffic remained almost steady.

The aircraft movement was approximately 292 thousand consisting 144 thousand domestic and 99 thousand international flights in 2014. In the last 10 years, the domestic flights increased by 6.4 % annually and international flights increased by 7.6 % annually.

As for the general aviation traffic demand, the air passenger demand was approximately 304 thousand, the air cargo demand was 492 tons and the aircraft movement was 49 thousand in 2014. In the last 10 years, the air passenger traffic, air cargo traffic and aircraft movements decreased by 0.2 %, 15.0 % and 0.8 % annually respectively.

Table 3.3.1-2 Air Traffic Demand Record in GCR

Year	Passenger ('000)				Cargo (tons)				Aircraft Movement			
	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total	Domestic	International	G. Aviation	Total
1991	3,074	4,529	205	7,809	74,565	179,680	18,471	272,716	43,133	26,143	56,578	125,854
1992	3,281	5,236	229	8,746	70,455	193,915	12,065	276,435	47,572	30,359	64,133	142,064
1993	3,531	5,671	216	9,418	79,275	212,152	13,137	304,564	45,217	32,989	59,180	137,386
1994	3,945	6,116	262	10,323	61,848	231,992	6,664	300,504	48,635	35,702	65,002	149,339
1995	4,329	6,560	304	11,193	80,009	274,849	9,782	364,640	55,096	37,311	72,640	165,047
1996	4,986	7,297	345	12,628	100,890	293,323	7,795	402,008	62,653	43,805	74,314	180,772
1997	6,137	7,726	283	14,146	107,020	377,775	8,336	493,131	72,331	49,274	76,278	197,883
1998	5,337	6,817	320	12,474	86,521	291,246	10,801	388,568	65,187	41,453	73,163	179,803
1999	5,742	7,019	251	13,011	80,663	290,414	6,445	377,521	63,714	41,207	61,336	166,257
2000	5,968	7,130	348	13,446	117,951	272,740	7,922	398,612	64,987	39,083	64,126	168,196
2001	5,403	6,533	270	12,206	120,908	273,250	8,743	402,901	73,882	43,262	58,760	175,904
2002	5,292	7,468	256	13,015	116,621	321,791	5,958	444,370	71,943	46,876	57,590	176,409
2003	5,797	7,134	251	13,182	119,259	338,897	2,947	461,103	75,206	46,662	49,318	171,186
2004	6,750	8,466	311	15,526	125,375	403,653	2,493	531,522	77,216	47,807	45,535	170,558
2005	6,979	9,447	327	16,753	119,984	403,301	2,367	525,652	84,651	55,075	45,280	185,006
2006	8,177	10,238	338	18,752	113,591	425,407	2,800	541,798	86,106	58,369	42,566	187,041
2007	9,751	11,215	284	21,249	96,152	420,758	2,028	518,938	94,371	63,611	44,961	202,943
2008	10,760	11,764	283	22,807	92,430	391,203	2,294	485,927	103,575	69,334	46,716	219,625
2009	12,711	11,763	249	24,723	100,768	366,362	2,643	469,774	122,984	74,170	41,106	238,260
2010	14,802	12,988	256	28,046	118,115	351,451	1,914	471,481	133,530	72,653	44,941	251,124
2011	16,729	13,695	295	30,718	119,872	331,789	1,977	453,638	145,962	79,361	48,620	273,943
2012	18,039	15,155	410	33,604	149,080	352,677	2,389	504,145	159,333	88,998	63,415	311,746
2013	17,905	16,163	438	34,505	166,783	334,592	1,713	503,087	151,337	96,049	60,249	307,635
2014	18,110	16,858	304	35,273	165,876	401,843	492	568,211	143,629	99,463	49,379	292,471

Source: JICA Survey Team (based on data of CAAP, MIAA, CRK, and others)

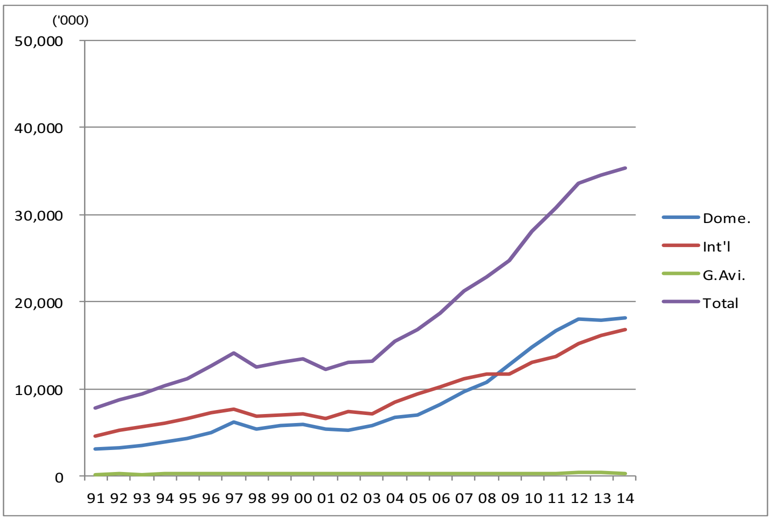


Figure 3.3.1-4 Actual Air Passenger Traffic Record in GCR

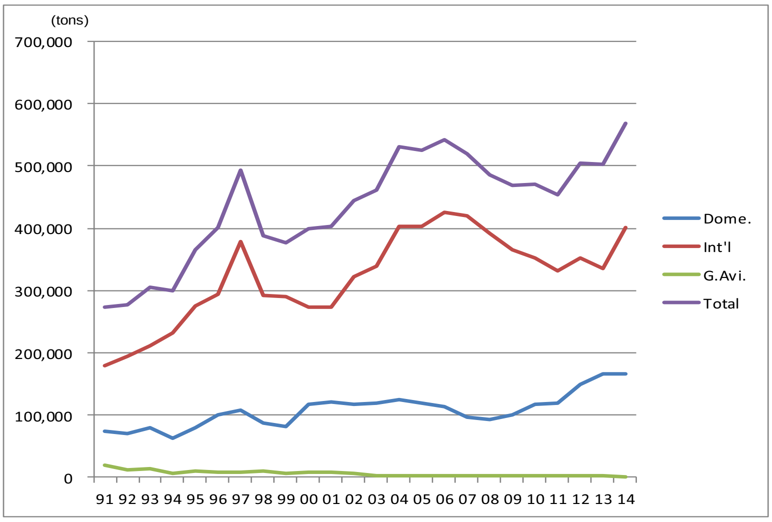


Figure 3.3.1-5 Actual Air Cargo Traffic Record in GCR

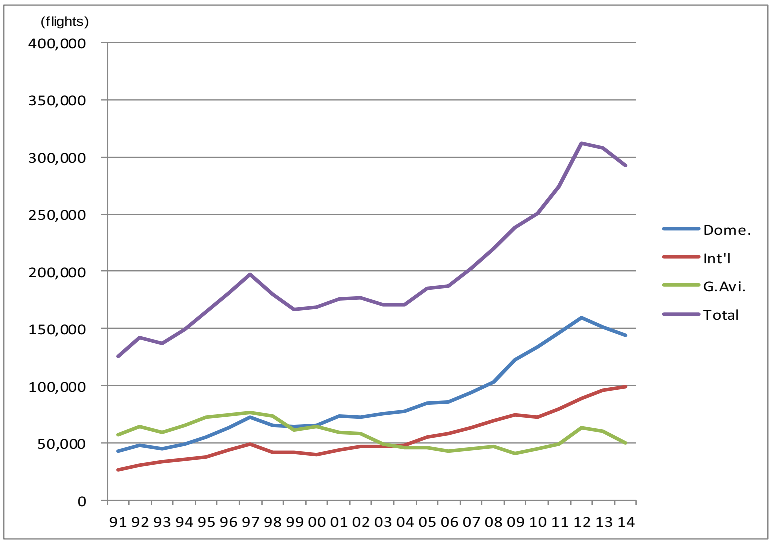


Figure 3.3.1-6 Actual Aircraft Movements Record in GCR

3.3.1.3. Air Traffic Demand at NAIA and CRK

The air traffic demand records at NAIA and CRK are shown in Section 2 (see Table 2.1.2-3 and Table 2.1.3-3). NAIA handled approximately 34 million air passengers, 520 thousand tons of air cargoes and 266 thousand aircraft movements in 2014, playing its important role as the international/domestic hub airport in the Philippines. On the other hand, CRK handled small scale demand because of the current poor air services network and frequency.

Table 3.3.1-3 shows the comparison of air traffic record between NAIA and CRK. In 2014, the shares of NAIA in domestic air traffic (passengers, cargoes and aircraft movements) were over 99%, and the shares in international air traffic were over almost 90%.

However, before 2010 when UPS had been operating at CRK, the shares of CRK in international cargo traffic were over almost 30%.

Therefore, it was considered that the air traffic demand at CRK will increase if the air services at CRK are expanded under the policy for division of functions between NAIA and CRK.

Table 3.3.1-3 Comparison of Air Traffic Demand Record between NAIA and CRK

	Year	Domestic Air Traffic					International Air Traffic					Genaral Aviation Traffic				
		NAIA		CRK		Total	NAIA		CRK		Total	NAIA		CRK		Total
		Traffic	Share	Traffic	Share		Traffic	Share	Traffic	Share		Traffic	Share	Traffic	Share	
Passengers ('000)	2004	6,741	99.9%	9	0.1%	6,750	8,416	99.4%	50	0.6%	8,466	272	87.5%	39	12.5%	311
	2005	6,972	99.9%	8	0.1%	6,979	9,222	97.6%	224	2.4%	9,447	292	89.0%	36	11.0%	327
	2006	8,159	99.8%	18	0.2%	8,177	9,767	95.4%	471	4.6%	10,238	304	89.8%	34	10.2%	338
	2007	9,707	99.6%	44	0.4%	9,751	10,725	95.6%	490	4.4%	11,215	262	92.3%	22	7.7%	284
	2008	10,720	99.6%	40	0.4%	10,760	11,273	95.8%	491	4.2%	11,764	259	91.6%	24	8.4%	283
	2009	12,680	99.8%	31	0.2%	12,711	11,203	95.2%	560	4.8%	11,763	225	90.3%	24	9.7%	249
	2010	14,755	99.7%	47	0.3%	14,802	12,381	95.3%	608	4.7%	12,988	204	79.9%	52	20.1%	256
	2011	16,687	99.7%	42	0.3%	16,729	12,969	94.7%	725	5.3%	13,695	227	76.9%	68	23.1%	295
	2012	17,739	98.3%	300	1.7%	18,039	14,140	93.3%	1,015	6.7%	15,155	243	59.2%	167	40.8%	410
	2013	17,689	98.8%	215	1.2%	17,905	15,177	93.9%	985	6.1%	16,163	250	57.1%	188	42.9%	438
	2014	18,020	99.5%	91	0.5%	18,110	16,072	95.3%	787	4.7%	16,858	184	60.4%	121	39.6%	304
Cargoes (tons)	2004	122,245	97.5%	3,130	2.5%	125,375	299,243	74.1%	104,410	25.9%	403,653	75,786	99.6%	311	0.4%	76,097
	2005	116,077	96.7%	3,907	3.3%	119,984	296,090	73.4%	107,211	26.6%	403,301	83,273	99.7%	260	0.3%	83,533
	2006	109,817	96.7%	3,774	3.3%	113,591	300,427	70.6%	124,981	29.4%	425,407	84,698	99.7%	285	0.3%	84,983
	2007	92,620	96.3%	3,533	3.7%	96,152	295,634	70.3%	125,124	29.7%	420,758	92,648	99.8%	156	0.2%	92,804
	2008	89,651	97.0%	2,780	3.0%	92,430	263,397	67.3%	127,805	32.7%	391,203	101,927	99.8%	193	0.2%	102,120
	2009	97,129	96.4%	3,639	3.6%	100,768	237,923	64.9%	128,439	35.1%	366,362	121,310	99.8%	256	0.2%	121,566
	2010	117,467	99.5%	648	0.5%	118,115	306,361	87.2%	45,090	12.8%	351,451	132,786	99.7%	386	0.3%	133,172
	2011	119,872	100.0%	0	0.0%	119,872	290,505	87.6%	41,284	12.4%	331,789	145,353	99.7%	456	0.3%	145,809
	2012	149,080	100.0%	0	0.0%	149,080	311,055	88.2%	41,621	11.8%	352,677	155,832	99.4%	974	0.6%	156,806
	2013	164,201	98.5%	2,582	1.5%	166,783	293,116	87.6%	41,476	12.4%	334,592	149,421	99.5%	734	0.5%	150,155
	2014	164,597	99.2%	1,280	0.8%	165,876	355,141	88.4%	46,702	11.6%	401,843	142,693	99.9%	195	0.1%	142,888
Aircraft Movements (flights)	2004	75,786	98.1%	1,430	1.9%	77,216	42,385	88.7%	5,422	11.3%	47,807	39,854	87.5%	5,681	12.5%	45,535
	2005	83,273	98.4%	1,378	1.6%	84,651	47,746	86.7%	7,329	13.3%	55,075	40,312	89.0%	4,968	11.0%	45,280
	2006	84,698	98.4%	1,408	1.6%	86,106	48,980	83.9%	9,389	16.1%	58,369	38,235	89.8%	4,331	10.2%	42,566
	2007	92,648	98.2%	1,723	1.8%	94,371	54,643	85.9%	8,968	14.1%	63,611	41,506	92.3%	3,455	7.7%	44,961
	2008	101,927	98.4%	1,648	1.6%	103,575	60,525	87.3%	8,809	12.7%	69,334	42,794	91.6%	3,922	8.4%	46,716
	2009	121,310	98.6%	1,674	1.4%	122,984	64,356	86.8%	9,814	13.2%	74,170	37,122	90.3%	3,984	9.7%	41,106
	2010	132,786	99.4%	744	0.6%	133,530	67,321	92.7%	5,332	7.3%	72,653	35,887	79.9%	9,054	20.1%	44,941
	2011	145,353	99.6%	609	0.4%	145,962	72,390	91.2%	6,971	8.8%	79,361	37,411	76.9%	11,209	23.1%	48,620
	2012	155,832	97.8%	3,501	2.2%	159,333	79,685	89.5%	9,313	10.5%	88,998	37,561	59.2%	25,854	40.8%	63,415
	2013	149,421	98.7%	1,916	1.3%	151,337	87,629	91.2%	8,420	8.8%	96,049	34,416	57.1%	25,833	42.9%	60,249
	2014	142,693	99.3%	936	0.7%	143,629	93,748	94.3%	5,715	5.7%	99,463	29,819	60.4%	19,560	39.6%	49,379

Source: JICA Survey Team (based on data from CAAP, MIAA, and CRK)

3.3.1.4. International Travelers in the Philippines

Historic trends of the international travelers (overseas visitors and outbound Philippine residents) are shown in Table 3.3.1-4. In the last 10 years, the overseas visitors increased by 9.4 % annually (2003-2013) and the outbound Philippine residents increase by 6.2 % annually (1999-2009). Number of Both travelers of overseas visitors and outbound Philippine residents were almost the same, and their past trends were very much similar as presented in Figure 3.3.1-7.

Table 3.3.1-4 International Travelers in the Philippines

Year	Overseas Visitors ('000)			Outbound Philippine Residents ('000)		
	Foreign Visitors	Overseas Filipinos	Total Visitors	Philippines Nationals	Foreign Nationals	Total Passengers
1993	-	-	-	1,274	42	1,316
1994	-	-	-	1,392	43	1,435
1995	-	-	-	1,574	42	1,615
1996	1,907	143	2,049	2,073	48	2,121
1997	2,088	135	2,223	1,892	39	1,930
1998	1,975	174	2,149	1,782	35	1,817
1999	1,973	199	2,172	1,725	30	1,755
2000	1,843	150	1,993	1,647	23	1,670
2001	1,698	99	1,797	1,766	21	1,787
2002	1,849	84	1,933	1,942	26	1,969
2003	1,807	100	1,907	1,780	23	1,803
2004	2,188	104	2,291	1,903	17	1,920
2005	2,498	125	2,623	2,127	17	2,144
2006	2,697	146	2,843	2,719	26	2,745
2007	2,911	181	3,092	3,033	32	3,066
2008	2,940	195	3,135	3,323	32	3,355
2009	2,819	198	3,017	3,157	31	3,188
2010	3,292	228	3,520	-	-	-
2011	3,719	207	3,927	-	-	-
2012	4,057	216	4,273	-	-	-
2013	4,478	204	4,681	-	-	-

Source: JICA Survey Team (based on data of DoT)

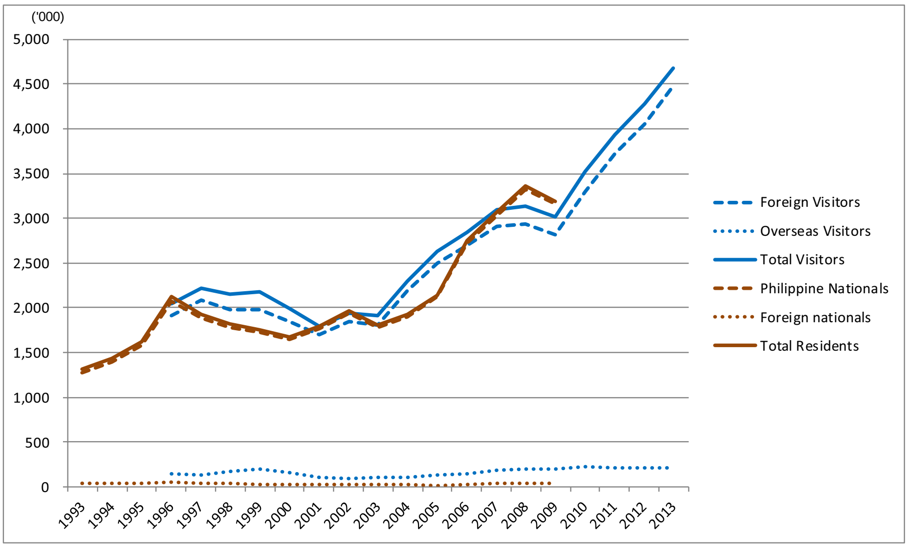


Figure 3.3.1-7 International Travelers in the Philippines

3.3.1.5. Regional Travelers in the Philippines

The past records of regional travelers (foreign travelers, overseas Filipinos and domestic travelers) are shown in Table 3.3.1-5.

These data are useful to estimate the potential for air passenger demand in the catchment areas of NAIA and CRK.

Table 3.3.1-5 Regional Travelers in the Philippines

('000)

Region	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	IX	X	XI	XII	XIII
Foreign Travellers																
2007	645	93	41	26	134	511		79	322	685	26	29	41	56	4	20
2008	946	113	38	32	161	366		184	352	766	40	18	43	53	4	30
2009	1,184	90	37	32	147	221		436	349	758	13	3	40	57	4	28
2010	1,465	96	38	34	142	631		626	439	854	12	49	37	59	4	29
2011	1,705	85	22	34	147	332	167	675	494	1,030	24	6	86	60	4	38
2012	1,513	78	36	13	344	81	212	713	607	1,162	28	54	51	84	13	42
Overseas Filipinos																
2007	64	14	1	0	3	12		27	77	12	1	10	5	9	5	2
2008	18	9	0	0	5	10		66	93	17	2	23	4	5	5	2
2009	21	13	3	0	4	22		12	66	23	0	0	5	5	3	2
2010	15	8	3	0	4	23		55	92	20	0	22	7	7	4	2
2011	25	7	0	0	12	10	5	67	71	17	3	1	44	7	4	2
2012	20	4	1	0	10	5	10	60	58	16	1	33	10	11	0	3
Domestic Trabvellers																
2007	338	1,011	307	625	282	6,808		792	1,579	1,241	213	497	1,350	740	627	358
2008	387	1,072	314	638	369	3,644		1,058	1,561	1,336	197	494	995	817	644	388
2009	703	1,070	354	643	396	2,716		1,840	1,621	1,418	132	235	982	838	652	419
2010	816	1,066	438	674	448	3,879		2,441	1,568	1,492	130	623	1,420	843	665	527
2011	998	863	488	686	1,558	5,049	719	2,672	1,888	1,563	338	447	1,579	890	675	636
2012	909	831	634	375	1,720	1,207	912	2,912	2,434	1,750	462	572	1,422	1,480	269	699
Total of Travellers																
2007	1,048	1,117	349	651	420	7,331		898	1,978	1,938	239	536	1,396	804	636	380
2008	1,351	1,194	352	670	534	4,020		1,307	2,006	2,118	238	534	1,041	875	652	420
2009	1,908	1,173	393	675	547	2,959		2,287	2,036	2,199	146	238	1,026	901	659	449
2010	2,296	1,169	478	709	594	4,534		3,122	2,099	2,367	142	695	1,463	909	674	558
2011	2,727	955	510	719	1,717	5,391	890	3,414	2,454	2,611	365	454	1,710	957	682	676
2012	2,443	913	670	387	2,074	1,293	1,133	3,685	3,099	2,928	490	659	1,483	1,575	281	745

Source: JICA Survey Team (based on data of DoT)

3.3.2. Socio-Economic Indices related to Air Traffic Demand in the Philippines

3.3.2.1. Nationwide and Worldwide Socio-Economic Indices

The historic trends of socio-economic indices are shown in Table 3.3.2-1. These indices have been used as independent variables in analysis of forecast models.

Table 3.3.2-1 Historic Trends of Socio-Economic Indices

Year	Indicators in the Philippines			Indicators in the World			External Events and Occurrences in the Worlfd
	GDP (2000 price) (PhP Million)	Population ('000)	GDP per Capita (PhP)	Exchange Rate (PhP / USD)	Weighted Foreign GDP (USD Bill.)	Crude Oil Price (USD/bbl)	
1991	2,710,873	62,286	43,523	27.479	2,878	19.37	
1992	2,715,662	63,869	42,520	25.513	3,011	19.02	
1993	2,768,675	65,451	42,301	27.120	3,163	16.84	
1994	2,885,656	67,034	43,048	26.417	3,349	15.89	
1995	3,015,302	68,617	43,944	25.715	3,560	17.18	
1996	3,187,425	70,197	45,407	26.216	3,487	20.42	
1997	3,348,907	71,774	46,659	29.471	3,459	19.17	
1998	3,326,903	73,350	45,357	40.893	3,458	13.06	(a) Asian Financial Crisis
1999	3,429,435	74,926	45,771	39.089	3,637	18.07	
2000	3,580,715	76,507	46,802	44.194	3,863	28.23	
2001	3,684,339	78,170	47,132	50.993	3,912	24.35	(b) September 11 attacks
2002	3,818,666	79,861	47,816	51.609	3,656	24.93	
2003	4,008,469	81,564	49,145	54.203	3,824	28.90	(c) SARS, Invasion of Iraq
2004	4,276,941	83,288	51,351	56.040	4,078	37.73	
2005	4,481,277	85,034	52,700	55.085	4,153	53.39	
2006	4,716,229	86,789	54,342	51.314	4,222	64.29	
2007	5,028,286	88,567	56,774	46.148	4,161	71.12	
2008	5,237,100	89,811	58,312	44.475	4,202	96.99	(d) Financial crisis (after Sep)
2009	5,297,240	91,068	58,168	47.637	4,263	61.76	(e) Financial crisis / Influenza pandemic
2010	5,701,539	92,338	61,747	45.110	4,388	79.04	(g) DMIA: UPS moved to SZX in China
2011	5,910,201	94,012	62,866	43.313	4,544	104.01	
2012	6,312,174	95,685	65,968	42.229	4,331	105.01	
2013	6,765,459	97,356	69,492	42.446	4,742	104.08	
2014	7,177,872	99,025	72,485	44.395	4,863	96.24	(f) DMIA: Air Phil. & ZEST moved to NAIA

Source: JICA Survey Team (based on data of NSCB, IMF, World Bank and others)

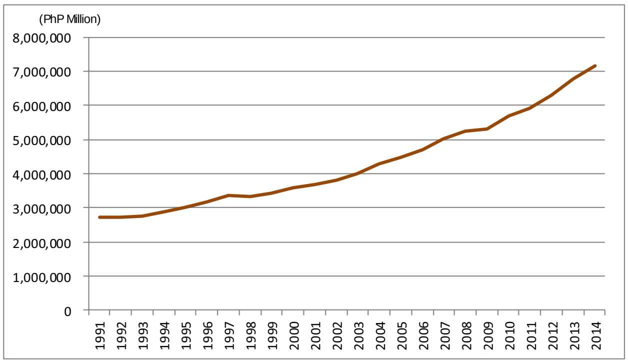


Figure 3.3.2-1 Gross Domestic Product (GDP) in the Philippines

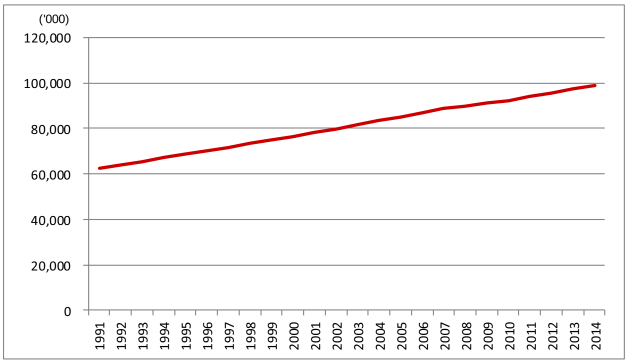


Figure 3.3.2-2 Population in the Philippines

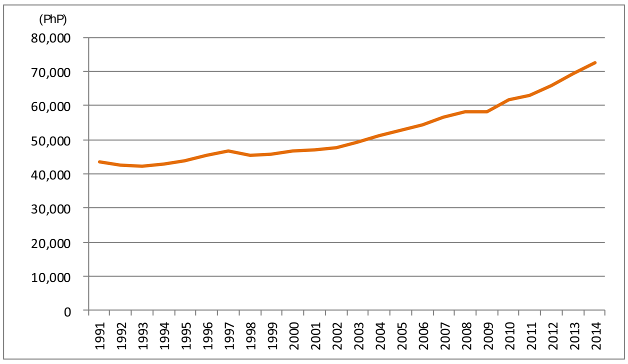


Figure 3.3.2-3 GDP per Capita in the Philippines

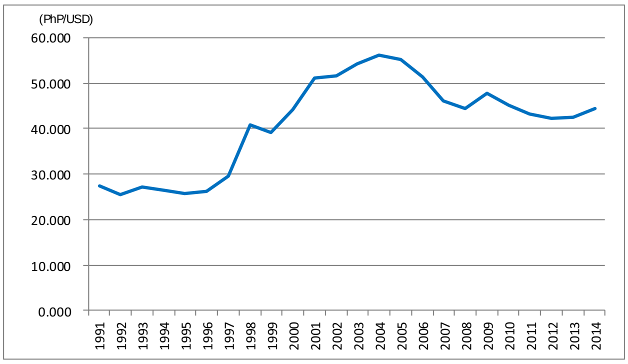


Figure 3.3.2-4 Exchange Rate (Peso vs U.S. Dollar Rate)

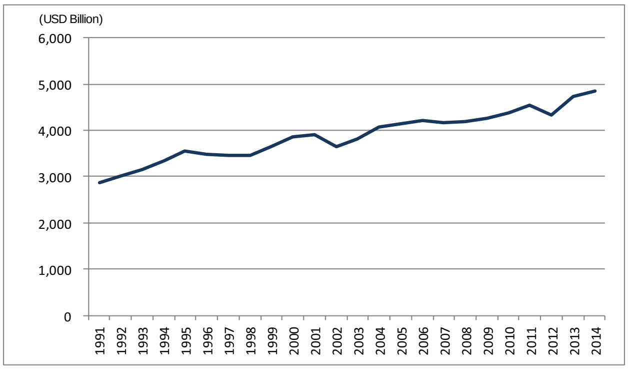


Figure 3.3.2-5 Weighted Foreign GDP

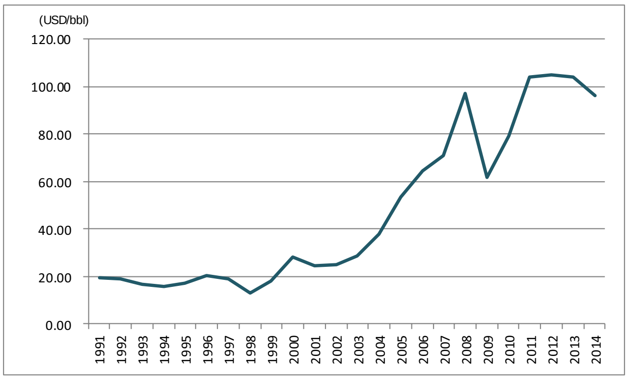


Figure 3.3.2-6 Crude Oil Price

3.3.2.2. Gross Regional Domestic Product (GRDP) in the Philippines

The historic trends of GRDP in the Philippines are shown in Table 3.3.2-2. GRDP are useful to estimate the potential for air traffic demand in the catchment areas of NAIA and CRK.

Table 3.3.2-2 Historic Trends of GRDP in the Philippines

(PhP Billion at constant prices in 2000)

Region	NCR	CAR	I	II	III	IV-A	IV-B	V	VI	VII	VIII	IX	X	XI	XII	ARMM	XIII
2000	1,196	87	121	80	345	657	64	69	135	201	108	81	100	187	74	43	34
2001	1,237	87	123	81	358	681	67	72	139	208	109	82	104	188	76	39	34
2002	1,264	90	127	79	373	729	73	75	144	212	111	82	132	141	108	45	34
2003	1,339	92	132	80	387	760	79	79	152	222	117	86	140	151	112	46	34
2004	1,461	97	140	88	397	796	82	84	165	239	123	90	151	162	119	49	35
2005	1,570	97	148	84	407	816	88	88	173	253	127	96	157	168	122	51	36
2006	1,675	101	156	90	425	848	89	90	181	265	134	98	168	175	130	53	39
2007	1,800	107	165	96	449	891	97	97	195	287	137	105	181	186	138	55	42
2008	1,894	110	169	98	468	913	101	101	204	298	143	107	191	194	145	56	43
2009	1,899	113	168	101	464	904	102	110	217	302	146	115	198	206	148	58	45
2010	2,038	120	180	100	511	1,009	102	114	227	341	151	117	211	217	151	48	65
2011	2,103	122	184	105	547	1,026	105	116	241	364	154	117	223	225	159	47	70
2012	2,251	123	194	114	582	1,101	110	124	260	398	144	132	239	242	172	48	78
2013	2,455	130	209	122	608	1,175	112	136	271	428	152	138	253	258	186	50	84
2014	2,617	134	220	130	645	1,238	116	144	287	462	153	146	269	274	200	51	91

Source: JICA Survey Team (based on data of NSCB)

3.3.3. Analysis and Establishment of Forecasting Models

1) Analysis of Forecasting Models

Various multiple regression models have been analyzed with the combinations of dependent and independent variables for various analysis periods as shown in Figure 3.3.3-1.

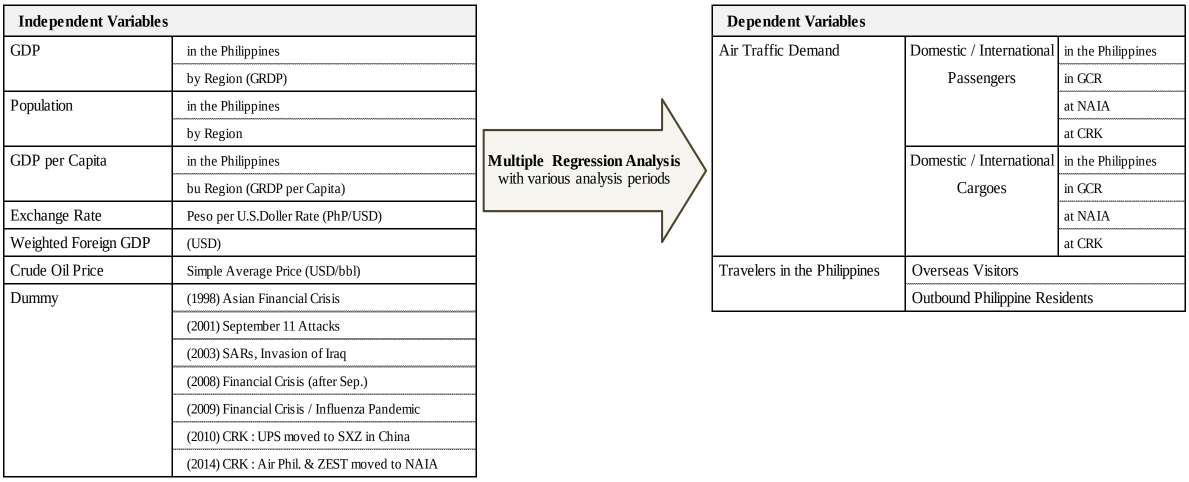


Figure 3.3.3-1 Outline of Multiple Regression Analysis

The forecasting models to estimate future air traffic demand have been chosen based on the coefficients of determination obtained through the regression analyses.

2) Forecasting Models for Air Traffic Demand at NAIA

a) Domestic Passengers at NAIA [Formula-N1]

$$DPAX_{(NAIA)} = 0.00363 \times GDP - 8054.8$$

(18.6) (-8.2) $r2 = 0.9404$

Where $DPAX_{(NAIA)}$: Annual Domestic Passengers at NAIA ('000)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

b) International Passengers at NAIA [Formula-N2]

$$IPAX_{(NAIA)} = 0.00234 \times GDP - 1067.3$$

(28.7) (-3.4) $r2 = 0.9740$

Where $IPAX_{(NAIA)}$: Annual International Passengers at NAIA ('000)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

c) Domestic Cargoes at NAIA [Formula-N3]

$$DCGO_{(NAIA)} = 0.0409 \times GDP - 129310.7$$

(9.7) (-4.6) $r2 = 0.9491$

Where $DCGO_{(NAIA)}$: Annual Domestic Cargoes at NAIA (tons)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

d) International Cargoes at NAIA [Formula-N4]

$$ICGO_{(NAIA)} = 0.0422 \times GDP - 51884.9$$

(3.4) (-0.5) $r2 = 0.6946$

Where $ICGO_{(NAIA)}$: Annual International Cargoes at NAIA (tons)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

3) Forecasting Models for Air Traffic Demand at CRK

a) Domestic Passengers at CRK [Formula-C1]

$$DPAX_{(CRK)} = 0.00002 \times GDP + 193.1 \times DMY(a) - 70.3$$

(3.5) (9.9) (-2.5) $r2 = 0.9484$

Where $DPAX_{(CRK)}$: Annual Domestic Passengers at CRK ('000)
GDP: Gross Domestic Product in the Philippines (million pesos)

DMY(a): Dummy Variable for Operating of Airphil Express and Zestair (before 2014 = 1)

r2: Coefficient of Determination ( ): t-value

b) International Passengers at CRK [Formula-C2]

$$IPAX_{(CRK)} = 0.00031 \times GDP - 1403.0$$

(9.6) (-6.7) r2 = 0.8841

Where IPAX(CRK): Annual International Passengers at CRK ('000)

GDP: Gross Domestic Product in the Philippines (million pesos)

r2: Coefficient of Determination ( ): t-value

c) Domestic Cargoes at CRK [Formula-C3]

$$DCGO_{(CRK)} = 0.00081 \times GDP - 1204.6 \times DMY(b) - 4006.1 \times DMY(c) - 548.8$$

(1.7) (-1.5) (-4.4) (-0.1)

r2 = 0.8467

Where DCGO(CRK): Annual Domestic Cargoes at CRK (tons)

GDP: Gross Domestic Product in the Philippines (million pesos)

DMY(b): Dummy Variable for Financial Crisis (2008 = 1)

DMY(c): Dummy Variable for Withdrawing of UPS (after 2009 = 1)

r2: Coefficient of Determination ( ): t-value

d) International Cargoes at CRK [Formula-C4]

$$ICGO_{(CRK)} = 0.01647 \times GDP - 98496.8 \times DMY(c) + 26999.4$$

(2.8) (-8.6) (1.3) r2 = 0.9436

Where ICGO(CRK): Annual International Cargoes at CRK (tons)

GDP: Gross Domestic Product in the Philippines (million pesos)

DMY(c): Dummy Variable for Withdrawing of UPS (after 2009 = 1)

r2: Coefficient of Determination ( ): t-value

4) Forecasting Model for Air Traffic Demand of GCR (Total of NAIA and CRK)

The forecasting models for air traffic demand of GCR (total of NAIA and CRK) have been examined through regression analysis similarly to the separate models for NAIA and CRK shown in items 2) and 3) above. The result of regression analysis has shown that the coefficients of determination of the model for GCR (total of NAIA and CRK) are lower than those for NAIA and CRK each.(*) Therefore, the air traffic demand in GCR has been regarded as the total of separately estimated air traffic demand of NAIA and CRK. The models obtained for the forecast of total demand of GCR (total of NAIA and CRK) but not employed are described below.

(*) Coefficients of determination (r2) of the model for GCR were follows;
- ✓ International Passengers in GCR: 0.9396,
- ✓ Domestic Passengers in GCR: 0.9737,
- ✓ International Cargoes in GCR: 0.6479, and
- ✓ Domestic Cargoes in GCR: 0.4532.

a) Domestic Passengers in GCR [Formula-G1]

$$DPAX_{(GCR)} = DPAX_{(NAIA)} + DPAX_{(CRK)}$$

Where $DPAX_{(GCR)}$: Annual Domestic Passengers in GCR ('000)
$DPAX_{(NAIA)}$: Annual Domestic Passengers at NAIA by Formula-N1 ('000)
$DPAX_{(CRK)}$: Annual Domestic Passengers at CRK by Formula-C1 ('000)

b) International Passengers in GCR [Formula-G2]

$$IPAX_{(GCR)} = IPAX_{(NAIA)} + IPAX_{(CRK)}$$

Where $IPAX_{(GCR)}$: Annual International Passengers in GCR ('000)
$IPAX_{(NAIA)}$: Annual International Passengers at NAIA by Formula-N2 ('000)
$IPAX_{(CRK)}$: Annual International Passengers at CRK by Formula-C2 ('000)

c) Domestic Cargoes in GCR [Formula-G3]

$$DCGO_{(GCR)} = DCGO_{(NAIA)} + DCGO_{(CRK)}$$

Where $DCGO_{(GCR)}$: Annual Domestic Cargoes in GCR (tons)
$DCGO_{(NAIA)}$: Annual Domestic Cargoes at NAIA by Formula-N3 (tons)
$DCGO_{(CRK)}$: Annual Domestic Cargoes at CRK by Formula-C3 (tons)

d) International Cargoes in GCR [Formula-G4]

$$ICGO_{(GCR)} = ICGO_{(NAIA)} + ICGO_{(CRK)}$$

Where $ICGO_{(GCR)}$: Annual International Cargoes in GCR (tons)
$ICGO_{(NAIA)}$: Annual International Cargoes at NAIA by Formula-N4 (tons)
$ICGO_{(CRK)}$: Annual International Cargoes at CRK by Formula-C4 (tons)

3.4 Air Traffic Demand Forecast

3.4.1. Forecasting Cases in This Study

1) Trend Forecast as the Base Case

Air traffic demand at NAIA has been estimated by forecasting models obtained in items 2) and 3) of Subsection 3.3.3. The forecasting models reflect the past trend of the airport traffic at NAIA and CRK, and future airport traffic demand forecast by these models is to be regarded as the basis and to be called as the "Base Case".

It should be noted that the Base Case forecast is based on an assumption of non-capacity-constrained NAIA. Impacts by NAIA's capacity constraint have been taken into account in examining the future traffic distribution as briefed below and discussed in Subsection 3.6.

2) Future Traffic Distribution

NAIA is a capacity constrained airport and its capacity will be saturated sooner or later. It will not be possible to develop NMIA before the capacity saturation of NAIA. After the forthcoming capacity saturation, the over-spilled traffic would only be able to use CRK until completion of NMIA, and a significant volume of traffic would be accommodated at CRK, offering much improved air network and flight frequencies. The airport access, being regarded as one of the major causes of underutilization, will progressively be improved by construction of skyway and other road system in Metro Manila as well as the proposed railway development. Therefore, even after completion of NMIA, the air passengers and cargo to/from CRK catchment area but now using NAIA could continue to use CRK. After estimating the Base Case forecast, possible future traffic distribution between NMIA and CRK has been examined based on the origin/destination of the NAIA users as discussed in Subsection 3.6. It is needless to say that various role demarcation scenarios between NMIA and CRK could exist and the traffic distribution discussed in Subsection 3.6 is for reference purpose only.

3.4.2. Projection of Future Socio-Economic Framework

3.4.2.1. Future GDP in the Philippines

Based on the future growth rates of GDP in the Philippines forecasted by various organizations (see Table 3.4.2-1), the future GDP in the Philippines has been estimated as shown in Table 3.4.2-2. Sensitivity analyses were made for + 1.0 % of GDP growth rate as a High Case and - 1.0 % of GDP growth rate as a Low Case respectively.

Table 3.4.2-1 Comparison of GDP Growth Rates by Various Organizations

Year	Assumption of 2011 GCR Study (Medium Case)	Actual Growth Rate (NSCB)	Recent Forecast by Various Organizations					
			NEDA		IMF	World Bank	ADB	SCB
			Low	High				
2011	5.0 %	3.66 %	-	-	-	-	-	-
2012	5.3 %	6.80 %	-	-	-	-	-	-
2013	5.0 %	7.18 %	-	-	-	-	-	-
2014	5.0 %	6.10 %	6.5 %	7.5 %	6.24 %	6.0 %	-	-
2015	5.0 %	-	7.0 %	8.0 %	6.27 %	6.5 %	6.4 %	5.7 %

Source: JICA Survey Team

Table 3.4.2-2 Assumed Future GDP in the Philippines

	Year	GDP in the Philippines [constnat price at 2000] (PhP Million)					
		Low Case (Med.-1%)		Medium Case		High Case (Med.+1%)	
		Value	Change	Value	Change	Value	Change
Actual	2010	5,701,539	7.63%	5,701,539	7.63%	5,701,539	7.63%
	2011	5,910,201	3.66%	5,910,201	3.66%	5,910,201	3.66%
	2012	6,312,174	6.80%	6,312,174	6.80%	6,312,174	6.80%
	2013	6,765,459	7.18%	6,765,459	7.18%	6,765,459	7.18%
	2014	7,177,872	6.10%	7,177,872	6.10%	7,177,872	6.10%
Forecast	2020	9,082,298	4.00%	9,619,035	5.00%	10,181,949	6.00%
	2025	10,528,873	3.00%	11,703,027	4.00%	12,995,033	5.00%
	2030	12,205,849	3.00%	14,238,522	4.00%	16,585,321	5.00%
	2035	13,476,244	2.00%	16,506,349	3.00%	20,178,579	4.00%
	2040	14,878,862	2.00%	19,135,382	3.00%	24,550,327	4.00%
	2045	16,427,466	2.00%	22,183,153	3.00%	29,869,227	4.00%
	2050	18,137,250	2.00%	25,716,354	3.00%	36,340,482	4.00%

Source: JICA Survey Team

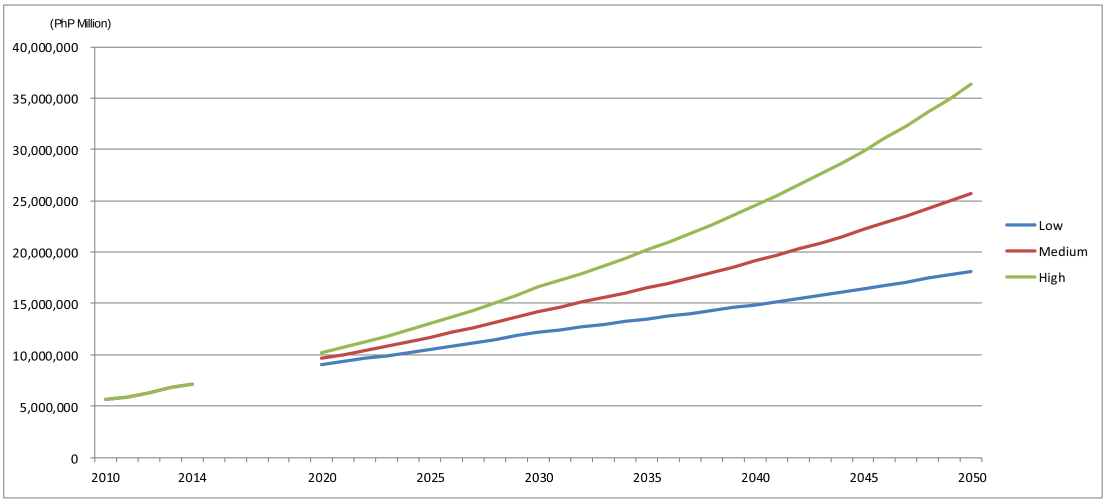


Figure 3.4.2-1 Assumed Future GDP in the Philippines

3.4.2.2. Categorization of Air Traffic Demand

Generally the international passengers consist of overseas visitors to the Philippines including overseas Filipinos (inbound passengers) and outbound Philippine residents including foreign nationals who are going out of the country (outbound passengers). The international and domestic passengers generally are categorized into Legacy Carrier users and LCC users. The air cargo demand is categorized into loaded/unloaded at NAIA or CRK. The international cargo demand can also be categorized into inbound and outbound. The air passenger and cargo demand estimated based on the forecasting models and assumed future GDP has been categorized into inbound and outbound passengers and cargo (international) as well as Legacy Carrier (LC) users and LCC Carrier users (international and domestic) as described hereunder.

1) Inbound and Outbound Ratio of International Passenger Demand

Based on the actual international travelers record (see Table 3.3.1-4), forecasting models for the overseas visitors and outbound Philippine residents have been obtained as follows:

a) Overseas Visitors to the Philippines (Inbound Passengers)

OSV = 0.00156 x GDP - 2233.4
(20.5) (-4.8) r2 = 0.9722

Where OCV: Annual Overseas Visitors including overseas Filipinos ('000)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

b) Outbound Philippine Residents in the Philippines

OPR = 0.00167 x GDP – 2881.5
(27.3) (-8.3) r2 = 0.9803

Where OPR: Annual Outbound Philippine Residents including foreign nationals ('000)
GDP: Gross Domestic Product in the Philippines (million pesos)
r2: Coefficient of Determination ( ): t-value

The ratio of the inbound and outbound passengers to the total international air passengers have been computed based on the above-stated forecasting models and future GDP as shown in Table 3.4.2-3.

Table 3.4.2-3 Estimated Ratios of Inbound (OSV) and Outbound (OPR) International Passengers

		Low Case			Medium Case			High Case		
	Year	OSV	OPR	Total	OSV	OPR	Total	OSV	OPR	Total
Passengers ('000)	2020	11,944	12,317	24,262	12,782	13,215	25,998	13,661	14,157	27,819
	2025	14,203	14,738	28,941	16,036	16,703	32,738	18,052	18,865	36,917
	2030	16,820	17,544	34,365	19,994	20,946	40,940	23,657	24,873	48,530
	2035	18,804	19,670	38,474	23,534	24,741	48,275	29,266	30,886	60,153
	2040	20,993	22,018	43,011	27,638	29,141	56,778	36,091	38,202	74,293
	2045	23,411	24,609	48,020	32,395	34,241	66,636	44,394	47,103	91,497
	2050	26,080	27,470	53,550	37,911	40,154	78,064	54,496	57,933	112,428
Share	2020	49.2%	50.8%	100.0%	49.2%	50.8%	100.0%	49.1%	50.9%	100.0%
	2025	49.1%	50.9%	100.0%	49.0%	51.0%	100.0%	48.9%	51.1%	100.0%
	2030	48.9%	51.1%	100.0%	48.8%	51.2%	100.0%	48.7%	51.3%	100.0%
	2035	48.9%	51.1%	100.0%	48.7%	51.3%	100.0%	48.7%	51.3%	100.0%
	2040	48.8%	51.2%	100.0%	48.7%	51.3%	100.0%	48.6%	51.4%	100.0%
	2045	48.8%	51.2%	100.0%	48.6%	51.4%	100.0%	48.5%	51.5%	100.0%
	2050	48.7%	51.3%	100.0%	48.6%	51.4%	100.0%	48.5%	51.5%	100.0%

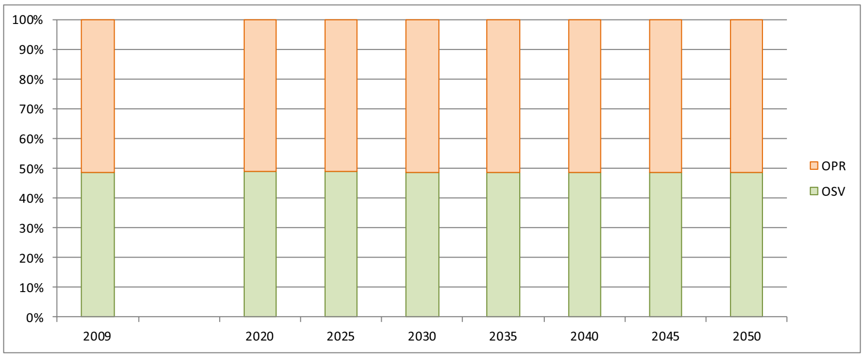


Figure 3.4.2-2 Share of Overseas Visitors (OSV) and Outbound Philippine Residents (OPR)

2) Legacy Carrier (LC) and Low Cost Carrier (LCC) Ratio of Air Passenger Demand

The legacy carrier (LC) and low cost carrier (LCC) ratios in the future have been assumed based on the recent trend of LC-LCC ratios as shown in Table 3.4.2-4.

Table 3.4.2-4 LC - LCC Ratio of Air Passengers at NAIA

	Year	Domestic Passenger			International Passenger				
		Local LC	Local LCC	Total	LC		LCC		Total
					Local	Foreign	Local	Foreign	
Passengers ('000)	2011	4,356	10,081	14,437	3,416	7,434	1,733	500	13,083
	2012	4,162	11,312	15,474	3,638	7,789	2,303	378	14,107
	2013	3,221	11,717	14,938	4,038	7,732	2,529	823	15,122
Share	2011	30.2%	69.8%	100.0%	26.1%	56.8%	13.2%	3.8%	100.0%
	2012	26.9%	73.1%	100.0%	25.8%	55.2%	16.3%	2.7%	100.0%
	2013	21.6%	78.4%	100.0%	26.7%	51.1%	16.7%	5.4%	100.0%
	Average	26.2%	73.8%	100.0%	26.2%	54.4%	15.4%	4.0%	100.0%
Future Assumed Share		15%	85%	100%	25%	45%	20%	10%	100%

Source: JICA Survey Team (based on data of MIAA)

3) Inbound and Outbound Ratio of Air Cargo Demand

The actual unload – load ratio of domestic cargoes and inbound - outbound ratio of international cargoes at NAIA in the recent 5 years were shown as Table 3.4.2-5 and Table 3.4.2-6 respectively.

Based on these actual ratios, unload - load of domestic cargoes and inbound - outbound ratios of international cargoes in the future were considered as almost equal (fifty-fifty).

Table 3.4.2-5 Actual Unload - Load Ratio of Domestic Cargoes at NAIA

Year	Domestic Cargoes (tons)			Share (%)		
	Unload	Load	Total	Unload	Load	Total
2010	62,763	54,704	117,467	53.43	46.57	100.00
2011	57,862	62,010	119,872	48.27	51.73	100.00
2012	71,403	77,677	149,080	47.90	52.10	100.00
2013	80,408	83,794	164,201	48.97	51.03	100.00
2014	83,720	80,876	164,597	50.86	49.14	100.00
Average	-	-	-	49.89	50.11	100.00

Source: MIAA

Table 3.4.2-6 Actual Inbound - Outbound Ratio of International Cargoes at NAIA

Year	International Cargoes (tons)			Share (%)		
	Inbound	Outbound	Total	Inbound	Outbound	Total
2010	142,751	163,610	306,361	46.60	53.40	100.00
2011	139,901	150,604	290,505	48.16	51.84	100.00
2012	148,822	162,233	311,055	47.84	52.16	100.00
2013	142,930	150,186	293,116	48.76	51.24	100.00
2014	173,753	181,389	355,141	48.92	51.08	100.00
Average	-	-	-	48.06	51.94	100.00

Source: MIAA

3.4.3. Results of Base Case Forecast

3.4.3.1. Air Traffic Demand at NAIA (Base Case)

1) Domestic and International Air Passenger Demand (Base Case)

Domestic and international air passenger demand at NAIA has been calculated by Formula-N1 and Formula-N2 obtained in Paragraph 3.3.3 as shown in Table 3.4.3-1 and Figure 3.4.3-1.

Table 3.4.3-1 Domestic and International Passenger Forecast at NAIA (Base Case)

	Year	Passengers ('000)														
		Low Case					Medium Case					High Case				
		Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total
Actual	2010	14,755	12,381	(6,266)	(6,115)	27,136	14,755	12,381	(6,266)	(6,115)	27,136	14,755	12,381	(6,266)	(6,115)	27,136
	2011	16,687	12,969	(6,449)	(6,520)	29,657	16,687	12,969	(6,449)	(6,520)	29,657	16,687	12,969	(6,449)	(6,520)	29,657
	2012	17,739	14,140	(6,999)	(7,141)	31,879	17,739	14,140	(6,999)	(7,141)	31,879	17,739	14,140	(6,999)	(7,141)	31,879
	2013	17,689	15,177	(7,490)	(7,687)	32,867	17,689	15,177	(7,490)	(7,687)	32,867	17,689	15,177	(7,490)	(7,687)	32,867
	2014	18,020	16,072	(7,965)	(8,106)	34,091	18,020	16,072	(7,965)	(8,106)	34,091	18,020	16,072	(7,965)	(8,106)	34,091
Forecast	2020	24,938	20,619	(10,151)	(10,468)	45,556	26,887	21,900	(10,768)	(11,133)	48,788	28,932	23,245	(11,415)	(11,830)	52,177
	2025	30,192	24,073	(11,814)	(12,259)	54,265	34,458	26,877	(13,164)	(13,712)	61,334	39,151	29,961	(14,651)	(15,311)	69,112
	2030	36,284	28,077	(13,743)	(14,334)	64,361	43,668	32,931	(16,082)	(16,848)	76,599	52,193	38,534	(18,784)	(19,750)	90,727
	2035	40,899	31,110	(15,205)	(15,906)	72,009	51,906	38,346	(18,693)	(19,652)	90,252	65,246	47,114	(22,922)	(24,191)	112,360
	2040	45,994	34,460	(16,819)	(17,640)	80,454	61,456	44,623	(21,721)	(22,902)	106,079	81,127	57,553	(27,958)	(29,594)	138,679
	2045	51,620	38,157	(18,602)	(19,555)	89,777	72,528	51,900	(25,231)	(26,669)	124,428	100,448	70,253	(34,086)	(36,167)	170,701
	2050	57,831	42,240	(20,571)	(21,668)	100,070	85,362	60,337	(29,302)	(31,035)	145,699	123,956	85,704	(41,542)	(44,162)	209,660

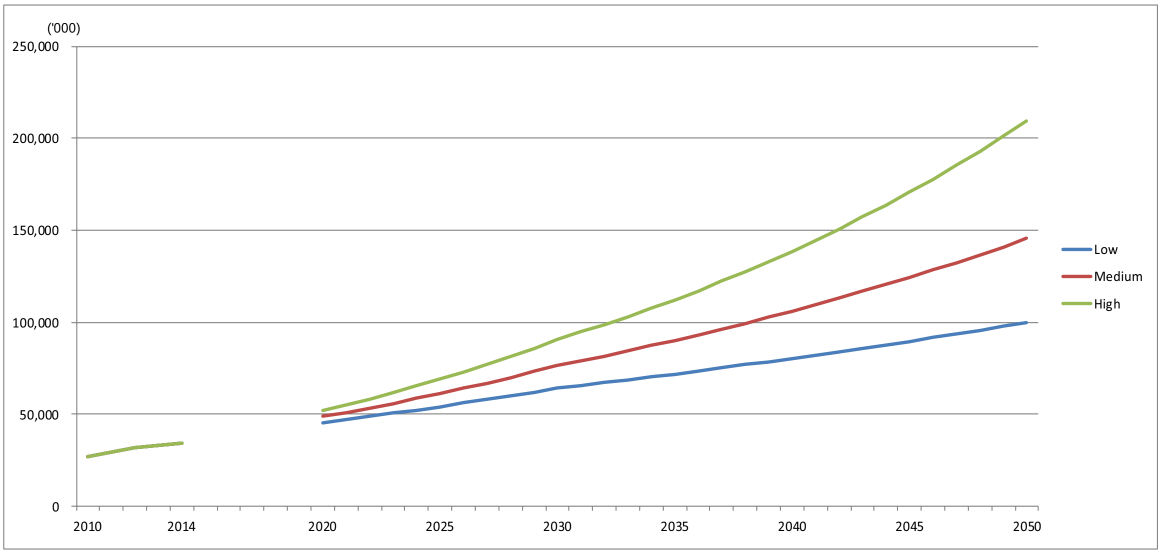


Figure 3.4.3-1 Air Passenger Demand at NAIA by GDP Growth Case (Base Case)
(Total of Domestic Passengers and International Passengers)

2) Domestic and International Air Cargo Demand (Base Case)

Domestic and international air cargo demand at NAIA has been calculated by Formula-N3 and Formula-N4 analyzed in Paragraph 3.3.3 as shown in Table 3.4.3-2 and Figure 3.4.3-2.

Table 3.4.3-2 Domestic and International Cargo Forecast at NAIA (Base Case)

	Year	Cargoes (tons)								
		Low Case			Medium Case			High Case		
		Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
Actual	2010	117,467	306,361	423,828	117,467	306,361	423,828	117,467	306,361	423,828
	2011	119,872	290,505	410,377	119,872	290,505	410,377	119,872	290,505	410,377
	2012	149,080	311,055	460,135	149,080	311,055	460,135	149,080	311,055	460,135
	2013	164,201	293,116	457,317	164,201	293,116	457,317	164,201	293,116	457,317
	2014	164,597	355,141	519,738	164,597	355,141	519,738	164,597	355,141	519,738
Forecast	2020	242,576	435,601	678,177	264,553	458,277	722,831	287,603	482,060	769,662
	2025	301,808	496,717	798,525	349,885	546,323	896,209	402,788	600,909	1,003,697
	2030	370,474	567,567	938,041	453,704	653,445	1,107,149	549,797	752,594	1,302,392
	2035	422,492	621,240	1,043,731	546,563	749,258	1,295,821	696,928	904,405	1,601,333
	2040	479,924	680,499	1,160,422	654,213	860,331	1,514,544	875,935	1,089,106	1,965,041
	2045	543,333	745,925	1,289,259	779,008	989,096	1,768,104	1,093,724	1,313,823	2,407,547
	2050	613,343	818,162	1,431,504	923,679	1,138,369	2,062,049	1,358,698	1,587,226	2,945,924

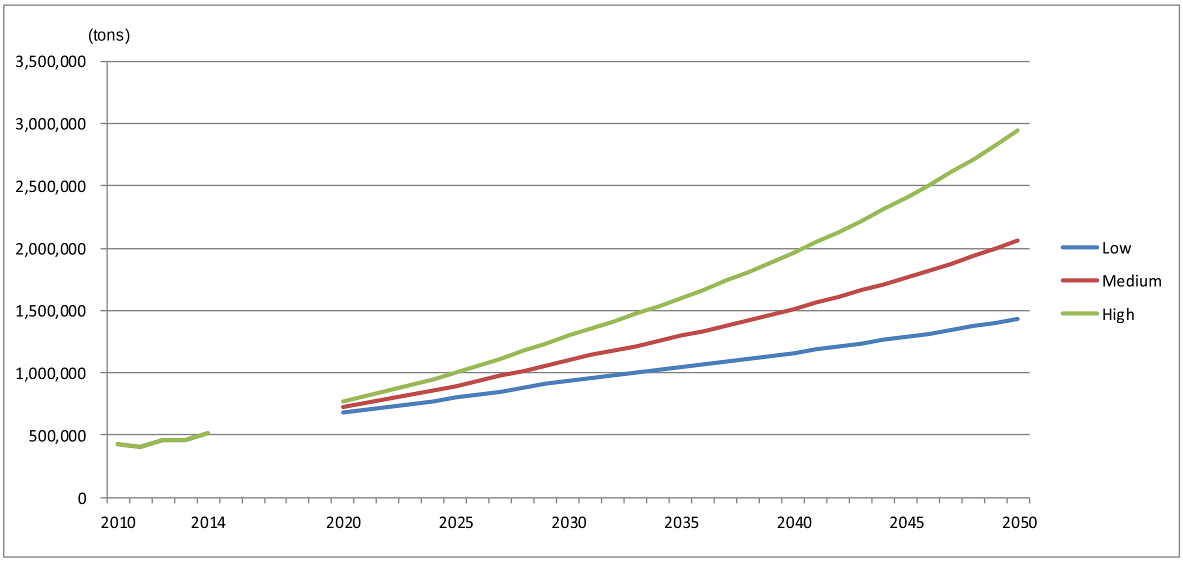


Figure 3.4.3-2 Air Cargo Demand at NAIA by GDP Growth Case (Base Case)
(Total of Domestic Cargoes and International Cargoes)

3.4.3.2. Air Traffic Demand at CRK (Base Case)

1) Domestic and International Air Passenger Demand (Base Case)

Domestic and international air passenger demand at CRK has been calculated by Formula-C1 and Formula-C2 obtained in Paragraph 3.3.3 as shown in Table 3.4.3-3 and Figure 3.4.3-3.

Table 3.4.3-3 Domestic and International Passenger Forecast at CRK (Base Case)

	Year	Passengers ('000)														
		Low Case					Medium Case					High Case				
		Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total
Actual	2010	47	608	(308)	(300)	654	47	608	(308)	(300)	654	47	608	(308)	(300)	654
	2011	42	725	(361)	(364)	767	42	725	(361)	(364)	767	42	725	(361)	(364)	767
	2012	300	1,015	(503)	(513)	1,316	300	1,015	(503)	(513)	1,316	300	1,015	(503)	(513)	1,316
	2013	215	985	(486)	(499)	1,201	215	985	(486)	(499)	1,201	215	985	(486)	(499)	1,201
	2014	91	787	(390)	(397)	878	91	787	(390)	(397)	878	91	787	(390)	(397)	878
Forecast	2020	134	1,368	(673)	(694)	1,502	146	1,532	(753)	(779)	1,677	158	1,703	(836)	(867)	1,862
	2025	166	1,809	(888)	(921)	1,975	193	2,167	(1,062)	(1,106)	2,360	222	2,561	(1,253)	(1,309)	2,783
	2030	204	2,321	(1,136)	(1,185)	2,525	250	2,941	(1,436)	(1,505)	3,190	302	3,657	(1,783)	(1,874)	3,959
	2035	232	2,708	(1,324)	(1,385)	2,941	300	3,633	(1,771)	(1,862)	3,933	383	4,753	(2,313)	(2,441)	5,136
	2040	264	3,136	(1,531)	(1,605)	3,400	360	4,435	(2,159)	(2,276)	4,794	481	6,087	(2,957)	(3,130)	6,568
	2045	299	3,609	(1,759)	(1,849)	3,907	428	5,365	(2,608)	(2,757)	5,793	601	7,709	(3,741)	(3,969)	8,310
	2050	337	4,130	(2,011)	(2,119)	4,467	507	6,442	(3,129)	(3,314)	6,950	746	9,684	(4,694)	(4,990)	10,430

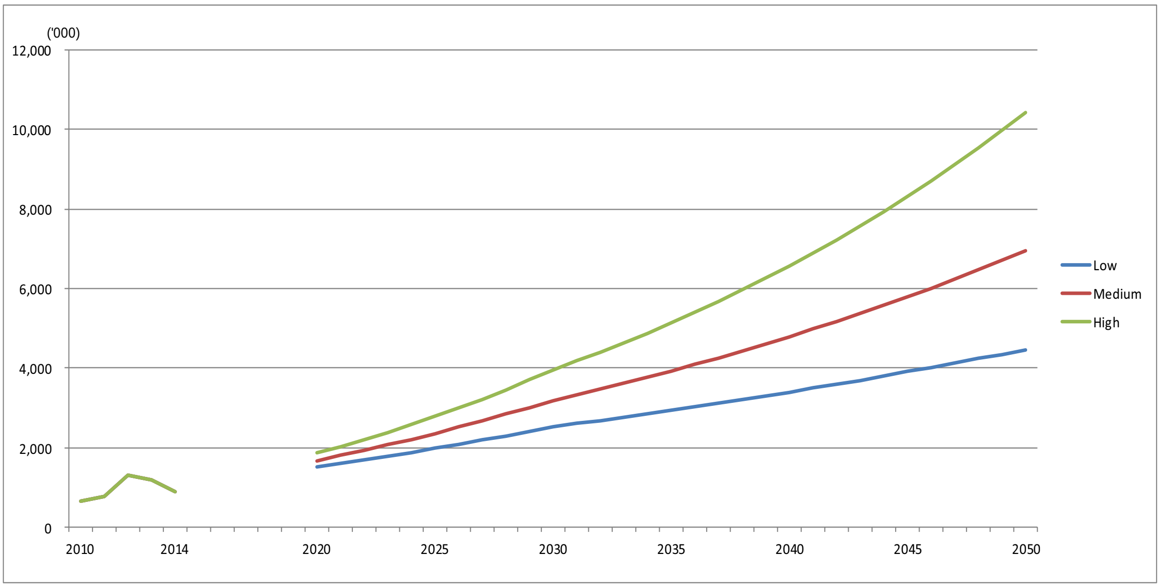


Figure 3.4.3-3 Air Passenger Demand at CRK by GDP Growth Case (Base Case)
(Total of Domestic Passengers and International Passengers)

2) Domestic and International Air Cargo Demand (Base Case)

Domestic and international air cargo demand at CRK has been calculated by Formula-C3 and Formula-C4 obtained in Paragraph 3.3.3 as shown in Table 3.4.3-4 and Figure 3.4.3-4.

Table 3.4.3-4 Domestic and International Cargo Forecast at CRK (Base Case)

	Year	Cargoes (tons)								
		Low Case			Medium Case			High Case		
		Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
Actual	2010	648	45,090	45,738	648	45,090	45,738	648	45,090	45,738
	2011	0	41,284	41,284	0	41,284	41,284	0	41,284	41,284
	2012	0	41,621	41,621	0	41,621	41,621	0	41,621	41,621
	2013	2,582	41,476	44,057	2,582	41,476	44,057	2,582	41,476	44,057
	2014	1,280	46,702	47,981	1,280	46,702	47,981	1,280	46,702	47,981
Forecast	2020	2,828	78,062	80,890	3,264	86,901	90,165	3,721	96,170	99,892
	2025	4,003	101,883	105,887	4,958	121,218	126,176	6,008	142,494	148,502
	2030	5,367	129,498	134,865	7,019	162,971	169,989	8,926	201,616	210,542
	2035	6,399	150,418	156,817	8,862	200,315	209,177	11,847	260,787	272,634
	2040	7,539	173,515	181,054	10,999	243,608	254,607	15,401	332,777	348,177
	2045	8,798	199,016	207,814	13,476	293,796	307,273	19,724	420,364	440,088
	2050	10,188	227,172	237,359	16,348	351,978	368,326	24,984	526,927	551,911

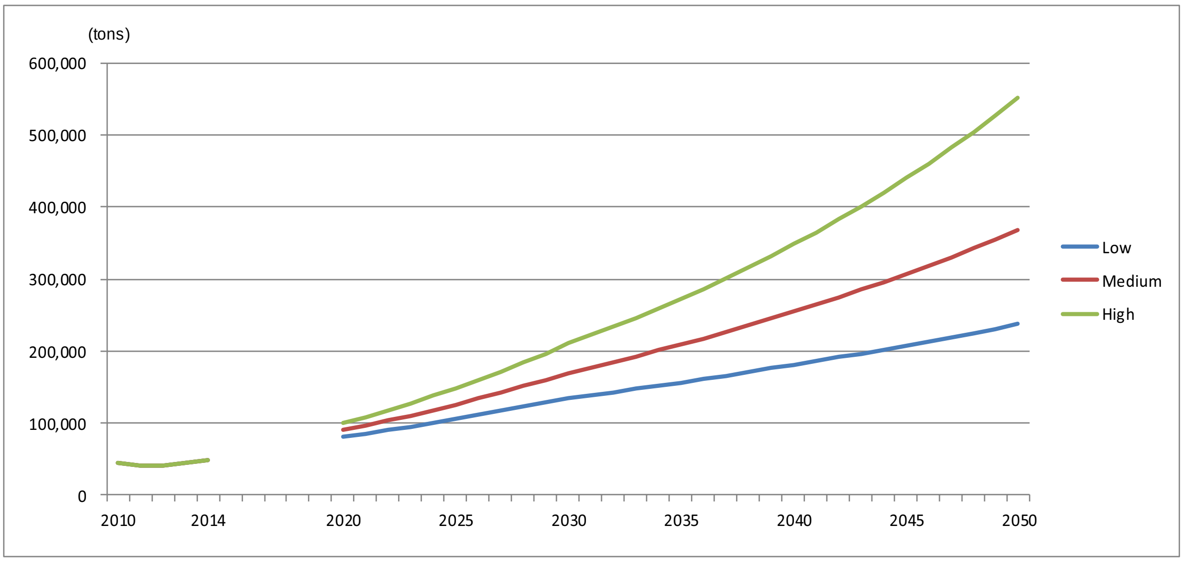


Figure 3.4.3-4 Air Cargo Demand at CRK by GDP Growth Case (Base Case)
(Total of Domestic Cargoes and International Cargoes)

3.4.3.3. Air Traffic Demand in GCR

1) Domestic and International Air Passenger Demand (GCR)

Domestic and international air passenger demand in GCR (total of NAIA and CRK) is shown in Table 3.4.3-5 and Figure 3.4.3-5.

Table 3.4.3-5 Forecast Domestic and International Passengers in GCR

	Year	Passengers ('000)														
		Low Case					Medium Case					High Case				
		Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total	Domestic	International	(Foreigner)	(Filipino)	Total
Actual	2010	14,802	12,988	(6,573)	(6,415)	27,790	14,802	12,988	(6,573)	(6,415)	27,790	14,802	12,988	(6,573)	(6,415)	27,790
	2011	16,729	13,695	(6,810)	(6,885)	30,424	16,729	13,695	(6,810)	(6,885)	30,424	16,729	13,695	(6,810)	(6,885)	30,424
	2012	18,039	15,155	(7,501)	(7,654)	33,195	18,039	15,155	(7,501)	(7,654)	33,195	18,039	15,155	(7,501)	(7,654)	33,195
	2013	17,905	16,163	(7,977)	(8,186)	34,067	17,905	16,163	(7,977)	(8,186)	34,067	17,905	16,163	(7,977)	(8,186)	34,067
	2014	18,110	16,858	(8,355)	(8,503)	34,969	18,110	16,858	(8,355)	(8,503)	34,969	18,110	16,858	(8,355)	(8,503)	34,969
Forecast	2020	25,071	21,987	(10,824)	(11,162)	47,058	27,033	23,432	(11,521)	(11,911)	50,465	29,091	24,948	(12,251)	(12,697)	54,038
	2025	30,359	25,882	(12,702)	(13,180)	56,241	34,650	29,044	(14,226)	(14,818)	63,694	39,373	32,523	(15,904)	(16,619)	71,896
	2030	36,488	30,398	(14,879)	(15,519)	66,886	43,918	35,871	(17,518)	(18,353)	79,789	52,495	42,191	(20,567)	(21,624)	94,686
	2035	41,131	33,819	(16,528)	(17,290)	74,950	52,207	41,978	(20,464)	(21,514)	94,185	65,629	51,867	(25,235)	(26,632)	117,496
	2040	46,258	37,596	(18,350)	(19,246)	83,854	61,816	49,058	(23,880)	(25,178)	110,874	81,608	63,639	(30,915)	(32,724)	145,247
	2045	51,918	41,766	(20,362)	(21,404)	93,684	72,956	57,265	(27,839)	(29,425)	130,221	101,049	77,962	(37,827)	(40,135)	179,011
	2050	58,168	46,370	(22,583)	(23,787)	104,538	85,870	66,779	(32,430)	(34,349)	152,649	124,702	95,388	(46,236)	(49,152)	220,090

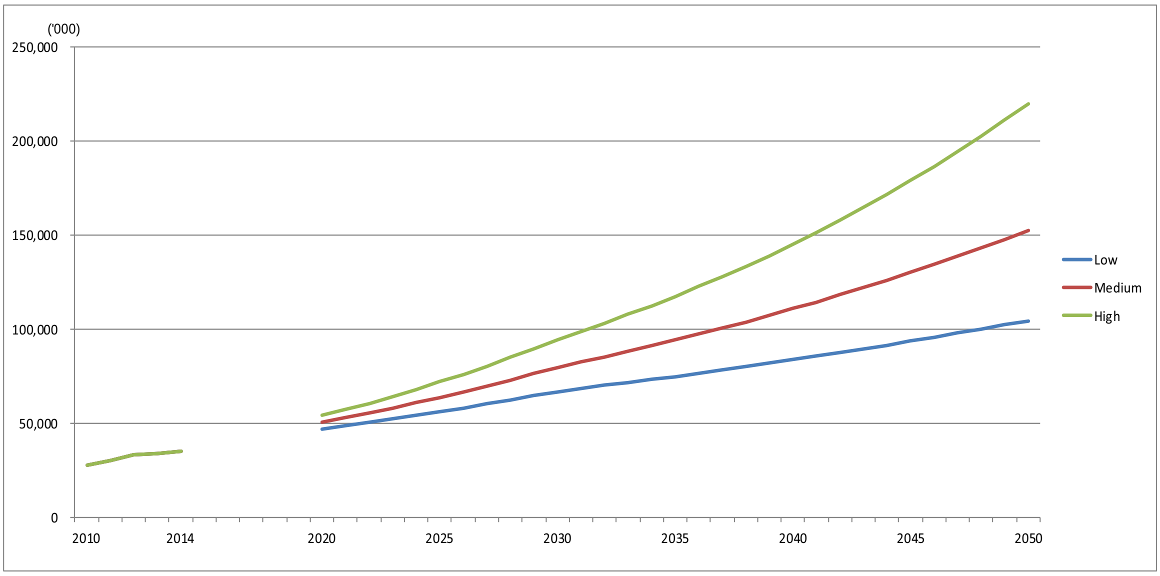


Figure 3.4.3-5 Forecast Air Passenger Demand in GCR by GDP Growth Case
(Total of Domestic Passengers and International Passengers)

2) Domestic and International Air Cargo Demand (GCR)

Domestic and international air cargo demand in GCR has been calculated by total of the demand at NAIA and CRK as shown in Table 3.4.3-6 and Figure 3.4.3-6.

Table 3.4.3-6 Forecast Domestic and International Cargo Demand in GCR

	Year	Cargoes (tons)								
		Low Case			Medium Case			High Case		
		Domestic	International	Total	Domestic	International	Total	Domestic	International	Total
Actual	2010	118,115	351,451	469,567	118,115	351,451	469,567	118,115	351,451	469,567
	2011	119,872	331,789	451,661	119,872	331,789	451,661	119,872	331,789	451,661
	2012	149,080	352,677	501,756	149,080	352,677	501,756	149,080	352,677	501,756
	2013	166,783	334,592	501,375	166,783	334,592	501,375	166,783	334,592	501,375
	2014	165,876	401,843	567,719	165,876	401,843	567,719	165,876	401,843	567,719
Forecast	2020	245,403	513,663	759,067	267,817	545,178	812,995	291,324	578,230	869,554
	2025	305,811	598,600	904,411	354,843	667,542	1,022,385	408,796	743,403	1,152,199
	2030	375,840	697,065	1,072,906	460,723	816,416	1,277,139	558,723	954,210	1,512,934
	2035	428,891	771,658	1,200,549	555,426	949,573	1,504,999	708,775	1,165,192	1,873,967
	2040	487,463	854,014	1,341,477	665,212	1,103,939	1,769,151	891,335	1,421,883	2,313,218
	2045	552,131	944,942	1,497,073	792,484	1,282,892	2,075,376	1,113,448	1,734,187	2,847,635
	2050	623,531	1,045,333	1,668,864	940,028	1,490,347	2,430,375	1,383,682	2,114,153	3,497,835

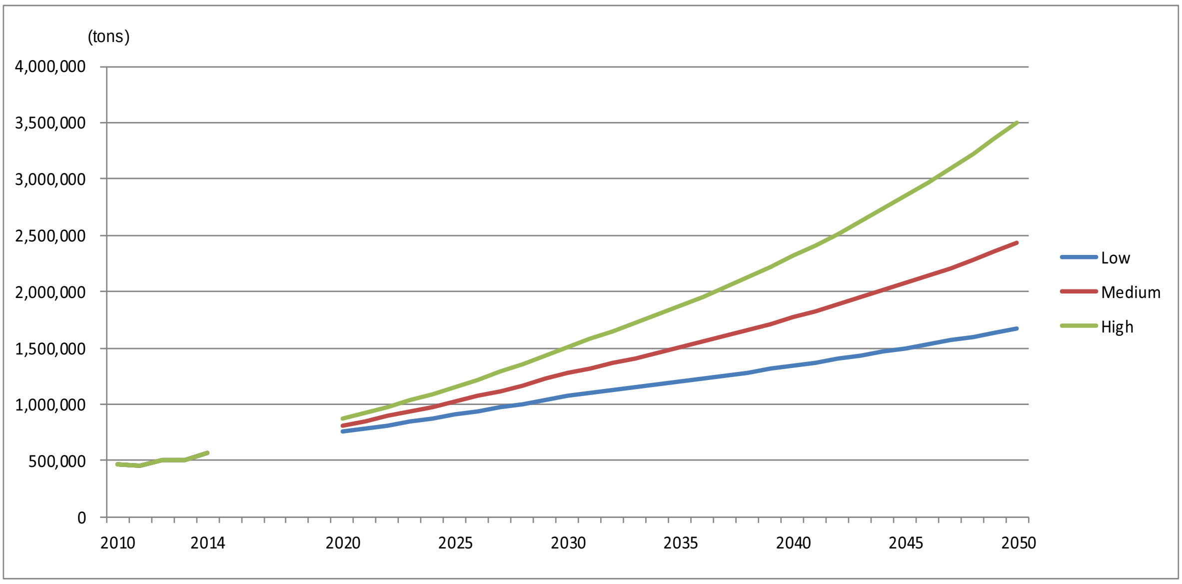


Figure 3.4.3-6 Forecast Air Cargo Demand in GCR by GDP Growth Case
(Total of Domestic Cargoes and International Cargoes)

3.4.4. Summary Result of Base Case Air Traffic Demand Forecast

3.4.4.1. Air Passenger Demand

1) Air Passengers in GCR

Domestic and international air passenger demand in GCR (total of NAIA and CRK) has been calculated as shown in Table 3.4.4-1.

The total passengers in GCR will increase to 79,789 thousand consisting 43,918 thousand domestic passengers and 35,871 thousand international passengers in 2030. And that will be over 110 million passengers in 2040. The total passenger demand at NAIA will reach 76,599 thousand in 2030, accounting for 96.0 % of the demand in GCR.

Table 3.4.4-1 Air Passenger Demand Forecast in GCR (Base Case)

		Domestic Passengers			International Passengers			Total		
	Year	GCR	NAIA	CRK	GCR	NAIA	CRK	GCR	NAIA	CRK
Forecast ('000)	2020	27,033	26,887	146	23,432	21,900	1,532	50,465	48,788	1,677
	2025	34,650	34,458	193	29,044	26,877	2,167	63,694	61,334	2,360
	2030	43,918	43,668	250	35,871	32,931	2,941	79,789	76,599	3,190
	2035	52,207	51,906	300	41,978	38,346	3,633	94,185	90,252	3,933
	2040	61,816	61,456	360	49,058	44,623	4,435	110,874	106,079	4,794
	2045	72,956	72,528	428	57,265	51,900	5,365	130,221	124,428	5,793
	2050	85,870	85,362	507	66,779	60,337	6,442	152,649	145,699	6,950
Growth Rate	'20 -'25	5.1%	5.1%	5.7%	4.4%	4.2%	7.2%	4.8%	4.7%	7.1%
	'25 -'30	4.9%	4.9%	5.3%	4.3%	4.1%	6.3%	4.6%	4.5%	6.2%
	'30 -'35	3.5%	3.5%	3.8%	3.2%	3.1%	4.3%	3.4%	3.3%	4.3%
	'35 -'40	3.4%	3.4%	3.7%	3.2%	3.1%	4.1%	3.3%	3.3%	4.0%
	'40 -'45	3.4%	3.4%	3.5%	3.1%	3.1%	3.9%	3.3%	3.2%	3.9%
	'45 -'50	3.3%	3.3%	3.5%	3.1%	3.1%	3.7%	3.2%	3.2%	3.7%
Share by Airport	2020	100.0%	99.5%	0.5%	100.0%	93.5%	6.5%	100.0%	96.7%	3.3%
	2025	100.0%	99.4%	0.6%	100.0%	92.5%	7.5%	100.0%	96.3%	3.7%
	2030	100.0%	99.4%	0.6%	100.0%	91.8%	8.2%	100.0%	96.0%	4.0%
	2035	100.0%	99.4%	0.6%	100.0%	91.3%	8.7%	100.0%	95.8%	4.2%
	2040	100.0%	99.4%	0.6%	100.0%	91.0%	9.0%	100.0%	95.7%	4.3%
	2045	100.0%	99.4%	0.6%	100.0%	90.6%	9.4%	100.0%	95.6%	4.4%
	2050	100.0%	99.4%	0.6%	100.0%	90.4%	9.6%	100.0%	95.4%	4.6%

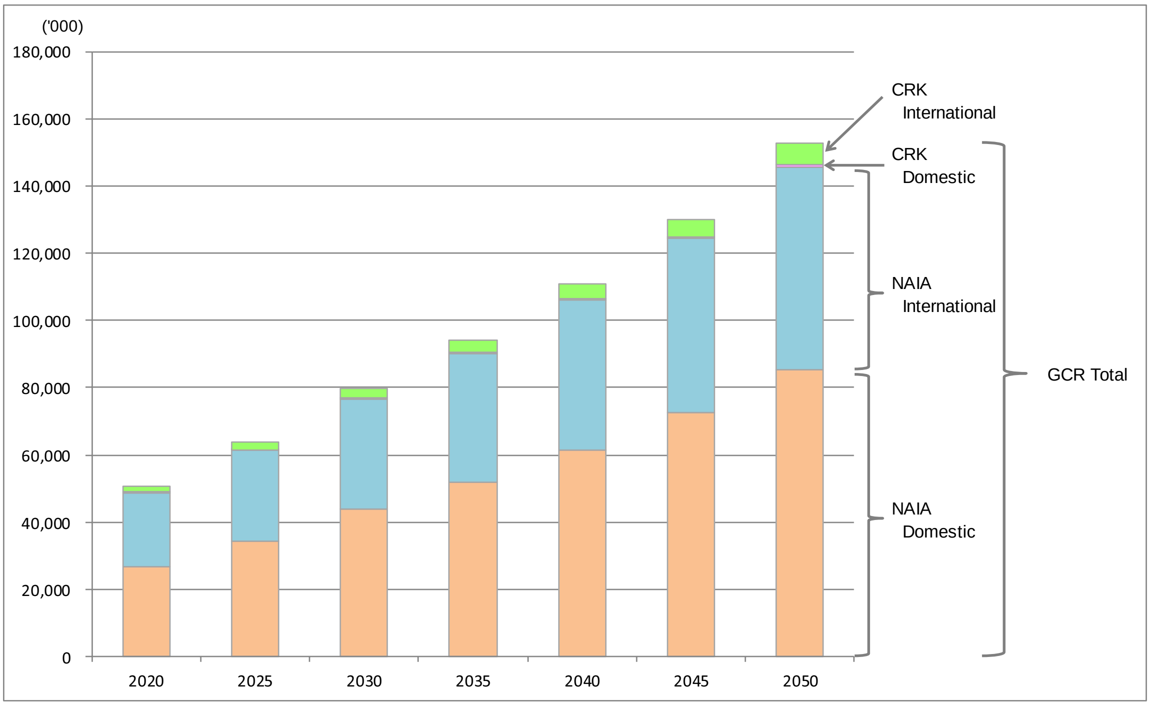


Figure 3.4.4-1 Air Passenger Demand in GCR by Airport (Base Case)

2) Air Passengers at NAIA

The total passengers will increase to 76,599 thousand consisting 43,668 thousand domestic 32,931 thousand international passengers in 2030, and it will exceed 100 million passengers in 2040 (see Table 3.4.4-2).

Table 3.4.4-2 Forecast Air Passenger Demand at NAIA (Base Case)

	Year	Passengers ('000)							
		Domestic		International				Total	
		Passengers	Growth Rate	Passengers	Growth Rate	(Foreigner)	(Filipino)	Passengers	Growth Rate
Actual	2010	14,755	–	12,381	–	(6,266)	(6,115)	27,136	–
	2011	16,687	13.09%	12,969	4.76%	(6,449)	(6,520)	29,657	9.29%
	2012	17,739	6.30%	14,140	9.02%	(6,999)	(7,141)	31,879	7.49%
	2013	17,689	-0.28%	15,177	7.34%	(7,490)	(7,687)	32,867	3.10%
	2014	18,020	1.87%	16,072	5.89%	(7,965)	(8,106)	34,091	3.73%
Forecast	2020	26,887	6.90%	21,900	5.29%	(10,768)	(11,133)	48,788	6.16%
	2025	34,458	5.09%	26,877	4.18%	(13,164)	(13,712)	61,334	4.68%
	2030	43,668	4.85%	32,931	4.15%	(16,082)	(16,848)	76,599	4.55%
	2035	51,906	3.52%	38,346	3.09%	(18,693)	(19,652)	90,252	3.33%
	2040	61,456	3.44%	44,623	3.08%	(21,721)	(22,902)	106,079	3.28%
	2045	72,528	3.37%	51,900	3.07%	(25,231)	(26,669)	124,428	3.24%
	2050	85,362	3.31%	60,337	3.06%	(29,302)	(31,035)	145,699	3.21%

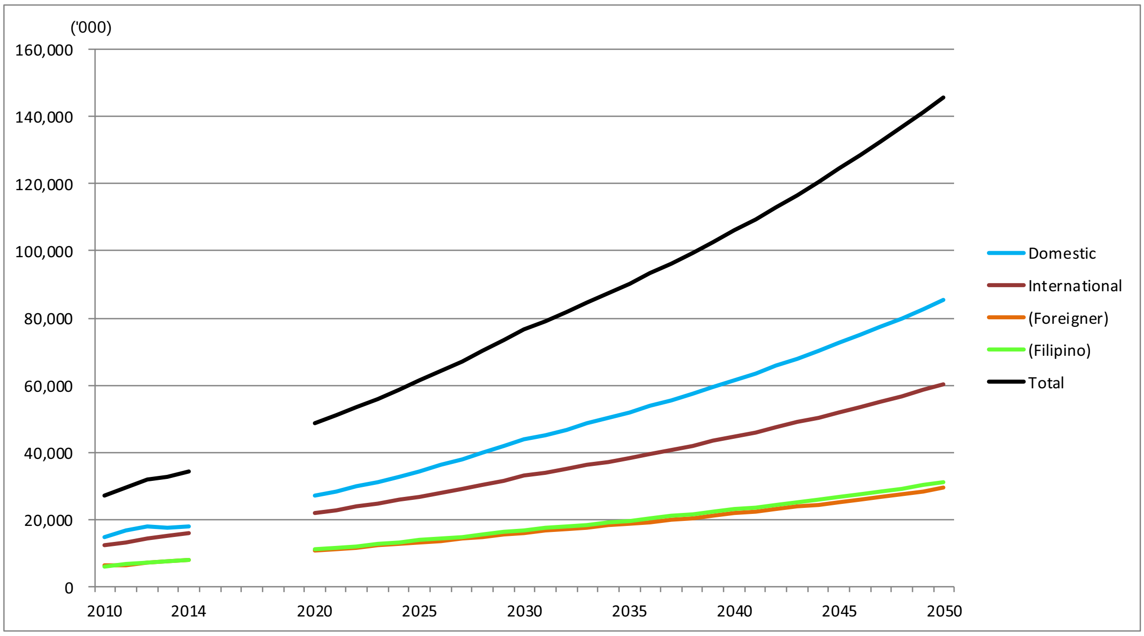


Figure 3.4.4-2 Forecast Air Passenger Demand at NAIA (Base Case)

Furthermore, domestic and international air passengers by carrier category (Legacy Carrier and Low Cost Carrier) were calculated using the ratios estimated in Paragraph 3.4.2.2 (see Table 3.4.2-3) as shown in Table 3.4.4-3.

Table 3.4.4-3 Air Passenger Demand by Carrier Category (LC and LCC) at NAIA (Base Case)

Year	Domestic Passengers ('000)			International Passengers ('000)							Total Passengers ('000)		
	Local LC	Local LCC	Total	LC			LCC			Total	LC	LCC	Total
				Local	Foreign	sub-total	Local	Foreign	sub-total				
2020	4,033	22,854	26,887	5,475	9,855	15,330	4,380	2,190	6,570	21,900	19,363	29,424	48,788
2025	5,169	29,289	34,458	6,719	12,094	18,814	5,375	2,688	8,063	26,877	23,982	37,352	61,334
2030	6,550	37,118	43,668	8,233	14,819	23,051	6,586	3,293	9,879	32,931	29,602	46,997	76,599
2035	7,786	44,120	51,906	9,586	17,256	26,842	7,669	3,835	11,504	38,346	34,628	55,624	90,252
2040	9,218	52,238	61,456	11,156	20,080	31,236	8,925	4,462	13,387	44,623	40,455	65,625	106,079
2045	10,879	61,649	72,528	12,975	23,355	36,330	10,380	5,190	15,570	51,900	47,209	77,219	124,428
2050	12,804	72,558	85,362	15,084	27,152	42,236	12,067	6,034	18,101	60,337	55,040	90,659	145,699

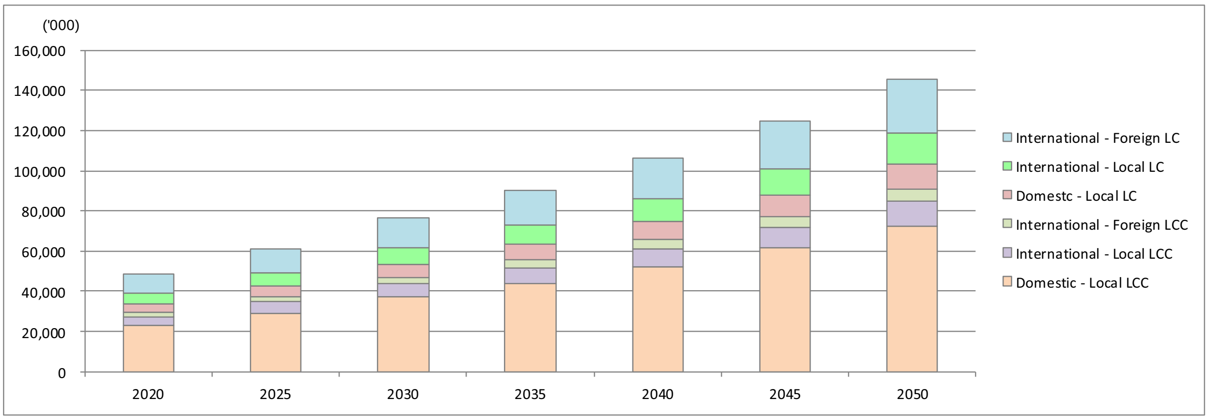


Figure 3.4.4-3 Air Passengers by Carrier Category at NAIA (Base Case)

3) Air Passengers at CRK

The total passengers will increase to 3,190 thousand consisting 250 thousand domestic and 2,941 thousand international passengers in 2030. The domestic passengers will be below a tenth part of the international passengers (see Table 3.4.4-4).

Table 3.4.4-4 Forecast Air Passenger Demand at CRK (Base Case)

	Year	Passengers ('000)							
		Domestic		International				Total	
		Passengers	Growth Rate	Passengers	Growth Rate	(Foreigner)	(Filipino)	Passengers	Growth Rate
Actual	2010	47	–	608	–	(308)	(300)	654	–
	2011	42	-9.47%	725	19.31%	(361)	(364)	767	17.27%
	2012	300	613.32%	1,015	40.04%	(503)	(513)	1,316	71.51%
	2013	215	-28.38%	985	-2.94%	(486)	(499)	1,201	-8.75%
	2014	91	-57.73%	787	-20.15%	(390)	(397)	878	-26.89%
Forecast	2020	146	8.18%	1,532	11.74%	(753)	(779)	1,677	11.40%
	2025	193	5.73%	2,167	7.19%	(1,062)	(1,106)	2,360	7.07%
	2030	250	5.32%	2,941	6.29%	(1,436)	(1,505)	3,190	6.22%
	2035	300	3.78%	3,633	4.32%	(1,771)	(1,862)	3,933	4.28%
	2040	360	3.65%	4,435	4.07%	(2,159)	(2,276)	4,794	4.04%
	2045	428	3.55%	5,365	3.88%	(2,608)	(2,757)	5,793	3.86%
	2050	507	3.46%	6,442	3.73%	(3,129)	(3,314)	6,950	3.71%

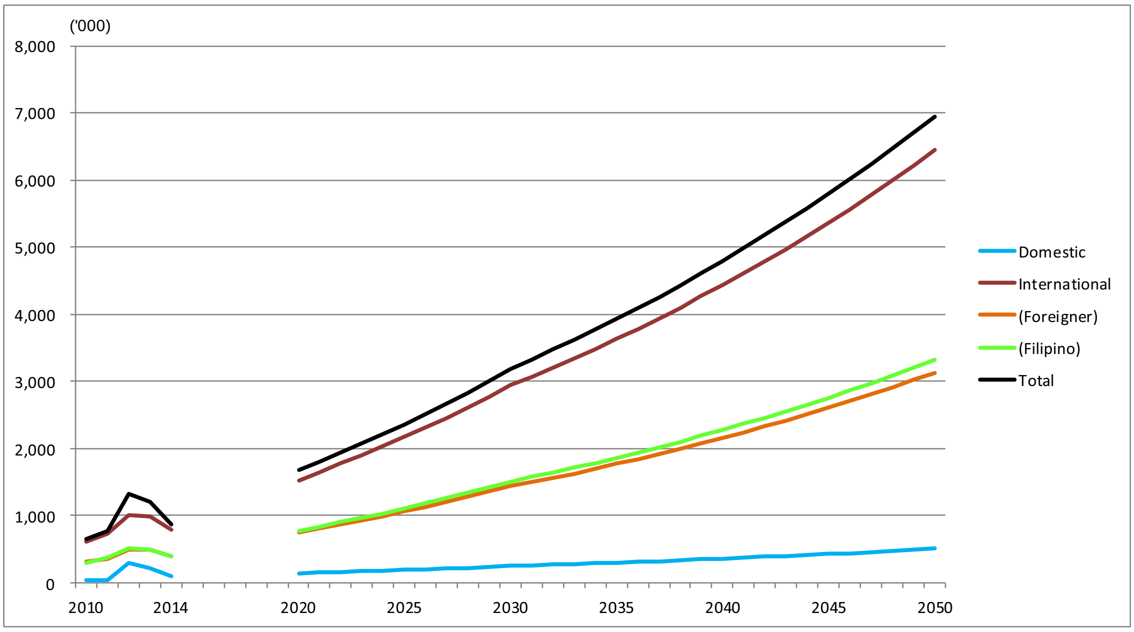


Figure 3.4.4-4 Forecast Air Passenger Demand at CRK (Base Case)

The domestic and international air passengers by carrier category (Legacy Carrier and Low Cost Carrier) were calculated using the ratios estimated in Paragraph 3.4.2.2 (see Table 3.4.2-3) as shown in Table 3.4.4-5.

Table 3.4.4-5 Forecast Air Passenger Demand by Category (LC and LCC) at CRK (Base Case)

Year	Domestic Passengers ('000)			International Passengers ('000)							Total Passengers ('000)		
	Local LC	Local LCC	Total	LC			LCC			Total	LC	LCC	Total
				Local	Foreign	sub-total	Local	Foreign	sub-total				
2020	22	124	146	383	689	1,072	306	153	459	1,532	1,094	583	1,677
2025	29	164	193	542	975	1,517	433	217	650	2,167	1,546	814	2,360
2030	37	212	250	735	1,323	2,059	588	294	882	2,941	2,096	1,094	3,190
2035	45	255	300	908	1,635	2,543	727	363	1,090	3,633	2,588	1,345	3,933
2040	54	306	360	1,109	1,996	3,104	887	443	1,330	4,435	3,158	1,636	4,794
2045	64	364	428	1,341	2,414	3,755	1,073	536	1,609	5,365	3,819	1,973	5,793
2050	76	431	507	1,611	2,899	4,510	1,288	644	1,933	6,442	4,586	2,364	6,950

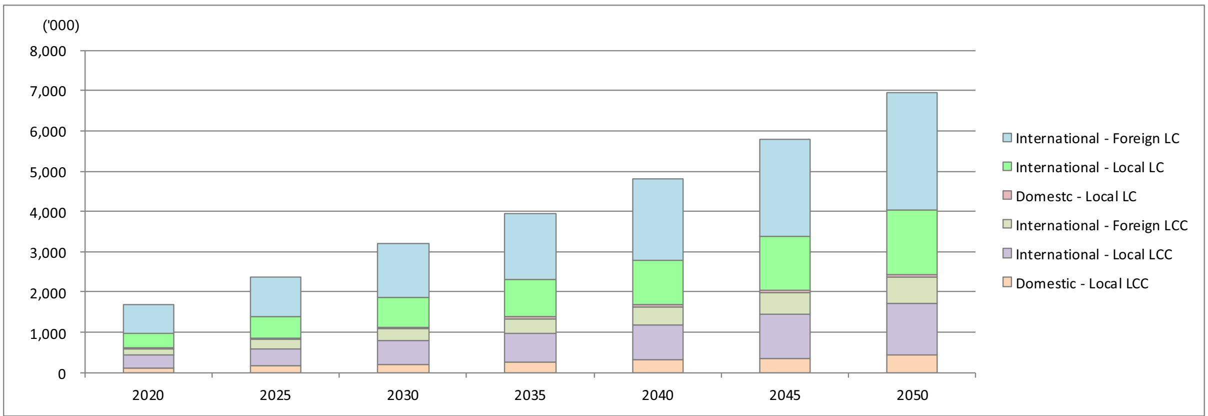


Figure 3.4.4-5 Forecast Air Passengers by Carrier Category at CRK (Base Case)

3.4.4.2. Air Cargo Demand Forecast

1) Air Cargoes in GCR

The domestic and international air cargo demand in GCR (total of NAIA and CRK) has been calculated as shown in Table 3.4.4-6.

The total cargoes in GCR will increase to 1,277,139 tons consisting 460,723 tons of domestic and 816,416 tons of international cargoes in 2030. It will be over 2 million tons in 2045.

The total cargo demand at NAIA has been forecasted as 1,107,149 tons in 2030 and it accounts for 86.7% of the demand in GCR.

Table 3.4.4-6 Forecast Air Cargo Demand in GCR (Base Case)

		Domestic Cargoes			International Cargoes			Total		
	Year	GCR	NAIA	CRK	GCR	NAIA	CRK	GCR	NAIA	CRK
Forecast (tons)	2020	267,817	264,553	3,264	545,178	458,277	86,901	812,995	722,831	90,165
	2025	354,843	349,885	4,958	667,542	546,323	121,218	1,022,385	896,209	126,176
	2030	460,723	453,704	7,019	816,416	653,445	162,971	1,277,139	1,107,149	169,989
	2035	555,426	546,563	8,862	949,573	749,258	200,315	1,504,999	1,295,821	209,177
	2040	665,212	654,213	10,999	1,103,939	860,331	243,608	1,769,151	1,514,544	254,607
	2045	792,484	779,008	13,476	1,282,892	989,096	293,796	2,075,376	1,768,104	307,273
	2050	940,028	923,679	16,348	1,490,347	1,138,369	351,978	2,430,375	2,062,049	368,326
Growth Rate	'20 -'25	5.8%	5.8%	8.7%	4.1%	3.6%	6.9%	4.7%	4.4%	7.0%
	'25 -'30	5.4%	5.3%	7.2%	4.1%	3.6%	6.1%	4.6%	4.3%	6.1%
	'30 -'35	3.8%	3.8%	4.8%	3.1%	2.8%	4.2%	3.3%	3.2%	4.2%
	'35 -'40	3.7%	3.7%	4.4%	3.1%	2.8%	4.0%	3.3%	3.2%	4.0%
	'40 -'45	3.6%	3.6%	4.1%	3.1%	2.8%	3.8%	3.2%	3.1%	3.8%
	'45 -'50	3.5%	3.5%	3.9%	3.0%	2.9%	3.7%	3.2%	3.1%	3.7%
Share by Airport	2020	100.0%	98.8%	1.2%	100.0%	84.1%	15.9%	100.0%	88.9%	11.1%
	2025	100.0%	98.6%	1.4%	100.0%	81.8%	18.2%	100.0%	87.7%	12.3%
	2030	100.0%	98.5%	1.5%	100.0%	80.0%	20.0%	100.0%	86.7%	13.3%
	2035	100.0%	98.4%	1.6%	100.0%	78.9%	21.1%	100.0%	86.1%	13.9%
	2040	100.0%	98.3%	1.7%	100.0%	77.9%	22.1%	100.0%	85.6%	14.4%
	2045	100.0%	98.3%	1.7%	100.0%	77.1%	22.9%	100.0%	85.2%	14.8%
	2050	100.0%	98.3%	1.7%	100.0%	76.4%	23.6%	100.0%	84.8%	15.2%

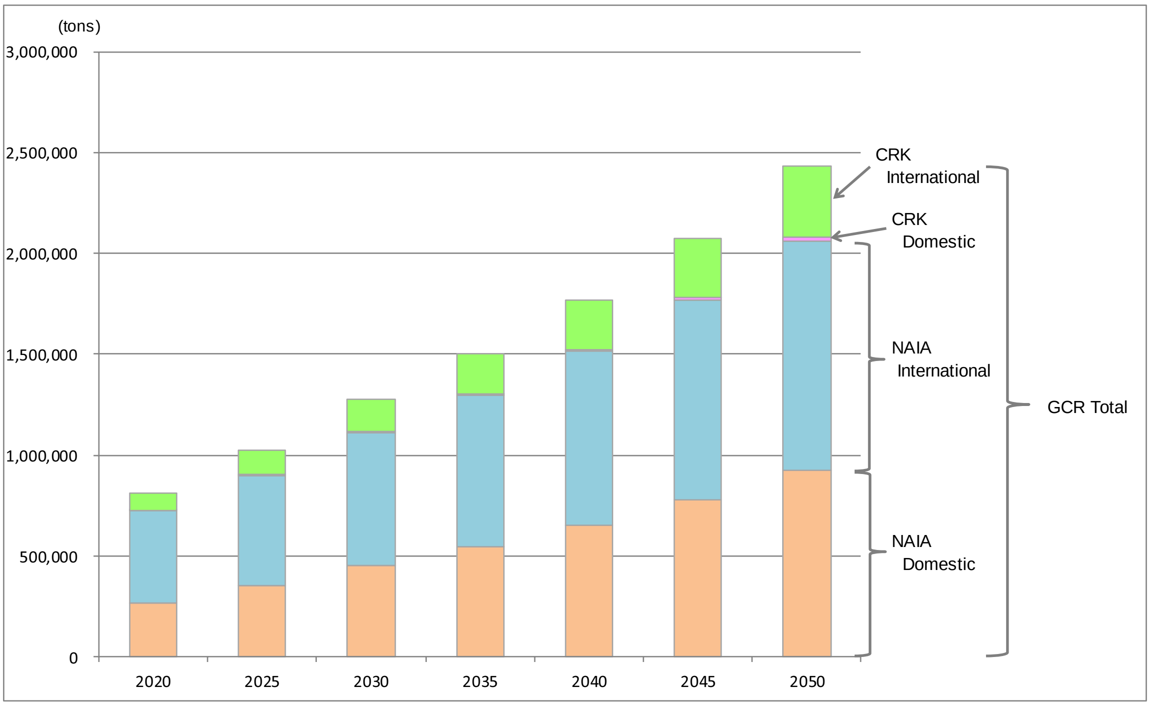


Figure 3.4.4-6 Forecast Air Cargo Demand in GCR by Airport (Base Case)

2) Air Cargoes at NAIA

Domestic and international air cargo demand at NAIA has been calculated as shown in Table 3.4.4-7.

The total cargoes will increase to 1,107,149 tons consisting 453,704 tons of domestic and 653,445 tons of international cargoes in 2030.

Table 3.4.4-7 Forecast Air Cargo Demand at NAIA (Base Case)

	Year	Cargoes (tons)									
		Domestic				International				Total	
		Cargoes	Growth Rate	(Unload)	(Load)	Cargoes	Growth Rate	(Inbound)	(Outbound)	Cargoes	Growth Rate
Actual	2010	117,467	–	(62,763)	(54,704)	306,361	–	(142,751)	(163,610)	423,828	–
	2011	119,872	2.05%	(57,862)	(62,010)	290,505	-5.18%	(139,901)	(150,604)	410,377	-3.17%
	2012	149,080	24.37%	(71,403)	(77,677)	311,055	7.07%	(148,822)	(162,233)	460,135	12.12%
	2013	164,201	10.14%	(80,408)	(83,794)	293,116	-5.77%	(142,930)	(150,186)	457,317	-0.61%
	2014	164,597	0.24%	(83,720)	(80,876)	355,141	21.16%	(173,753)	(181,389)	519,738	13.65%
Forecast	2020	264,553	8.23%	(132,277)	(132,277)	458,277	4.34%	(229,139)	(229,139)	722,831	5.65%
	2025	349,885	5.75%	(174,943)	(174,943)	546,323	3.58%	(273,162)	(273,162)	896,209	4.39%
	2030	453,704	5.33%	(226,852)	(226,852)	653,445	3.65%	(326,723)	(326,723)	1,107,149	4.32%
	2035	546,563	3.79%	(273,282)	(273,282)	749,258	2.77%	(374,629)	(374,629)	1,295,821	3.20%
	2040	654,213	3.66%	(327,106)	(327,106)	860,331	2.80%	(430,166)	(430,166)	1,514,544	3.17%
	2045	779,008	3.55%	(389,504)	(389,504)	989,096	2.83%	(494,548)	(494,548)	1,768,104	3.14%
	2050	923,679	3.47%	(461,840)	(461,840)	1,138,369	2.85%	(569,185)	(569,185)	2,062,049	3.12%

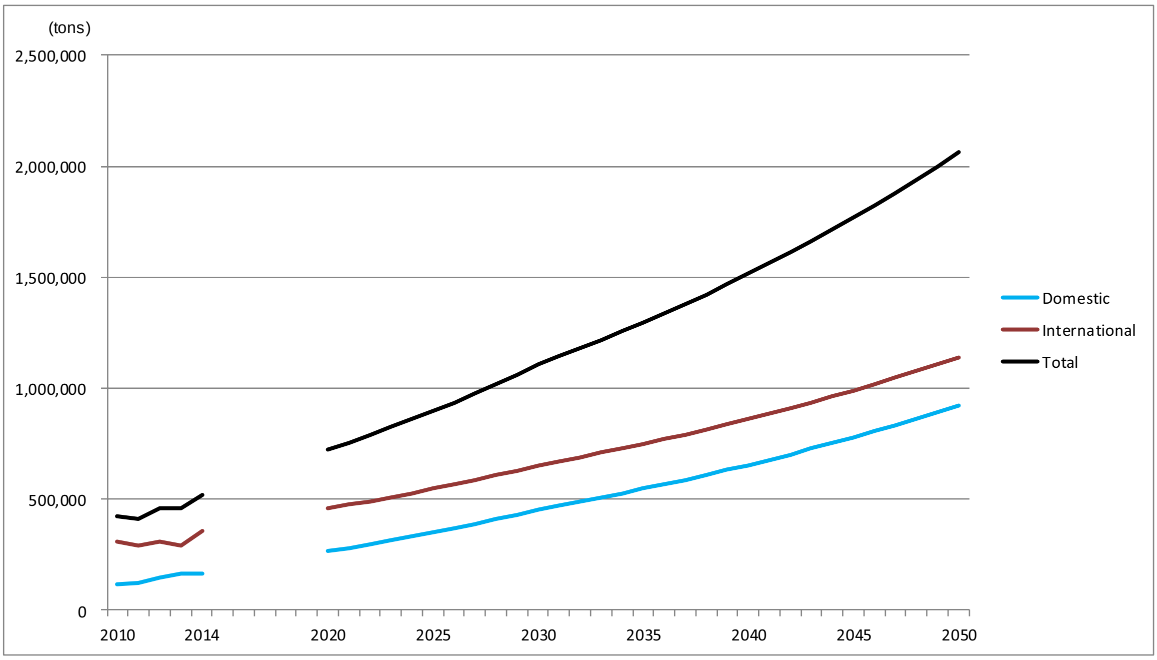


Figure 3.4.4-7 Forecast Air Cargo Demand at NAIA (Base Case)

3) Air Cargoes at CRK

Domestic and international air cargo demand at CRK has been calculated as shown in Table 3.4.4-8.

The total cargoes will increase to 169,989 tons consisting 7,019 tons of domestic and 162,971 tons of international cargoes in 2030.

Table 3.4.4-8 Forecast Air Cargo Demand at CRK (Base Case)

	Year	Cargoes (tons)									
		Domestic				International				Total	
		Cargoes	Growth Rate	(Unload)	(Load)	Cargoes	Growth Rate	(Inbound)	(Outbound)	Cargoes	Growth Rate
Actual	2010	648	–	(322)	(326)	45,090	–	(23,447)	(21,643)	45,738	–
	2011	0	–	(0)	(0)	41,284	-8.44%	(21,095)	(20,189)	41,284	-9.74%
	2012	0	–	(0)	(0)	41,621	0.82%	(21,821)	(19,800)	41,621	0.82%
	2013	2,582	–	(1,586)	(996)	41,476	-0.35%	(21,836)	(19,640)	44,057	5.85%
	2014	1,280	-50.44%	(750)	(529)	46,702	12.60%	(25,229)	(21,473)	47,981	8.91%
Forecast	2020	3,264	16.89%	(1,632)	(1,632)	86,901	10.90%	(43,450)	(43,450)	90,165	11.09%
	2025	4,958	8.72%	(2,479)	(2,479)	121,218	6.88%	(60,609)	(60,609)	126,176	6.95%
	2030	7,019	7.20%	(3,509)	(3,509)	162,971	6.10%	(81,485)	(81,485)	169,989	6.14%
	2035	8,862	4.77%	(4,431)	(4,431)	200,315	4.21%	(100,158)	(100,158)	209,177	4.24%
	2040	10,999	4.42%	(5,500)	(5,500)	243,608	3.99%	(121,804)	(121,804)	254,607	4.01%
	2045	13,476	4.15%	(6,738)	(6,738)	293,796	3.82%	(146,898)	(146,898)	307,273	3.83%
	2050	16,348	3.94%	(8,174)	(8,174)	351,978	3.68%	(175,989)	(175,989)	368,326	3.69%

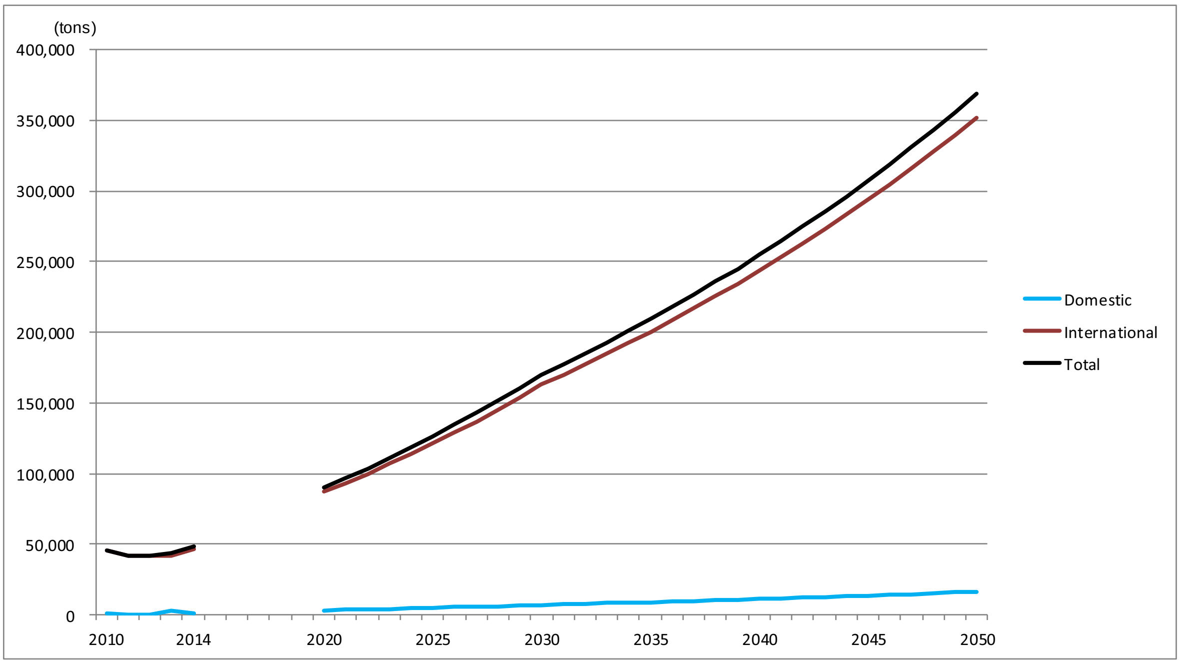


Figure 3.4.4-8 Forecast Air Cargo Demand at CRK (Base Case)

3.4.4.3. Comparison of Air Traffic Forecast between This Study and 2011 GCR Airport Study

1) Air Traffic Demand in GCR

Comparison of the forecast air traffic demand of GCR between this Study and 2011 GCR Airport study are shown in Table 3.4.4-9.

As for the air passenger demand, the forecast in this Study is a little higher than the forecast of Medium Case in 2011 GCR Airport Study.

Table 3.4.4-9 Comparison of Air Passenger Demand Forecast in GCR with 2011 GCR Airport Study

Year	Total Passengers [Domestic + International] ('000)							
	Forecast in This Survey [Medium Case]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate
2010	27,790	–						
2011	30,424	9.48%						
2012	33,195	9.11%						
2013	34,067	2.63%						
2014	34,969	2.65%						
2020	50,465	6.30%	45,981	4.67%	50,001	6.14%	54,410	7.65%
2025	63,694	4.77%	54,877	3.60%	61,942	4.38%	70,092	5.20%
2030	79,789	4.61%	64,160	3.18%	75,185	3.95%	88,545	4.79%
2035	94,185	3.37%	73,974	2.89%	90,077	3.68%	110,573	4.54%
2040	110,874	3.32%	84,514	2.70%	106,991	3.50%	137,027	4.38%
2045	130,221	3.27%	95,054	2.38%	123,905	2.98%	163,481	3.59%
2050	152,649	3.23%	105,594	2.13%	140,819	2.59%	189,935	3.05%

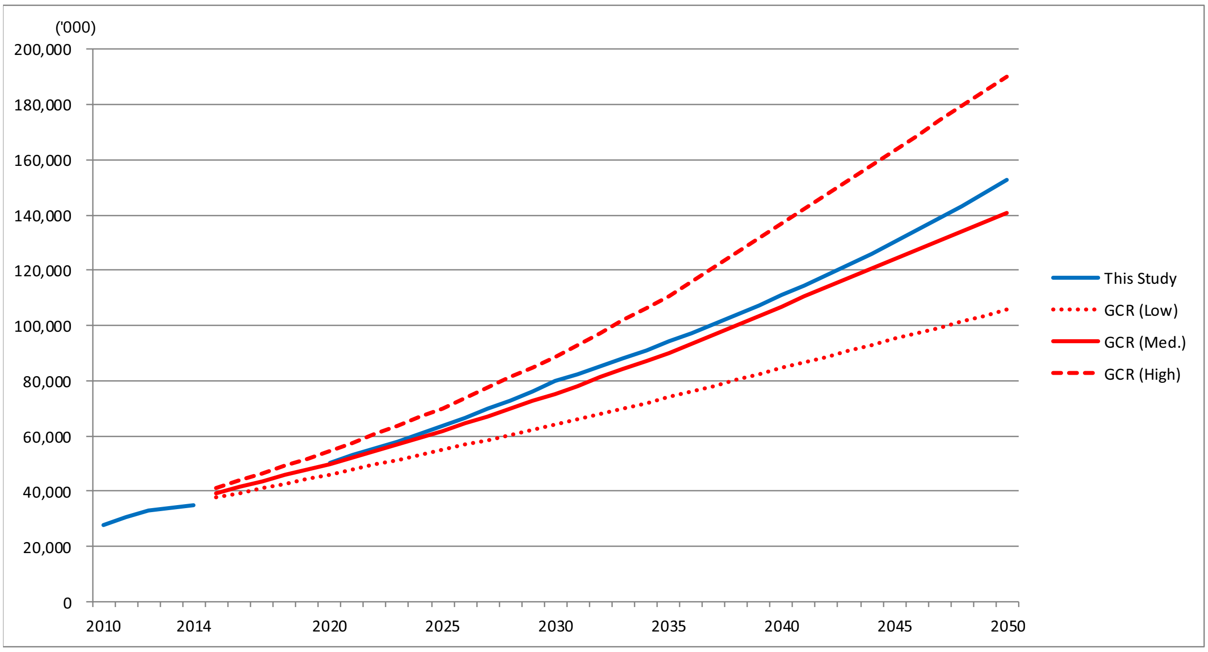


Figure 3.4.4-9 Comparison of Air Passenger Demand in GCR

Meanwhile, the air cargo forecast in this Study is between the forecast of High Case and Medium Case in 2011 GCR Airport study. And growth rates of the forecasts in this study and of

Medium Case in 2011 GCR Airport Study were approximate values.

Table 3.4.4-10 Comparison of Air Cargo Demand Forecast in GCR with 2011 GCR Airport Study

Year	Total Cargoes [Domestic + International] (tons)							
	Forecast in This Survey [Medium]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate
2010	469,567	–						
2011	451,661	-3.81%						
2012	501,756	11.09%						
2013	501,375	-0.08%						
2014	567,719	13.23%						
2020	812,995	6.17%	660,108	2.54%	729,692	4.27%	805,629	6.01%
2025	1,022,385	4.69%	772,532	3.20%	896,810	4.21%	1,039,145	5.22%
2030	1,277,139	4.55%	893,360	2.95%	1,088,940	3.96%	1,324,019	4.96%
2035	1,504,999	3.34%	1,024,827	2.78%	1,311,604	3.79%	1,673,377	4.79%
2040	1,769,151	3.29%	1,170,652	2.70%	1,572,831	3.70%	2,105,286	4.70%
2045	2,075,376	3.24%	1,316,477	2.38%	1,834,058	3.12%	2,537,195	3.80%
2050	2,430,375	3.21%	1,462,302	2.12%	2,095,285	2.70%	2,969,104	3.19%

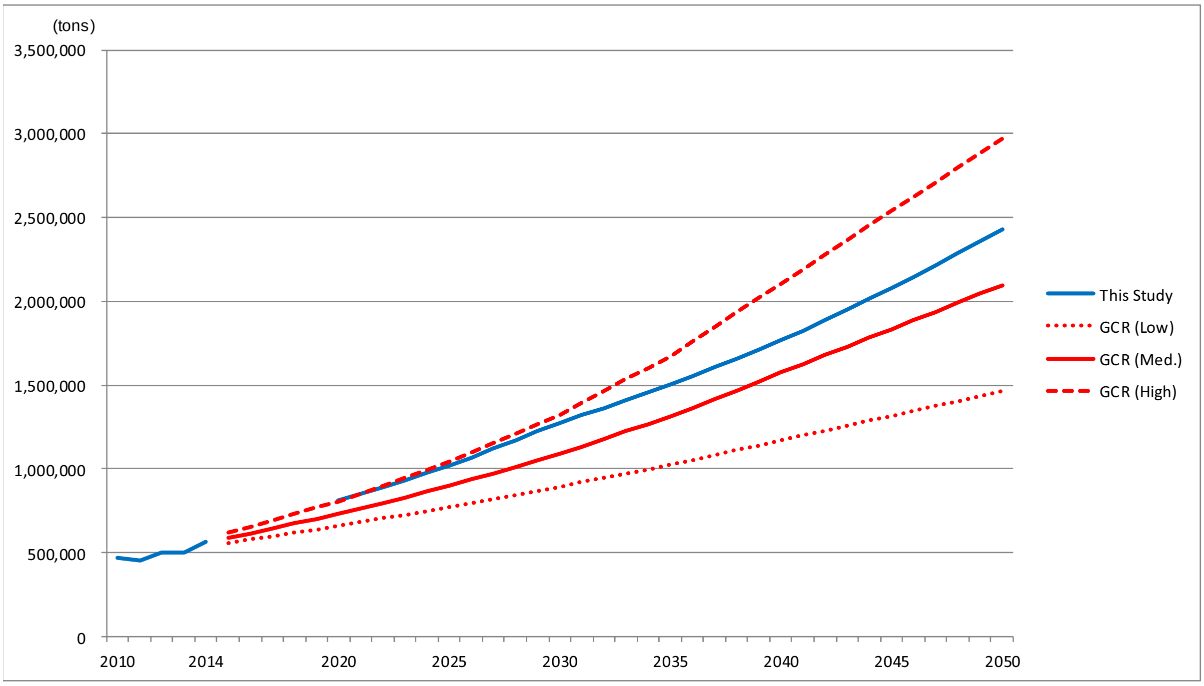


Figure 3.4.4-10 Comparison of Air Cargo Demand in GCR

2) Air Traffic Demand at NAIA

Comparison of the air traffic demand between forecast at NAIA were shown as Table 3.4.4-11 and Table 3.4.4-12.

As for air passenger demand, the forecast of Medium Case in 2011 GCR Airport Study was almost occupying position between the forecast of Base Case and Reference Case in this study. And the growth rates of these forecasts in the future were approximate values.

Table 3.4.4-11 Comparison of Air Passenger Demand Forecast at NAIA with 2011 GCR Airport Studies

Year	Total Passengers [Domestic + International] ('000)							
	Forecast in This Survey [Medium Case]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate
2010	27,136	–						
2011	29,657	9.29%						
2012	31,879	7.49%						
2013	32,867	3.10%						
2014	34,091	3.73%						
2020	48,788	6.16%	44,458	4.52%	47,830	5.81%	51,503	7.12%
2025	61,334	4.68%	52,990	3.57%	59,096	4.32%	66,077	5.11%
2030	76,599	4.55%	61,894	3.16%	71,584	3.91%	83,209	4.72%
2035	90,252	3.33%	71,284	2.87%	85,564	3.63%	103,537	4.47%
2040	106,079	3.28%	81,385	2.69%	101,485	3.47%	128,032	4.34%
2045	124,428	3.24%	91,486	2.37%	117,406	2.96%	152,527	3.56%
2050	145,699	3.21%	101,587	2.12%	133,327	2.58%	177,022	3.02%

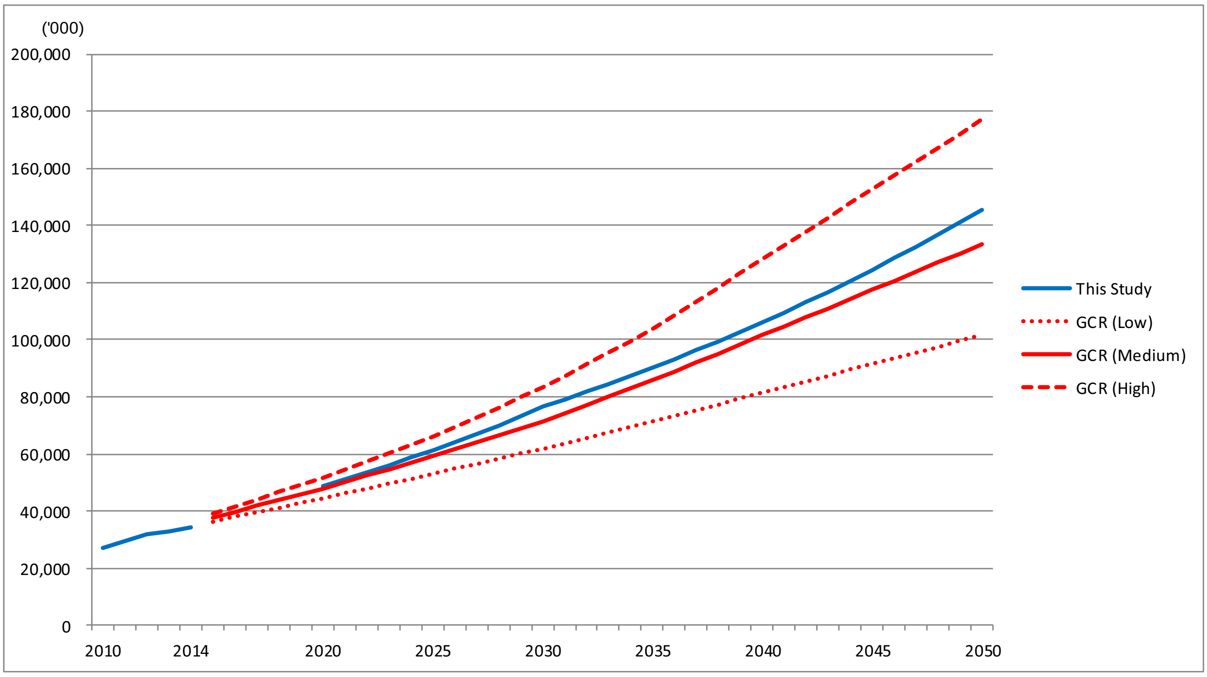


Figure 3.4.4-11 Comparison of Air Passenger Demand at NAIA

Meanwhile, the air cargo forecasts both of Base Case and Reference Case in this study were high than the forecast of Medium Case in 2011 GCR Airport study. But the differences of those were few and growth rates of these forecasts in the future were approximate values.

Table 3.4.4-12 Comparison of Air Cargo Demand Forecast at NAIA with 2011 GCR Airport study

Year	Total Cargoes [Domestic + International] (tons)							
	Forecast in This Survey [Medium Case]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate
2010	423,828	–						
2011	410,377	-3.17%						
2012	460,135	12.12%						
2013	457,317	-0.61%						
2014	519,738	13.65%						
2020	722,831	5.65%	602,806	2.50%	665,044	4.19%	732,881	5.89%
2025	896,209	4.39%	704,754	3.17%	816,390	4.19%	944,049	5.19%
2030	1,107,149	4.32%	814,470	2.94%	990,566	3.94%	1,201,860	4.95%
2035	1,295,821	3.20%	933,909	2.77%	1,192,426	3.78%	1,517,924	4.78%
2040	1,514,544	3.17%	1,066,542	2.69%	1,429,528	3.69%	1,909,133	4.69%
2045	1,768,104	3.14%	1,199,175	2.37%	1,666,630	3.12%	2,300,342	3.80%
2050	2,062,049	3.12%	1,331,808	2.12%	1,903,732	2.70%	2,691,551	3.19%

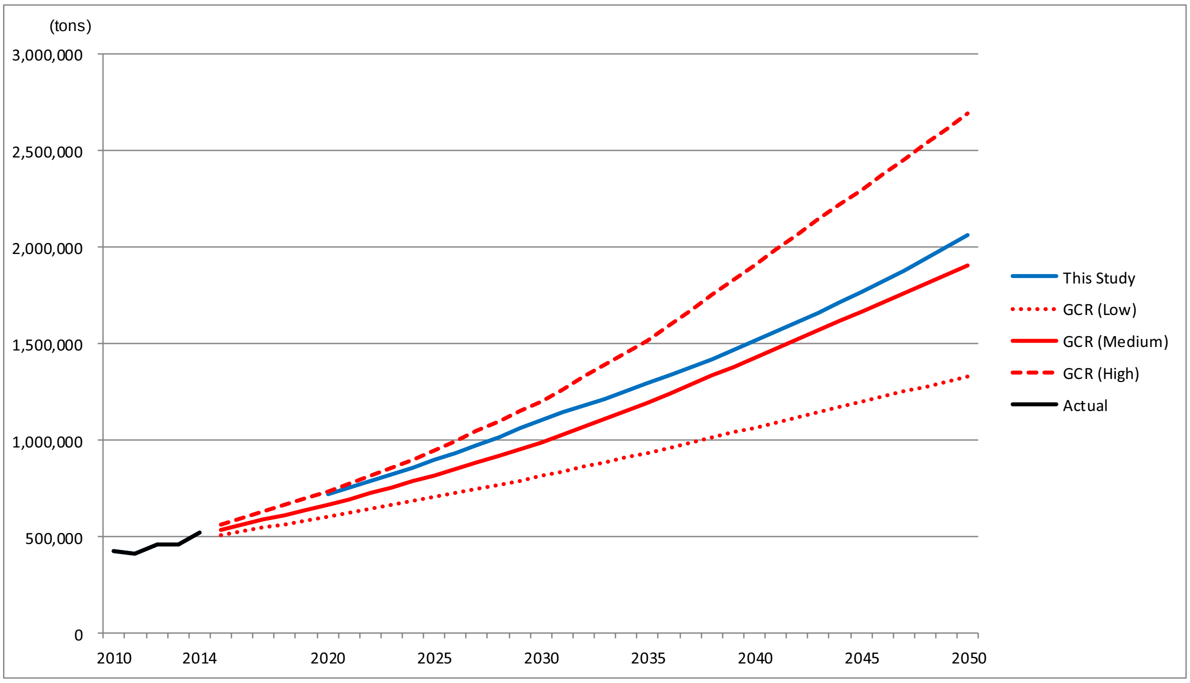


Figure 3.4.4-12 Comparison of Air Cargo Demand at NAIA

As a reference, the comparison of international passenger demand between the forecast in this study and by ACI (Airports Council International) was shown as Table 3.4.4-13. The forecast in this study was calculated unobtrusively.

Table 3.4.4-13 Comparison of International Air Passenger Demand Forecast with ACI's Forecast

	Forecast in This Study [Medium Case]		Forecast by ACI
	2030	2035	2031
International Air Passengers ('000)	32,931	38,346	39,103

Source: Global Traffic Forecast 2012-2031 (Edition 2013), ACI

3) Air Traffic Demand at CRK

Comparison of the air traffic demand between forecast at CRK were shown as Table 3.4.4-14 and Table 3.4.4-15.

As for air passenger demand, the forecasts of Base Case in this study were approximate values with the forecasts of Medium Case in 2011 GCR Airport Study. And the forecasts of Reference Case in this study were over one and a half times as volumes of the forecasts of High Case in 2011 GCR Airport Study.

Table 3.4.4-14 Comparison of Air Passenger Demand Forecast at CRK with 2011 GCR Airport Studies

Year	Total Passengers [Domestic + International] ('000)							
	Forecast in This Survey [Medium Case]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate	Passengers	Growth Rate
2010	654	—						
2011	767	17.27%						
2012	1,316	71.51%						
2013	1,201	-8.75%						
2014	878	-26.89%						
2020	1,677	11.40%	1,523	9.62%	2,171	16.29%	2,907	22.09%
2025	2,360	7.07%	1,887	4.38%	2,846	5.56%	4,015	6.67%
2030	3,190	6.22%	2,266	3.73%	3,601	4.82%	5,336	5.85%
2035	3,933	4.28%	2,690	3.49%	4,513	4.62%	7,036	5.69%
2040	4,794	4.04%	3,129	3.07%	5,506	4.06%	8,995	5.04%
2045	5,793	3.86%	3,568	2.66%	6,499	3.37%	10,954	4.02%
2050	6,950	3.71%	4,007	2.35%	7,492	2.88%	12,913	3.35%

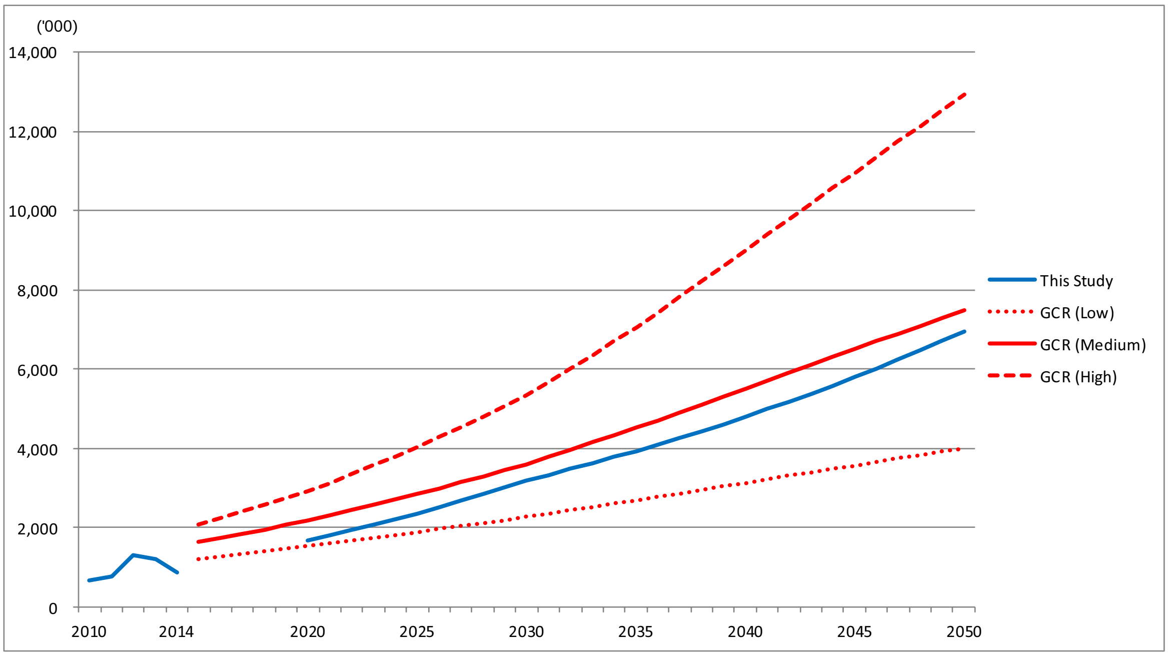


Figure 3.4.4-13 Comparison of Air Passenger Demand at CRK

Meanwhile, the air cargo forecasts of both Base Case and Reference Case in this study were high than the forecast of High Case in 2011 GCR Airport study. The growth rates of Base Case in this study and High Case in 2011 GCR Airport Study were approximate values, and .the growth rates of Reference Case in this study and Medium Case in 2011 GCR Airport Study were approximate values.

Table 3.4.4-15 Comparison of Air Cargo Demand Forecast at CRK with 2011 GCR Airport Study

Year	Total Cargoes [Domestic + International] (tons)							
	Forecast in This Survey [Medium]		Forecast in 2011 GCR Airport Survey (2011)					
			Low Case		Medium Case		High Case	
	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate	Cargoes	Growth Rate
2010	45,738	–						
2011	41,284	-9.74%						
2012	41,621	0.82%						
2013	44,057	5.85%						
2014	47,981	8.91%						
2020	90,165	11.09%	57,302	3.00%	64,648	5.09%	72,748	7.18%
2025	126,176	6.95%	67,778	3.42%	80,420	4.46%	95,096	5.50%
2030	169,989	6.14%	78,890	3.08%	98,374	4.11%	122,159	5.14%
2035	209,177	4.24%	90,918	2.88%	119,178	3.91%	155,453	4.94%
2040	254,607	4.01%	104,110	2.75%	143,303	3.76%	196,153	4.76%
2045	307,273	3.83%	117,302	2.41%	167,428	3.16%	236,853	3.84%
2050	368,326	3.69%	130,494	2.15%	191,553	2.73%	277,553	3.22%

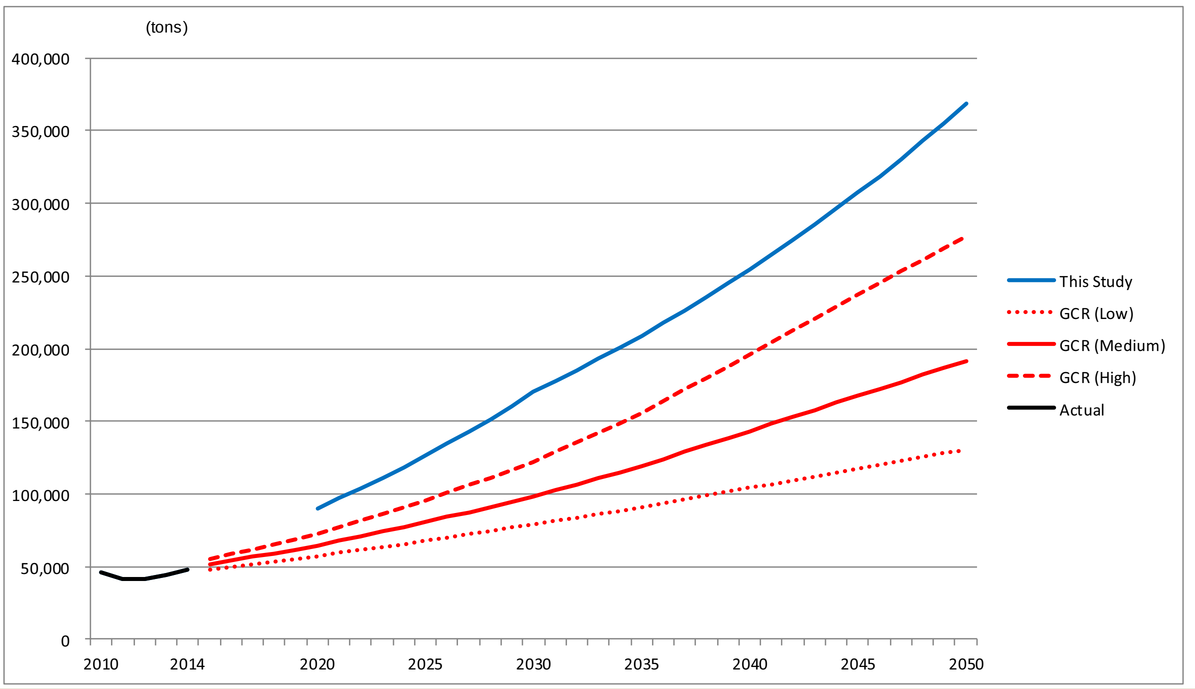


Figure 3.4.4-14 Comparison of Air Cargo Demand at CRK

3.5 Peak-day and Peak-hour Air Traffic Demand and Annual Aircraft Movement Forecast

3.5.1. Basic Approach for Calculation

3.5.1.1. Method of Calculation

The peak-day and peak-hour air traffic demands at NAIA and CRK have been calculated in accordance with the flow chart shown Figure 3.5.1-1. And annual aircraft movement forecasts were calculated based on those results.

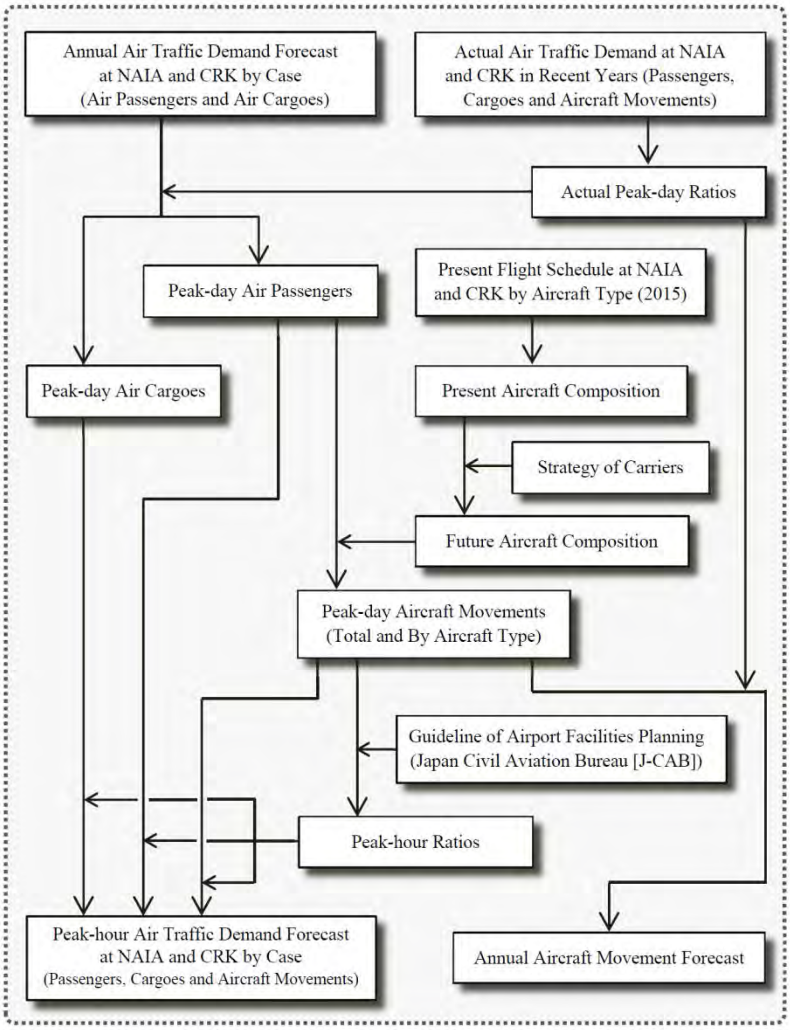


Figure 3.5.1-1 Flowchart for Calculation of Peak-day and Peak-hour Air Traffic Demand

3.5.1.2. Precondition of Calculation

1) Peak-day Ratio

Future peak-day ratio at NAIA and CRK has been adopted same as average of recent peak-day ratio at NAIA shown in Table 3.5.1-1 and Table 3.5.1-2.

Table 3.5.1-1 Actual Monthly Air Traffic Demand and Day Ratio at NAIA (2010-2014)

			Monthly Traffic Demand					Monthly Ratio						Average
			2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	Average	Day-ratio
Passengers ('000)	Domestic	Jan.	1,079	1,397	1,620	1,442	1,577	7.3%	8.4%	9.1%	8.2%	8.8%	8.3%	1 / 372
		Feb.	1,091	1,262	1,392	1,337	1,363	7.4%	7.6%	7.8%	7.6%	7.6%	7.6%	1 / 369
		Mar.	1,210	1,400	1,529	1,526	1,556	8.2%	8.4%	8.6%	8.6%	8.6%	8.5%	1 / 365
		Apr.	1,409	1,572	1,786	1,717	1,775	9.5%	9.4%	10.1%	9.7%	9.9%	9.7%	1 / 309
		May.	1,444	1,637	1,831	1,731	1,879	9.8%	9.8%	10.3%	9.8%	10.4%	10.0%	**1 / 309**
		Jun.	1,228	1,337	1,405	1,480	1,485	8.3%	8.0%	7.9%	8.4%	8.2%	8.2%	1 / 367
		Jul.	1,166	1,300	1,310	1,396	1,329	7.9%	7.8%	7.4%	7.9%	7.4%	7.7%	1 / 404
		Aug.	1,199	1,325	1,294	1,387	1,381	8.1%	7.9%	7.3%	7.8%	7.7%	7.8%	1 / 399
		Sep.	1,122	1,214	1,242	1,331	1,264	7.6%	7.3%	7.0%	7.5%	7.0%	7.3%	1 / 412
		Oct.	1,225	1,395	1,433	1,434	1,451	8.3%	8.4%	8.1%	8.1%	8.1%	8.2%	1 / 379
		Nov.	1,214	1,314	1,391	1,329	1,412	8.2%	7.9%	7.8%	7.5%	7.8%	7.9%	1 / 382
		Dec.	1,369	1,536	1,505	1,579	1,548	9.3%	9.2%	8.5%	8.9%	8.6%	8.9%	1 / 348
		Total	14,755	16,687	17,739	17,689	18,020	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365
	International	Jan.	1,071	1,151	1,282	1,307	1,449	8.7%	8.9%	9.1%	8.6%	9.0%	8.8%	1 / 351
		Feb.	915	995	1,101	1,145	1,230	7.4%	7.7%	7.8%	7.5%	7.7%	7.6%	1 / 368
		Mar.	1,098	1,103	1,242	1,343	1,382	8.9%	8.5%	8.8%	8.8%	8.6%	8.7%	1 / 355
		Apr.	1,121	1,201	1,328	1,366	1,500	9.1%	9.3%	9.4%	9.0%	9.3%	9.2%	**1 / 326**
		May.	1,151	1,211	1,313	1,361	1,488	9.3%	9.3%	9.3%	9.0%	9.3%	9.2%	1 / 336
		Jun.	1,044	1,050	1,145	1,242	1,320	8.4%	8.1%	8.1%	8.2%	8.2%	8.2%	1 / 366
		Jul.	1,039	1,082	1,134	1,226	1,274	8.4%	8.3%	8.0%	8.1%	7.9%	8.2%	1 / 380
		Aug.	1,016	1,075	1,087	1,223	1,290	8.2%	8.3%	7.7%	8.1%	8.0%	8.1%	1 / 385
		Sep.	886	943	1,030	1,103	1,134	7.2%	7.3%	7.3%	7.3%	7.1%	7.2%	1 / 416
		Oct.	966	890	1,097	1,219	1,242	7.8%	6.9%	7.8%	8.0%	7.7%	7.6%	1 / 406
		Nov.	996	1,065	1,125	1,225	1,272	8.0%	8.2%	8.0%	8.1%	7.9%	8.0%	1 / 373
		Dec.	1,077	1,202	1,254	1,416	1,493	8.7%	9.3%	8.9%	9.3%	9.3%	9.1%	1 / 341
		Total	12,381	12,969	14,140	15,177	16,072	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365
Cargoes (tons)	Domestic	Jan.	7,997	9,441	11,689	9,495	13,341	6.8%	7.9%	7.8%	5.8%	8.1%	7.3%	1 / 426
		Feb.	8,337	8,172	10,995	10,891	13,765	7.1%	6.8%	7.4%	6.6%	8.4%	7.3%	1 / 386
		Mar.	9,455	9,921	12,841	11,927	13,482	8.0%	8.3%	8.6%	7.3%	8.2%	8.1%	1 / 384
		Apr.	9,546	8,759	13,408	12,591	13,379	8.1%	7.3%	9.0%	7.7%	8.1%	8.0%	1 / 373
		May.	8,470	9,422	13,022	12,183	13,819	7.2%	7.9%	8.7%	7.4%	8.4%	7.9%	1 / 391
		Jun.	9,279	9,343	12,673	14,560	13,050	7.9%	7.8%	8.5%	8.9%	7.9%	8.2%	1 / 366
		Jul.	8,937	10,129	12,369	15,006	15,739	7.6%	8.5%	8.3%	9.1%	9.6%	8.6%	1 / 360
		Aug.	11,678	9,124	12,859	14,517	17,932	9.9%	7.6%	8.6%	8.8%	10.9%	9.2%	1 / 338
		Sep.	11,686	9,320	14,501	14,243	15,678	9.9%	7.8%	9.7%	8.7%	9.5%	9.1%	1 / 329
		Oct.	10,036	8,824	13,825	15,284	10,650	8.5%	7.4%	9.3%	9.3%	6.5%	8.2%	1 / 378
		Nov.	10,452	12,123	9,790	16,304	10,415	8.9%	10.1%	6.6%	9.9%	6.3%	8.4%	1 / 359
		Dec.	11,594	15,294	11,108	17,201	13,346	9.9%	12.8%	7.5%	10.5%	8.1%	9.7%	**1 / 319**
		Total	117,467	119,872	149,080	164,201	164,597	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365
	International	Jan.	24,421	23,873	25,358	22,366	25,818	8.0%	8.2%	8.2%	7.6%	7.3%	7.8%	1 / 395
		Feb.	23,197	22,514	26,017	21,859	23,361	7.6%	7.8%	8.4%	7.5%	6.6%	7.5%	1 / 371
		Mar.	27,077	25,596	30,056	27,022	28,336	8.8%	8.8%	9.7%	9.2%	8.0%	8.9%	**1 / 348**
		Apr.	25,411	23,792	27,700	25,658	26,250	8.3%	8.2%	8.9%	8.8%	7.4%	8.3%	1 / 361
		May.	26,915	23,740	27,969	25,259	28,284	8.8%	8.2%	9.0%	8.6%	8.0%	8.5%	1 / 364
		Jun.	26,057	24,745	25,747	24,092	29,207	8.5%	8.5%	8.3%	8.2%	8.2%	8.3%	1 / 359
		Jul.	25,317	24,638	25,527	23,891	31,009	8.3%	8.5%	8.2%	8.2%	8.7%	8.4%	1 / 371
		Aug.	24,764	24,280	24,400	22,696	32,237	8.1%	8.4%	7.8%	7.7%	9.1%	8.2%	1 / 377
		Sep.	25,724	23,386	25,129	23,381	32,237	8.4%	8.1%	8.1%	8.0%	9.1%	8.3%	1 / 361
		Oct.	26,765	22,860	24,351	23,961	33,380	8.7%	7.9%	7.8%	8.2%	9.4%	8.4%	1 / 369
		Nov.	24,788	24,304	24,371	26,410	32,642	8.1%	8.4%	7.8%	9.0%	9.2%	8.5%	1 / 353
		Dec.	25,924	26,778	24,430	26,520	32,379	8.5%	9.2%	7.9%	9.0%	9.1%	8.7%	1 / 355
		Total	306,361	290,505	311,055	293,116	355,141	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365
Aircraft Movements (flights)	Domestic	Jan.	11,040	12,247	13,795	12,487	12,611	8.3%	8.4%	8.9%	8.4%	8.8%	8.6%	1 / 362
		Feb.	9,852	11,120	12,269	11,243	11,297	7.4%	7.7%	7.9%	7.5%	7.9%	7.7%	1 / 365
		Mar.	11,136	12,137	13,457	13,031	12,473	8.4%	8.4%	8.6%	8.7%	8.7%	8.6%	1 / 362
		Apr.	12,269	12,822	14,253	13,099	12,787	9.2%	8.8%	9.1%	8.8%	9.0%	9.0%	**1 / 334**
		May.	12,789	13,372	14,745	13,139	13,227	9.6%	9.2%	9.5%	8.8%	9.3%	9.3%	1 / 334
		Jun.	11,341	12,077	12,968	12,385	11,662	8.5%	8.3%	8.3%	8.3%	8.2%	8.3%	1 / 360
		Jul.	10,684	12,076	12,190	12,569	11,207	8.0%	8.3%	7.8%	8.4%	7.9%	8.1%	1 / 383
		Aug.	10,599	11,815	12,754	12,010	11,707	8.0%	8.1%	8.2%	8.0%	8.2%	8.1%	1 / 382
		Sep.	9,890	11,218	11,587	12,258	10,469	7.4%	7.7%	7.4%	8.2%	7.3%	7.6%	1 / 393
		Oct.	10,619	11,220	12,721	12,759	11,653	8.0%	7.7%	8.2%	8.5%	8.2%	8.1%	1 / 382
		Nov.	10,575	11,922	12,355	11,609	11,596	8.0%	8.2%	7.9%	7.8%	8.1%	8.0%	1 / 375
		Dec.	11,992	13,327	12,738	12,832	12,004	9.0%	9.2%	8.2%	8.6%	8.4%	8.7%	1 / 357
		Total	132,786	145,353	155,832	149,421	142,693	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365
	International	Jan.	5,833	6,039	6,557	7,147	8,227	8.7%	8.3%	8.2%	8.2%	8.8%	8.4%	1 / 368
		Feb.	5,190	5,430	5,989	6,400	7,208	7.7%	7.5%	7.5%	7.3%	7.7%	7.5%	1 / 371
		Mar.	5,729	6,016	6,489	7,208	7,810	8.5%	8.3%	8.1%	8.2%	8.3%	8.3%	1 / 373
		Apr.	5,592	6,108	6,617	7,267	7,996	8.3%	8.4%	8.3%	8.3%	8.5%	8.4%	1 / 358
		May.	5,770	6,212	6,853	7,583	8,028	8.6%	8.6%	8.6%	8.7%	8.6%	8.6%	1 / 361
		Jun.	5,506	5,985	6,557	7,359	7,573	8.2%	8.3%	8.2%	8.4%	8.1%	8.2%	1 / 365
		Jul.	5,656	6,185	6,781	7,431	7,703	8.4%	8.5%	8.5%	8.5%	8.2%	8.4%	1 / 368
		Aug.	5,771	6,091	6,814	7,253	7,849	8.6%	8.4%	8.6%	8.3%	8.4%	8.4%	1 / 367
		Sep.	5,273	5,846	6,538	7,021	7,530	7.8%	8.1%	8.2%	8.0%	8.0%	8.0%	1 / 374
		Oct.	5,476	6,073	6,759	7,290	7,795	8.1%	8.4%	8.5%	8.3%	8.3%	8.3%	1 / 372
		Nov.	5,506	5,982	6,660	7,529	7,716	8.2%	8.3%	8.4%	8.6%	8.2%	8.3%	1 / 360
		Dec.	6,019	6,423	7,071	8,141	8,313	8.9%	8.9%	8.9%	9.3%	8.9%	9.0%	**1 / 346**
		Total	67,321	72,390	79,685	87,629	93,748	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1 / 365

Source: MIAA

Table 3.5.1-2 Future Peak-day Ratio

	Domestic	International
Air Passengers	1 / 309	1 / 326
Air Cargoes	1 / 319	1 / 348
Aircraft Movements	1 / 334	1 / 346

2) Peak-hour Ratio

Peak hour air traffic demand has been forecasted using peak-hour coefficients calculated according to the guideline for airport facilities planning of Japan Civil Aviation Bureau (JCAB). The formulas to calculate peak-hour coefficients are follows:

i) Domestic Peak-hour coefficient = 1.51 / PDM + 0.115 (in case of PDM < 100)

Domestic Peak-hour coefficient = 6.61 / PDM + 0.064 (in case of PDM >= 100)

ii) International Peak-hour coefficient = 1.05 / PDM + 0.114

Where PDM: 2-way peak-day movements

3) Aircraft Composition

Aircraft Compositions at NAIA and CRK have been estimated based on the present aircraft compositions at NAIA and CRK shown in Table 3.5.1-3, Table 3.5.1-4 and Table 3.5.1-5.

Table 3.5.1-3 Aircraft Category in This Study

Category	Seat	Aircraft
LJ1	420	B747, B777-300
LJ2	350	A330, A340, B777-200
MJ	280	A300, A310, B767, B787
SJ	180	A320, A321, B737, MD90
TP / RJ	70	DHC8, ATR72, MRJ70/90

Source: JICA Survey Team

Table 3.5.1-4 Present Aircraft Composition at NAIA (1 week in Feb. 2015)

Aircraft Type	International Flights					Domestic Flights Total	Total
	Southeast Asia	Northeast Asia	Middle East, Australia	Europe, USA	Total		
LJ1	37	94	91	40	262		262
(share)	(7.2%)	(10.2%)	(33.0%)	(59.7%)	(14.7%)		(5.1%)
LJ2	54	78	122	22	276	51	327
(share)	(10.4%)	(8.5%)	(44.2%)	(32.8%)	(15.5%)	(1.5%)	(6.3%)
MJ	29	179	10		218		218
(share)	(5.6%)	(19.4%)	(3.6%)		(12.2%)		(4.2%)
SJ	397	571	53	5	1,026	2,786	3,812
(share)	(76.8%)	(61.9%)	(19.2%)	(7.5%)	(57.6%)	(82.7%)	(74.0%)
TP / RJ						533	533
(share)						(15.8%)	(10.3%)
Total	517	922	276	67	1,782	3,370	5,152

Source: JICA Survey Team (based on Flight Time Table at NAIA)

Table 3.5.1-5 Present Aircraft Composition at CRK (1 week in Feb. 2015)

Aircraft Type	International Flights					Domestic Flights Total	Total
	Southeast Asia	Northeast Asia	Middle East, Australia	Europe, USA	Total		
LJ1							
(share)							
LJ2							
(share)							
MJ			14		14		14
(share)			(100.0%)		(11.6%)		(11.0%)
SJ	71	36			107	6	113
(share)	(100.0%)	(100.0%)			(88.4%)	(100.0%)	(89.0%)
TP / RJ							
(share)							
Total	71	36	14		121	6	127

Source: JICA Survey Team (based on Flight Time Table at CRK)

Future aircraft composition at NAIA and CRK has been estimated as shown in Table 3.5.1-6 and Table 3.5.1-7 considering future increase of the aircraft size.

Table 3.5.1-6 Future Aircraft Composition at NAIA

Aircraft Type		Domestic Flights					International Flights				
Type	Seat	2015	2020	2025	2030	2035 -	2015	2020	2025	2030	2035 -
LJ1	420						15%	13%	11%	10%	8%
LJ2	350	2%	5%	7%	8%	10%	15%	17%	21%	23%	25%
MJ	280		10%	17%	23%	30%	12%	17%	21%	25%	30%
SJ	180	83%	69%	63%	56%	50%	58%	53%	47%	42%	36%
TP / RJ	70	16%	16%	14%	12%	10%					

Source: JICA Survey Team

Table 3.5.1-7 Future Aircraft Composition at CRK

Aircraft Type		Domestic Flights					International Flights				
Type	Seat	2015	2020	2025	2030	2035 -	2015	2020	2025	2030	2035 -
LJ1	420							17%	6%	13%	11%
LJ2	350		5%	7%	8%	10%		17%	18%	22%	26%
MJ	280		10%	17%	23%	30%	12%	8%	18%	26%	33%
SJ	180	100%	69%	63%	56%	50%	88%	58%	59%	39%	30%
TP / RJ	70		16%	14%	12%	10%					

Source: JICA Survey Team

4) Load Factor

Average load factors were estimated as follows;

i) Average Load Factor of Domestic Flights: 85%, and,

ii) Average Load Factor of International Flights: 75%.

5) Cargo Freighter Movements

Cargo freighter movements at New Manila International Airport have been calculated using 1.0% of ratio to total passenger aircraft movements based on the estimation in 2011 GCR Airport Study due to unavailability of recent data.

6) General Aviation Movements

The aircraft movement records of general aviation (GA) in the Philippines are shown in Table 3.5.1-8.

NAIA handled approximately 30 thousand GA movements in 2014. However, the traffic records have been decreasing after 2008 and the ratio to nationwide traffic has declined to 55% in 2014 from 76% in 2005. The primary factor of that decreasing was considered that the general aviation operations including many flight training schools had moved to other airports such as CRK, Plaridel Airport and others under the recent situation of traffic congestions in NAIA.

Meanwhile, CRK handled approximately 20 thousand GA aircraft movements in 2014 and the ratio to nationwide traffic has increased to 36% in 2014 from 9% in 2005.

Table 3.5.1-8 Actual General Aviation Traffic (Aircraft Movements)

Year	Philippines	GCR	NAIA	CRK
2005	52,752	45,280	40,312	4,968
2006	44,831	42,566	38,235	4,331
2007	51,897	44,961	41,506	3,455
2008	59,784	46,716	42,794	3,922
2009	47,782	41,106	37,122	3,984
2010	53,496	44,941	35,887	9,054
2011	56,087	48,620	37,411	11,209
2012	68,744	63,415	37,561	25,854
2013	70,569	60,249	34,416	25,833
2014	54,214	49,379	29,819	19,560

Source: JICA Survey Team (based on data of CAAP)

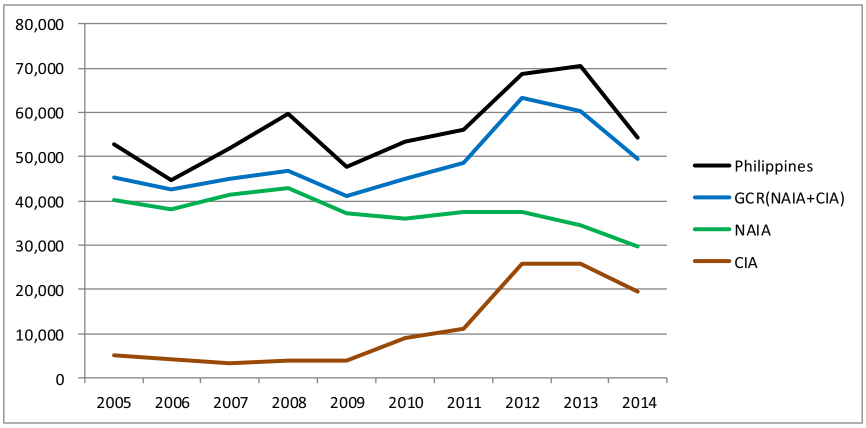


Figure 3.5.1-2 Actual Aircraft Movements of General Aviation in the Philippines

Based on that present situation, increase of GA aircraft movements at NAIA and CRK in the future is considered not likely.

Therefore, it has been assumed that GA traffic demand at NAIA and CRK would be the same situation as the present and operate at 2014 level of 30 thousand and 20 thousand respectively in this Study.

3.5.2. Peak-day and Peak-hour Air Traffic Demand and Annual Aircraft Movements

Based on the process explained in Paragraph 3.5.1, the peak-day and peak-hour air traffic demand (including annual aircraft movements) at NAIA as well as CRK have been estimated as shown in Table 3.5.2-1, Table 3.5.2-2, Table 3.5.2-3 and Table 3.5.2-4.

Table 3.5.2-5 and Table 3.5.2.6 show the total of estimated NAIA and CRK total traffic as the demand of GCR.

Table 3.5.2-1 Peak-day and Peak-hour Air Traffic Demand at NAIA [Base Case]

	Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
		Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
Annual Traffic	2020	26,887	21,900	48,788	264,553	458,277	722,830	189,044	119,716	3,090	311,850	30,000	341,850
	2025	34,458	26,877	61,334	349,885	546,323	896,208	227,120	144,628	3,720	375,468	30,000	405,468
	2030	43,668	32,931	76,599	453,704	653,445	1,107,149	271,876	173,692	4,460	450,028	30,000	480,028
	2035	51,906	38,346	90,252	546,563	749,258	1,295,821	305,276	199,296	5,050	509,622	30,000	539,622
	2040	61,456	44,623	106,079	654,213	860,331	1,514,544	362,056	231,128	5,930	599,114	30,000	629,114
	2045	72,528	51,900	124,428	779,008	989,096	1,768,104	426,852	269,188	6,960	703,000	30,000	733,000
	2050	85,362	60,337	145,699	923,679	1,138,369	2,062,048	502,336	312,092	8,140	822,568	30,000	852,568
Peak-day Traffic	2020	87,014	67,179	154,193	829	1,317	2,146	566	346	10	922	-	-
	2025	111,513	82,443	193,956	1,097	1,570	2,667	680	418	10	1,108	-	-
	2030	141,321	101,014	242,335	1,422	1,878	3,300	814	502	14	1,330	-	-
	2035	167,981	117,625	285,606	1,713	2,153	3,866	914	576	14	1,504	-	-
	2040	198,888	136,881	335,769	2,051	2,472	4,523	1,084	668	18	1,770	-	-
	2045	234,717	159,203	393,920	2,442	2,842	5,284	1,278	778	20	2,076	-	-
	2050	276,254	185,082	461,336	2,896	3,271	6,167	1,504	902	24	2,430	-	-
Peak-hour Traffic	2020	6,593	7,862	14,455	63	154	217	43	40	2	85	-	-
	2025	8,229	9,606	17,835	81	183	264	50	49	2	101	-	-
	2030	10,201	11,727	21,928	103	218	321	59	58	2	119	-	-
	2035	11,975	13,624	25,599	122	249	371	65	67	2	134	-	-
	2040	13,951	15,820	29,771	144	286	430	76	77	2	155	-	-
	2045	16,245	18,364	34,609	169	328	497	88	90	2	180	-	-
	2050	18,904	21,315	40,219	198	377	575	103	104	2	209	-	-

Table 3.5.2-2 Aircraft Movements by Aircraft Type at NAIA [Base Case]

Year	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
Annual Traffic													
2020		9,352	18,704	130,928	30,060	189,044	15,916	20,760	20,068	62,972		119,716	3,090
2025		15,364	38,076	142,284	31,396	227,120	16,608	29,756	30,448	67,816		144,628	3,720
2030		22,712	63,460	152,972	32,732	271,876	17,300	39,444	44,288	72,660		173,692	4,460
2035		30,728	91,516	152,304	30,728	305,276	15,916	50,516	60,204	72,660		199,296	5,050
2040		36,072	108,884	181,028	36,072	362,056	18,684	58,128	69,200	85,116		231,128	5,930
2045		42,752	128,256	213,092	42,752	426,852	22,144	68,508	80,272	98,264		269,188	6,960
2050		50,100	150,968	251,168	50,100	502,336	26,296	80,272	93,420	112,104		312,092	8,140
Peak-day Traffic													
2020		28	56	392	90	566	46	60	58	182		346	10
2025		46	114	426	94	680	48	86	88	196		418	10
2030		68	190	458	98	814	50	114	128	210		502	14
2035		92	274	456	92	914	46	146	174	210		576	14
2040		108	326	542	108	1,084	54	168	200	246		668	18
2045		128	384	638	128	1,278	64	198	232	284		778	20
2050		150	452	752	150	1,504	76	232	270	324		902	24
Peak-hour Traffic													
2020		4	6	26	8	44	6	8	8	20		42	2
2025		4	10	30	8	52	6	12	12	20		50	2
2030		6	14	32	8	60	6	14	16	24		60	2
2035		8	20	30	8	66	6	18	22	22		68	2
2040		8	24	38	8	78	8	20	24	26		78	2
2045		10	28	42	10	90	8	24	28	30		90	2
2050		12	32	48	12	104	10	28	32	34		104	2

Table 3.5.2-3 Annual Air Traffic Demand at CRK [Base Case]

Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
	Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
2020	146	1,532	1,677	3,264	86,901	90,165	1,336	8,304	100	9,740	20,000	29,740
2025	193	2,167	2,360	4,958	121,218	126,176	1,336	11,764	130	13,230	20,000	33,230
2030	250	2,941	3,190	7,019	162,971	169,990	2,004	15,916	180	18,100	20,000	38,100
2035	300	3,633	3,933	8,862	200,315	209,177	2,004	18,684	210	20,898	20,000	40,898
2040	360	4,435	4,794	10,999	243,608	254,607	2,672	22,836	260	25,768	20,000	45,768
2045	428	5,365	5,793	13,476	293,796	307,272	2,672	27,680	300	30,652	20,000	50,652
2050	507	6,442	6,950	16,348	351,978	368,326	3,340	33,908	370	37,618	20,000	57,618

Table 3.5.2-4 Annual Aircraft Movements by Aircraft Type at CRK [Base Case]

Year	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
2020				1,336		1,336	1,384	1,384	692	4,844		8,304	100
2025				1,336		1,336	692	2,076	2,076	6,920		11,764	130
2030			668	1,336		2,004	2,076	3,460	4,152	6,228		15,916	180
2035			668	1,336		2,004	2,076	4,844	6,228	5,536		18,684	210
2040			668	2,004		2,672	2,076	5,536	6,920	8,304		22,836	260
2045			668	2,004		2,672	2,076	6,920	8,996	9,688		27,680	300
2050		668	1,336	668	668	3,340	2,768	8,996	10,380	11,764		33,908	370

Table 3.5.2-5 Annual Air Traffic Demand in GCR [Base Case]

Year	Air Passenger Demand ('000)			Air Cargo Demand (tons)			Aircraft Movements (flights)					
	Domestic Passengers	International Passengers	Total	Domestic Cargoes	International Cargoes	Total	Domestic Flights	International Flights	Freighter Flights	Total	General Aviation	Grand Total
2020	27,033	23,432	50,465	267,817	545,178	812,995	190,380	128,020	3,190	321,590	50,000	371,590
2025	34,650	29,044	63,694	354,843	667,541	1,022,384	228,456	156,392	3,850	388,698	50,000	438,698
2030	43,918	35,871	79,789	460,723	816,416	1,277,139	273,880	189,608	4,640	468,128	50,000	518,128
2035	52,207	41,978	94,185	555,425	949,573	1,504,998	307,280	217,980	5,260	530,520	50,000	580,520
2040	61,816	49,058	110,874	665,212	1,103,939	1,769,151	364,728	253,964	6,190	624,882	50,000	674,882
2045	72,956	57,265	130,221	792,484	1,282,892	2,075,376	429,524	296,868	7,260	733,652	50,000	783,652
2050	85,870	66,779	152,649	940,027	1,490,347	2,430,374	505,676	346,000	8,510	860,186	50,000	910,186

Table 3.5.2-6 Annual Aircraft Movements by Aircraft Type in GCR [Base Case]

Year	Domestic Passenger Flights (flights)						International Passenger Flights (flights)						Freighter
	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total	(flights)
2020		9,352	18,704	132,264	30,060	190,380	17,300	22,144	20,760	67,816		128,020	3,190
2025		15,364	38,076	143,620	31,396	228,456	17,300	31,832	32,524	74,736		156,392	3,850
2030		22,712	64,128	154,308	32,732	273,880	19,376	42,904	48,440	78,888		189,608	4,640
2035		30,728	92,184	153,640	30,728	307,280	17,992	55,360	66,432	78,196		217,980	5,260
2040		36,072	109,552	183,032	36,072	364,728	20,760	63,664	76,120	93,420		253,964	6,190
2045		42,752	128,924	215,096	42,752	429,524	24,220	75,428	89,268	107,952		296,868	7,260
2050		50,768	152,304	251,836	50,768	505,676	29,064	89,268	103,800	123,868		346,000	8,510

3.6 Traffic Distribution between NMIA and CRK

CRK has two main runways and a newly expanded passenger terminal building capable of accommodating 4.5 million passengers annually, but still being underutilized, possibly because:

- ✓ Convenient and reliable access to/from Metro Manila is lacking;
- ✓ Currently no metropolis exists near CRK and CRK's inherent air traffic demand is not enough to attract more airlines to come; and
- ✓ As a result CRK's air network and frequency of the flight services are less competitive than NAIA.

However, NAIA is capacity constrained gateway airport and is now reaching its capacity limit. Once saturated, the over spilled air traffic demand would need to be accommodated at CRK or otherwise the demand would not be realized. In addition, Bases Conversion and Development Authority (BCDA) is planning to implement its ambitious plan of Clark Green City Development Project.

These two factors, together with ongoing efforts to improve traffic conditions inside Metro Manila, could be driving forces to increase the air traffic demand at CRK. Based on several simple assumptions, a future possible traffic distribution scenario is discussed hereunder but for reference purpose.

3.6.1 Basic Considerations

1) NAIA'S Capacity Limit

The air traffic demand forecasts discussed above are based on an assumption that no restriction on the capacity of NAIA would not exist. Practically the runway capacity of NAIA is limited while the airport traffic demand has been increasing and definitely NAIA's runway capacity would be saturated sooner or later. In 2011 GCR Airport Study, the runway capacity of NAIA has been estimated to be 250,000 movements annually (GA to be transferred to other airports), based on an assumption that airport facilities and staffing at local airports would be improved and the hours of domestic operations at NAIA would be expanded. In the 2011 GCR Airport Study the assumed capacity limit of 250,000 aircraft movements was translated to annual passenger volume of 35 MPA based on then average number of 140 passengers per flight. Assuming that the size of aircraft fleet would be expanded as shown in Table 3.5.1-6 above, the average numbers of domestic and international passengers per flight would have increased to 142 and 190 respectively; an average of about 166. Then the assumed capacity limit of 250,000 movements could be translated to 41.5 MPA.

2) Clark Green City Development Project

Meanwhile Bases Conversion and Development Authority (BCDA) is now implementing the

Clark Green City Development Plan. According to the information of Invest Philippines, "recently approved by the National Economic Development Authority (NEDA), the Clark Green City Project is envisioned to become the Philippines most modern and the first technologically-integrated city with a mix of residential, commercial, agro-industrial, institutional and information technology developments at the same time having a green, sustainable and intelligent community for its residents, workers and business establishments. The 9,450-hectare Clark Green City is located within the Clark Special Economic Zone (CSEZ) and at the heart of the bustling urban centers and major infrastructures in the Central Luzon Region. The development is focused on two (2) key elements; 1) on the areas natural resources and ecosystems as the defining factors of development; and 2) on smart urban development. The development is generally mixed-use and is structured into five (5) districts defined by their main functions, namely Government District; Central Business District; Academic District; Agri-Forestry Research and Development District; and Wellness, Recreation and Eco-tourism District". The Clark Green City Development will be implemented in phases; the first phase was scheduled to be implemented during a period from 2014 to 2019. Although the project implementation seems to be a little bit delayed, its implementation would have significant impact on the air traffic demand at CRK.

3) Measures for Improving Attractiveness of CRK

In order to attract the over spilled traffic from NAIA to utilize CRK, several measures would need to be implemented such as improvement of the airport access, introduction of incentives, etc. According to the result of transport survey (see Table 7.5-6 in Subsection 7.5), 22% of international passengers and 15% of domestic passengers at NAIA are to/from Regions I, II, III and CAR and they would be happy to utilize CRK if CRK can offer adequate level of services. This issue is to be further examined in the second half of this Survey.

3.6.2 Traffic Distribution Scenario and Results

Bearing the capacity constraint of NAIA and implementation of the Clark Green City Development Project as well as the measures for improving attractiveness of CRK, following traffic distribution scenario has been prepared:

i) According to the Base Case forecast, the passenger movements at NAIA would exceed 41.5 MPA in 2018, reaching its capacity limit. Until such time and thereafter, several measures for improving attractiveness of CRK would be implemented. Then utilization of CRK could be the choice for the over spilled passengers and airlines. If this happens, due to the availability of wider network and increased frequency, CRK would become capable of offering better opportunity to its users of more destinations and flight frequency.

ii) GA currently operating at NAIA should be transferred to Sangley or any other airports as soon as possible.

iii) However, 22% of the international and 15% of the domestic passengers of NAIA of the Base Case forecast would continue to utilize CRK as they would be to/from Regions I, II, III and CAR.

Results of the assumed traffic distribution scenario are shown in Table 3.6.2-1 and Figures 3.6.2-1 through 3.6.2-3 (the domestic, international and total passengers) as well as Table 3.6.2-2 and Figures 3.6.2-4 through 3.6.2-6 (the aircraft movements).

Table 3.6.2-1 Assumed Traffic Distribution Scenario (Passenger Movements)

('000)

	Year	Air Passenger Forecast in Base Case						Moved Air Passenger Demand from NAIA to Other Airports			Assumed Distribution of Air Passenger Demand												
		NAIA			CRK						NAIA			NMIA			Sangley	CRK			GCR		
		Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	International	Total	Domestic	Domestic	International	Total	Domestic	International	Total
	2010	14,755	12,381	27,136	47	608	654				14,755	12,381	27,136					47	608	654	14,802	12,988	27,790
	2011	16,687	12,969	29,657	42	725	767				16,687	12,969	29,657					42	725	767	16,729	13,695	30,424
Actual	2012	17,739	14,140	31,879	300	1,015	1,316				17,739	14,140	31,879					300	1,015	1,316	18,039	15,155	33,195
	2013	17,689	15,177	32,867	215	985	1,201				17,689	15,177	32,867					215	985	1,201	17,905	16,163	34,067
	2014	18,020	16,072	34,091	91	787	878				18,020	16,072	34,091					91	787	878	18,110	16,858	34,969
	2015	19,498	17,043	36,541	100	911	1,011				19,498	17,043	36,541					100	911	1,011	19,598	17,954	37,552
	2016	20,975	18,015	38,990	109	1,035	1,144				20,975	18,015	38,990					109	1,035	1,144	21,085	19,050	40,134
	2017	22,453	18,986	41,439	118	1,159	1,278				22,453	18,986	41,439					118	1,159	1,278	22,572	20,145	42,717
	2018	23,931	19,958	43,889	128	1,283	1,411	1,310	1,079	2,389	22,621	18,879	41,500					1,437	2,362	3,800	24,059	21,241	45,300
	2019	25,409	20,929	46,338	137	1,407	1,544	2,788	2,050	4,838	22,621	18,879	41,500					2,925	3,458	6,382	25,546	22,336	47,882
Forecast	2020	26,887	21,900	48,788	146	1,532	1,677	4,266	3,022	7,288	22,621	18,879	41,500					4,412	4,553	8,965	27,033	23,432	50,465
	2021	28,285	22,819	51,104	154	1,649	1,803	5,664	3,941	9,604	22,621	18,879	41,500					5,818	5,590	11,408	28,439	24,468	52,908
	2022	29,739	23,775	53,513	163	1,771	1,934	7,117	4,896	12,013	22,621	18,879	41,500					7,281	6,667	13,948	29,902	25,546	55,448
	2023	31,250	24,768	56,019	173	1,898	2,071	8,629	5,890	14,519	22,621	18,879	41,500					8,802	7,788	16,589	31,423	26,666	58,089
	2024	32,823	25,802	58,624	182	2,030	2,212	10,201	6,923	17,124	22,621	18,879	41,500					10,384	8,953	19,337	33,005	27,832	60,837
	2025	34,458	26,877	61,334	193	2,167	2,360	11,836	7,998	19,834	22,621	18,879	41,500					12,029	10,165	22,194	34,650	29,044	63,694
	2026	36,158	27,994	64,152	203	2,310	2,513	13,537	9,116	22,652	22,621	18,879	41,500					13,740	11,426	25,166	36,361	30,304	66,666
	2027	37,927	29,157	67,083	214	2,459	2,673	15,305	10,278	25,583	22,621	18,879	41,500					15,519	12,737	28,256	38,141	31,615	69,756
	2028	39,766	30,366	70,132	225	2,613	2,839	5,965	6,680	12,645				33,801	23,685	57,486		6,190	9,294	15,484	39,991	32,979	72,970
	2029	41,679	31,623	73,302	237	2,774	3,011	6,252	6,957	13,209				35,427	24,666	60,093		6,489	9,731	16,220	41,916	34,397	76,313
	2030	43,668	32,931	76,599	250	2,941	3,190	6,550	7,245	13,795				37,118	25,686	62,804		6,800	10,186	16,985	43,918	35,871	79,789
	2035	51,906	38,346	90,252	300	3,633	3,933	7,786	8,436	16,222				44,120	29,910	74,030		8,086	12,069	20,155	52,207	41,978	94,185
	2040	61,456	44,623	106,079	360	4,435	4,794	9,218	9,817	19,036				52,238	34,806	87,044		9,578	14,252	23,830	61,816	49,058	110,874
	2045	72,528	51,900	124,428	428	5,365	5,793	10,879	11,418	22,297				61,649	40,482	102,131		11,307	16,783	28,090	72,956	57,265	130,221
	2050	85,362	60,337	145,699	507	6,442	6,950	12,804	13,274	26,078				72,558	47,063	119,621		13,312	19,717	33,028	85,870	66,779	152,649

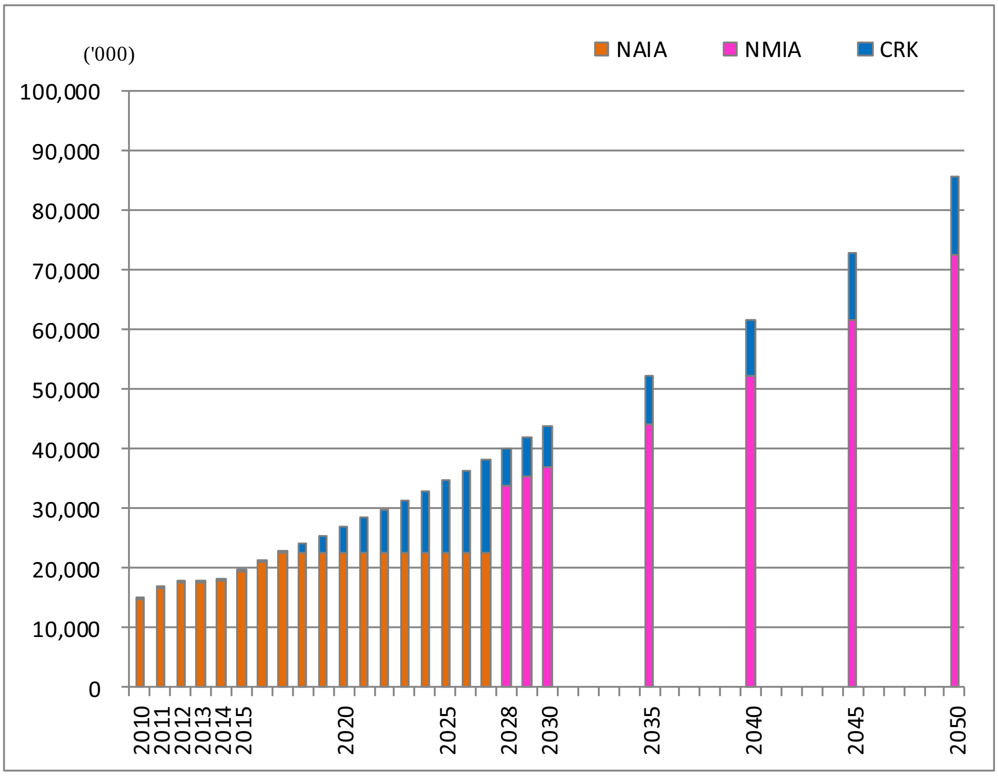


Figure 3.6.2-1 Assumed Distribution of Domestic Passengers

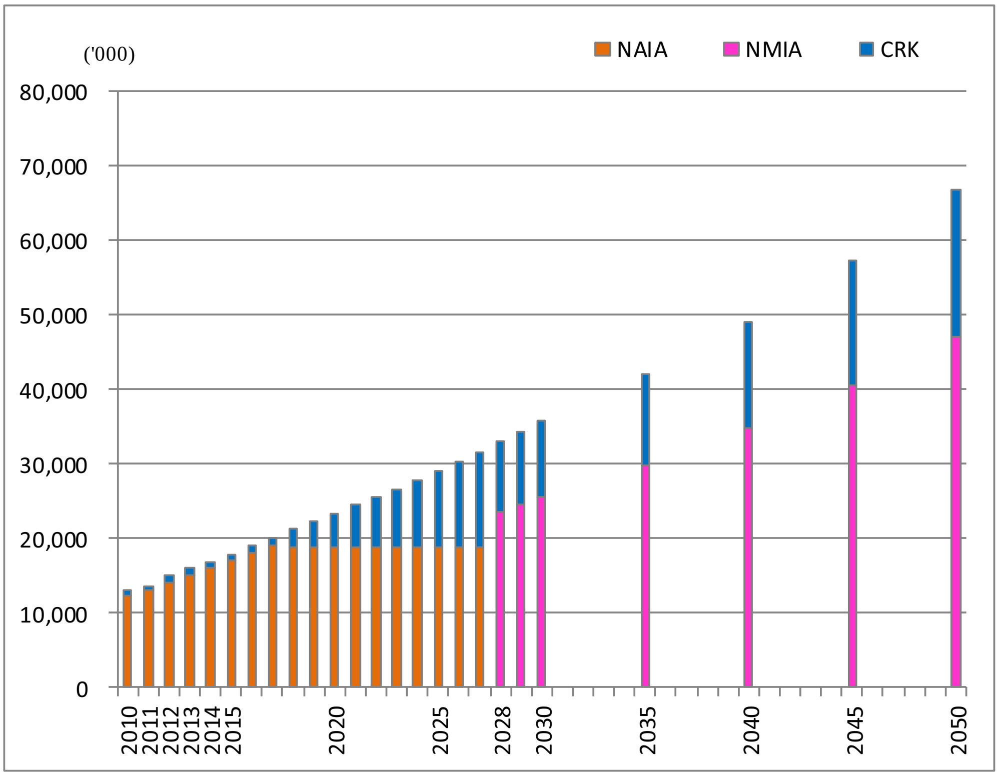


Figure 3.6.2-2 Assumed Distribution of International Passengers

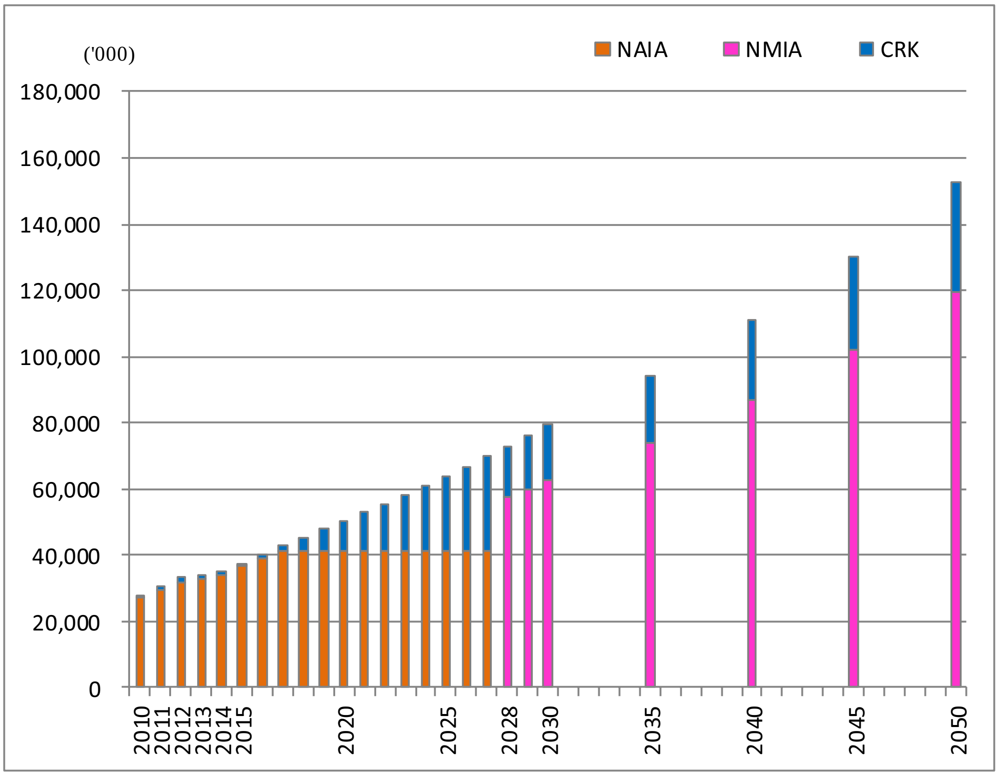


Figure 3.6.2-3 Assumed Distribution of Total Passengers

Table 3.6.2-2 Assumed Traffic Distribution Scenario (Aircraft Movements including Freighters)

Rem.) (*) : including Cargo Freighter Movements (flights)

	Year	Assumed Distribution of Aircraft Movements																		
		NAIA				NMIA				Sangley			CRK				GCR			
		Domestic	Int'l (*)	GA	Total	Domestic	Int'l (*)	GA	Total	Domestic	GA	Total	Domestic	Int'l (*)	GA	Total	Domestic	Int'l (*)	GA	Total
Actual	2010	132,786	67,321	35,887	235,994								744	5,332	9,054	15,130	133,530	72,653	44,941	251,124
	2011	145,353	72,390	37,411	255,154								609	6,971	11,209	18,789	145,962	79,361	48,620	273,943
	2012	155,832	79,685	37,561	273,078								3,501	9,313	25,854	38,668	159,333	88,998	63,415	311,746
	2013	149,421	87,629	34,416	271,466								1,916	8,420	25,833	36,169	151,337	96,049	60,249	307,635
	2014	142,693	93,748	29,819	266,260								936	5,715	19,560	26,211	143,629	99,463	49,379	292,471
Forecast	2015	149,229	99,780		249,009						29,849	29,849	996	6,168	20,000	27,164	150,225	105,948	49,849	306,022
	2016	150,235	99,765		250,000						29,879	29,879	8,021	11,232	20,000	39,253	158,256	110,997	49,879	319,133
	2017	150,235	99,765		250,000						29,910	29,910	16,052	16,283	20,000	52,335	166,287	116,048	49,910	332,245
	2018	150,235	99,765		250,000						29,940	29,940	24,083	21,335	20,000	65,418	174,318	121,100	49,940	345,357
	2019	150,235	99,765		250,000						29,970	29,970	32,114	26,384	20,000	78,498	182,349	126,149	49,970	358,468
	2020	150,235	99,765		250,000						30,000	30,000	40,145	31,445	20,000	91,590	190,380	131,210	50,000	371,590
	2021	150,235	99,765		250,000						30,000	30,000	47,761	37,251	20,000	105,012	197,996	137,016	50,000	385,012
	2022	150,235	99,765		250,000						30,000	30,000	55,377	43,057	20,000	118,434	205,612	142,822	50,000	398,434
	2023	150,235	99,765		250,000						30,000	30,000	62,993	48,863	20,000	131,856	213,228	148,628	50,000	411,856
	2024	150,235	99,765		250,000						30,000	30,000	70,609	54,669	20,000	145,278	220,844	154,434	50,000	425,278
	2025	150,235	99,765		250,000						30,000	30,000	78,221	60,477	20,000	158,698	228,456	160,242	50,000	438,698
	2026	150,235	99,765		250,000						30,000	30,000	87,307	67,277	20,000	174,584	237,542	167,042	50,000	454,584
	2027	150,235	99,765		250,000						30,000	30,000	96,393	74,077	20,000	190,470	246,628	173,842	50,000	470,470
	2028					215,880	129,658	30,000	375,538				39,834	50,984	20,000	110,818	255,714	180,642	50,000	486,356
	2029					223,489	134,306	30,000	387,795				41,311	53,136	20,000	114,447	264,800	187,442	50,000	502,242
	2030					231,095	138,959	30,000	400,054				42,785	55,289	20,000	118,074	273,880	194,248	50,000	518,128
	2035					259,485	159,390	30,000	448,875				47,795	63,850	20,000	131,645	307,280	223,240	50,000	580,520
	2040					307,748	184,905	30,000	522,653				56,980	75,249	20,000	152,229	364,728	260,154	50,000	674,882
	2045					362,824	215,396	30,000	608,220				66,700	88,732	20,000	175,432	429,524	304,128	50,000	783,652
	2050					426,986	249,781	30,000	706,767				78,690	104,729	20,000	203,419	505,676	354,510	50,000	910,186

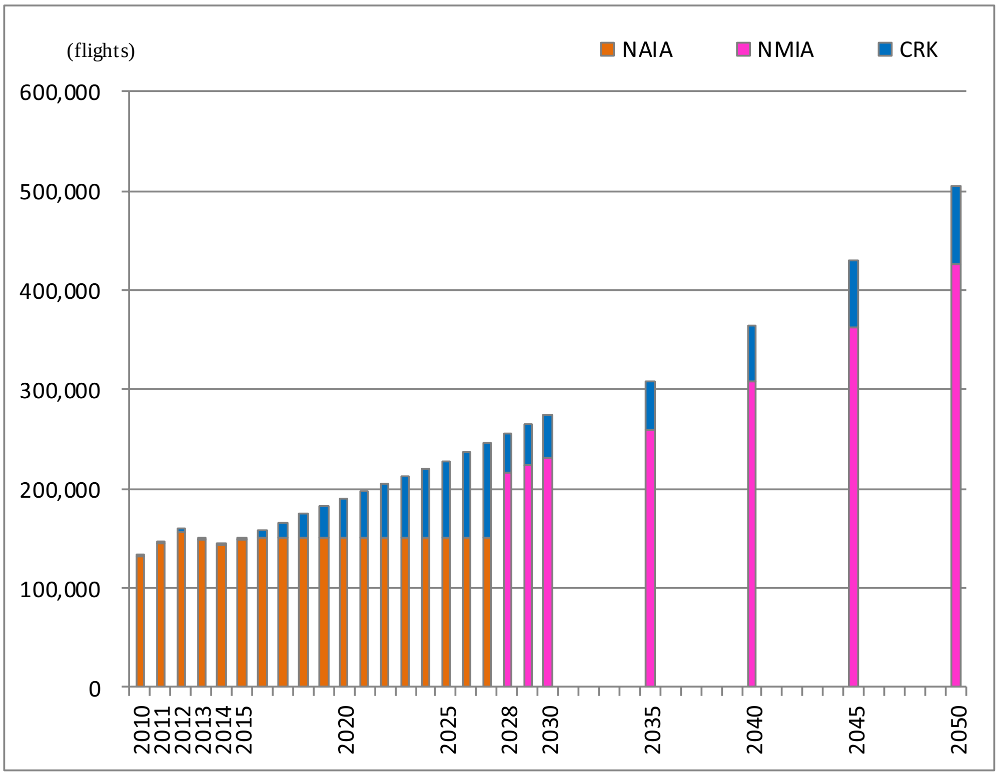


Figure 3.6.2-4 Assumed Distribution of Domestic Flights

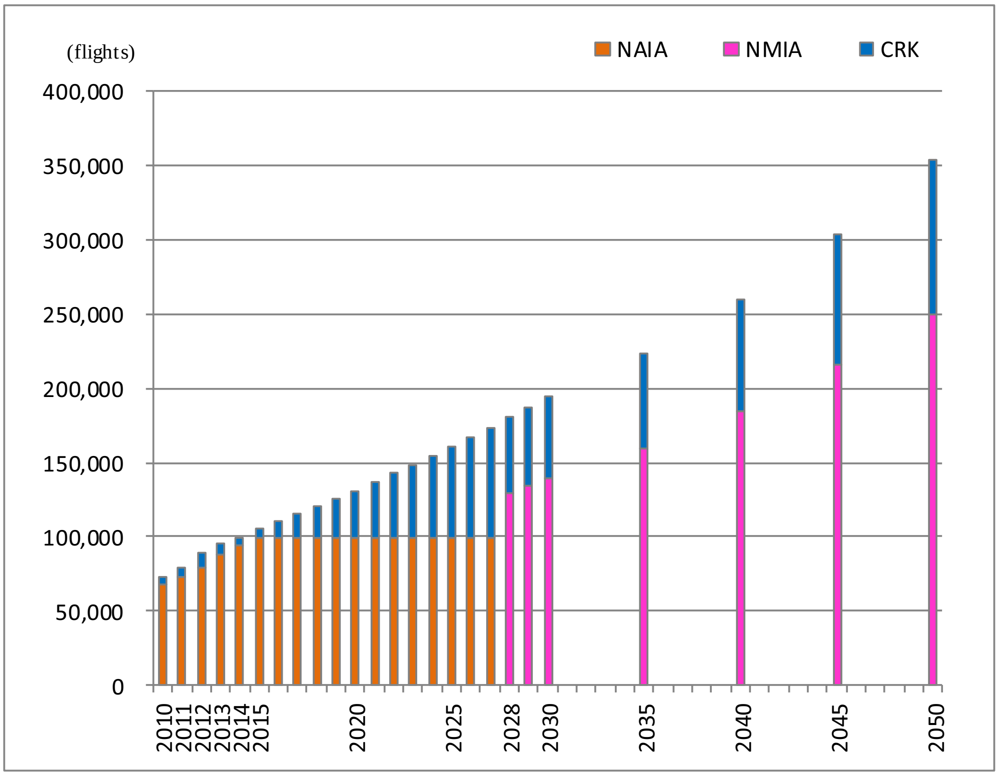


Figure 3.6.2-5 Assumed Distribution of International Flights including Freighters

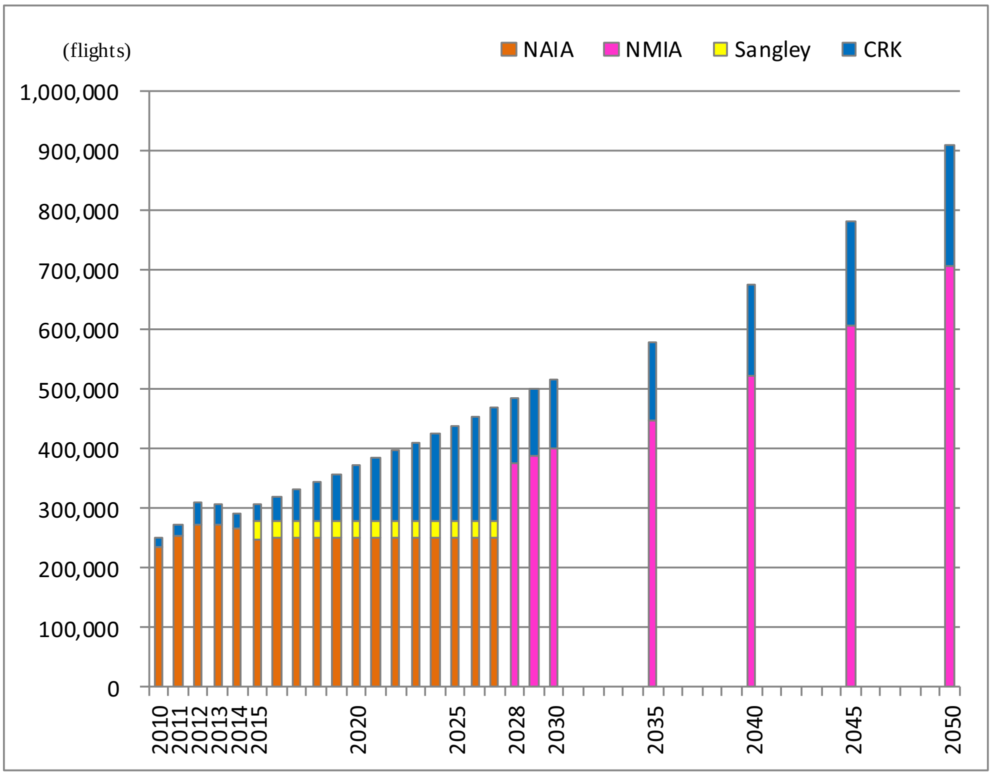


Figure 3.6.2-6 Assumed Distribution of Total Flights including GA

SECTION 4

AIRPORT ACCESS TRAFFIC DEMAND FORECAST

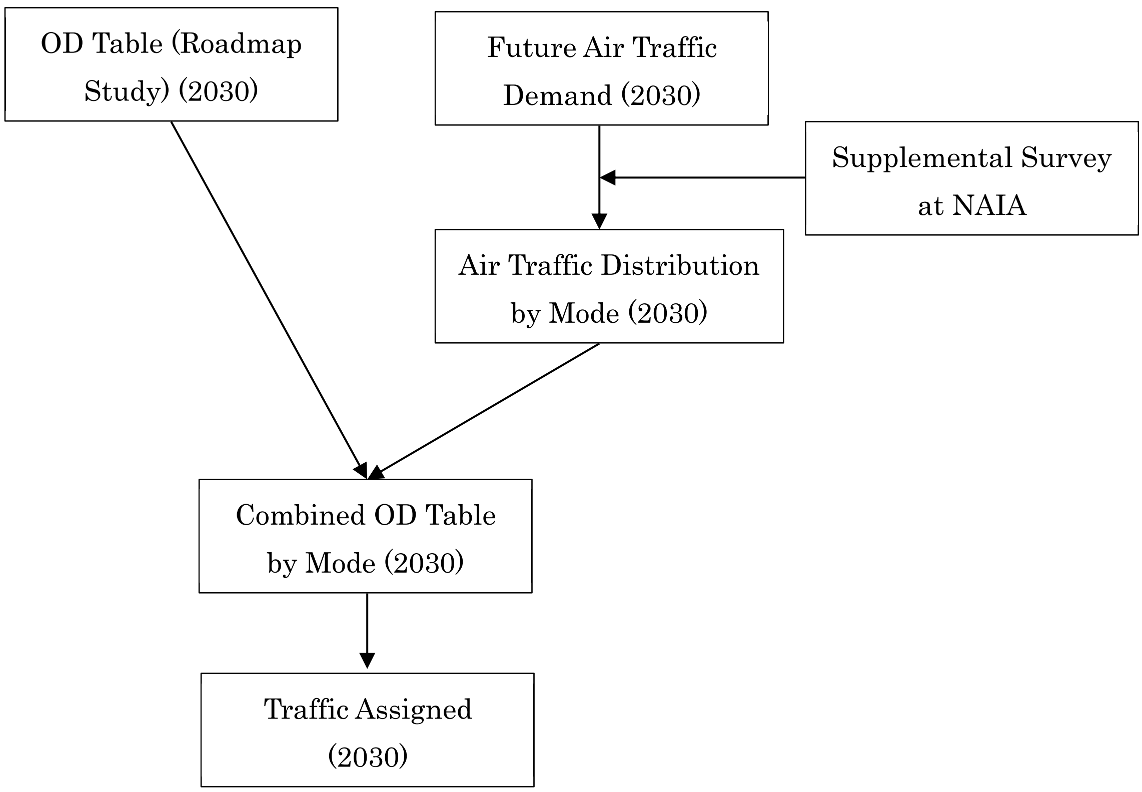
(BASE CASE)

SECTION 4: AIRPORT ACCESS TRAFFIC DEMAND FORECAST (BASE CASE)

4.1 Methodology

Based on the data already available in MUCEP and Transport Roadmap Study as well as the result of supplemental survey at NAIA (see more detail in ***Section 7.5***), the assumptions for airport access traffic forecast such as origin and destination of airport users, their travel mode, the number of well-wishers per air passengers, etc. were adjusted.

Using the travel demand model developed through the previous transport study by STRADA, each demand group has been estimated based on the forecasted future air traffic demand at NAIA as a base case. Figure 4.1-1 shows the flow charge for the airport access traffic demand forecast at NAIA.



Source: JICA Study Team

Figure 4.1-1 Flow Chart for the Forecasting Airprot Access Traffic Demand

In order to keep the consistency with other transport related study, the future transport network in 2030 includes the following transport projects (see Table 4.1-1).

Table 4.1-1 Railway and Road Projects

Year	Rail Project	Section
2020	NSRP	Malolos – Tutuban/ Solis - Paco
	Line 7	Trinoma - San jose del Monte
	LRT1 Extension	Baclaran – Niog – Das Marinas
	LRT2 East Extension	Santolan –Masinag
	MTSL	BGC – Makati
2025	NSRP	Paco – Calamba
	LRT2 West Extension	Recto-Tutuban
2035	MRT EDSA Subway	San Jose Del Monte-Dasmarinas
Year	Road Project	
2020	Segment 9 & 10	
	NLEX-SLEX connector	
	Skyway stage 3	
	NAIA expressway	
	Laguna Lakeshore Expressway Dike (LLED)	
	Calamba - Los Banos	
	CALA expressway	
	Plaridel Bypass	

Source: JICA Study Team

4.2 Trip Forecast

As a result of the supplemental survey at NAIA, the numbers of trips per air passenger by demand group and the number of trips per load of cargoes were gained (see Table 4.2-1). Considering the past situation in the Philippines and other countries, the number of well-wishers would decrease in the future. In this Study, it is assumed that the number of well-wishers in 2030 will be half of 2015 based on the survey results in MMUTIS (1997) and this Study.

Table 4.2-1 Average Number of Trips per Air Passenger and Cargo Load in 2015

No. of Trips per Air Passenger					No. of Trips per Load
Air Pax	Well-wisher (International)	Well-wisher (Domestic)	Workers	Others	
1.00	2.25	1.20	0.30	0.03	1.08

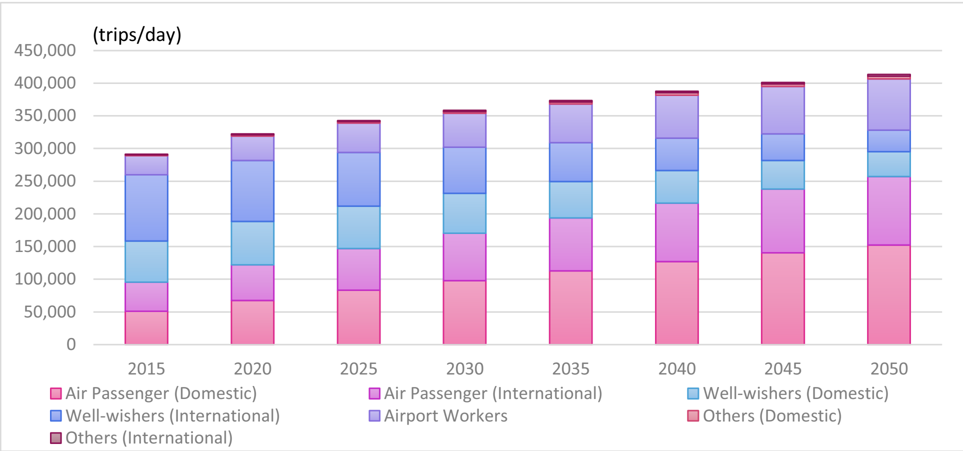
Source: JICA Study Team

Using the above assumption and the results of future air traffic demand, the total number of airport access trips would increase about 1.2 times in the period of 2015 – 2030 (i.e., from 291,463 in 2015 to 358,443 in 2030). At the same time, the number of cargo vehicles accessing to the airport increase about 1.4 times from 1,587 vehicle in 2015 to 2,203 vehicle in 2030.

Table 4.2-2 No. of Trips by Airport Users Type

Year	No. of Trips/Day							
	Air Passenger		Well-wishers		Airport Workers	Others		Total
	Domestic	International	Domestic	International		Domestic	International	
2015	51,013	44,504	62,854	101,441	29,098	1,439	1,113	291,463
2020	67,670	54,389	66,342	93,376	37,184	1,909	1,361	322,230
2025	83,234	63,627	64,932	82,273	44,739	2,349	1,592	342,744
2030	98,070	72,433	60,878	70,543	51,941	2,767	1,812	358,443
2035	112,726	81,130	55,682	59,511	59,056	3,181	2,029	373,315
2040	126,877	89,531	49,869	49,464	65,926	3,580	2,240	387,488
2045	140,351	97,527	43,896	40,583	72,466	3,960	2,440	401,224
2050	152,549	104,767	37,965	32,835	78,388	4,304	2,621	413,430

Source: JICA Study Team



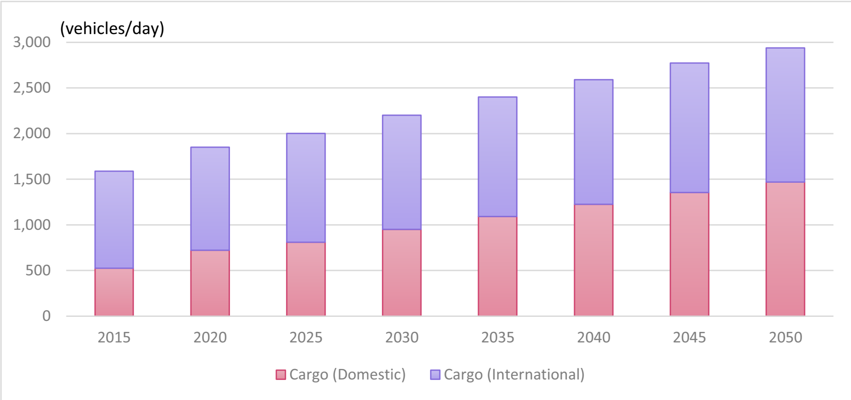
Source: JICA Study Team

Figure 4.2-1 No. of Trips by Airport Users Type

Table 4.2-3 No. of Vehicles Accessing to the Airport by Cargo Type

Year	No. of Vehicles/Day		
	Cargo		Total
	Domestic	International	
2015	525	1,062	1,587
2020	722	1,129	1,850
2025	810	1,191	2,001
2030	951	1,250	2,202
2035	1,091	1,309	2,400
2040	1,225	1,366	2,591
2045	1,354	1,420	2,774
2050	1,470	1,469	2,939

Source: JICA Study Team



Source: JICA Study Team

Figure 4.2-2 No. of Vehicles Accessing to the Airport by Cargo Type

In order to plan the transport infrastructure for airport access, the modal share and the traffic volume by pcu (passenger car unit) would be other important indicators. Since there is no plan to construct the airport access rail by 2030, the modal share in the future is supposed to be the same as the current share.

The airport workers have a relatively higher share of public transport use, but the car is the dominant for all types of airport users except cargo traffic. Due to this, there is no significant difference between the total traffic volumes by the number of vehicles and the number of pcu. At present, the total volume of airport access is about 124,000 pcu/day which is almost the same level as traffic volume of EDSA in Caloocan section and Makati section[1]. However, NAIA has four passenger terminals and one main cargo terminal, so that those access traffic has been distributed to those terminals.

By 2030, the traffic volume of airport access will increase slightly up to about 146,000. As an indication, if the future airport terminals would be integrated at one site and future modal share remains the same as current, the airport access road requires the similar capacity of EDSA, i.e., 8 – 10 lanes.

1 AADT in 2013: Caloocan section = 129,939 pcu, Makati section = 138,584 pcu

Table 4.2-4 Airport Access Traffic Volume by Travel Modes and Airport User Types in 2015

Airport Users Types		No. of Vehicles/day					Modal Share (%)				
		Car	Jeepney	Bus	Truck	Total	Car	Jeepney	Bus	Truck	Total
Air Passengers	Domestic	15,752	491	545	0	16,788	93.8	2.9	3.2	0.0	100.0
	Int'l	16,019	370	383	0	16,771	95.5	2.2	2.3	0.0	100.0
Cargo	Domestic	0	0	0	525	525	0.0	0.0	0.0	100.0	100.0
	Int'l	0	0	0	1,062	1,062	0.0	0.0	0.0	100.0	100.0
Well-wishers	Domestic	24,021	664	432	0	25,117	95.6	2.6	1.7	0.0	100.0
	Int'l	46,011	768	436	0	47,215	97.4	1.6	0.9	0.0	100.0
Airport Workers		9,211	917	116	0	10,243	89.9	9.0	1.1	0.0	100.0
Others	Domestic	550	15	10	0	575	95.6	2.6	1.7	0.0	100.0
	Int'l	505	8	5	0	518	97.4	1.6	0.9	0.0	100.0
Total		112,068	3,233	1,927	1,587	118,815	94.3	2.7	1.6	1.3	100.0
Total (pcu)		112,068	4,850	3,853	3,174	123,945	90.4	3.9	3.1	2.6	100.0

Source: JICA Study Team

Table 4.2-5 Airport Access Traffic Volume by Travel Modes and Airport User Types in 2030

Airport Users Types		No. of Vehicles/day					Modal Share (%)				
		Car	Jeepney	Bus	Truck	Total	Car	Jeepney	Bus	Truck	Total
Air Passengers	Domestic	30,282	944	1,048	0	32,274	93.8	2.9	3.2	0.0	100.0
	Int'l	26,071	602	623	0	27,296	95.5	2.2	2.3	0.0	100.0
Cargo	Domestic	0	0	0	951	951	0.0	0.0	0.0	100.0	100.0
	Int'l	0	0	0	1,250	1,250	0.0	0.0	0.0	100.0	100.0
Well-wishers	Domestic	23,265	643	419	0	24,327	95.6	2.6	1.7	0.0	100.0
	Int'l	31,996	534	303	0	32,833	97.4	1.6	0.9	0.0	100.0
Airport Workers		16,441	1,637	207	0	18,285	89.9	9.0	1.1	0.0	100.0
Others	Domestic	1,058	29	19	0	1,106	95.6	2.6	1.7	0.0	100.0
	Int'l	822	14	8	0	843	97.4	1.6	0.9	0.0	100.0
Total		129,936	4,403	2,626	2,202	139,166	93.4	3.2	1.9	1.6	100.0
Total (pcu)		129,936	6,605	5,252	4,403	146,195	88.9	4.5	3.6	3.0	100.0

Source: JICA Study Team

SECTION 5

BASIC REQUIREMENTS FOR NMIA DEVELOPMENT

SECTION 5: BASIC REQUIREMENTS FOR NMIA DEVELOPMENT

5.1 Long-term Facility Requirements of NMIA

5.1.1 Design Considerations

5.1.1.1 General

Once constructed, the new airport will serve Manila Metropolitan Area for a long time. An airport needs to be expanded to cope with increasing demand and changing market environment. Several new airports were constructed in Asia in the last two decades, those are Kansai International Airport, Chubu International Airport, Hong Kong International Airport (HKIA), Kuala Lumpur International Airport (KLIA), Seoul Incheon International Airport, Bangkok Suvarnabhumi International Airport, etc. After opening, some of these airports were expanded. For example, Kansai International Airport was opened with a single runway in 1994 and new runway was constructed in 2007. KLIA was opened in 1998 and new Low Cost Carrier Terminal Building was opened in 2014. Seoul Incheon International Airport was opened in 2001 with 2 runways and a terminal building and a new runway and satellite building was opened in 2008. These new airports were constructed considering future expansions. Without perspective of expansion plan, it will be difficult to expand the capacity in future.

5.1.1.2 Planning Parameters

1) Target Year

Facility requirements are calculated based on the air traffic demand forecast. Since expected opening day of the new airport is around 2025, air traffic demand in 2030, which is after 5 years from airport opening, is used for short-term requirements, air traffic demand in 2035, which is after 10 years from airport opening, is for medium-term, and that of in 2045 demand, which is after 20 years from airport opening, is used for long-term requirements.

2) Design Aircraft and Aerodrome Reference Code

To plan airport facility, design aircraft have to be selected. Because the new airport will be a capital's gateway airport, it is reasonable to select the largest aircraft in current market as the design aircraft. Largest aircraft today are Airbus A380s and Boeing B747-8. These aircraft are selected as the design aircraft. The ICAO code number and letter of these aircraft are code 4F.

3) Approach Category of Runways

The approach category of a precision approach equipped with Instrument Landing System (ILS) has been chosen.

4) Passenger, Cargo and Aircraft Movements

The air traffic demand forecast in Section 3 presented the Base Case demand forecast based on the past traffic trend of NAIA and CRK, and also a trial distribution of the total demand into these two airports as reference. As this Section discusses base requirements for NMIA development, the Base Case forecast for NMIA, which would increase much faster than the distribution case, is more critical and to be used for facility requirement analysis.

a) Annual, Daily and Peak-hour Passengers

Annual, daily and peak-hour passengers have been projected in Section 3 of air traffic demand forecast in this report. Estimated annual, daily and peak-hour passenger are shown in the table below.

Table 5.1.1.2-1 Domestic and International Peak-hour Passenger Movement

Year	Domestic Passengers			International Passengers		
	Annual (1,000)	Daily	Peak-hour	Annual (1,000)	Daily	Peak-hour
2020	26,887	87,014	6,593	21,900	67,179	7,862
2025	34,458	115,513	8,229	26,877	82,443	9,606
2030	43,668	141,321	10,201	32,931	101,014	11,727
2035	51,906	167,981	11,975	38,346	117,625	13,624
2040	61,456	198,888	13,951	44,623	136,881	15,820
2045	72,528	234,717	16,245	51,900	159,203	18,364
2050	85,362	276,254	18,904	60,337	185,082	21,315

Source: JICA Survey Team

b) Annual Cargo Volume

Annual cargo volume has been projected in air traffic demand forecast and its result of cargo volume is summarized as follows.

Table 5.1.1.2-2 Annual Cargo Volume

Year	Domestic Cargo (t)	International Cargo (t)	Total (t)
2020	264,553	458,277	722,830
2025	349,885	546,323	896,208
2030	453,704	653,445	1,107,149
2035	546,563	749,258	1,295,821
2040	654,213	860,331	1,514,544
2045	779,008	989,096	1,768,104
2050	923,679	1,138,369	2,062,048

Source: JICA Survey Team

c) Annual, Daily and Peak-hour Aircraft Movements

Annual, daily and peak-hour aircraft movements are projected in air traffic demand forecast, and the results are summarized in tables below.

Table 5.1.1.2-3 Annual Aircraft Movements

Year	Domestic	International	Freighter	Total
2020	189,044	119,716	3,090	311,850
2025	227,120	144,628	3,720	375,468
2030	271,876	173,692	4,460	450,028
2035	305,276	199,296	5,050	509,622
2040	362,056	231,128	5,930	599,114
2045	426,852	269,188	6,960	703,000
2050	502,336	312,092	8,140	822,568

Source: JICA Survey Team

Table 5.1.1.2-4 Peak-hour Aircraft Movements by Types

Year	Domestic						International						Freighter
	LJ1	LJ2	MJ	SJ	TP/RJ	Total	LJ1	LJ2	MJ	SJ	TP/RJ	Total	
2020	0	4	6	26	8	44	6	8	8	20	0	42	2
2025	0	4	10	30	8	52	6	12	12	20	0	50	2
2030	0	6	14	32	8	60	6	14	16	24	0	60	2
2035	0	8	20	30	8	66	6	18	22	22	0	68	2
2040	0	8	24	38	8	78	8	20	24	26	0	78	2
2045	0	10	28	42	10	90	8	24	28	30	0	90	2
2050	0	12	32	48	12	104	10	28	32	34	0	104	2

Source: JICA Survey Team

5.1.2 Runways

1) Number of Runways

Runway capacity depends on many factors such as runway layout, taxiway system, meteorological condition, local flight procedure, aircraft mix, etc. To calculate runway capacity for the new airport, instrument meteorological condition with no constrains on taxiway system is presumed.

There are many configurations of runway layout, such as single runway, close parallel runways, open parallel runways, non-parallel runways, etc. However, the wind speed in Manila area is generally weak and prevailing wind direction in Manila changes seasonally, about 180 degrees so that it is presumed that cross wind runway would not be required.

Based on future aircraft mix, runway capacity of different runway configurations has been assumed as shown in Table 5.1.2-1.

Table 5.1.2-1 Assumed Runway Capacity

ID	No. of Runways	Configuration	Optimum peak	Practical 95%	Remarks
1)	1	Single runway landing only	37.04	35	
2)	1	Single runway takeoff only	34.72	33	
3)	1	Single runway mixed use	58.31	55	
4)	2	Close parallel runway	65.66	62	
5)	2	Open parallel runways segregate use	71.76	68	1) +2)
6)	2	Open parallel runways mixed use	116.62	110	3) x 2
7)	3	1 pair of close parallel runways and 1 single runway mixed use	123.97	118	3) + 4)
8)	4	2 pair of closed parallel	131.32	125	4) x 2
9)	3	3 open parallel mixed use	174.92	165	3) x 3
10)	4	1 pair of close parallel and 2 single mixed	182.27	172	3) x 2 + 4)

According to IATA ADRM 9th Edition, peak hour is defined as the second busiest day in an average week of the peak month. The day that fits the definition was 12 May in 2014 and 21 May in 2013[1]. The peak movements of domestic flights were 31, those of international flights were 19, and combined peak period movements of domestic and international flight were 42 in 12 May, 2014. Thus, combined peak hour movement of domestic and international flights was approximately 84 % of total domestic and international (42/(31+19)=84%). Same calculation was made for the data in 21 May 2013 and the combined peak hour was 82 % of the total of domestic and international peak hour movements.

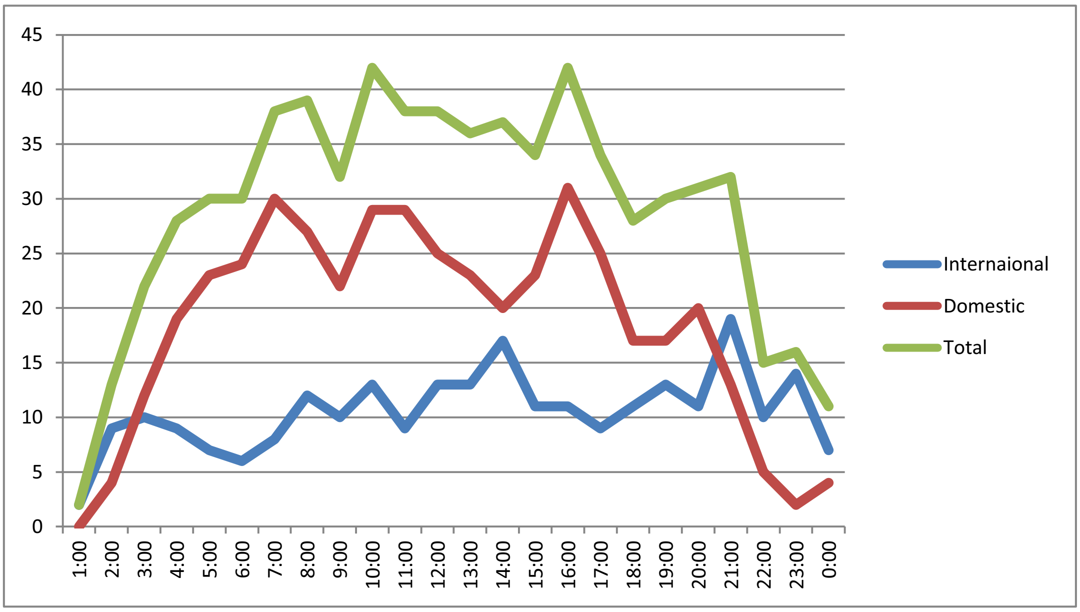


Figure 5.1.2-1 Hourly Distribution of Aircraft Movements at NAIA on 12 May 2014

1 *From Manila Control Tower Log*

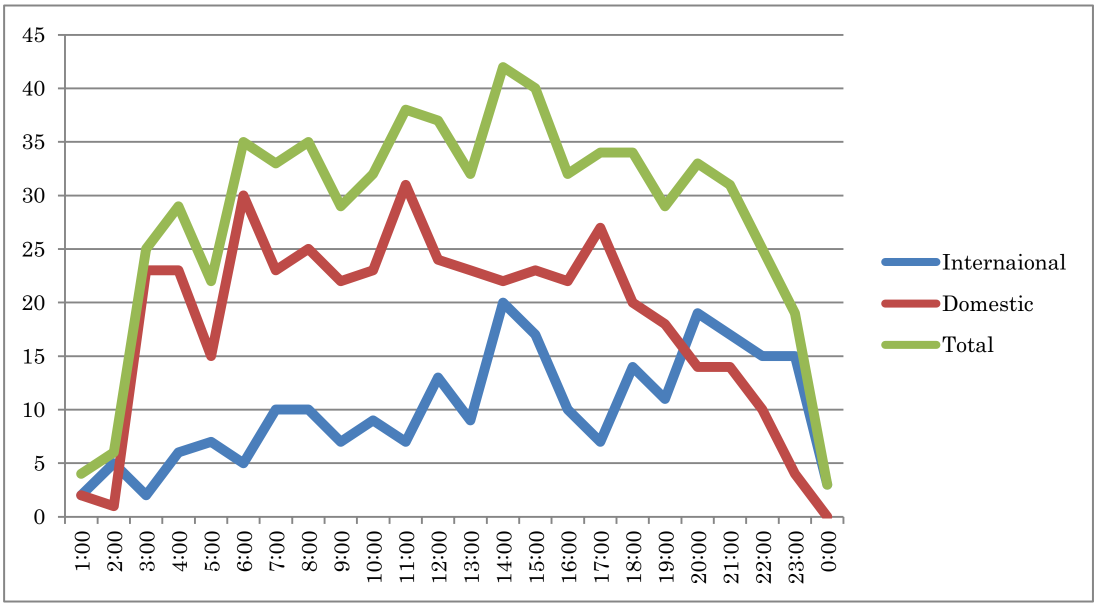


Figure 5.1.2-2 Hourly Distribution of Aircraft Movements at NAIA on 25 May 2013

Peak hour aircraft movements in future estimate based on the air traffic demand forecast are summarized in the Table 5.1.2-2. The combined peak-hour ratio for the international and domestic aircraft movements has been assumed to be 85 % based on the past record at NAIA.

Table 5.1.2-2 Estimated Future Peak Hour Aircraft Movements

	Domestic						International						Total	85 % of Total
Year	LJ1	LJ2	MJ	SJ	TP / RJ	Total	LJ1	LJ2	MJ	SJ	TP / RJ	Total		
2030	0	6	14	32	8	60	6	14	16	22	0	58	118	100
2035	0	8	20	30	8	66	6	18	20	22	0	66	132	112
2040	0	8	24	38	8	78	8	20	24	24	0	76	154	131
2045	0	10	28	42	10	90	8	24	28	28	0	88	178	151
2050	0	12	32	48	12	104	10	26	32	34	0	102	206	175

In 2030, the peak hour aircraft movements will reach 100 and an open parallel runway system (estimated hourly capacity is 110, see Table 5.1.2-1) would be required on the opening day of NMIA. For the long-term, two sets of close parallel runways or three open parallel could be possible options, but the choice depends mainly on future distribution of the air traffic demand between NMIA and CRK, and should be subjected to further examination during the next feasibility stage. Required number of runways would be as follows:

i) On opening day; open parallel runway system, and
ii) Long-term/Ultimate stage; two sets of close parallel runways (widely spaced) or three open parallel runway system.

2) Runway Length

Table 5.2.1-3 shows runway length requirement for A380 and B747-8 based on the manufactures' aircraft characteristics for airport planning. The lengths are based on aircraft maximum takeoff weight.

Table 5.1.2-3 Runway Length Requirements at ISA Condition for A380 and B747-8

	A380	B747-8
Takeoff Runway length requirement (m)	3,000	3,150
Landing Runway length requirement (m)	1,950	2,700

Source: Boeing and Airbus

These requirements are adjusted to consider temperature of 34.7 degrees and 7 m altitude at the new airport site condition. The rate of adjustment for temperature is 1 % for 1 degree and the correction factor is 34.7 – 15 (ISA) = 19.7, thus 1.197. The rate of adjustment for elevation is 7 % per 300 m so the correction factor is 1.002. These factors are multiplied to the runway length in ISA condition and the results are shown in Table 5.1.2-4 below.

Table 5.1.2-4 Adjusted Runway Length Requirements

	A380	B747-8
Takeoff Runway requirement (m)	3,598	3,778
Landing Runway Length requirement (m)	2,348	3.238

As the result of the calculation, B747-8 is the most demanding aircraft for runway length and 3,800 m runway length is required. Considering difficulty to extend the runway in future, a runway length of 4000 m has been adopted in this Survey. The runway length of major airports in Southeast Asia is shown in Table below for reference.

Table 5.1.2-5 Runway Length in Major Southeast Asia Airport

Airport	RWYs Length (m)	Airport	RWYs Length (m)
Changi Int'l	4,000	Suvarnabhumi Int'l	3,700
Hong Kong Int'l	3,800	Soekarno-Hatta Int'l	3,600
Kuala Lumpur Int'l	RWY1:4,124 RWY2:4,056		

Source: GCR Report

3) Runway Separation

ICAO Annex 14 stipulates 1,035 m as the minimum separation distance between the runway centerlines for independent parallel approaches. To cater for a large air traffic demand for GCR area, independent parallel approach would be appropriate. According to ICAO Doc 9643 (Manual of Simultaneous Operations on Parallel Near-Parallel Instrument Runways (SOIR)) and ICAO Doc 4444 PANS-OPS, there are requirements of additional equipment and air traffic control arrangement if the distance between the two runways is less than 1,525 m, 1,310 m and 1,035 m. Meanwhile, the distance between runways to be applied also has other parameter such as required width of passenger terminal building and/or the number of aircraft parking stands and so forth in such large scale of airport. Table 5.1.2-6 shows that the distance between runways at surrounding major airports reclaimed in Southeast Asia. In this Survey, a separation distance of 1635 m has been adopted based on a preliminary facility layout planning as discussed in Subsection 5.2 below.

Table 5.1.2-6 Distance between RWYs at Major Airports in Southeast Asia

Airport	Distance bet. RWYs (m)	Pax in 2013 (Million)	Land Area (ha)
Changi Int'l	1,650	53.7	1,663
Hong Kong Int'l	1,540	60.0	1,248
Incheon Int'l	2,080	41.7	1,170
Haneda Int'l	1,700	68.9	1,100

Source: JICA Survey Team

4) Runway Width

According to Annex 14, the runway width for Code-F aircraft should be 60 m. The total width with the runway shoulder for Code-F is 75 m so that 7.5-m wide shoulders should be provided on both sides of the runway.

5.1.3 Runway Strip

The width of the runway strip for ICAO Code Number 4 for precision instrument approach runway is 150 m on each side of the runway centerline. The runway strip should extend by 60 m before the threshold and beyond the runway end. So in case of 4000-m long runway, the length of runway strip should be 4120m.

5.1.4 Runway End Safety Area

According to ICAO Annex 14, runway end safety area should be provided on both ends of the runway at least 240 m from the end of runway strip where code number is 4. The width of the runway end safety area should be the same as the graded portion of the runway strip width, which is 150 m.

5.1.5 Taxiway

1) Taxiway Separation

According to ICAO Annex 14, minimum taxiway separation distance between a runway and a parallel taxiway centerlines should be 190 m and distance between parallel taxiways should be 97.5 m where code number is 4F.

2) Taxiway Width

According to ICAO Annex 14, the width of the taxiway for code number of 4 is 25 m and width of the taxiway with shoulders on both sides is 60 m.

3) Taxiway Strip

Width of the taxiway strip where code number is 4 should be 57.5 m on both sides of the taxiway from taxiway centerline.

5.1.6 Apron

1) Number of parking stands

Required numbers of parking stands are calculated based on the following formula:

$$N = \sum Ai \times Ti \times 1.2 \div 60 + S$$

Where, N: Number of parking stands, A: Number of peak hour arriving aircraft, T: Stand occupancy time, and S: Reserved stands

To decide stand occupancy time, a weekly schedule of middle of April 2015 at NAIA was studied. Figure below shows turnaround time of all flights in the week including domestic and international flights. The most dominant turnaround time was 30 minutes to 40 minutes for domestic flights and 60 minutes to 80 minutes for international flight. According to the interview with Cebu Pacific Air, the target turnaround time for small jet such as A320s is 20 to 25 minutes and for large jet such as A330s are 60 to 70 minutes. The figure below confirms their targeted time. However, for planning purpose this short turnaround time cannot be adopted directly because approximately 25 % of the flights are leaving 4 hours after their arrival and average parking hour is much longer. To reflect realistic turnaround time, average turnaround time is used to plan the number of required aircraft stands.

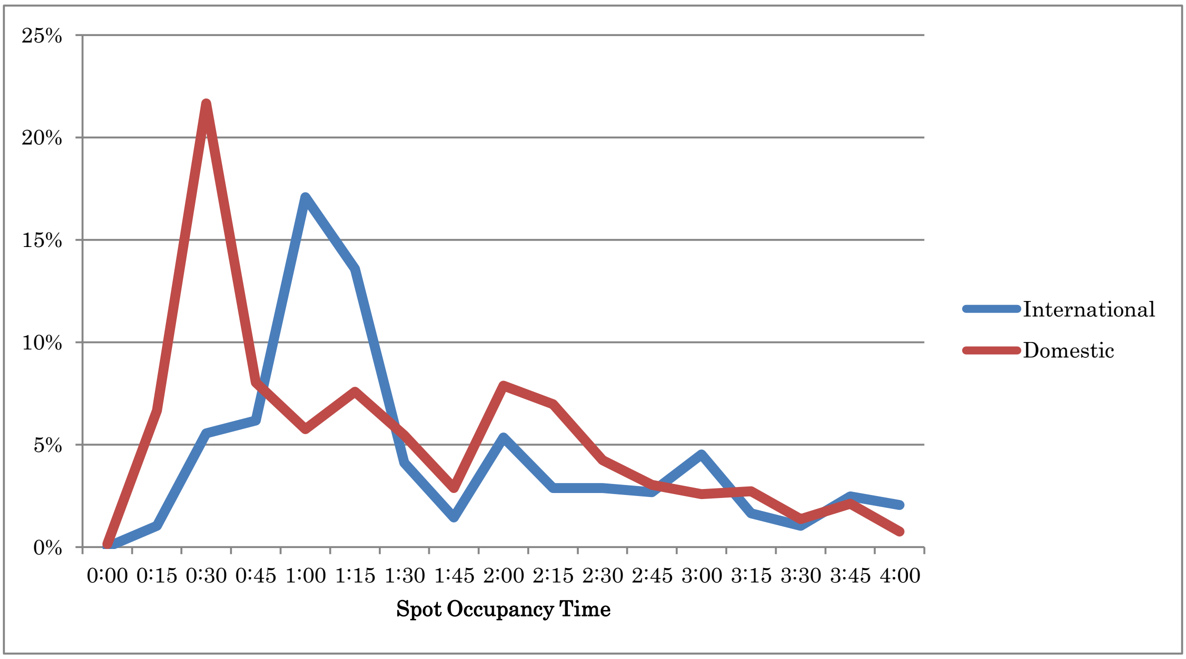


Figure 5.1.6-1 Turn-around Time of All Flights in a Week of April 2015

Table below shows summary of average turnaround time by aircraft type.

Table 5.1.6-1 Average Turn Around Time by Aircraft Type

	Turboprop	Small Jet	Medium Jet	Large Jet
Average Turn Around Time (Minutes)	63	78	71	92

Turnaround time of medium jet was shorter than that of small jet because medium jets were operated only routes between Manila and Japan, and Manila and Korea by foreign airlines and these aircraft stay in the airport for short time. It is reasonable to assume the average occupancy time of the medium jet will be same as that of large jet because there will be more medium jet flights in long haul international routes in future. Stand occupancy time of domestic flights are set to be shorter than the international flight and as the results, following stand occupancy time is adopted to calculate required number of aircraft parking stands.

Table 5.1.6-2 Assumed Stand Occupancy Time

	Turboprop	Small Jet	Medium Jet	Large Jet
Domestic (Min.)	55	70	70	70
International (Min.)	65	80	90	90

Safety margin of 1.2 is used for the calculation. It is necessary to put a reserve stand in every 10 stands to consider unexpected delay. The table below shows required number of parking stands.

Table 5.1.6-3 Required Aircraft Parking Stands in 2025

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
Peak Hour Landing	0	3	7	16	4	30	3	7	8	11	0	29	59
Occupancy Time (Min.)	70	70	70	70	55		90	90	80	80	65		
Calculated Required Parking Spots	0	5	10	23	5	43	6	13	13	18	0	50	93
Spare Spots	0	0	1	2	0	3	0	1	1	1	0	3	6
Total Parking Spots	0	5	11	25	5	46	6	14	14	19	0	53	99

Table 5.1.6-4 Required Aircraft Parking Stands in 2030

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
Peak Hour Landing	0	4	10	15	4	33	3	9	10	11	0	33	66
Occupancy Time (Min.)	70	70	70	70	55		90	90	80	80	65		
Calculated Required Parking Spots	0	6	14	21	5	46	6	17	16	18	0	57	103
Spare Spots	0	0	1	2	0	3	0	1	1	1	0	3	6
Total Parking Spots	0	6	15	23	5	49	6	18	17	19	0	60	109

Table 5.1.6-5 Required Aircraft Parking Stands in 2035

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
Peak Hour Landing	0	4	12	19	4	39	4	10	12	12	0	38	77
Occupancy Time (Min.)	70	70	70	70	55		90	90	80	80	65		
Calculated Required Parking Spots	0	6	17	27	5	55	8	18	20	20	0	66	121
Spare Spots	0	0	1	2	0	3	0	1	2	2	0	5	8
Total Parking Spots	0	6	18	29	5	58	8	19	22	22	0	71	129

Table 5.1.6-6 Required Aircraft Parking Stands in 2040

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
Peak Hour Landing	0	5	14	21	5	45	4	12	14	14	0	44	89
Occupancy Time (Min.)	70	70	70	70	55		90	90	80	80	65		
Calculated Required Parking Spots	0	7	20	30	6	63	8	22	23	23	0	76	139
Spare Spots	0	0	2	3	0	5	0	2	2	2	0	6	11
Total Parking Spots	0	7	22	33	6	68	8	24	25	25	0	82	150

Table 5.1.6-7 Required Aircraft Parking Stands in 2045

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
Peak Hour Landing	0	6	16	24	6	52	5	13	16	17	0	51	103
Occupancy Time (Min.)	70	70	70	70	55		90	90	80	80	65		
Calculated Required Parking Spots	0	9	23	34	7	73	9	24	26	28	0	87	160
Spare Spots	0	0	2	3	0	5	0	2	2	2	0	6	11
Total Parking Spots	0	9	25	37	7	78	9	26	28	30	0	93	171

In addition to the passenger apron, cargo apron for freighter is necessary. According to the result of the air traffic demand forecast, peak day operation of freighter will be 14 and peak hour movements will be 2 in short-term. Freighter stays in airport much longer than passenger aircraft for unloading and loading the cargo. A stand occupancy time of 5 hours is adopted and number of parking stands for freighter is 6. Peak hour movements of freighter will be the same to 2045 so that number of stands required for freighter will be 6 in the long-term.

According to the aircraft movement records in April 2014, 13 % of daily aircraft movements stayed on aprons overnight. Assuming the same rate in future, total overnight aircraft in 2030 will be 66 in total. Estimated numbers of overnight aircraft are shown in Table 5.1.6-8 below.

Table 5.1.6-8 Estimated Number of Overnight Aircraft

Year	Domestic	International	Total
2030	53	13	66
2035	59	13	72
2040	70	16	86
2045	83	18	101
2050	98	20	118

In general, 50 % of overnight aircraft can share other parking stands because required number of parking stands was calculated based on the peak hour traffic and peak hour is not in nighttime. Required number of overnight stands of each aircraft type is calculated based on the ratio of required number of stands by aircraft type. The table below summarizes required number of aircraft parking stands including overnight in future.

Table 5.1.6-9 Required Number of Aircraft Parking Stands

	Domestic						International						Total
	LJ1	LJ2	MJ	SJ	TP	Total	LJ1	LJ2	MJ	SJ	TP	Total	
2025	0	8	17	40	8	73	7	16	16	22	0	61	134
2030	0	10	24	37	8	79	7	20	19	21	0	67	146
2035	0	10	29	47	8	94	9	21	24	24	0	79	173
2040	0	11	36	53	10	110	9	27	28	28	0	91	201
2045	0	15	41	60	11	127	10	29	31	33	0	103	230

5.1.7 Airfield Lighting System

Airfield lighting system is required to operate instrument approach system and for nighttime operation. The following lighting system is required in the airport.

- Precision Approach Lighting System for both sides of a runway
- Sequenced Flashing Lights for both sides of a runway
- Precision Approach Path Indicator for both sides of a runway
- Runway Edge Lights, Runway Threshold Lights, Runway End Lights
- Runway Center Line Lights
- Runway Touchdown Zone Lights for both sides of a runway
- Taxiway Edge Lights, Taxiway Center Line Lights
- Stop Bar Lights, Runway Guard Lights
- Aerodrome Beacon
- Wind Direction Indicator Lights for both sides of a runway
- Apron Floodlights
- Visual Docking Guidance System
- Underground Cable Ducts
- Central Control Room, Control and Monitoring System

5.1.8 CNS/ATM System

CNS/ATM system, an essential system for safe and efficient operation of an airport, has been evolving and it is not practicable to foresee required systems for the opening day of NMIA. For the time being following CNS/ATM system has been assumed to be required:

[Communication System]

i) Tower VHF Air to Ground
ii) Approach VHF Air to Ground
iii) Aeronautical Information Service/Aeronautical Message Handling System

[Navigation System]

i) Doppler Very High Omni Direction Radio-Range/Distance Measuring Equipment
ii) Instrument Landing System CAT III for both sides of runway
iii) Ground Based Augmentation System

[Surveillance System]

i) Primary Surveillance Radar/Mono-pulse Secondary Surveillance Radar with Mode-S
ii) Advanced Surface Movement Guidance & Control System with Automatic Dependent Surveillance/Broadcast

[Air Traffic Management]

i) Tower ATC Console
ii) Voice Switching Control System and Voice Recorder
iii) Terminal Radar Data Processing System

5.1.9. Terminal Buildings

1) Passenger Terminal

Floor area of a passenger terminal building is estimated by multiplication of the number of peak hour passengers and square meters per peak hour passengers (PHP). The following table shows size of passenger terminal building and peak hour passengers of some airports in Asia. Area per PHP ranges from 31.4 of Chubu Centrair to 56.8 of Haneda International Terminal.

Table 5.1.9-1 Airport Area and Design Passenger Numbers in Other Airports

Airport Terminal	Floor Area	Assumed PHP	sqm/PHP
Haneda Intl Terminal	159,000	2,800	56.8
Ninoy Aquino - Manila T3	182,500	4,550	40.1
Chubu Centrair	220,000	7,000	31.4
Changi - Singapore T3	380,000	6,600	57.6
Seoul – Incheon	496,000	13,200	37.6
Beijing Capital T3	986,000	18,000	54.8
Hong Kong	710,000	18,000	39.4

Source: ADRM 9th and the Study Team

In general, required floor area per passenger for a domestic passenger building is less than that for an international passenger building because immigration and customs area for international passenger is not necessary in the domestic building. This might be a reason why floor area per passengers is small in Chubu Centrair as the airport building is for both international and domestic flights.

In the GCR Study, following typical passenger throughputs were used to estimate the required floor areas of passenger terminal building:

- ✓ For domestic; 15 sq.m/php.
- ✓ For international; 40 sq.m/php.

The same throughputs have been also applied in the Survey.

The required area of passenger terminal building is summarized in the table below.

Table 5.1.9-2 Required Area of Passenger Terminal Building

	Domestic				International				
Year	MPPA	PHP	sqm/ php	Total Floor Area (m2)	MPPA	PHP	sqm/ php	Total Floor Area (m2)	Total
2025	44	10,201	15	153,015	76.6	11,384	40	455,360	608,375
2030	52	11,975	15	179,625	90.25	13,226	40	529,040	708,665
2035	61	13,951	15	209,265	106.08	15,355	40	614,200	823,465
2040	73	16,245	15	243,675	124.43	17,824	40	712,960	956,635
2045	85	18,904	15	283,560	145.7	20,687	40	827,480	1,111,040

2) Cargo Terminal

According to IATA ADRM 9th, 17 tons per square meter is recommended for highly automated cargo building. Since forecast demand of annual cargo volume in 2030 is 1,107,149 ton, required area of Cargo Terminal Building is 65,100 sqm. Required area of Cargo Terminal is shown in the table below.

Table 5.1.9-3 Required Area of Highly Automated Cargo Terminal

Year	Cargoes (MT)	Required area (sqm)
2025	1,107,149	65,100
2030	1,295,821	76,200
2035	1,514,544	89,100
2040	1,768,104	104,000
2045	2,062,048	121,300

3) Control Tower

Air traffic control tower should be provided with VFR room on the top of tower. The location of the control tower is important for air traffic safety operation, and air traffic controllers should be able to clearly see all runways, taxiways and aprons without obstructions in order to ensure safety. Hence, the height of the control tower should be considered to ensure clear line-of-sight requirement.

The estimated floor space for control tower is shown as follows.

Table 5.1.9-4 Facility Requirements for Control Tower

	2025	2030	2035	2040	2045	2050
Floor Space (m^2)	3,500	3,500	3,500	3,500	3,500	3,500

Source: JICA Survey Team

5.1.10. Airside Facilities

1) Hangars

There are two NAIA-based major airlines; PAL and Cebu Pacific. Current fleet of PAL is 78 aircraft and that of Cebu Pacific Air is 55 aircraft. It will be doubled by 2030 so that total aircraft fleet by 2 major airlines will be approximately 270. It is assumed 70% of the aircraft, which is 189 aircraft, will use the new airport as their base. In general, one hanger for line maintenance is required for every 20 aircraft so that required number of hangers in the new airport is 9. Size of 160 m x 100m is adopted for the dimensions of the hanger to accommodate 2 medium size aircraft and number of hanger is 5 in 2030.

2) Rescue and Fire-Fighting (RFF)

According to ICAO Annex14 recommendation, rescue and fire-fighting station should be so located that a response time not exceeding two minutes to any point of each operational runway should be achievable, and three minutes to any other part of the movement area. To consider airport layout, two RFF stations are required to meet the recommendation. ICAO RFF category for the airport should be 9 considering the maximum aircraft of B777 class. The required minimum number of fire fighting vehicles in the category is three. The table below shows requirements of RFF services. Regarding the size of the fire station, 4,500 sq.m is adopted to consider size of current RFF vehicles.

Table 5.1.10-1 Requirements for Fire Fighting Services

Criteria	Rescue and fire fighting vehicles	Foam meeting Performance level B		Complementary Extinguishing Agents	
Aerodrome Category		Water (L)	Discharge rate foam solution/minute (L)	Dry chemical powders (kg)	Discharge Rate (kg/second)
9	3	24300	9000	450	4.5

Source: ICAO Annex 14

Estimated floor space of the fire station as well as training facility is shown below.

Table 5.1.10-2 Rescue and Fire Fighting Facility Requirements

	2025	2030	2035	2040	2045	2050
Main Facility Floor Space (m^2)	3,000	3,000	3,000	3,000	3,000	3,000
Sub Facility Floor Space (m^2)	1,500	1,500	1,500	1,500	1,500	1,500
Total Floor Space (m^2)	4,500	4,500	4,500	4,500	4,500	4,500

Source: JICA Survey Team

Table 5.1.10-3 Fire Fighting Training Station

	2025	2030	2035	2040	2045	2050
Fire Fighting Training Area (m^2)	10,000	10,000	10,000	10,000	10,000	10,000

Source: JICA Survey Team

3) Meteorological Facility

It is necessary to provide meteorological information to aircraft and meteorological facilities such as wind velocity and direction measuring equipment, temperature, barometer, ceilometer, runway visual range, etc. should be provided. Automatic Weather Observation System (AWOS) stations should be located in close proximity to the runway.

5.1.11 Landside Facilities

Facility requirements of major facilities in landside are planned. There is no guideline to decide the area of these facilities so that facility size of major airports in Asia is adopted.

1) Airline office and Airport Authority Office Building

Airline office and airport authority office building are necessary facility for an airport. The floor area is estimated based on the assumed number of airport employees as shown below.

Table 5.1.11-1 Facility Requirements for Administration Building

	2025	2030	2035	2040	2045	2050
Floor Space (m^2)	29,000	36,000	42,000	50,000	58,000	68,000

Source: JICA Survey Team

2) Catering Building

Catering building is for catering service facilities such as kitchen, loading bay and offices. The building is kind of factory for producing catering foods. Floor area of 30,000 sq.m is adopted.

3) Police office building

Police office building is provided in the airport area. Floor area of 1,500 sq.m is adopted.

4) Car Parking

It is expected that many people uses their own cars to come to the airport in Philippine. To minimize the floor area of the car park, multi story car parking building is planned. Multi story car parks are used in many airport in Asia, for example, Kansai International Airport, Kuala Lumpur International Airport, and Bangkok Suvearnabhumi International Airport, 6-story car parking building are used. In the study same 6-story multi floor car park building is adopted. Total floor area of the building is 200,000 sq.m.

Table 5.1.11-2 Size of Car Parking of New Airports in East and Southeast Asia

Airport	Parking Building			Ground Parking
	Construction Area	Number of Floor	Total Floor Area (m^2)	Site Area (m^2)
Kansai	17000 x 2	6	204,000	24,000
KLIA	17400 x 2	6	208,800	20,000
Suvarnabhumi	16000 x 2	6	192,000	140,000
Hongkong	9,000	5	45,000	84,000

Source: measured by Google Earth

5.1.12. Utility Facilities

Utilities such as power supply system, water supply system, sewage system, etc., should be provided in order to accommodate passengers, aircraft and/or other airport activities. Estimated utility demand is described below.

1) Power Supply System

The power demand required is estimated based on the following assumptions. Estimated power demand is shown in the table below.

i) PTB, Airport Admin., ATC Tower 80 ~ 100 VA/m^2

ii) CTB, Fire Station, Miscellaneous Buildings 60 ~ 80 VA/m^2

iii) Airport Utilities, Car Park, etc. 20 ~ 40 VA/m^2

iv) CNS/ATM/AGL/MET facilities – depending on the number of equipment installations.

Table 5.1.12-1 Estimated Power Demand

Facility		Year 2025 Demand 2030
Required	Passenger Terminal Building	62,200
	Cargo Terminal Building	7,320
	ATC Tower ＆ Operation Building	350
	Rescue and Fire Fighting	270
	Rescue and Fire Fighting Training Station	200
	Airport Administration Building	3,600
	Miscellaneous Buildings	5,840
	Main Power House	480
	Multistory Car Park	420
	Water Supply Facility	1,300
	Waste Disposal Facility	300
	Fuel Farm	2,352
	CNS/ATM ＆ Met Facilities	450
	Aeronautical Ground Lights	1,650
Total Demand Power Supply		87,000

Source: JICA Survey Team

2) Telephone System

The number of unit channels for the terminal facility is estimated as 60 channels per PTB 10,000m2. Estimated communication numbers are shown in the table below.

Table 5.1.12-2 Required Communication Numbers

Item	Demand 2030	Demand 2035	Demand 2045
Communication Numbers	4,350	5,050	6,820

Source: JICA Survey Team

3) Water Supply and Sewage System

Water supply and sewage demand required are estimated based on the following assumptions. Estimated water supply and sewage demand are shown in the table below.

i) PTB, Airport Admin., ATC Tower, Fire Station, Others 10 litter/m^2 /day

ii) CTB, Main Power House, Multistory Car Park 2 litter/m^2 /day

Table 5.1.12-3 Required Demand of Water Supply and Sewage System

Item	Demand 2030	Demand 2035	Demand 2045
Water Supply and Sewage System (m^3/day)	9,110	10,640	14,420

Source: JICA Survey Team

4) Waste Disposal Facility

Wasted disposal facility required is estimated based on the following assumptions. Estimated waste disposal facility is shown in the table below.

i) CTB, Airport Admin., ATC Tower, Fire Station, Others 0.14 kg/m^2 /day

ii) PTB, Main Power House, Multistory Car Park 0.07 kg/m^2 /day

Table 5.1.12-4 Facility Requirements for Waste Disposal

Item	Demand 2030	Demand 2035	Demand 2045
Waste Disposal Facility (kg/day)	97,230	115,080	157,920

Source: JICA Survey Team

5) Fuel Supply System

Daily fuel consumption is estimated based on the number of peak day departures and average fuel consumption by aircraft category. Seven days storage capacity is adopted. Estimated fuel supply requirements are shown in the table below.

Table 5.1.12-5 Fuel Supply Requirements

Item	Demand 2030	Demand 2035	Demand 2045
Daily Fuel Requirements (kl)	19,800	27,000	36,800
Storage Capacity (kl)	138,600	189,000	257,600
Farm Area (ha)	11.8	16.0	21.8

Source: JICA Survey Team

5.2 Required Size of NMIA Property

5.2.1 Imaginary Development Concept of NMIA

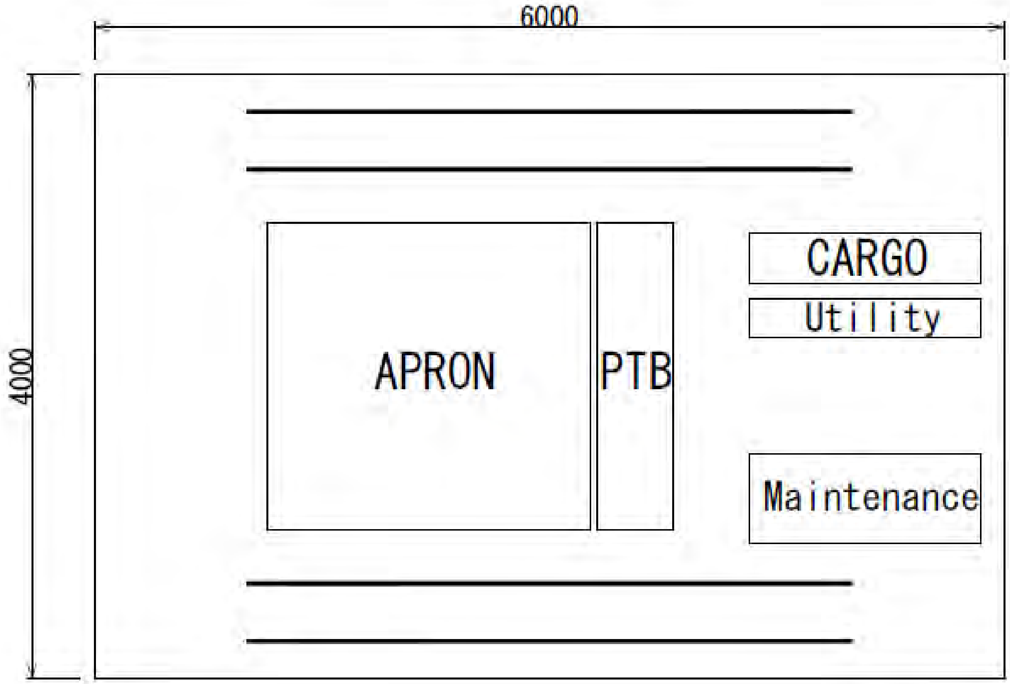
NMIA is likely to be built on a platform prepared by reclamation. The cost of reclamation would be excessive and it is necessary to minimize the platform size. At the same time, the platform should enable development of necessary facilities to meet the demand while ensuring safe and efficient operations as the world-class international gateway airport.

NMIA on its opening day will need to be provided with two open parallel runways (4000-m long 60-m wide) capable of accommodating approximately 110 aircraft movements during a peak-hour. In between the runways, there should be an ample area for development of the taxiway system, aircraft parking aprons, the landside facilities such as passenger and cargo terminals, administration building, aircraft maintenance facilities and fuel storage and supply facilities, catering facilities, etc. Result of the preliminary facility planning showed that the runways should be spaced by approximately 1635 m. The taxiway system, aircraft parking aprons as well as the landside facilities capable of accommodating the forecast airport traffic demand of 2030 to 2035 may be developed between the open parallel runways. In order to develop this size of international gateway airport, the platform will need to be approximately 6km by 2.5km (1500ha) on the opening day.

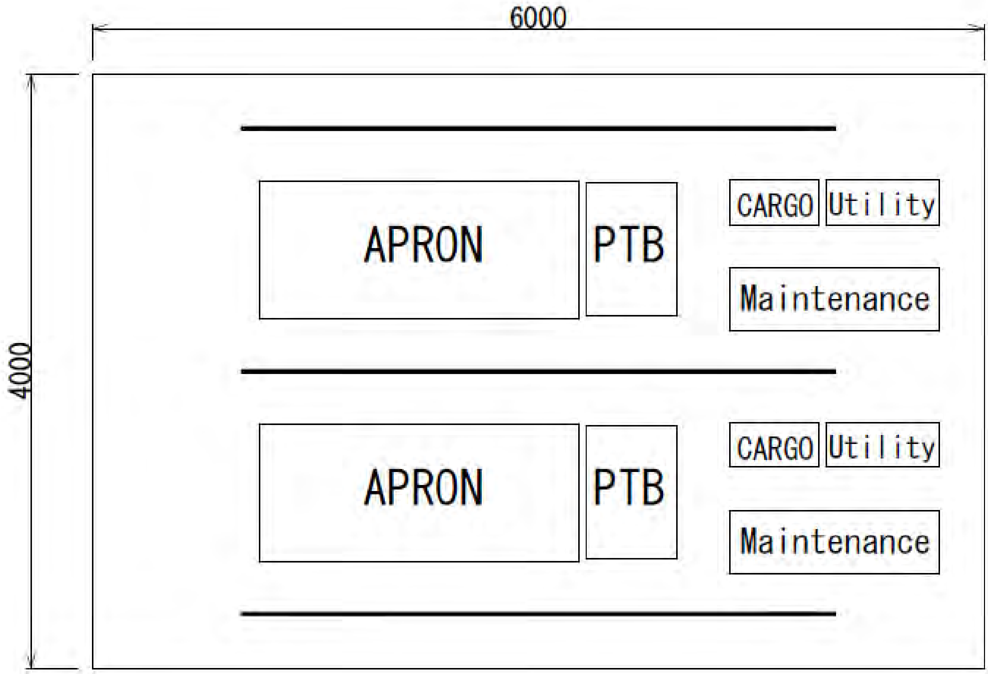
Figure 5.2.1-1 Imaginary Concept of NMIA Development on Opening Day

Ultimately the platform size will need to be approximately 6 km by 4 km (2400 ha) for development of widely spaced two sets of close parallel runways or three open parallel runways.

Figure 5.2.1-2 shows imaginary concepts of ultimate phase of NMIA development.



Ultimate Phase Option 1: Widely Spaced Two Sets of Close Parallel Runways



Ultimate Phase Option 2: Three Open Parallel Runways

Figure 5.2.1-2 Imaginary Concepts of Ultimate Phase of NMIA Development

5.2.2 Preliminary Facility Layout Plan for Opening Day

5.2.2.1 Runways

As described in the previous part of the report, two open parallel runways are required to meet the air traffic demand in 2030. Required runway length for the largest aircraft expected to operate in the airport is 3,780 m. Considering difficulty to extend the runway in future as an island airport, runway length of 4,000 m is planned.

As the result of the terminal area layout plan to place necessary facilities in between the runways, the planed runway separation is 1,635 m.

5.2.2.2 Taxiways

To maximize the capacity of the runways, full-length dual parallel taxiways with rapid exit taxiways are planned. However, layout of the rapid exit taxiways depends on aircraft mix in the airport, the location of the rapid exit taxiways should be analyzed in further study. Minimum separation distance for Code 4F aircraft in accordance with ICAO Annex 14 is used for planning the taxiways.

5.2.2.3 Aprons

According to IATA ADRM 9th Edition, it is recommended that 90 % of passengers can use the passenger boarding bridge in a terminal building. However, Low Cost Carriers prefer not to use passenger boarding bridges to minimize operation cost. According to the result of the passenger demand forecast, share of LCC for domestic passenger will be 85 % and that for international passenger 30 % in 2030 so that preference of LCC is considered on planning the apron layout. Another LCC's preference for apron is not to use power-in and push-back but power-in and power-out to park the aircraft in a stand. As compared to power-in and push-back, power-in and power-out requires more space but less operation cost and shorter turn-round time. Power-in and power-out apron is planned in remote parking space for LCC.

5.2.2.4 Passenger Terminal Building

There are several concepts of configuration of a passenger terminal building in an international airport. Those are:

- One large passenger terminal building for all airlines for domestic and international passengers. This concept is adopted in Bangkok Suvarnabhumi International Airport, Hong Kong International Airport, Seoul Incheon International Airport, etc.
- Separate passenger terminal buildings for Low Cost Carriers and Legacy Carriers. This concept is adopted in Kuala Lumpur International Airport, Singapore International Airport, Narita International Airport, etc.
- Separate passenger terminal buildings for domestic and international passengers. This

concept is adopted in Tokyo Haneda International Airport, Jakarta Soekarno Hatta International Airport, Manila Ninoy Aquino International Airport, etc.

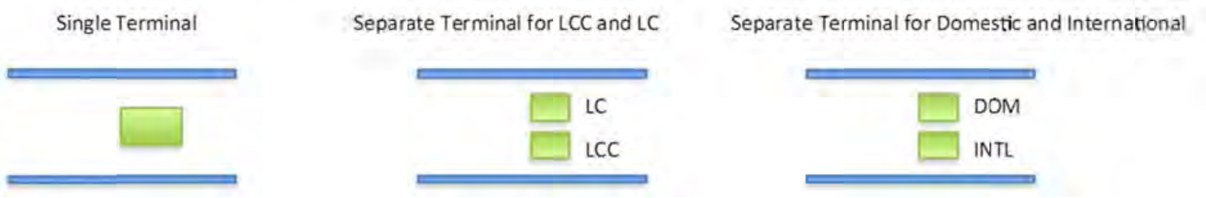


Figure 5.2.2-1 Passenger Terminal Building Concepts

According to interviews with Philippine Airlines and Cebu Pacific Air, their preference for the new airport is separate buildings by airlines but the building should be for both international and domestic flights. Reasons of the preference are aircraft usage by these airlines and many transit passengers in Manila. Major fleets of airlines in the Philippines are small jet and medium size jet and those aircraft are operated in both domestic and international routes. Layout of passenger terminal buildings in NAIA is difficult for such transit passengers because there are four passenger buildings in the airport and connection of these terminals is difficult because of lack of proper public transport system. A combined passenger building for international and domestic passenger will make transit passengers easy to transfer from international to domestic and vice versa.

Requirement for passenger building for LCC and that for Legacy Carriers (LC) is different. LCC terminal requires low maintenance and operational cost. Also, passenger-boarding bridge is not used in most of LCC terminal in the world while it is required in the passenger building for LC.

A single large passenger terminal has advantage if there is limitation of the area because the building can share common facilities for passenger operation. Also it is more flexible to reflect future change of airline market share. Construction and operation cost will also be lower than separate buildings because total area of the building is smaller than that of separate buildings. Transfer of passengers between international and domestic, and between different airlines is easier because it is not necessary for transit passengers to go out of the building.

One large building with long pier and linear satellite building is planned in the initial stage. Underground passenger mover is planned to connect the main building and the satellite building. However, terminal concept will be studied in further phase of the study in more details.

5.2.2.5 Airport Access

Airport access road and railway are planned. The access to the airport is from one side and loop road in the terminal area is planned. To serve large number of passengers, elevated double deck curbside road is planned. Ground transportation center with railway station and multi-story car park is planned inside of the loop road to minimize walking distance from the passenger building.

5.2.2.6 Other Facilities

Other airside and landside facilities are planned along the access road to consider easy accessibility. General aviation area is planned close to the ground transportation center so that user of the general aviation terminal can use railway station and public car parks. Catering area is planned between the passenger building and the general aviation area.

Maintenance hangar, fire-fighting training facility and run-up aprons are planned in the left hand side of the access road from Manila. In the right hand side, cargo terminal, utilities such as wastewater treatment plant, solid waste disposal plant, and electrical power / centralized heating and cooling plant, and fuel farm are planned. Expansion areas for these facilities are planned in vicinity of each facility.

Two fire stations are planned at both ends of the passenger terminal building to be able to access to any part of airport area within required access time at the initial opening of the airport.

Future expansion area for remote aircraft parking is planned at far end of the terminal area in initial stage to cope with sudden growth of air traffic and change of aircraft usage. At the initial stage of the airport operation, this area can be utilized for solar power station.

5.2.2.7 Facility Layout Plan

Figure below shows airfield layout plan in opening for reference purpose only.

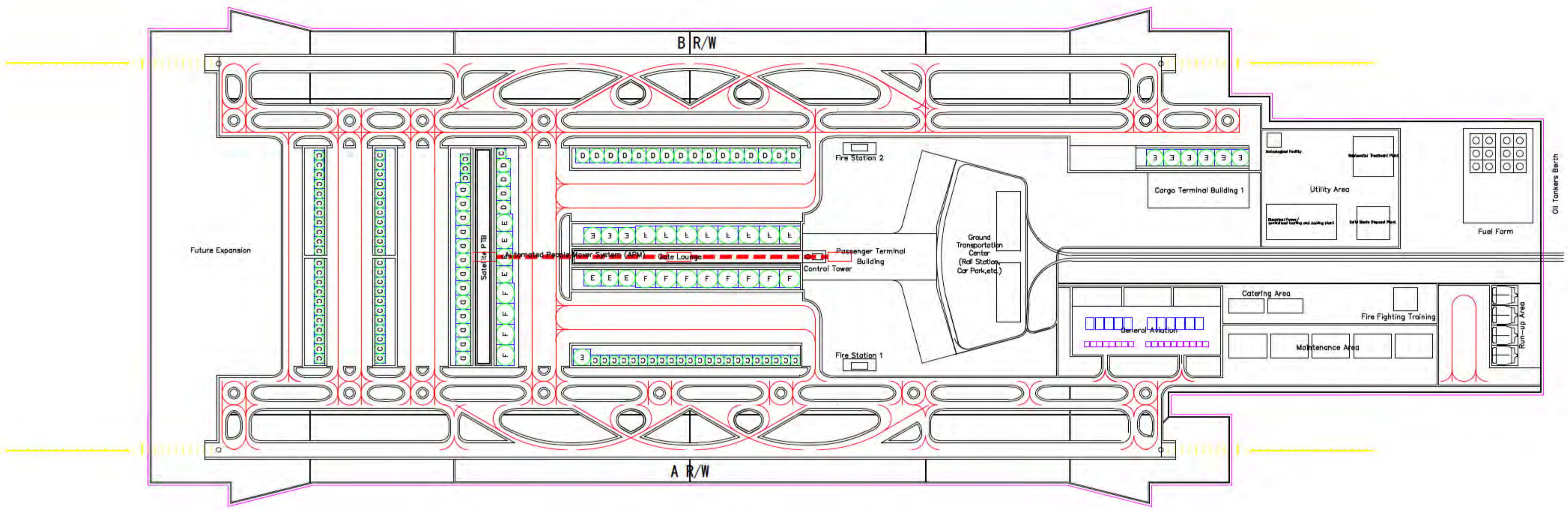


Figure 5.2.2-2 New Airport Layout on Opening Day for Reference

5.2.3 Preliminary Construction Cost of Airport Facilities for Opening Day

Preliminary construction cost estimate related to airport facility in short-term has been made and shown in Table 5.2.3-1.

Table 5.2.3-1 Preliminary Construction Cost Estimate Related to Airport Facility in Short-term

No.	Code	Name	Scale		Unit Price		2030	(mil. USD)
1.Civil works								
1) Site Preparaton								
010	SCL	Site Preparation Earth Work	1	sum			156.0	
030	SDR	Stormwater Drainage System	1	sum			71.0	
2) Underground Tunnel								
020	UUT	Underground Utility Tunnel	10,000	m	7,252	USD/m	72.5	
3) Pavement work								
040	CRD	Airport Circulation Road	30,000	m	2,825	USD/m	84.8	
050	RWY	Runway Pavement	596,200	m^2	102	USD/m^2	60.8	
060	TWY	Taxiway Pavement	2,061,500	m^2	102	USD/m^2	210.3	
060	APR	Apron Pavement	752,200	m^2	68	USD/m^2	51.1	
2. Building works								
1) Passenger Terminal Building								
100	PTB	Passenger Terminal Building	627,900	m^2	3,800	USD/m^2	2386.0	
2) Cargo Terminal Building								
110	CTB	Cargo Terminal	64,500	m^2	1,820	USD/m^2	117.4	
3) Other Buildings								
120	GRD	Gurad Houses	18	nos	217,000	USD/nos	3.9	
130	AFF	ARFF Stations	4,088	m^2	2,950	USD/m^2	12.1	
200	LMF	Landscape Maintenance Facility	4,700	m^2	2,400	USD/m^2	11.3	
210	AMF	Airport Maintenance Facility	5,100	m^2	1,240	USD/m^2	6.3	
220	AAF	Airport Authority Facility	17,600	m^2	1,810	USD/m^2	31.9	
230	CTW	Contol Tower & Operations Building	3,500	m^2	10,457	USD/m^2	36.6	
240	MET	Meteorological Facility	400	m^2	1,750	USD/m^2	0.7	
250	GSE	GSE Storage Area	17,400	m^2	50	USD/m^2	0.9	
260	CPK	Car Park Building	188,750	m^2	433	USD/m^2	81.7	
3. Utility Facilites								
1) Aircraft Fuel Hydrant System								
300	FHS	Aircraft Fuel Hydrant System	100	stands	4,492,500	USD/stands	449.3	
2) Electrical Works								
310	PSS	Electrical works (Exterior Power Supply System)	3,700,000	m^2	11.5	USD/m^2	42.6	
3) Mechanical works								
320	WSS	Exterior Water Supply System	3,700,000	m^2	1.96	USD/m^2	7.3	
330	HSS	Heat Supply System	3,700,000	m^2	32.0	USD/ha	117.6	
340	STP	Sewage Treatment Plant	630,000	m^3/day	29.2	USD/m^3	18.4	
350	TCM	Telecommunication System	870,000	m^2	12.5	USD/ha	10.9	
4. Air Navigation Facilites								
1) Air Navigation								
400	ILS	ILS	4	sets	1,970,000	USD/set	7.9	
410	VOR	DVOR/DME	1	set	1,410,000	USD/set	1.4	
420	ASR	PSR/MSSR	1	set	8,912,000	USD/set	8.9	
430	TRD	Multi Radar Tracking in Manila ACC	1	set	3,250,000	USD/set	3.3	
440	ASM	A-SMGCS with ADS-B	1	set	6,535,000	USD/set	6.5	
450	TRX	TX/RX	1	set	1,410,000	USD/set	1.4	
460	ATC	VCCS/REC/ATC Console, AFTN/AMHS Terminal, D-ATIS	1	set	2,122,000	USD/set	2.1	
470	AWS	AWOS (2-Runway)	1	set	1,878,000	USD/set	1.9	
2) Lighitings								
500	PAL	PALS+SFL	4	sets	1,353,000	USD/set	5.4	
510	PAP	PAPI	4	sets	856,400	USD/set	3.4	
520	RWL	Runway Lighting	2	sets	5,607,920	USD/set	11.2	
530	TWL	Taxiway Lighting	39	km	1,085,413	USD/km	42.3	
540	AFL	Apron Flood Lighting	146	sets	107,767	USD/set	15.7	
550	CTL	Control System & Other Lighting/Marking	1	set	47,643,188	USD/set	47.6	
Total							**4200.4**	

SECTION 6

INITIAL SCREENING OF ALTERNATIVE NEW AIRPORT SITES

SECTION 6: INITIAL SCREENING OF ALTERNATIVE NEW AIRPORT SITES

6.1 List of Alternative New Airport Sites

The Terms of Reference issued by JICA defines nine new airport sites as listed below (also see Figure 6.1-1):

i) Angat-Pandi-Bustos located to the north of Metro Manila in the Province of Bulacan in Region III;
ii) Obando, located to the north of Metro Manila in the Province of Bulacan in Region III;
iii) Northern Portion of Manila Bay;
iv) Central Portion of Manila Bay;
v) Sangley Point Option 1 located offshore Cavite Peninsular
vi) Sangley Point Option 2, located parallel to the existing runway at Sangley Point;
vii) San Nicholas Shoals located to the south of Sangley;
viii) Western side of Laguna de Bay; and
ix) Rizal-Talim Island located in the central part of Laguna de Bay

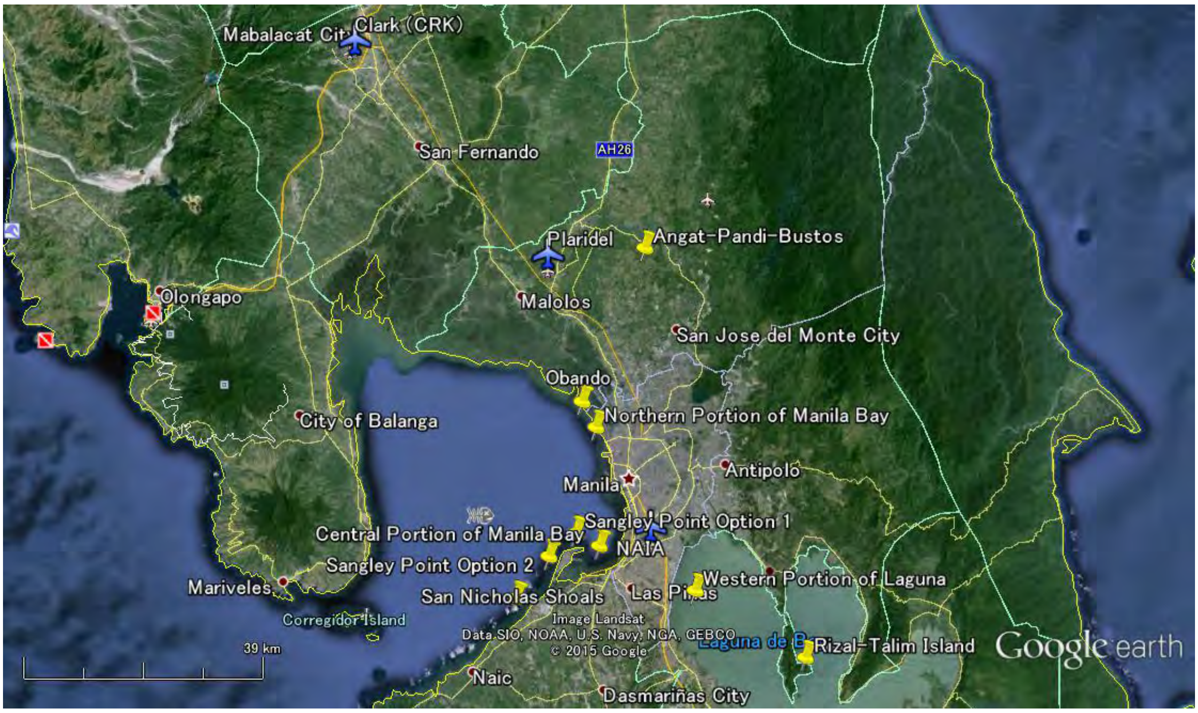


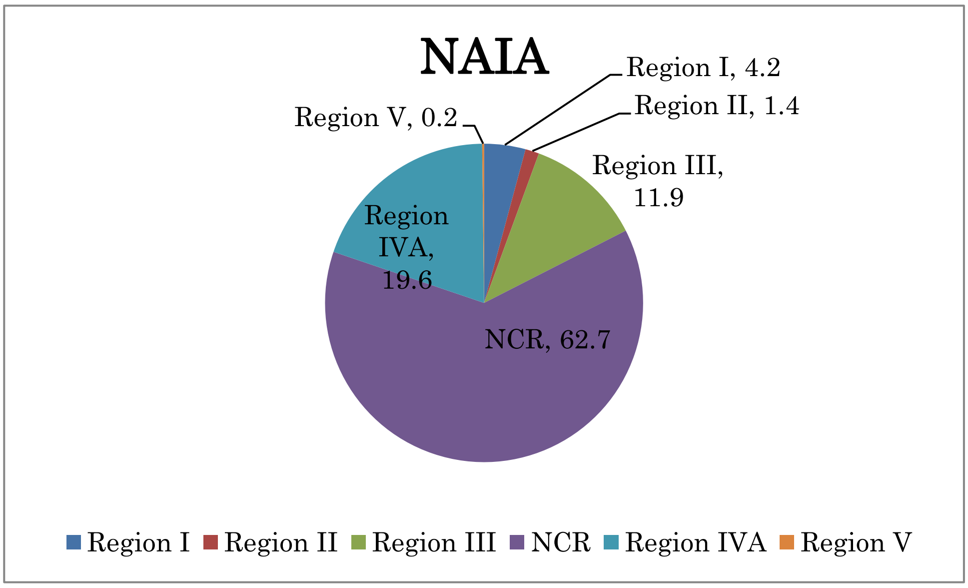
Figure 6.1-1 Location of Existing Airports and Alternative New Airport Sites

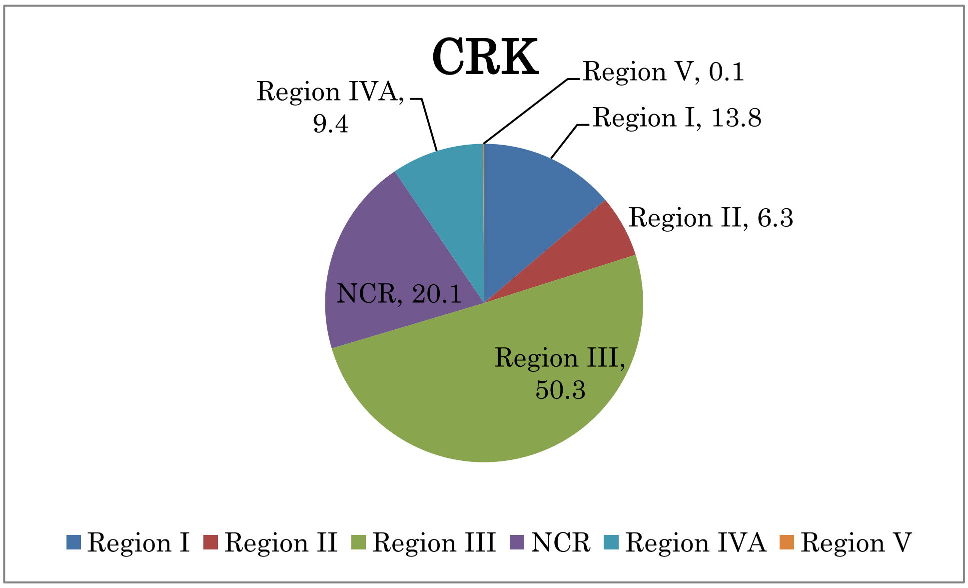
There are several sites which are not properly located to play the expected role of NMIA as the gateway international airport for NCR and Southern Luzon. These sites are to be eliminated through initial screening as discussed hereunder. Any sites which pass this initial screening have been subjected to further detail examination as discussed in Section 8.

6.2 Planning Consideration

6.2.1 Role Demarcation and Catchment Area

Figure 6.2-1 shows aerial distribution of NAIA and CRK air passengers. Majority of NAIA air passengers are to/from National Capital Region (NCR, 62.7%) followed by Region IVA (CALABARZON, 19.6%) located to the immediate south of NCR, and Region III (Central Luzon, 11.9%) while majority of CRK passengers are to/from Region III (50.3%) followed by NCR (20.1%). In order to serve the catchment area efficiently and comfortably, NMIA should be so located that it can offer fast, reliable and convenient access to the airport users to/from NCR and Southern Luzon.





Source: 2011 GCR Airport Study

Figure 6.2-1 Aerial Distribution of NAIA and CRK Passengers

Figure 6.2-2 shows the existing and future spatial development structure of GCR proposed under the Roadmap Study. In addition to the existing Metro Manila, development of new Regional Centers at Metro Clark to the north and Metro Batangas to the south, as well as Sub-Regional Centers of Malolos and Tarlac to the north and Sta. Cruz and Lucena to the of south, of Metro Manila respectively has been proposed. Within this future spatial structure, NMIA is to serve Metro Manila and Southern Regional and Sub-regional centers while CRK is best situated to serve Metro Clark and its surroundings, thus the twin-airport system of the Greater Capital Region would be able to jointly and efficiently accommodate the expected future large volume of the air traffic demand.

Therefore, NMIA should be so located that it would offer fast and convenient airport access to the prospective airport users to/from NCR and Southern Luzon, without overlapping with the catchment area of CRK.

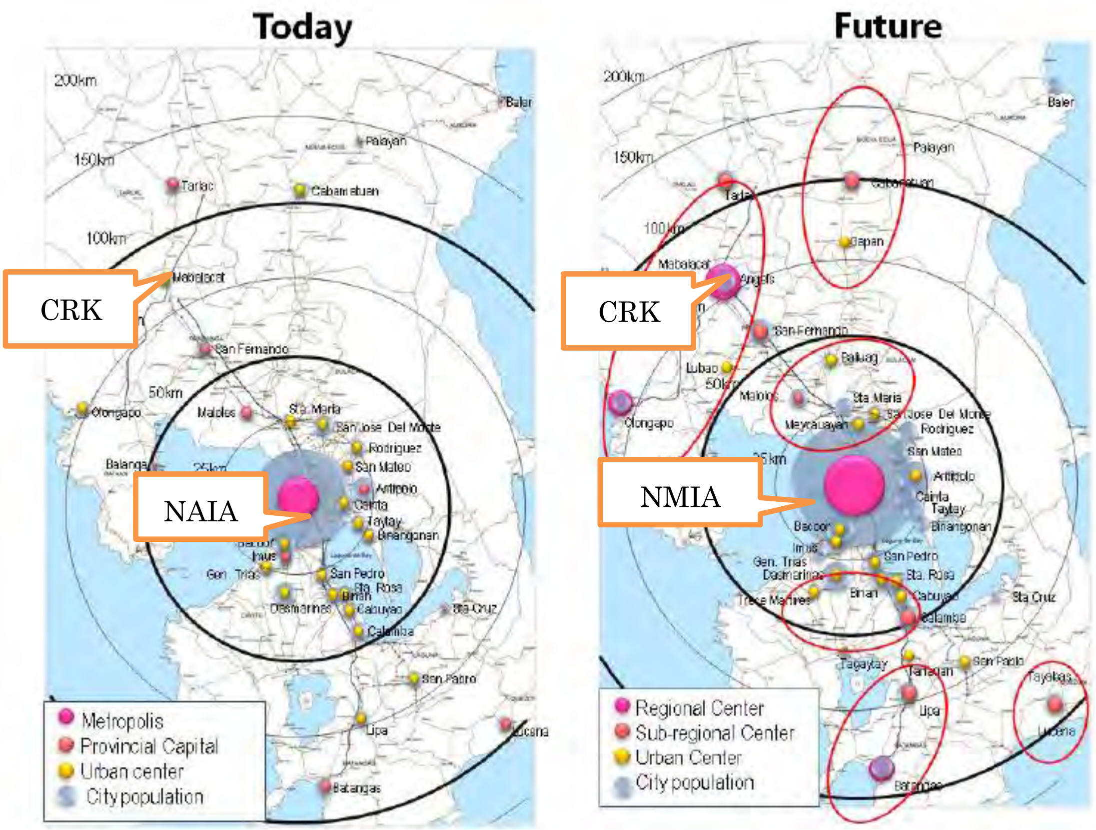


Figure 6.2-2 Proposed Future Spatial Structure of GCR (Source: Roadmap Study)

6.2.2 Urbanization

While CRK has potential to serve for the north of the NCR as well as Central Luzon (Region III) and grow as the regional center as shown in Figure 6.2-2, currently no airport is operating for the public in Calabarzon (Region IV-A). However, north part of Region IV-A such as Cavite and Laguna Province already started to accommodate the overspill of NCR's expansion in terms of population and facilities. For example, many people commute from Cavite and Laguna Province to NCR by major arterial such as CAVITEX and SLEX as well as Phillippe National Railway (PNR). In addition, Cavite-Laguna Expressway (CALAX), Laguna-Lakeshore Expressway Dike (LLED) and LRT-Line 1 extension are under implementation to enhance the accessibility among NCR, Cavite and Laguna Province. With regards to the educational facilities, many high schools and universities start to relocate or establish their branch campuses due to the limited land availability in NCR. In terms of industrial facilities, majority of Special Economic Zones (PEZAs) are located in NCR, Cavite and Laguna Province. Judging from these facts that these provinces already started to serve as the extended capital region as a part of Mega Manila, development of NMIA in these areas would be highly recommended to take advantage of the integrated urban development opportunities and to offer the maximum benefits for the local communities. However, since Cavite and Laguna Provinces have already been developed as shown in Figure 6.2-3 and the land for the development of an international gateway airport with size of approximately 1800 ha associated with obstacle-free airspace is unlikely to be available, reclamation of either Manila Bay or Laguna de Bay needs to be considered. Once the reclamation of NMIA were integrated with the consolidated reclamation for the holistic urban development, it would be a catalyst for the urban renewal of the adjacent LGUs as well as Region IV-A.

Figure 6.2-3 Satellite Image of NCR and Surrounding Areas (Source: Roadmap Study

6.2.3 Environmentally Protected Land/Water near Alternative New Airport Sites

Figure 6.2-4 shows locations of the environmentally protected land and sea located near the alternative new airport sites.

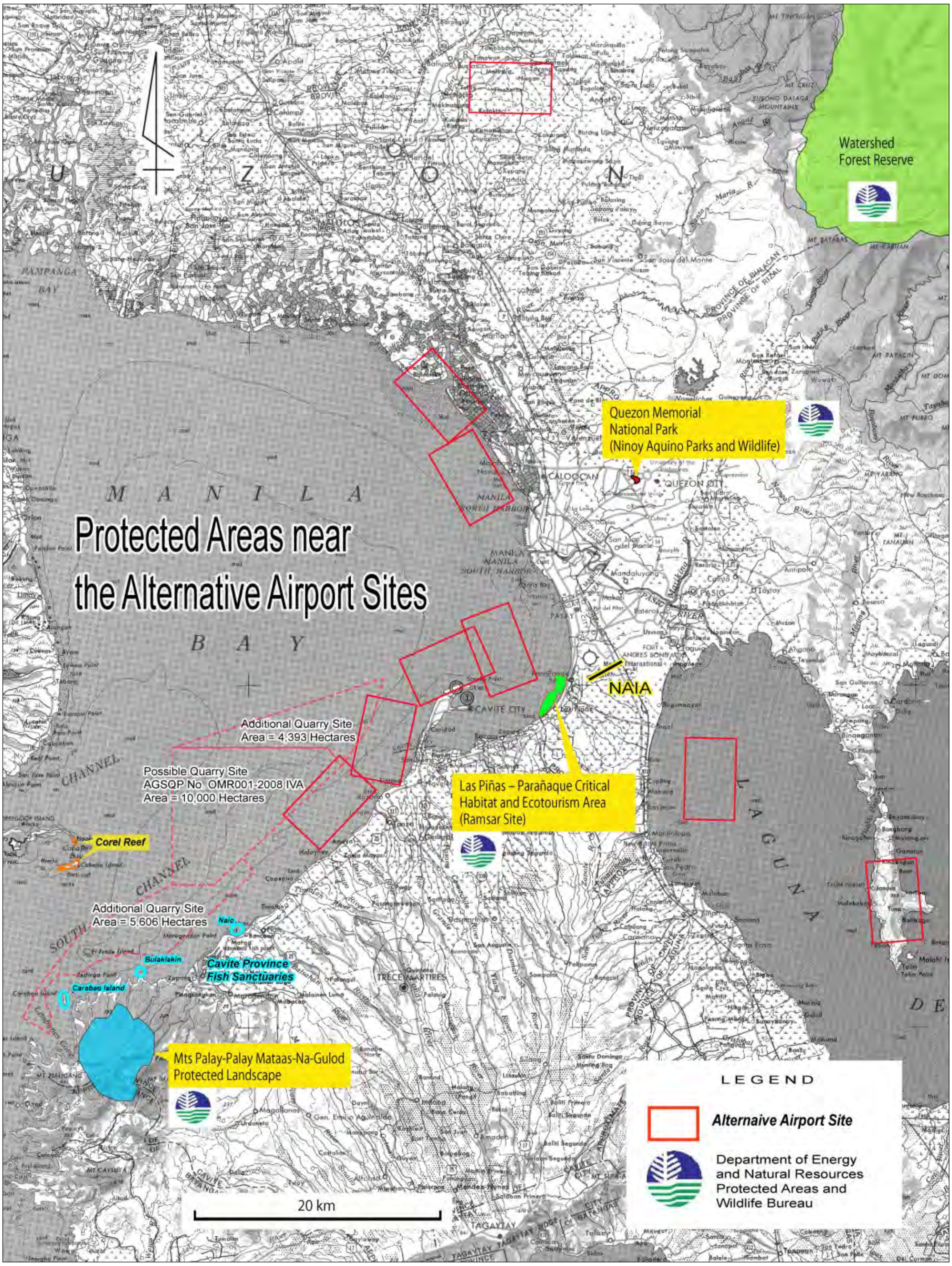


Figure 6.2-4 Locations of Environmentally Protected Land and Sea near Alternative New Airport Sites
(Source: Department of Environment and Natural Resources: DENR)

There is the Las Pinas – Paranaque Critical Habitat and Ecotourism Area (LPPCHEA).

According to DENR NCR, LPPCHEA is located on the western side of the Aguinaldo Highway (Coastal Road) and is bounded on the north by the Paranaque River and on the South by the Las Pinas River. It covers an area of 175 hectares consisting of mangroves, mudflats and diverse avifauna. It is the first Critical Habitat established in the country. By virtue of Presidential Proclamation No. 1412 dated April 22, 2007 LPPCHEA was established. On January 31, 2008, it was amended by Presidential Proclamation 1412-A which directs the DENR to convene and chair a Manila Bay Critical Management Council.

Its declaratioin as a critical habitat was based on the findings that it harbors adiversive species of birds both migratory and residents. At least 5,000 heads of birds were counted in 2004. Most significanct is the presence in the area of at least 1% of the population of Greenshank 10% of the population of Black-winged Stilt within the East Asian – Aistralian flyway. Therefore, when planning a new airport near LPPCHEA, a risk of bird strike should be taken into account.

Figure 6.2-5 East Asia – Australian Flyway
(Source: IEMP Avifauna Component of MBEMP)

There is no other protected land/sea near the alternative new airport sites.

6.2.4 Conflict with Port Activities in Manila Bay

There are three major commercial ports in Manila Bay managed by the Philippine Port Authority (PPA); North Harbor, South Harbor and Manila International Container Terminal (MICT). These three ports accepted more than 11,400 ship calls accommodating about 26 % of the total cargo handled in the Philippines in terms of the gross registered tonnage in 2013. In addition to the three commercial ports, there is Navotas Fish Port under the Philippine Fisheries Development Authority (PFDA), which is the premier fish center of the Philippines and one of the largest in Asia. About 800 tons of fish are landed and additional 50 tons are brought in by land. The roads in surrounding area of these ports are already congested.

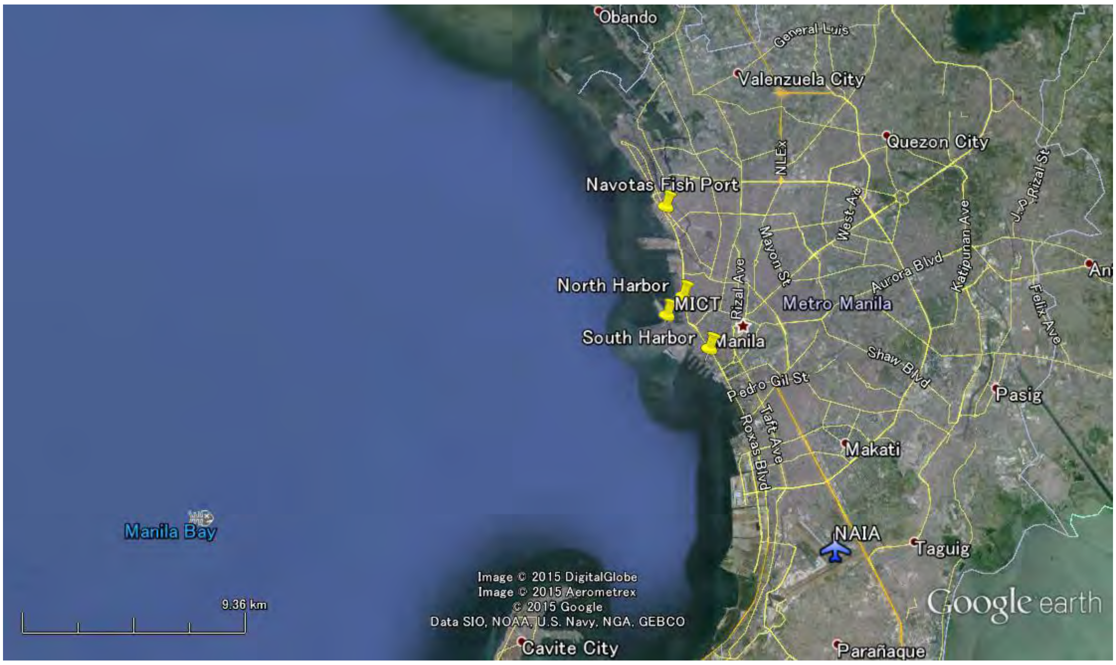


Figure 6.2-6 Location of Commercial Ports and Fish Port in Manila Bay

Table 6.2-1 Summary Shipping Statistics at PPA Ports

Port District	2013					
	SHIPCALLS			GROSS REGISTERED TONNAGE		
	Total	Domestic	Foreign	Total	Domestic	Foreign
PDO MANILA/NORLUZ	18,931	13,748	5,183	114,195,361	26,739,465	87,455,896
Manila - N. Harbor	4,855	4,387	468	20,620,897	16,001,619	4,619,278
Manila - S. Harbor	4,702	2,827	1,875	37,040,620	4,578,104	32,462,516
- M.I.C.T.	1,877	92	1,785	34,137,114	883,384	33,253,730
Subtotal	11,434	7,306	4,128	91,798,631	21,463,107	70,335,524
(Share %)	3.2%	2.1%	39.0%	26.1%	11.6%	41.9%
Others	7,497	6,442	1,055	22,396,730	5,276,358	17,120,372
PDO SOUTHERN LUZO	94,247	92,561	1,686	76,156,232	49,497,565	26,658,667
PDO VISAYAS	140,748	140,091	657	67,052,171	59,805,884	7,246,287
PDO NORTHERN MIND	55,748	54,720	1,028	55,134,708	31,721,117	23,413,591
PDO SOUTHERN MIND.	46,843	44,825	2,018	39,713,261	16,527,190	23,186,071
TOTAL	356,517	345,945	10,572	352,251,733	184,291,221	167,960,512

Data source: Philippines Port Authority Website

6.2.5 Ground Elevation

NCR is located in Manila-Calabarzon plains, and it has open air space to the north (toward Calabarzon), to the west (Manila Bay) and to the east (Laguna de Bay). However, NCR is surrounded by several mountain ranges such as Mr. Mariveles (1388 m) to the west in Bataan, Sierra Madre Range (1800-m class) to the northeast to east and Tagaytay (average 600m) to the south. NMIA should be so located that such mountain ranges shall not obstruct safe and efficient aircraft operations.

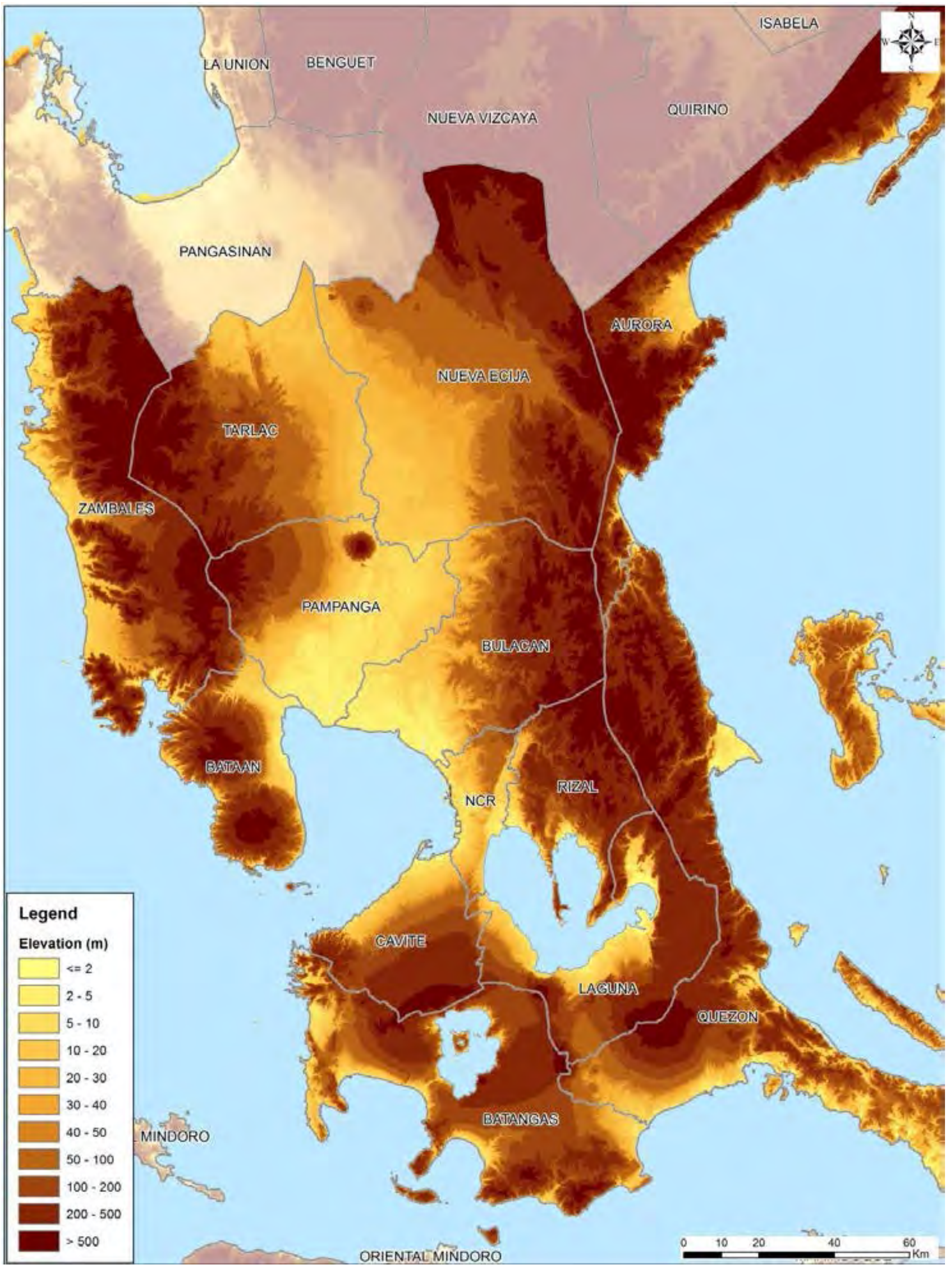


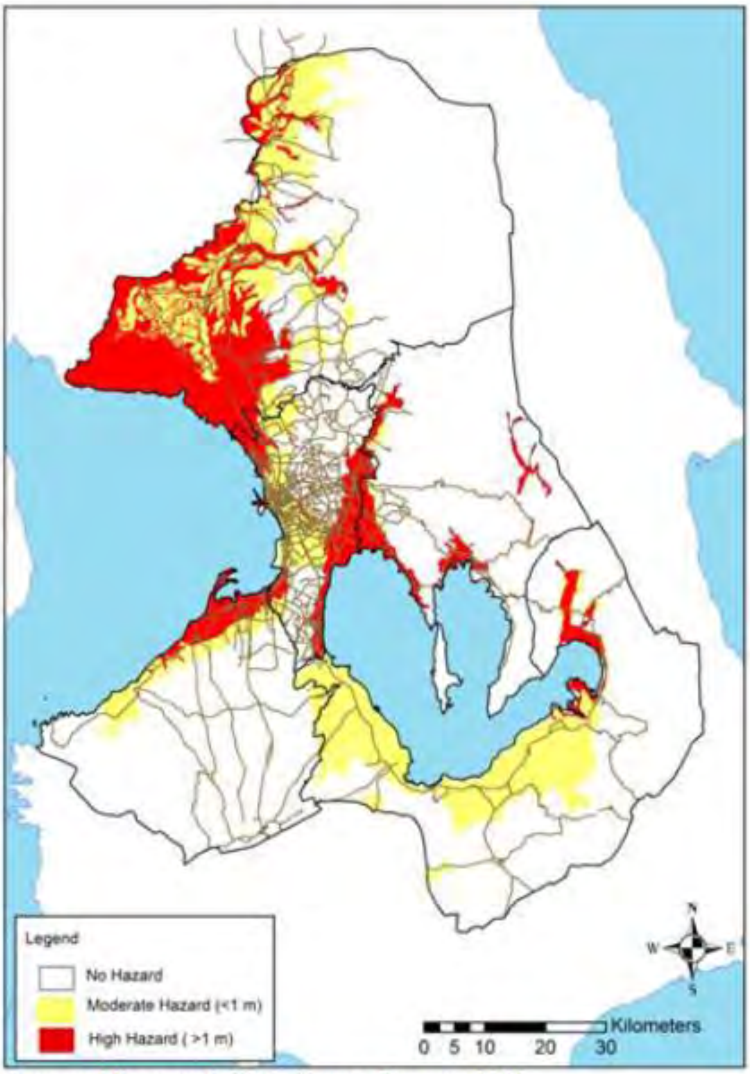
Figure 6.2-7 Elevations of Central and South Luzon (Source: Roadmap Study)

6.2.6 Flood Hazard

NCR is located mainly on low lying area and is prone to flooding problem. The red colored portions in Figure 6.2-8 are high flooding risk areas, such as:

- ✓ Manila Bay coastal areas in part in Bulacan (northeastern area) and Cavite (southwest); and
- ✓ Laguna de Bay northern coastal areas in NCR and Rizal.

Although NMIA itself can be built on an elevated land, severe flooding in the airport surrounding area, in particular the wide flood prone area located in Bulacan and part of NCR, would give rise to a significant operational difficulty in case of flooding.



Source: Mines and Geosciences Bureau, 2012.

Figure 6.2-8 Flood Prone Areas around NCR (Source: Roadmap Study)

6.2.7 Wind Speed and Direction

Wind rose analysis data at NAIA, Sangley and Port Area of Manila Point have been purchased from PAGASA. The records cover a period of 1981-2010. Wind roses data and figures are shown in Tables 6.2-2 through 6.2-4 as well as Figures 6.2-9 through 6.2-11. Prevailing wind directions vary at three locations. Prevailing wind directions at NAIA seems to be almost from the east to the west while Port Area data showed from the southwest to the north/northeast. At Sangley the prevailing wind direction is ESE. The wind speed is generally low at three locations as occurrences of wind speed exceeding 8 m/s were 0.2 to 0.4 % only. In the case of Sangley however, the occurrence of wind speed 5 to 8 m/s was 7.9 %, of which 3.5 % point was ESE, requiring attention to be paid.

With regard to the crosswind component, ICAO Annex 14 recommended that landing or take-off of aircraft is, in normal circumstances, precluded when the crosswind component exceeds:

- ✓ 37 km/h (10.28 m/s or 20 knots) in the case of aircraft whose reference field length is 1500 m or over, except that when poor runway braking actions owing to an insufficient longitudinal coefficient of friction is expected with some frequency a crosswind component not exceeding 24 km/h (6.67 m/s or 13 knots) should be assumed;
- ✓ 24 km/h (6.67 m/s or 13 knots) in the case of aircraft whose reference field length is 1200 m or up to but not including 1500 m; and
- ✓ 19 km/h (5.27 m/s or 10 knots) in the case of aircraft whose reference field length is less than 1200 m.

Therefore as far as any jet aircraft requiring 1500 m or more runway length is concerned, the runway may be directed to any orientation to achieve sufficient runway usability. Attention needs to be paid when considering turbo prop aircraft including the general aviation.

Table 6.2-2 Occurrences of Wind Speed and Direction at NAIA (%): 1981-2010

Speed (m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S
Calm	-	-	-	-	-	-	-	-	-
1-4	1.3	1.4	1.0	2.4	22.6	20.6	5.1	1.2	1.1
5-8	0.1	0.0	0.1	0.0	4.6	1.7	0.3	0.0	0.1
9-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.4	1.4	1.1	2.4	27.2	22.3	5.4	1.2	1.2

Speed (m/s)	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	-	-	-	-	-	-	-	0.1
1-4	1.3	2.6	6.4	17.5	2.9	1.0	0.6	88.9
5-8	0.0	0.4	1.4	1.7	0.1	0.0	0.1	10.8
9-12	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.3	3.0	7.9	19.3	3.0	1.0	0.7	100.0

Data Source: PAGASA

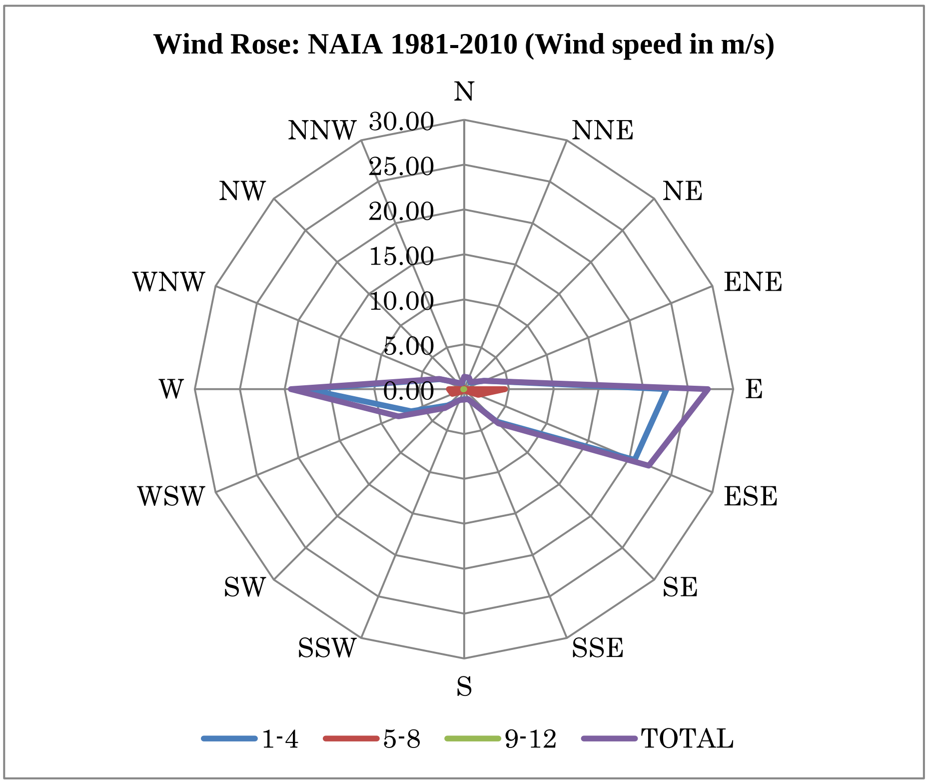


Figure 6.2-9 Wind Rose Analysis: NAIA from 1981 to 2010 (Data Source: PAGASA)

Table 6.2-3 Occurrences of Wind Speed and Direction at Port Area: 1981-2010

Speed (m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S
Calm	-	-	-	-	-	-	-	-	-
1-4	9.5	4.1	5.2	1.9	7.6	3.8	6.8	1.9	5.0
5-8	0.3	0.2	0.0	0.0	0.2	0.2	0.2	0.2	0.6
9-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	9.8	4.3	5.2	1.9	7.8	4.0	7.0	2.1	5.6

Speed (m/s)	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	-	-	-	-	-	-	-	0.1
1-4	4.9	15.0	8.0	10.1	2.6	4.8	1.8	93.0
5-8	0.9	1.9	0.5	0.9	0.1	0.0	0.1	6.5
9-12	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.4
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	5.8	17.0	8.5	11.1	2.7	4.8	1.9	100.0

Data Source: PAGASA

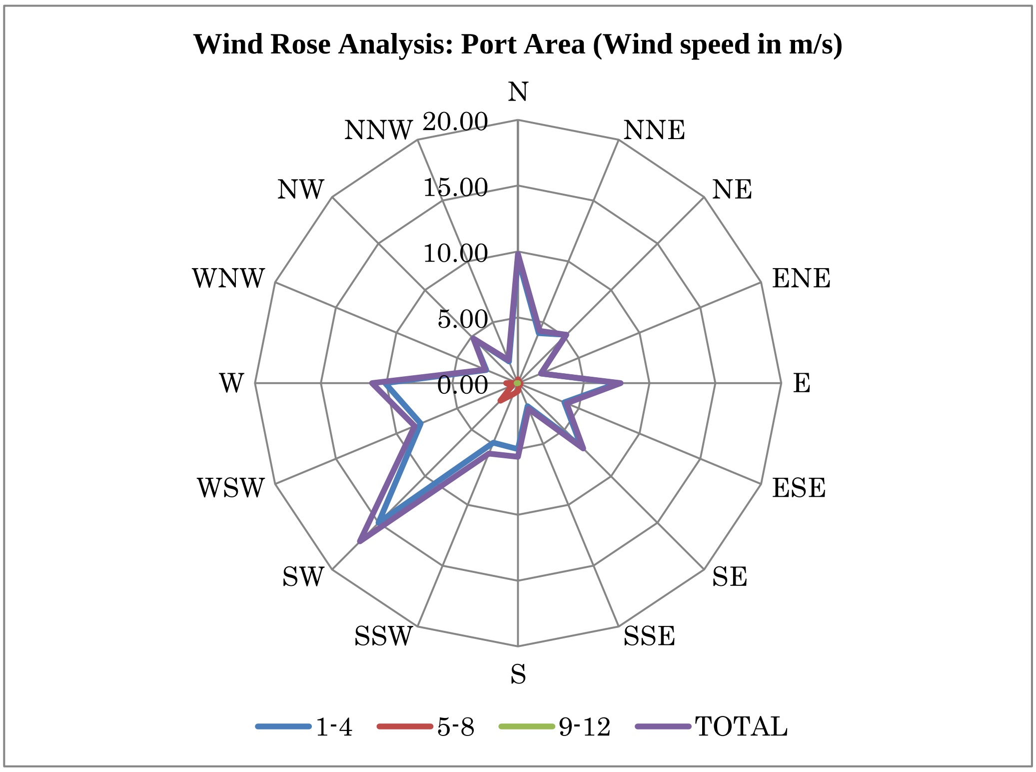


Figure 6.2-10 Wind Rose Analysis: Port Area from 1981 to 2010 (Data Source: PAGASA)

Table 6.2-4 Occurrences of Wind Speed and Direction at Sangley: 1981-2010

Speed (m/s)	N	NNE	NE	ENE	E	ESE	SE	SSE	S
Calm	-	-	-	-	-	-	-	-	-
1-4	7.8	2.8	1.2	1.0	9.2	28.4	4.6	2.9	3.8
5-8	0.4	0.2	0.1	0.0	0.7	3.5	0.4	0.2	0.1
9-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	8.2	3.0	1.3	1.0	9.9	31.9	5.0	3.1	3.9

Speed (m/s)	SSW	SW	WSW	W	WNW	NW	NNW	Total
Calm	-	-	-	-	-	-	-	0.0
1-4	1.4	6.8	5.2	6.8	1.3	4.9	3.7	91.8
5-8	0.1	0.6	0.4	0.8	0.1	0.1	0.2	7.9
9-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
13-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
>16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.5	7.4	5.6	7.6	1.4	5.0	3.9	100.0

Data Source: PAGASA

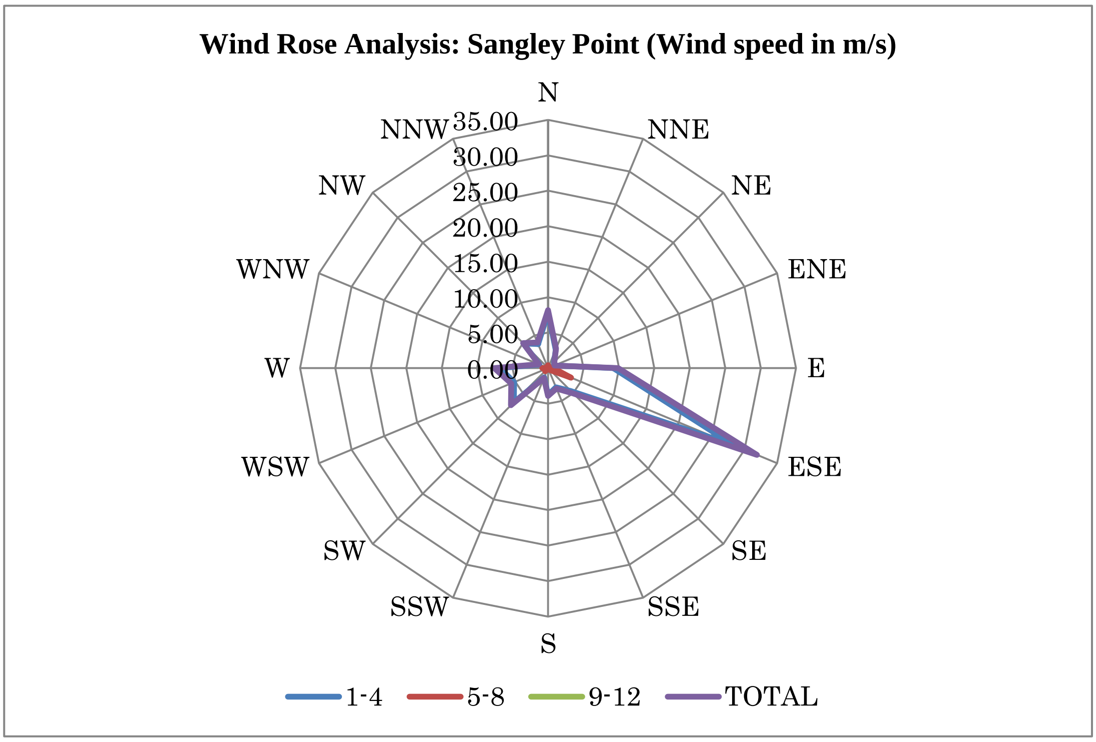


Figure 6.2-11 Wind Rose Analysis: Sangley from 1981 to 2010 (Data Source: PAGASA)

6.2.8 Related Major Projects

1) Laguna Lakeshore Expressway Dike Project (LLED)

According to DPWH website, Laguna Lakeshore Expressway Dike Project (LLED) is envisioned to provide a high standard highway cum dike that will facilitate traffic flow and mitigate flooding in the western coastal communities along Laguna Lake, from Bicutan/Taguig in Metro Manila through Calamba to Los Baños in Laguna. The proposed alignment runs 500 meters away but following the shoreline of the Laguna Lake.

The Project has the following components:

A. Expressway Dike, Taguig–Los Baños, 47 km, with two (2) sections as follows:
   1. Bicutan–Calamba
   2. Calamba–Los Baños
   c. 6–lane tollway with 8 interchanges and access roads
   d. Dike designed for 100–year flood, and 16 floodgates/pumping stations designed for 60–year flood.

B. Reclamation, 700 hectares, Taguig–Muntinlupa
   . 7 islands, about 450–500m wide and 15.6km long
   a. With horizontal development (roads, drainage, open spaces)
   b. 100–150m channel between lakeshore and reclamation

The expressway is intended to relieve the heavily travelled Bicutan–Calamba corridor (SLEX and Manila South Road) and to serve as an alternate to the congested road of the National Highway from Calamba to Los Baños. The proposed expressway will be used to integrate a flood control system to protect the flood prone areas located along the shore land of Laguna Lake. Main economic benefits include savings in vehicle operating costs, savings in passenger time, reduction in flood damages, increase in land productivity in existing communities due to flood protection, and increase in land productivity (value added) in the reclamation area.

Invitation to prequalify to Bid was published in August 2014, followed by Investor's Forum in October 2014, Prequalification Conference in December 2014 and Prequalification Evaluation in March 2015. Currently this project is under bidding process and the deadline for submission of the bids is set in July 2015.

Figure 6.2-12 Location Map of Laguna Lakeshore Expressway Dike Project (Source: DPWH Website)

2) Manila Bay Integrated Flood Control, Coastal Defense and Expressway Project

The Project's main purpose is to protect the Manila Bay coastline against flooding from the sea, by means of a city flood barrier and coastal sea barrier, and provide an attractive urban waterfront development with space for new commercial activities. The coastal sea barrier also functions as an expressway that cuts the travel time between Bataan and the National Capital Region (NCR). Along the barrier, the Project also offers reclaimed land for urban and economic development. In between the reclaimed land and the present shoreline are mangrove forests that help develop the ecological value of Manila Bay. The Project can be sorted into two subprojects: the City Flood Proofing and the Coastal Sea Barrier and Expressway.

This is an unsolicited proposal developed by the New San Jose Builders, Inc. (NSJBI) in accordance with the stipulations set out in Republic Act (RA) 6957 as amended by RA 7718 (BOT Law) and its Revised Implementing Rules and Regulations (BOT Law IRR). The project is intended to:

- Improve adaptive capacity against city coastal flooding of northwest Metro Manila;
- Improve adaptive capacity against typhoon waves of the coastal zone in the northern part of Manila Bay;

- Increase efficiency of logistics;
- Provide space to accommodate urban growth;
- Provide alternative space for industrial development; and
- Enhance the littoral ecological system of Manila Bay.

Figure 6.2-13 Manila Bay Integrated Flood Control, Coastal Defense and Expressway Project (Source: DPWH)

3) Las Pinas – Paranaque Coastal Bay Project

According to the website of Philippine Reclamation Authority (PRA), Las Pinas – Paranaque Coastal Bay Project is one of the reclamation projects in the pipeline. It summarizes the project as follows:

"The Las Pinas – Paranaque Coastal Bay Project involves the reclamation of shallow portions of Manila Bay in the southwest of Manila. Las Pinas City has 431.71 hectares under its jurisdiction while Paranaque City has 203.43 hectares. This 635.14 hectare project is intended to be a government center, residential, industrial, educational and commercial zone. It is bounded by Asia World Properties in the North and the Municipality of Bacoor, Cavite in the north." (PRA website)

According to several newspaper articles, it seems that the project would involve reclamation of an area to the immediate north of the Las Pinas – Paranaque Critical Habitat and Ecotourism Area (LPPCHEA).

Figure 6.2-14 Location of LPPCHEA

It is reported that ECC was already issued by DENR for the project. However, according to a Philippine Star article dated February 17, 2014, one of the conditions set by the DENR prior to the project's implementation is for its proponents to seek the approval of the Manila Bay Critical Habitat Management Council and the Biodiversity Management Bureau, and if the proponents do not fulfill the condition they can be penalized for that and the ECC can be canceled or suspended eventually". No more information thereafter is available. In case this project were to be realized, a new reclaimed land for urban development including high rise buildings would be developed to the immediate vicinity of the Central Portion of Manila Bay site.

6.3 Description of the Alternative Sites

Summary description of the alternative sites is presented hereunder.

1) Angat-Pandi-Bustos

The Angat-Pandi-Bustos site is located approximately 53 km to the north of Manila on the southern bank of the Angat River and stretching through the Municipalities of Angat, Pandi and Bustos in the Province of Bulacan. Combined population of Angat, Pandi and Bustos in 2010 was about 184 thousand. The site is easily accessible from the NLEx. Majority of the site is covered with irrigated rice fields. There are also several fish ponds. Water for irrigation is supplied by the Angat Dam through a main irrigation canal and its tributaries. The dam also supplies drinking water to the Metro Manila area. Adjacent to this dam is the West Valley Fault which is a major earthquake fault in Metro Manila and Central Luzon. There are scattered villages including schools. The average elevation of the site is approximately 20 m, ranging from 10 to 30 m. There exists no designated area under the National Integrated Protected Area System (NIPAS).

Figure 6.3-1 Surrounding Condition of Angat-Pandi-Bustos Site

Obstacle-free airspace would be available if the runway is oriented to 03/21 and more than 95% of the wind coverage would be achievable, according to the DOTC-commissioned report carried out by F.F. Cruz & Co. Inc. Plaridel Airport (runway 900m x 30m), which is mainly utilized by general aviation aircraft, is located approximately 10km to the west of the site. If a new airport is to be constructed at this site, the eastern airspace of Plaridel Airport would not be usable for Plaridel and traffic patterns would be provided only to the western side. Figure 6.3-2 shows the approximate location and runway orientation of the Angat-Pandi-Bustos Site (2011 GCR Study). As this site does not require significant volume of reclamation, the cost for construction of a platform for NMIA would be less than the other alternative sites which require reclamation of Manila Bay or Laguna Lake, even taking into account of the compensation for resettlement and loss of livelihood for the PAP. However, CRK already exists in this catchment area. Development of NMIA in this site would probably formulate three-airport system for GCR, consisting of the existing CRK in Pampanga, NMIA in Bulacan as well as the existing NAIA in Metro Manila. Because of the shorter distance of NMIA to Metro Manila than CRK, the demand generated in Northern Metro Manila would choose NMIA rather than CRK while majority of the demand in Metro Manila and Southern Luzon would continue to use the existing NAIA. NMIA would compete with the existing CRK to attract any demand from/to northern Metro Manila and Region III, thereby decreasing potential demand of CRK and making the investment inefficient. The existing NAIA would remain the most conveniently located gateway international airport in Metro Manila, and the severe capacity constraint issue of NAIA would not properly be addressed.

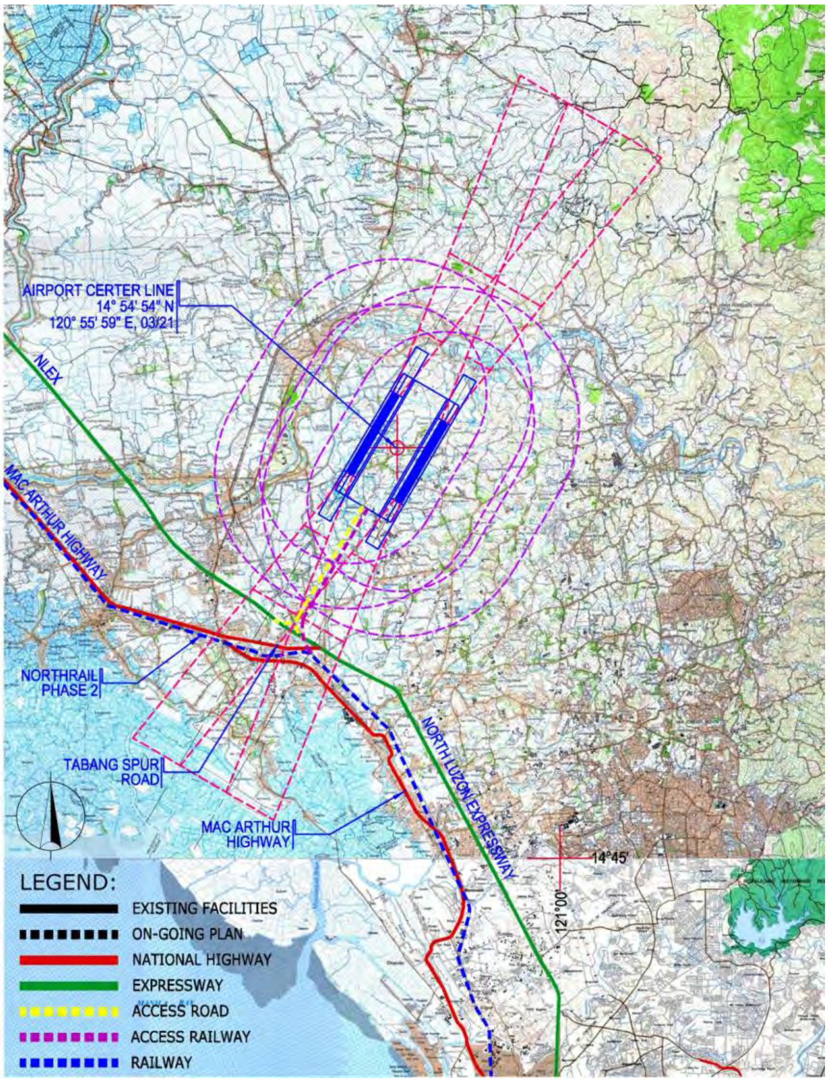


Figure 6.3-2 Approximate Location and Runway Orientation of the Angat-Pandi-Bustos Site
(Source: 2011 GCR Airport Study)

2) Obando

The Obando site is located approximately 25 km to the north-northwest of Manila on the coastal area of Manila Bay in the Province of Bulacan in Region III. To the immediate east of the site, along J.P. Rizal Street, is a densely populated area. To the east of J. P. Rizal Street consists of wet land and marine ponds. The site consists of existing fish ponds and Manila Bay where reclamation would be required for airport development. The water depth is up to 10m. NLEx runs approximately 10 km northeast of the site but currently access to NLEx is not easy as only narrow and congested roads are available as shown in Figure 6.3-3. The coastal zone in this site is characterized as natural spawning ground for fish at the same time with certain areas devoted to fishpond operations. Towards the inland side, agricultural production is main use of the land (Manila Bay Coastal Strategy, PEMSEA, 2001). This site is located at the estuary of Meycauayan River. The area is low and flat made up of the sediments produced by the Meycauayan River. Development of NMIA in this site could cause significant obstruction against discharge from the river in case of heavy rain, resulting in a high risk of flooding. There is a large informal settlers' community at the estuary of Meycauayan River, estimated to be approximately 6,000 (1,300 households). Almost all of the settlers are depending on fishery in that area. Development of NMIA in this area could necessitate their relocation. There are Navotas Fishing Port, North Harbor, MICT and South Harbor to the immediate south of this site, and surrounding roads are heavily congested by the port-related vehicle traffic.

Figure 6.3-3 Poor Connection between Obando Site and NLEX (Google data)

According to the geotechnical investigation carried out by F.F. Cruz & Co. Inc. as part of the DOTC-commissioned study, the majority of the sub-surface soil consisted of soft and highly compressible clays, most likely carried with flow discharges from the river. Figure 6.3-4 shows the approximate location and runway orientation of the Obando Site (2011 GCR Study).

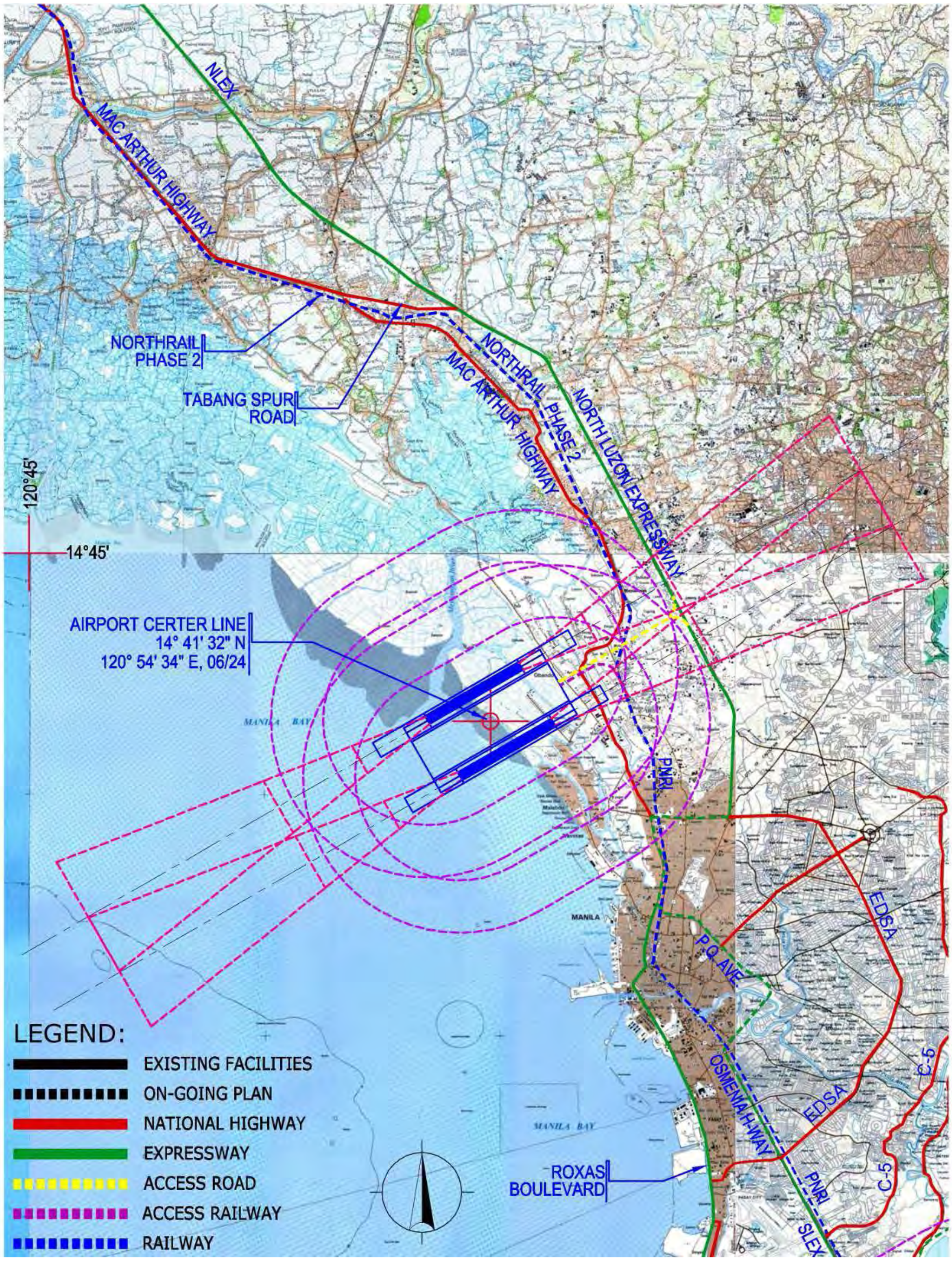


Figure 6.3-4 Approximate Location and Runway Orientation of the Obando Site
(Source: 2011 GCR Airport Study)

3) Northern Portion of Manila Bay

The Northern Portion of Manila Bay is along the Navotas City situated near the boundary between NCR and Bulacan to the immediate south of the Obando site. Because this site is very close to the Obando site, the poor soil condition mentioned with respect to the Obando site is likely to be applicable to this site. This option requires reclamation for construction of airport platform. The water depth is up to 10m.

Figure 6.3-5 Location of Northern Portion of Manila Bay

The coastal area is densely occupied by the residents. There are more than 50 fish cages in the site. The existing roads are narrow and heavily congested by the trucks to/from the Fish Port and the commercial ports of North Harbor, South Harbor and MICT. To the south of this site is the Navotas Fish Port. Development of NMIA at this site including the access roads and rail would cause relocation of significant number of the affected people and loss of their livelihood as well as significant traffic congestion attributable to the airport access vehicles.

4) Sangley Point Option 1

The Sangley Point Option 1 is situated almost parallel to the Cavite Peninsular, surrounded by the City of Cavite as well as the municipalities of Noveleta and Rosario. Brief description of this site is provided below taken from the Roadmap Study.

"The nearest site at the southern portion of Manila Bay is the Sangley Point Air Base located just at the northern end of Cavite Peninsular. A number of proposals have been made in the past for this site. The latest one was prepared by All-Asia Resources and Reclamation Corporation (ARRC) and submitted to the Philippines Reclamation Authority (PRA) in January 2013. The proposal included development of an international gateway airport and seaport. In 2007, PRA was directed by former President Gloria Macapagal-Arroyo to convert Sangley Point in Cavite City into an international logistics hub through a reclamation project. An offshore airport development at Sangley Point can offer adequate size of land, obstacle-free airspace above Manila Bay on both sides as well as convenient reliable access to/from NCR. Risk of conflict with urban development, natural hazard, aircraft crash and noise problems to urban areas can be minimized because of the surrounding water of Manila Bay. Therefore the offshore area of Sangley Point has been identified as one of the alternative sites for development of New International Airport. It should be noted that there are several newspaper articles reporting strong opposition to the reclamation plan of Sangley from the affected fishermen and the residents due to their perception on loss of livelihood and degradation of the natural environment." Considering the potential advantage of the site, the Sangley Point Option 1 should be subjected to the detail examination.

Figure 6.3-6 Location of Sangley Point Option 1

5) Sangley Point Option 2

The Sangley Point Option 2 was also considered during the Roadmap Study as a modification to the Option 1 considering a possibility to utilize the existing Sangley runway (after its improvement) as NAIA's supplemental runway while constructing the new international airport at offshore Sangley. In case of this option, the new international airport needs to be constructed parallel to the existing Sangley runway so that the construction works of the new international airport should not constitute obstructions to the aircraft operation on the existing Sangley runway. The existing Sangley runway may be developed in future as the third or fourth runway of new international airport. This option would offer some additional runway capacity for NAIA as an immediate measure before opening of the new international airport and reduction of the reclamation area for development of the new international airport to some extent. Similar advantage mentioned for the Sangley Point Option 1 can be expected in case of the Option 2 and this option should be subjected to detail examination.

Figure 6.3-7 Location of Sangley Point Option 2

6) Central Portion of Manila Bay

The Central Portion of Manila Bay site is situated to the eastern side of Bacoor Bay and Canacao Bay surrounded by the Cities of Paranaque, Las Pinas, Bacoor and Cavite as well as the Municipality of Kawit. The water depth is up to 10 m. Manila Cavite Expressway runs along the coastal line of Paranaque, Las Pinas and Bacoor. There are the South Harbor, Manila International Container Terminal (MICT) and the North Harbor to the north of this site. Development of NMIA at this site would impose height limitation on the ship masts requiring coordination with PPA and most likely revision to the utilization of the harbors. There is LPPCHEA, where a diverse species of birds both migratory and residents are harbored (DENR NCR). Therefore, a risk of bird strikes should be expected. Las Pinas – Paranaque Coastal Bay Project site could overlap with NMIA if developed in this site.

There are significant number of fisherfolk in Bacoor Bay and Canacao Bay where mariculture involving mussels and oyster farming is common and widespread. Development of NMIA at this site would not physically affect those fisherfolk but negative impacts due to disturbance of water flow, etc. would be anticipated.

This site is very much close to the central business district of NCR and could be easily connected with the existing express road and rail network.

Figure 6.3-8 Location of Central Portion of Manila Bay

7) San Nicholas Shoals (See Figure 6.3-9 as reference).

San Nicholas Shoals site is an offshore new airport site situated along the coastline of municipalities of Rosario and Tanza where fishing and agriculture are predominant industries. Sometime in 1981, DOTC examined the relevance of San Nicholas Shoals as an alternative site of Sangley Point to avoid overlapping with the restricted area RP-P1 (official residence of the President of the Philippines) for development of a new gateway airport, although no decision was made at the time (1981 DOTC Study). Actually the aircraft flight operations would affect the restricted area RP-P1 if a new international airport would be constructed at this site. This site is to be retained for further examination as possible alternative to Sangley Point Options 1 and 2.

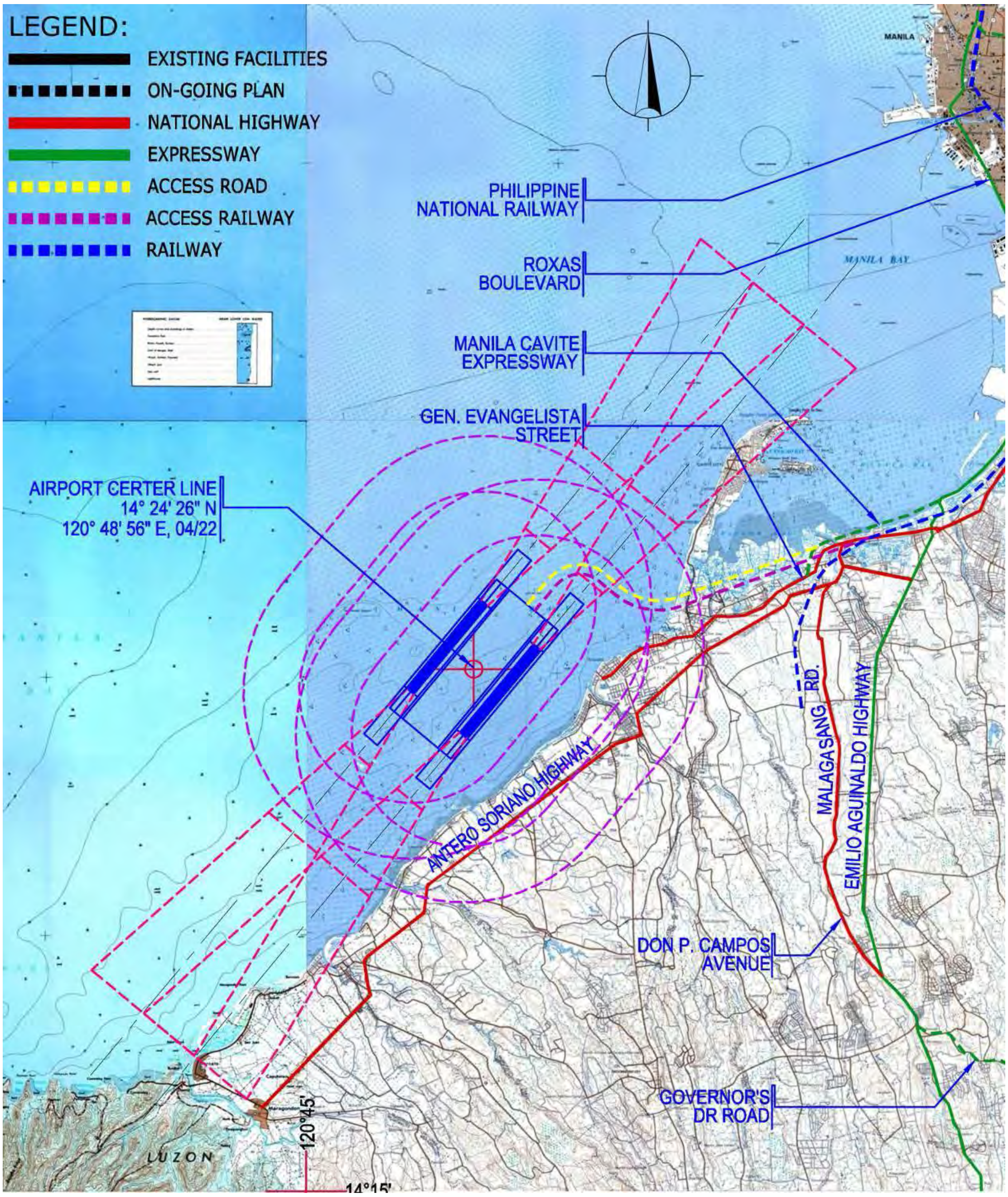


Figure 6.3-9 Approximate Location of San Nicholas Shoals (Source: 2011 GCR Airport Study)

8) Western Side of Laguna de Bay

Western side of Laguna de Bay (Laguna West) is situated in Laguna de Bay approximately 3km from the coast of Paranaque City. Approximate location of NMIA in this alternative site is shown in Figure 6.3-10.

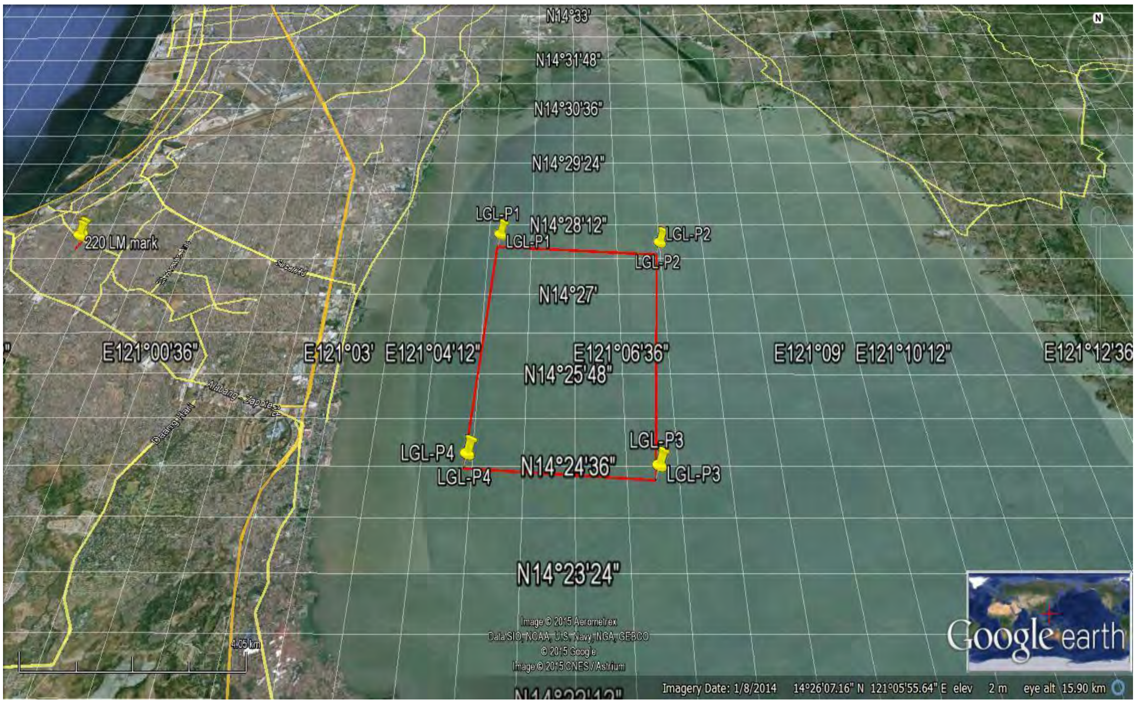


Figure 6.3-10 Approximate Location of Laguna West

The Lake is classified by DENR in 1990 as Class C inland freshwater body and it is suitable for fishery. The Lake presently serves multiple uses such as fisheries, transportation, flood control, power generation recreation/leisure, irrigation, water supply and industrial cooling. The Lake is habitat for commercially cultivated fish and home to indigenous freshwater and brackish water aquatic fauna. The Lake ranges in depth of 2.5-7.0 m. At present, Laguna Lake Development Authority (LLDA), responsible agency for Laguna de Bay under DENR, has no report of rare, threatened or endangered lake flora or fauna in the Laguna Lake. However, Lake Net reports that Laguna de Bay watershed has experienced extensive urbanization and industrialization, especially on the western edge of the lake. Sewage flows freely through surface waters and in the Pasig and Marikina rivers. Aquaculture is another cause of extensive nutrient pollution. Deforestation is resulting in accelerated erosion rates. Water diversion for irrigation, although decreasing due to urbanization, is till serious. Lake Net also pointed out the polluted runoff, sediment contamination and toxics are issues, among others.

According to newspaper articles in December 2008, the City of Taguig prepared a plan to develop an airport city requiring the reclamation of 3,000 (some articles say 5,000) hectares of lakeshore areas northwest of Laguna de Bay. The development of an international airport formed a part of the project scope.

As presented in 6.2.7, Laguna Lakeshore Expressway Dike Project (LLED) is ongoing as one of the PPP projects. According to the information of DPWH, the project is now in bidding process. Once the project is completed, the accessibility from NCR as well as Region IV-A would be significantly improved as, in addition to SLEx currently running almost along the western coast of Laguna, the dike road could be utilized for airport access. The right of way of Philippine National Railways (PNR) might be utilized for rail link between NMIA in this site and central NCR. However, LEED is now facing strong opposition by fisherfolk and other stakeholders claiming significant loss of livelihood and concern on environmental degradation, among others. It should be noted that according to hearing information very soft silty sediments accumulated at the bottom of Lake to a thickness of as much as 10m. The sediments are result of discharges from neighboring watershed of the Lake.

9) Rizal-Talim Island

Rizal-Talim Island is located approximately 46km from Manila in the center of Laguna de Bay and consisting of the Municipalities of Binangonan on the western and Municipality of Cordona on the eastern part of the coastal line. The Rizal-Talim Island site is located between hilly terrains to the west (Mt. Susung Dalaga: 420m) and a hilly peninsular (Mt. Sembrano: 716 m) to the east as shown in Figure 6.3-11. Neither expressway nor rail link with the central business district of NCR is currently available. There are 24 barangays, consisting of 17 in Binangonan and 7 in Cordona.

Figure 6.3-11 Location of Talim Island

The topography of Talim Island is very steep and the highest elevation is 420 m on the top of Mt. Susung Dalaga. This island is rich in bamboo and bamboo-related products and these serve one of the major industries together with fish farming. The average water depth of the site is reported to be at approximately 2 m. Fish pens are placed in almost all areas around Talim Island, and fishing by boats is also an important livelihood for the residents.

Talim Island looking from the south

Fish pen installed in all water surface around the Island

In 2011 GCR Study oriented the runway to 03/21 to avoid infringement to the airspace by the hilly terrain on the eastern peninsular, however the hilly terrains on Talim Island would need to be removed in order to secure obstacle-free airspace. This would involve massive excavation of hilly and rocky terrains resulting in serious negative environmental and social impacts as well as significant cost. Refer to Figure 6.3-12. Considering above-mentioned surrounding conditions, this site is considered not a practical option for development of NMIA.

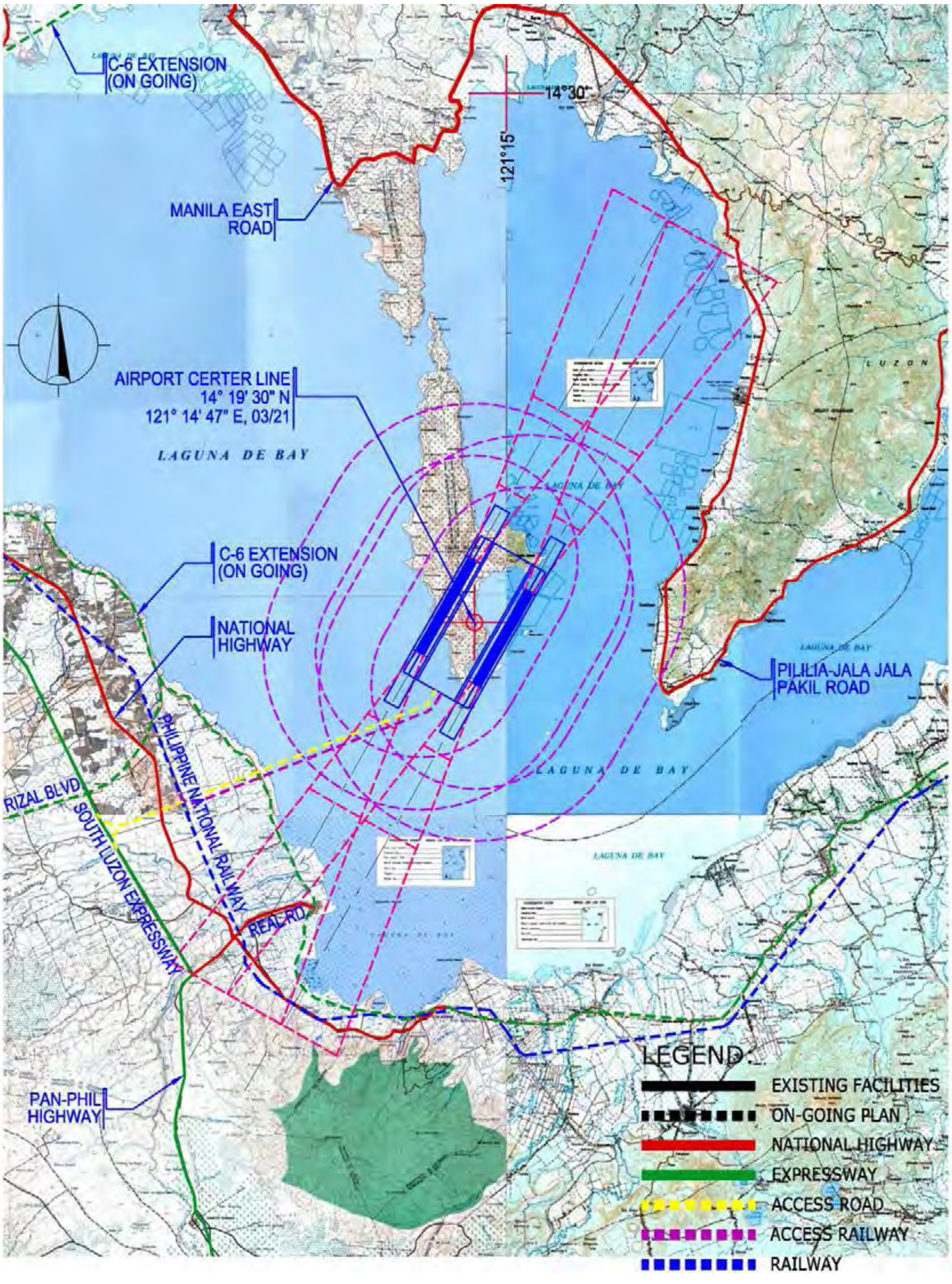


Figure 6.3-12 Approximate Location and Runway Orientation of Rizal-Talim Island Site
(Source: 2011 GCR Airport Study)

6.4 Evaluation and Selection of Prospective New Airport Sites

For the purpose of efficient conduct of the Survey, a qualitative assessment of the nine alternative new airport sites has been conducted based on the initial screening criteria. The criteria are categorized into five as listed below:

a) Criteria related to the Air

  i) Navigation Risks; A site should be free from any significant physical obstruction such as mountain ranges and manmade structures.

  ii) Risk of Aircraft Crash and Noise Problems: The expected aircraft flight paths preferably should not overlap with urbanized areas and dangerous facilities.

  iii) Runway Usability; Runways can preferably be oriented to prevailing wind direction.

b) Criteria related to Social Issues

  i) Land Availability; A site should be able to offer adequate space for airport development with less negative environmental and social impacts.

  ii) Resettlement and Compensation; Anticipated magnitude of resettlement and required compensation.

c) Criteria related to the Natural Environment

  i) Impact on Ecosystem; A site should be developed without significant irreversible impacts on the natural environment.

  ii) Natural Hazard Risks; A site should be less vulnerable to flooding, tsunami and other natural hazards.

d) Criteria related to Economics

  i) Accessibility; Proximity to NCR and Region IV-A as well as connectivity with the existing and planned expressways and rail link.

  ii) Integrated Urban Development Opportunity; A site should offer integrated urban development opportunities for enhancement of the airport function and cost recovery.

e) Criteria related to the Cost; A site should not be associated with unreasonably high cost implication such as a need to totally excavate a rocky mountain.

Qualitative evaluation of the alternative new airport sites has been conducted based as summarized in Tables 6.4-1 through 6.4-9 and summarized below:

1) Angat-Pandi-Bustos site

This alternative site is not properly located to play its expected role to fundamentally resolve the serious capacity constraint of NAIA. Development of NMIA in this site would cause competition with CRK, rather than addressing the capacity constraint issue of NAIA. There are other disadvantages associated with this site, such as limited expansibility, risk of natural hazards and less opportunity of integrated urban development. Although the construction cost could be less than those required for the other sites, this advantage does not offset the fundamental disadvantage of this alternative site in terms of the accessibility. Therefore this site is not an appropriate option to consider development of NMIA.

2) Obando site

This alternative site has several disadvantages such as risk of flooding, limited possibility of urban development and expected high cost for stabilization of sub-surface soils. There is no significant advantage offsetting these disadvantages. Therefore this site is not an appropriate option to consider development of NMIA.

3) Northern Portion of Manila Bay

This alternative site has several disadvantages such as aircraft crash and noise issues, limited possibility of urban development and expected high cost for stabilization of sub-surface soils and access development. There is no significant advantage offsetting these disadvantages. Therefore this site is not an appropriate option to consider development of NMIA.

4) Central Portion of Manila Bay

This alternative site has several disadvantages such as high risk of bird strikes. Proximity to LPPCHEA should be taken into account when preparing an airport layout and development plan. On the other hand, this alternative site can offer several significant advantages such as very good accessibility. Therefore, this site should be subjected to the next detail examination.

5) Sangley Point Option 1

This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of examination. Therefore this site should be subjected to the next detail examination.

6) Sangley Point Option 2

This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of examination. Therefore this site should be subjected to the next detail examination.

7) San Nicholas Shoals

As majority of the aircraft departure and arrival paths near the runways can be located on Manila Bay, no significant problems related to aircraft crash and noise is anticipated. Fairly good condition of sub-surface soils is anticipated. As no significant disadvantage is recognized, this site should be subjected to the next detail examination.

8) West Portion of Laguna de Bay

Although significant negative environmental and social impacts as well as high cost implication are anticipated, this alternative site is very much conveniently located to serve NCR and Region IV-A, offering very favorable accessibility both by road and rail. Therefore this site should be subjected to the next detail examination.

9) Rizal-Talim Island

This alternative site is surrounded by high mountains on both sides which would infringe the obstacle limitation surfaces. Removal thereof is not practicable due to anticipated high cost, environmental and social negative impacts. Access from NCR and Region IV-A to this site is very much inconvenient. This alternative site is not a place for development of a gateway airport.

Consequently following four sites have been eliminated from further examination:

a) Angat-Pandi-Bustos;
b) Obando;
c) Northern Manila Bay; and
d) Rizal-Talim Island.

Following five options are subjected to further detail examination as the prospective new airport sites:

i) Sangley Option 1;
ii) Sangley Option 2;
iii) Central Portion of Manila Bay;
iv) San Nicholas Shoals; and
v) Western Portion of Laguna de Bay.

Table 6.4-1 Initial Screening of Alternative New Airport Site: i) Angat-Pandi-Bustos

Criteria		Remarks
Air	Navigation Risks	No significant physical obstruction recognized.
	Aircraft Crash & Noise	Green belts may be provided to the runway ends.
	Runway Usability	Previous DOTC study estimated more than 95% of usability factor achievable.
Social	Land Availability	This area is irrigated agricultural area. Conversion of its land use to airport could increase a risk of shortage of food supply.
	Resettlement & Compensation	There are residents in and around the assumed NMIA area. Development of NMIA would involve significant number of resettlement and loss of livelihood.
Natural Environment	Impact on Ecosystem	There exists no area designated under NIPAS.
	Natural Hazard Risks	Risk of significant earthquake due to the West Valley Fault Line has been recognized. Possibility of destruction of Angat Dam is also an issue.
Economics	Accessibility	Distance from Manila is about 53km located close to CRK. Development of NMIA in this site would cause competition with CRK, rather than addressing the capacity constraint issue of NAIA.
	Integrated Urban Development Opportunities	Far from the existing and future development of Metro Clark such as Green City Plan. CRK is located more convenient for Metro Clark.
Cost Implication		Reclamation of neither Manila Bay nor Laguna required and cost for airport platform construction would be less as compared with other options.
Overall		This alternative site is not properly located to play its expected role to fundamentally resolve the serious capacity constraint of NAIA. There are other disadvantages associated with this site, such as limited expansibility, risk of natural hazards and less opportunity of integrated urban development. Although the cost could be less than required for the other sites, this advantage does not offset the fundamental disadvantage of this alternative site in terms of the accessibility.

Table 6.4-2 Initial Screening of Alternative New Airport Site: ii) Obando

Criteria		Remarks
Air	Navigation Risks	No significant physical obstruction recognized.
	Aircraft Crash & Noise	Majority of northern side of this site is less populated swampy area. Southern side is Manila Bay. Low risk of significant lives in case of aircraft crash and noise impact anticipated.
	Runway Usability	Previous DOTC study estimated more than 95% of usability factor achievable.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	There are fisherfolk in and around assumed NMIA area in this site, and many of them would need to be relocated for development of NMIA. Significant loss of livelihood is also expected.
Natural Environment	Impact on Ecosystem	There exists no site designated under NIPAS. Aggravation of water quality anticipated due to disturbance to the flow discharge from the river to be blocked by NMIA platform.
	Natural Hazard Risks	Development of NMIA in this site could give rise to a risk of fooding due to disturbance to the fow discharge from the rive to be blocked by NMIA platform.
Economics	Accessibility	Surrounding area is swampy with narrow and already congested road network. Even though this site is located relatively close to Manila (25km), development of reliable and convenient airport access would be costly and time-consuming due to the swampy condition of the surrounding area.
	Integrated Urban Development Opportunities	Surrounding area is swampy with narrow and already congested road network. Efficient urban development would not be practicable.
Cost Implication		Depth of Manila Bay in this site area is up to 10m, almost equal to the other sites located in Manila Bay. But the majority of the sub-surface soil would consist of soft and highly compressive clays. Significant amount of cost for stabilization of the sub-surface soils expected.
Overall		This alternative site has several disadvantages such as increased risk of flooding, limited possibility of urban development and expected high cost for stabilization of sub-surface soils. There is no significant advantage offsetting these disadvantages.

Table 6.4-3 Initial Screening of Alternative New Airport Site: iii) Northern Portion of Manila Bay

Criteria		Remarks
Air	Navigation Risks	No significant physical obstruction recognized. Coordination with PPA for the height limitation on the ship routes and mast height would be required.
	Aircraft Crash & Noise	To the north of the sites is densely populated urban area and risk of significant loss of lives in case of aircraft accident right after/before take-off/landing and noise impact could be recognized.
	Runway Usability	Because of the proximity to Obando site, more than 95% of usability factor could be expected.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	Land acquisition for access road and rail network would require significant relocation of residents.
Natural Environment	Impact on Ecosystem	There exists no area designated under NIPAS.
	Natural Hazard Risks	Risk of bird strikes recognized. A risk of Tsunami and high tide should be taken into account in platform design.
Economics	Accessibility	Although located within NCR, surround is already congested port area with narrow road network.
	Integrated Urban Development Opportunities	Surrounding is already highly developed as the major port area with dense road network. Coordination with the existing facilities would not be practicable unless fundamental urban reform is implemented including relocation of the ports.
Cost Implication		Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay. Because of the proximity to Obando site, similar poor characteristics of the sub-surface soil would be encountered. The cost for development of access road and rail network would also be significant.
Overall		This alternative site has several disadvantages such as aircraft crash and noise issue, limited possibility of urban development and expected high cost for stabilization of sub-surface soils and access development. There is no significant advantage offsetting these disadvantages.

Table 6.4-4 Initial Screening of Alternative New Airport Site: iv) Central Portion of Manila Bay

Criteria		Remarks
Air	Navigation Risks	No significant physical obstruction recognized. Coordination with PPA for the height limitation on the ship routes and mast height would be required.
	Aircraft Crash & Noise	Adequate distance between the site and coastal area of Baccor City would be provided.
	Runway Usability	Based on PAGASA data, the runway usability of more than 95% would achievable.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	There are over 200 zaphra or fish nets in the assumed NMIA site. Development of access road and rail would require resettlement of residents.
Natural Environment	Impact on Ecosystem	Attention to be paid to protection of LPPCHEA located to the east of the assumed NMIA site.
	Natural Hazard Risks	High risk of bird strike is anticipated due to LPPCHEA. A risk of Tsunami and high tide should be taken into account in platform design.
Economics	Accessibility	This alternative site is nearly best situated to serve NCR and Region IV-A with connection to the existing and planned road and rail network.
	Integrated Urban Development Opportunities	While the site has certain potential for the integrated development due to its proximity to the CBDs in NCR, detailed coordination will be required for the on-going reclamation projects in the adjacent areas including height of the buildings to confirm the safe aircraft operations. In addition, careful attention also should be paid to the ongoing lawsuit regarding Las Pinas-Paranaque Coastal Reclamation Project.
Cost Implication		This alternative site requires reclamation of Mania Bay and significant amount of cost should be anticipated. Fairly good condition of sub-soil layers could be anticipated.
Overall		This alternative site has several disadvantages such as high risk of bird strikes. Proximity to LPPCHEA should be taken into account when preparing an airport layout and development plan. On the other hand, this alternative site can offer several significant advantages such as very good accessibility. This option should be subjected to next detail examination.

Table 6.4-5 Initial Screening of Alternative New Airport Site: v) Sangley Point Option 1

Criteria		Remarks
Air	Navigation Risks	No physical obstruction exists.
	Aircraft Crash & Noise	Adequate distance between the site and coastal area of Cavite could be provided. However an oil refinery operated by PETRON in Rosario is located beneath the take-off and arrival paths of NMIA.
	Runway Usability	Based on PAGASA data, the runway usability of more than 95% would be achievable.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	Construction of access roads and rail including bridges would necessitate relocation and loss of livelihood of PAP.
Natural Environment	Impact on Ecosystem	There exists no area designated under NIPAS in and around this site. Negative impact on traditional fishing zone anticipated.
	Natural Hazard Risks	A risk of bird strikes anticipated. A risk of Tsunami and high tide should be taken into account in platform design.
Economics	Accessibility	This alternative site is nearly best situated to serve NCR and Region IV-A. This site could be connected with the existing and planed road and rail network, however construction of access bridges would be costly and time-consuming.
	Integrated Urban Development Opportunities	Reclamation of NMIA is highly consistent with the existing development plan by the Government (E.O. 629) to establish a logistic hub through the reclamation of a port and an airport in Sangley. Consolidated reclamation with the proximity to the CBDs in NCR and industrial estates such as PEZAs has potential to maximize the effects of urban development by stimulating the further development in the adjacent areas.
Cost Implication		This alternative site requires reclamation of Mania Bay and significant amount of cost should be anticipated. Fairly good condition of sub-soil layers could be anticipated.
Overall		This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of evaluation. This option should be subjected to next detail examination.

Table 6.4-6 Initial Screening of Alternative New Airport Site: iv) Sangley Point Option 2

Criteria		Remarks
Air	Navigation Risks	No physical obstruction exists.
	Aircraft Crash & Noise	Both ends of runways would be sea. High structures in and around Makati would be under aircraft departure and arrival paths.
	Runway Usability	Based on PAGASA data, the runway usability of more than 95% would be achievable.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	Construction of access roads and rail including bridges would necessitate relocation and loss of livelihood of PAP.
Natural Environment	Impact on Ecosystem	There exists no area designated under NIPAS in and around this site.
	Natural Hazard Risks	A risk of bird strikes anticipated. A risk of Tsunami and high tide should be taken into account in platform design.
Economics	Accessibility	This alternative site is nearly best situated to serve NCR and Region IV-A. This site could be connected with the existing and planed road and rail network, however construction of access bridges would be costly and time-consuming.
	Integrated Urban Development Opportunities	Reclamation of NMIA is highly consistent with the existing development plan by the Government (E.O. 629) to establish a logistic hub through the reclamation of a port and an airport in Sangley. Consolidated reclamation with the proximity to the CBDs in NCR and industrial estates such as PEZAs has potential to maximize the effects of urban development by stimulating the further development in the adjacent areas.
Cost Implication		This alternative site requires reclamation of Mania Bay and significant amount of cost should be anticipated. Fairly good condition of sub-soil layers could be anticipated.
Overall		This alternative site can offer several advantages such as good location to serve the demand in NCR and Region IV-A and good opportunity for urban development in harmony with surrounding area, while no significant disadvantage is recognized at this stage of evaluation. This option should be subjected to next detail examination.

Table 6.4-7 Initial Screening of Alternative New Airport Site: vii) San Nicholas Shoals

Criteria		Remarks
Air	Navigation Risks	No physical obstruction exists.
	Aircraft Crash & Noise	Both ends of runways would be sea.
	Runway Usability	Based on PAGASA data, the runway usability of more than 95% would be achievable.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Manila Bay.
	Resettlement & Compensation	Construction of access roads and rail including bridges would necessitate relocation and loss of livelihood of PAP. The assumed NMIA site overlaps with fishery reserves designated by Municipality of Tanza.
Natural Environment	Impact on Ecosystem	There exists no area designated under NIPAS in and around this site.
	Natural Hazard Risks	A risk of bird strikes anticipated. A risk of Tsunami and high tide should be taken into account in platform design.
Economics	Accessibility	This site is located a little bit far from the existing and planned expressways and rail. In particular provision of rail link between NCR and this site would be costly and time-consuming.
	Integrated Urban Development Opportunities	While the site has certain proximity to the existing PEZA (Cavite Economic Zone, Suntrust Ecotown), it has slight disadvantage in terms of the distance from NCR.
Cost Implication		This alternative site requires reclamation of Mania Bay and significant amount of cost should be anticipated. Fairly good condition of sub-soil layers could be anticipated.
Overall		As majority of the aircraft departure and arrival paths near the runways can be located on Manila Bay, no significant problem related to aircraft crash and noise is anticipated. According to DOTC-commissioned study carried out by F.F. Cruz & Co. Inc., this site was examined as alternative to Sangley Point as Sangley airspaces would overlap with RP-P1: Malacanang. This option should be subjected to next detail examination.

Table 6.4-8 Initial Screening of Alternative New Airport Site: viii) Western Portion of Laguna de Bay

Criteria		Remarks
Air	Navigation Risks	No physical obstruction exists.
	Aircraft Crash & Noise	Both ends of runways would be lake water.
	Runway Usability	Wind speed and direction data are not available for this alternative site. According to a trial using the wind data at NAIA, the usability factor could be a little bit less than 95%.
Social	Land Availability	Development of NMIA in this site requires construction of airport platform by reclamation of Laguna de Bay.
	Resettlement & Compensation	Development of NMIA in this site would result in significant loess of livelihood of fisherfolk of Laguna de Bay.
Natural Environment	Impact on Ecosystem	Further deterioration of water quality, etc. would be anticipated.
	Natural Hazard Risks	Coastal area of Laguna de Bay frequently experienced serious flooding problems. Such risk should be taken into account into design.
Economics	Accessibility	This alternative site is nearly best situated to serve NCR and Region IV-A. SLEx and PNR south line run along the coast line. LLED is also being implemented.
	Integrated Urban Development Opportunities	Ample opportunity for the integrated urban development could be expected due to the proximity to the CBDs in NCR, industrial estates such as PEZAs and ongoing LLED project.
Cost Implication		Although the water depth is shallower than Manila Bay, significant amount of cost would be required for reclamation of lake water including quarrying and stabilization of lake bed.
Overall		Although significant negative environmental and social impacts as well as high cost implication are anticipated, this alternative site is very much conveniently located to serve NCR and Region IV-A, offering very favorable accessibility both by road and rail. This option should be subjected to next detail examination.

Table 6.4-9 Initial Screening of Alternative New Airport Site: ix) Rizal-Talim Island

Criteria		Remarks
Air	Navigation Risks	Even after massive excavation for construction of platform, there would be mountainous ranges obstructing aircraft flight operations as entire removal of the maintains is not practicable.
	Aircraft Crash & Noise	Both ends of runways would be lake water.
	Runway Usability	Wind speed and direction data are not available for this alternative site. However usability factor of more or less 95% would be achievable.
Social	Land Availability	Construction of platform for NMIA in this site would require massive excavation of rocky mountain on the Talim Island, resulting in relocation of the residents as well as significant loss of livelihood, huge amount of cost and environmental impacts.
	Resettlement & Compensation	Development of NMIA in this site would require massive excavation of rocky mountain for construction of airport platform on the Talim Island, resulting in huge amount of cost, negative environmental and social impacts, etc.
Natural Environment	Impact on Ecosystem	The massive excavation would result in significant negative impact on the natural environment of Laguna de Bay.
	Natural Hazard Risks	Coastal area of Laguna de Bay frequently experienced serious flooding problems. Such risk should be taken into account in the design.
Economics	Accessibility	This alternative site is located far from the central business district of NCR. Currently neither expressway nor rail link is available.
	Integrated Urban Development Opportunities	Opportunity for the integrated urban development is very limited comparing to the other alternative sites due to the distance from the CBDs in NCR and the current development conditions in the adjacent areas.
Cost Implication		Cost for construction of platform for both excavation and reclamation including soil stabilization would be huge.
Overall		This alternative site is not a place for development of a gateway airport.

SECTION 7

NATURAL AND ENVIRONMENTAL CONDITIONS, AND AIRPORT ACCESS TRAFFIC CONDITION FOR PROSPECTIVE SITES

SECTION 7: NATURAL AND ENVIRONMENTAL CONDITIONS, AND AIRPORT ACCESS TRAFFIC CONDITION FOR PROSPECTIVE SITES

7.1 General

This Section generally describes natural conditions, initial baseline conditions of natural and social environment, airport access traffic condition for the five (5) prospective sites, i.e. Sangley Point-1 (SP1), Sangley Point-2 (SP2), Manila Bay Center (MBC) San Nicolas Shoal (SNS) and Laguna Lake West (LLW), based on results of field surveys and investigation, and collected data and information. The field surveys and investigation such as Bathymetric Survey, Geotechnical Investigation, Water Quality and Sediment Surveys, Current and Siltation Surveys, Preliminary Social Environmental Survey and Traffic Volume Survey were carried out under this Survey. The summaries of the results of the surveys and investigation areintroduced into this secrion as well as Appendices summarized at the end of the report.

7.2 Natural Conditions

7.2.1 Topography

According to topographic maps collected from NAMRIA (see Figure 7.2-1), coastal zone areas adjacent to four (4) prospective sites in Manila Bay, i.e. SP1, SP2, MBC and SNS,, are most likely flat and less than 10 meters from MSL covering 3 kilometers inland from the shoreline. Besides, lakeshore area adjacent to LLW has commonly elevated configuration about 5 to 20 meters from MSL to the extent of one (1) kilometer inland from the shoreline.

Source: NAMRIA

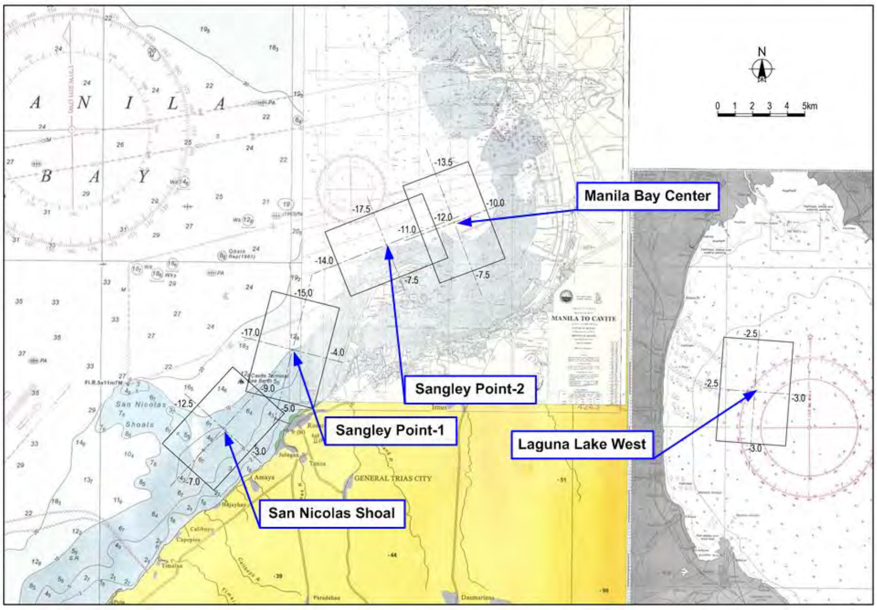
Figure 7.2-1 Topographic Map of Greater Metro Manila Area

7.2.2 Bathymetry and Sedimentation

1) Bathymetry

Manila Bay is located at west of Metro Manila and the south-west of the Bay is connected to the South China Sea. The channel at the entrance of the Bay is narrow due to appearance of Battan Peninsula and Corregidor Island. The seabed configuration is typically 1/250 up to approximate 10 kilometers away from the shoreline and is 1/1,000 up to approximate 30 kilometers to the entrance where the depth is more than 40 meters. On the other hand, Laguna Lake is located at the south-east of Metro Manila surrounded by Metro Manila, Rizal province and Laguna province. The lake is categorized as a freshwater lake and has more than 900 square-kilometers water area. The lakebed configuration is gradually sloped from the lakeshore to the center of the lake. The deepest lakebed is about 4 meters and the average of the depth is 3 meters from annual Low Lake Water Level almost equivalent to MSL at Manila Bay.

Figure 7.2-2 particularly presents the proposed locations of the prospective five (5) sites showing the seabed/riverbed configurations. Also the results of the bathymetric survey carried out by the Survey Team are shown in Appendix A1.



Source: Survey Team processed on NAMRIA Charts from Manila Bay and Laguna de Bay

Figure 7.2-2 Bathymetric Conditions of Five Prospective Sites

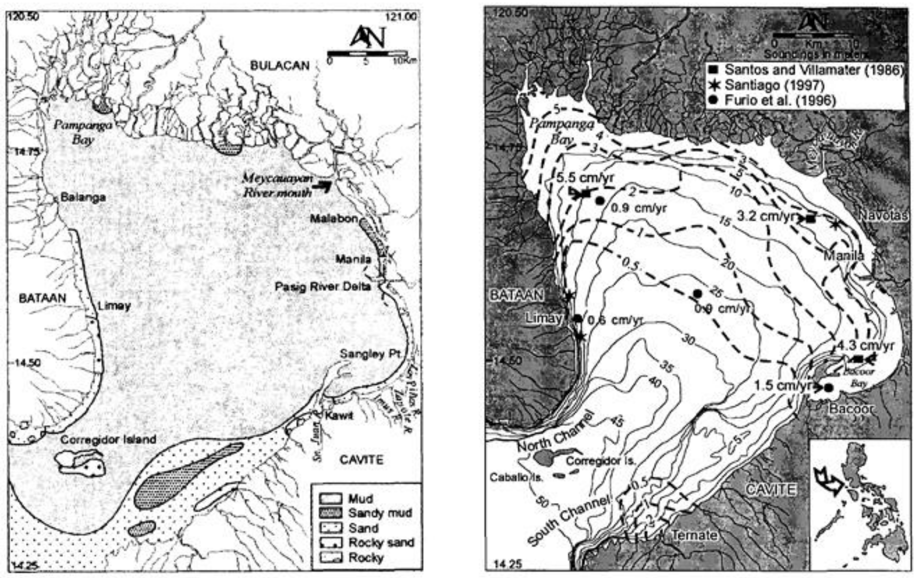
As shown in Figure 7.2-2, SP1 is located same on 10 meters contour line but the half of the area is within the range of 10-22 meters in depth from MLLW. The average depth is approximate 10 meters from MLLW. SP2 is totally laid on the deepest seabed with averaged 11 meters deep from MLLW even one-third of the area is within 10 meters contour line. MBC is similar bathymetrically to SP2 and its averaged depth is about 11 meters from MLLW. SNS is mostly fallen within 10 meters contour line and the area is averaged of about 7 meters in depth from

MLLW. LLW is positioned almost on flat lakebed configuration with averaged 3 meters in depth from MSL (equivalent to 2.5 meters in depth from MLLW).

2) Sedimentation

Commonly, the sedimentation is preliminarily affected by currents generated by waves, winds, temperature, salinity, tides etc. as mentioned in 7.2.4 3), discharges from inland water, residual bed materials and its distribution or such. The following general characteristics of sedimentation around the five (5) perspective sites are briefly summarized based on a preliminary examination upon collected data and information in Current and Sedimentation Surveys carried out by the Survey Team.

Sringan et al. (1998)[1] complied a sediment distribution in Manila Bay based on NAMRIA bathymetric maps as shown in Figure 7.2-3 a). The figure indicates the majority of the sediment in Manila Bay seems to Mud, but there appear a distribution of sandy soil along Cavite coastline toward the outer Manila Bay from Cavite Spit. From this suggestion given, it is assumed that the sediment at SNS and SP1 is possible of sandy soil or mud , or their mixed, and the one at SP2 and MBC is most likely of mud. Figure 7.2-3 b) exhibits an estimated sedimentation rates and their source locations. As seen in this figure, there is a tendency of increasing the sedimentation rates from the inner bay to the center of the bay, and the areas where outflow exist and that are geographically shaped as pocket feature such as Bacoor and Panpanga Bays imply higher rate of the sedimentation. According to this figure, SP1 and SP2 are categorized in the range from 0.9 to 2 cm per year and MBC is to the extent from 3 to 4 cm per year. Aside from the four (4) sites, it seems that SNS is not located within same area having such nature significantly changing.



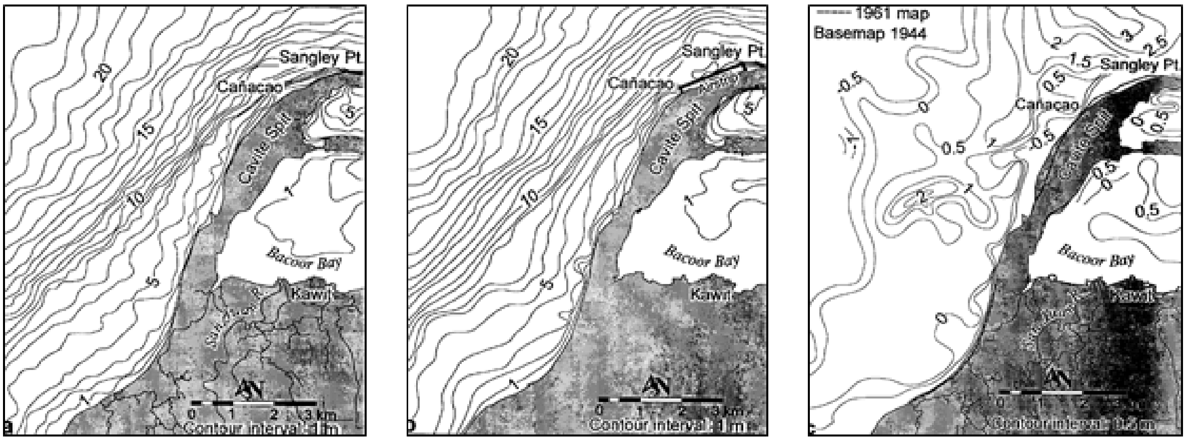
a) Sediment Distribution in Manila Bay b) Estimated Sedimentation Rates and Their Source Locations

Source: Sringan et al. (1998)

Figure 7.2-3 Estimated Radionuclide-derived Sedimentation Rates and Their Sources

[1] Sringan and Ringor (1998) *Changes in Bathymetry and Their Implications to Sediment Dispersal and Rates of Sedimentation in Manila Bay*, The University of the Philippines, Science Diliman, July-December, 1998, 10:2, pp12-26

Figure 7.2-4 a) and b) present bathymetric features around Cavite Spit respectively of 1944 and 1956. Figure 7.2-4 c) illustrates a comparison of water depth and shoreline position between 1944 and 1961. These figures suggest significant variation of seabed configuration. It is consequently confirmed that coastal retrogression was occurred as much as 100 meters at least during the period along the western cost of Cavite Spit except where porgradation was made from Canacano to Sangley Point due to formation of reclaimed airstrip. According to Stringan et al., deepening was interestedly observed as much as 4 meters at offshore of reclaimed cost between Canacano and Sangley Point because the materials for reclamation was dredged from this area, and shoaling was confirmed from north to northeast of Sngley Point.



a) Bathymetric Map (1944) b) Bathymetric Map (1956) c) Comparison between 1944 and 1961

Source: Sringan et al. (1998)

Figure 7.2-4 Chronological Changes in Bathymetric Conditions Western Coast of Cavite Spit

In case of Laguna Lake, Herrera et al.(2011)[2] explains that rivers emptying into Laguna Lake unload wastes, organic matter, sediments that settle and accumulate on the lakebed, and point or non-point sources of lake pollution and lake erosion contribute to sedimentation. Based on a study carried out NIGS (1999)[3], sediment input in Laguna de Bay is at 7.93 x 10^6 m^3/y equivalent to a shoaling rate of 8.36 mm/y. It seems that sedimentation mechanism of the Lake is not simple and rather complex, because the mechanism is attributed by the lake circulation influenced by inflow and outflow from river and seawater, water balance, water volume control, currents, winds, temperature, salinity etc. which individually have difference in seasonal or layer by layer of their characteristics.

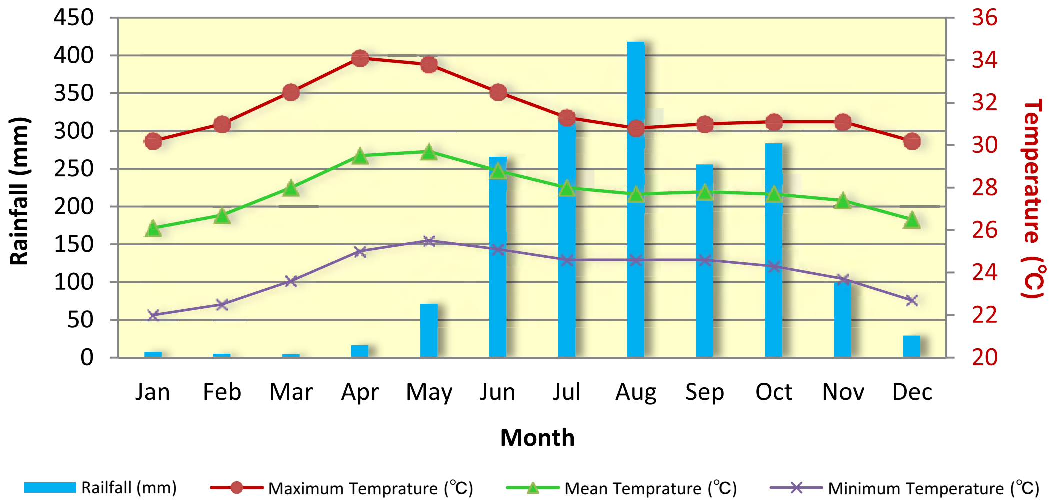
2 Herrera, Nadaoka, Blanco and Hernandez (2011) *Partnership for Sustainable Lake Environment: Collaborative Monitoring and Research of Laguna Bay, Philippines for Resource-use Management and Ecosystem Conservation*

3 National Institute of Geological Sciences (1999) *Sedimentation patterns, sediment quality and bathymetry of Laguna de Bay: establishing environmental baselines for lake management using the geologic record, Philippines*

7.2.3 Meteorology

1) Temperature and Rainfall

Metro Manila area is generally categorized as a tropical wet and dry/savanna climate which is fallen into Aw in Köppen-Geiger classification. Figure 7.2-5 illustrates monthly average temperature and rainfall at Manila International Airport (MIA) from 1981 to 2010. As shown in the Figure, the climate of Metro Manila area has a pronounced dry season from December to May and wet season from June to November. The maximum rainfall was observed as 420 mm in August and the minimum rainfall was observed as 4.0 mm in March. The annual total rainfall is about 1,800 mm and the total rainfall in wet season is about 1,670 mm which is 93% of the total annual rainfall. The range of temperature is comparatively small about 7-12 degrees Celsius in whole year. The highest temperature is 34.1 degrees Celsius in April and the lowest temperature is 22.0 degrees Celsius in January both in dry season. During wet season, the maximum temperature is 33 degrees Celsius and the minimum temperature is 24 degrees Celsius. Because of flatness without any hills and mountains, all five (5) prospective sites located within 25 kilometers from MIA are to be most likely regarded as same temperature and rainfall conditions of MIA.

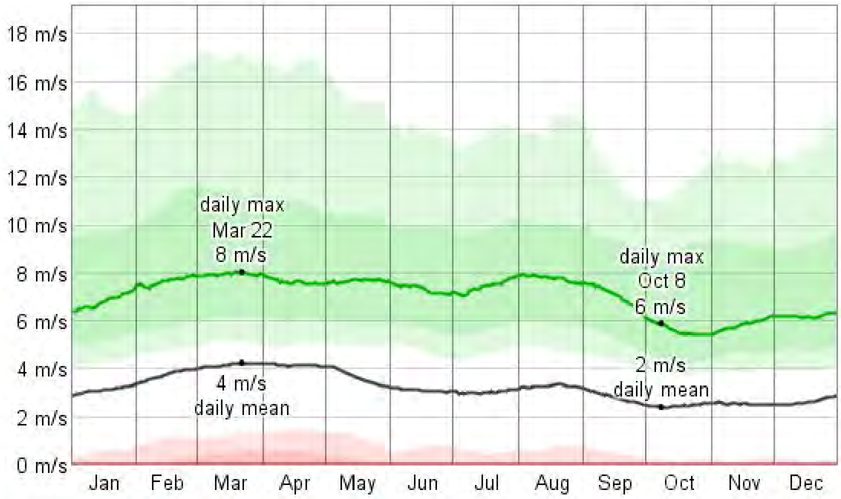


Source: PAGASA

Figure 7.2-5 Monthly Average Temperature and Rainfall at MIA (1981-2010)

2) Winds

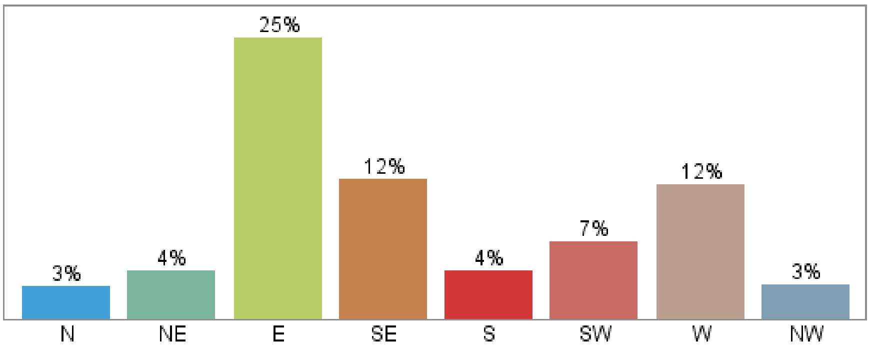
Figure 7.2-6 presents average daily mean and maximum wind speeds at MIA from 1974 to 2012. As suggested in the Figure, the average daily wind speed is usually in the range between 0-8 meters per second in annual. The highest average daily maximum and mean wind speeds were respectively 8 and 4 meters per second in March. The lowest average daily maximum and mean wind speeds are respectively 6 and 2 meters per second in October. The higher average daily wind speeds tend to frequently occur from February to April. The highest wind speed extremely appeared as about 17 meters per second which was recorded in March but very seldom. From October to December, the average daily wind speeds are totally lower than those from February and April.



Note: The above are sourced from historical records at Manila International Airport from 1974 to 2012. The average daily minimum (red), maximum (green), and average (black) wind speed with percentile bands (inner band from 25th to 75th percentile, outer band from 10th to 90th percentile).
Source: WeatherSparks Bata (https://weatherspark.com/averages/33313/Metro-Manila-Philippines)

Figure 7.2-6 Daily Mean & Maximum Wind Speeds at MIA (1974-2012)

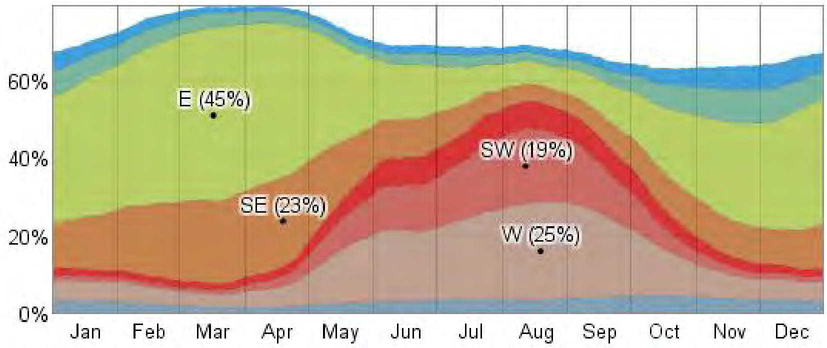
Figure 7.2-7 shows wind directions over entire year at MIA from 1974 to 2012. As found in the Figure, the wind direction between E to SE is primary dominant and the one between W and SW is secondary dominant. Other wind directions are smaller percentage in occurrence frequency compared with the mentioned above.



Note: The above are sourced from historical records at Manila International Airport from 1974 to 2012. Values do not sum to 100% because the wind direction is undefined when the wind speed is zero.
Source: WeatherSparks Bata (https://weatherspark.com/averages/33313/Metro-Manila-Philippines)

Figure 7.2-7 Wind Directions Over Entire Year at MIA (1974-2012)

Figure 7.2-8 shows fraction of time spent with various wind directions at MIA from 1974 to 2012. As described in the Figure, the wind direction between E to SE is dominant from November to May and the one between W and SW is dominant from July to September. For June and October, the both rages of wind direction are mostly even.



Note: The above are sourced from historical records at Manila International Airport from 1974 to 2012. Stacked values do not always sum to 100% because the wind direction is undefined when the wind speed is zero.

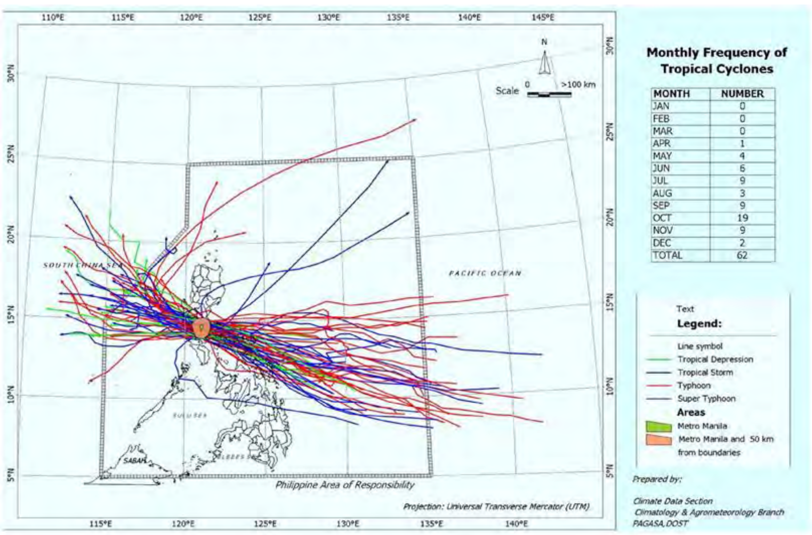
Source: WeatherSparks Bata (https://weatherspark.com/averages/33313/Metro-Manila-Philippines)

Figure 7.2-8 Fraction of Time Spent with Various Wind Directions at MIA (1974-2012)

As same as temperature and rainfall conditions, the five (5) prospective sites are located within 25 kilometers from MIA, so the above information of MIA is technically considered to cover all the sites.

3) Tropical Cyclones

According to PAGASA (2014)[4], totally eighteen (18) tropical cyclones were entered or developed within the Philippine Area of the Responsibility (PAR) in 2014. Generally, it is reported that the averaged total number of the cyclone is about twenty (20) per year. The number of 2014 was less than the averaged. In case of Metro Manila and 50 km from its boundaries, totally sixty-two (62) tropical cyclones were crossed from 1948 to 2009 as described in Figure 7.2-9, which consequently represents at least appearance of one (1) tropical cyclone per year in the areas. As shown in the Figure, the appearance of the cyclones was from April to December and the most crossed cyclones were observed in October.



Source: PAGAS

Figure 7.2-9 Tropical Cyclones Crossed on Metro Manila & 50 km from Boundaries (1948-2009)

4 PAGASA (2014) *2014 Annual Report*, pp 14

7.2.4 Oceanographic and Hydraulic Conditions

1) Tides and Lake Water Level

NAMRIA have observed tide elevations in Manila Bay. Based on the observation data accumulated, PPA established the relationships between tide elevations at the Port of Manila as shown in Table 7.2-1. Basically, it is recognized that the tide conditions at SP1, SP2, MBC and SNS are considered as same tidal relationships as specified in Manila Port due to close distance within 30 kilometers and small difference of tidal phase and geographical features be affected..

Table 7.2-1 Relationships Between Tide Levels at Port of Manila

Water Level		Manila Port (Manila bay) MLLW (m)	Remark
Highest High Water Level	HHWL	1.77	
High Water Level	HWL	1.26	
Mean Higher High Water Level	MHHW	1.01	
Mean High Water Level	MHW	0.85	
Mean Tide Level	MTL	0.49	say 0.50 rounded =MSL
Mean Low Water Level	MLW	0.10	
Mean Lower Low Water Level	MLLW	0.00	NAMIRIA Chart Datum
Low Water Level	LWL	-0.23	
Design Low Tide Level	DLT	-0.35	
Lowest Low Water Level	LLWL	-0.67	

Source: Design Manual for Port and Habour Facilities in the PPA

Laguna Lake has own datum specified as Laguna Del Bay Datum (LDNDL) established by LLDA as described in Table7.2-2. As seen in the Table, MSL is 10.5 meters lower than LDBDL and MLLW is 10 meters lower than LDBL.

Table 7.2-2 Laguna Lake Water Levels in Correlation with MSL & MLLW at Port of Manila

Water Level	LDBDL (m)	MSL (m)	MLLW (m)	Remark
Annual Maximum Lake Water Level	12.50	2.00	2.50	
Annual Low Lake Water Level (=MSL)	10.50	0.00	0.50	NAMRIA Chart Datum
MLLW	10.00	-0.50	0.00	at Manila Bay
Laguna Del Bay Datum (LDBDL)	0.00	-9.50	-10.00	

Source: LLDA

2) Waves

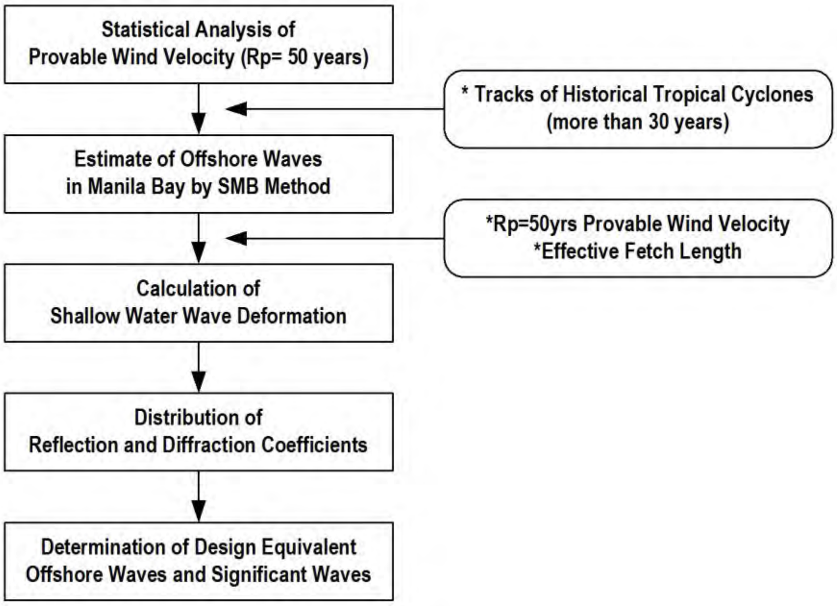
In general, waves in Manila Bay are comparatively calmer than those along the Pacific Ocean. However, waves generated by tropical cyclones crossed on and affected to Manila Bay sometime cause serious damages and malfunctions especially along the shorelines of Manila Bay, e.g. inundation by wave over-topping along Roxas Blvd concurrently with high tide condition. Such waves is particularly originated by extreme winds blowing on the surface of the Manila Bay and the waves heights are to be bigger if wind velocity is higher and effective fetch is longer. Unfortunately, it seems that there is no wave monitoring station in Manila Bay which is established and operated by governmental agencies or research institute of university. Through collection of existing data and information, it was found that a study report for port development in Manila Bay previously carried out by JICA (1994)[5] summarized wave conditions in Manila Bay as tabulated in Table 7.2-3.

Table 7.2-3 Existing Design Wave Conditions in Manila Bay

Location	Offshore Waves			Sgnificant Waves			Remark
	Ho (m)	To (sec)	Direction	H1/3 (m)	T1/3 (sec)	Direction	
Manila Port	-	-	-	2.69	6.50	W	PPA Manual
Nica/Cavite	3.18	-	-	2.41	-	NNE	Rp=50yrs
Sangley Point	2.75	-	-	2.08	-	NNE	ditto

Source: JICA Study Report

As shown in the Table, the existing design wave conditions are not fit to examination of necessary wave protective facilities for reclaimed airport area at the five (5) prospective sites, because the location and depth are different, so that the wave conditions could not reappear in order, also the wind data used for wave hind-casting was only 73 typhoons for 21 years from 1972 to 1992 and was statistically smaller and not latest information updated. For such situation, the Survey Team executed design wave analysis for SNS, SP1, SP2 and MBC. The sequence of the analysis is shown in Figure 7.2-10.



Source: Survey Team

Figure 7.2-10 Flowchart of Design Wave Analysis for New Manila International Airport

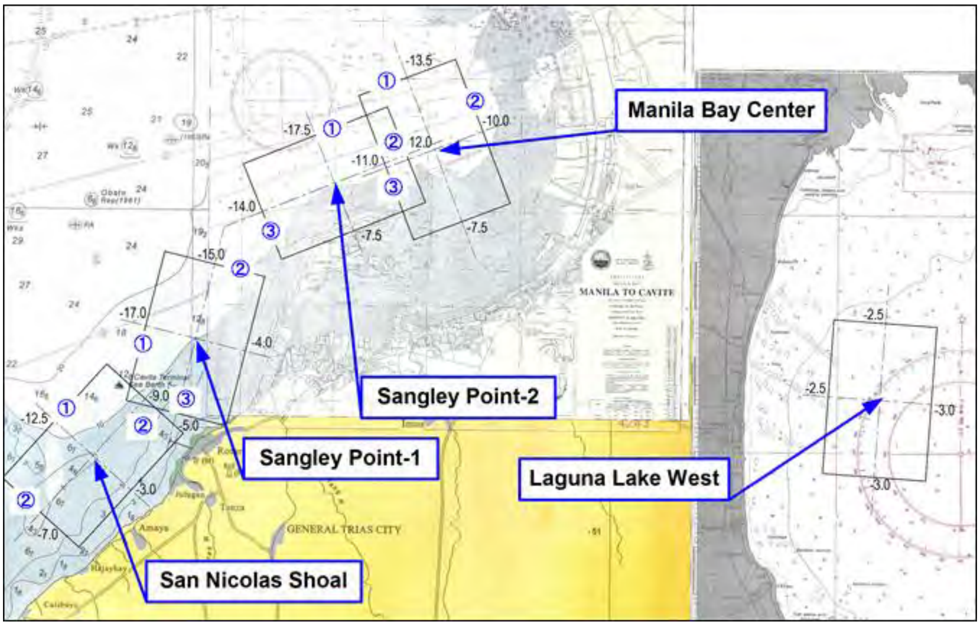
As the results of the analysis, the design wave conditions for four (4) prospective sites are summarized (tentative) in Table 7.2-4 and the coverages of each design waves are presented in Figure 7.2-11 (refer to Appendix A2)

[5] JICA and DOTC (1994) *Final Report on The Greater Capital Region Integrated Port Development Study in The Republic of The Philippines*, Vol.2, pp19-24

Table 7.2-4 Design Wave Conditions for Four (4) Prospective Sites

Location		Offshore Waves			Equivalent Offshore	Sgnificant Waves
		Ho (m)	To (sec)	Direction	Ho' (m)	H1/3 (m)
Sangley Point-1 (SP1)	①	4.13	6.59	WNW	4.13	3.89
	②	4.13	6.59	WNW	4.07	3.63
	③	4.13	6.59	WNW	3.88	3.21
Sangley Point-2 (SP2)	①	4.13	6.59	WNW	4.14	3.82
	②	4.68	7.14	W	3.84	2.86
	③	4.13	6.59	WNW	4.07	3.63
Manila Bay Center (MBC)	①	4.13	6.59	WNW	3.91	3.27
	②	4.13	6.59	WNW	2.89	1.66
	③	3.96	6.43	NW	2.58	1.36
San Nicholas Shoal (SNS)	①	4.68	7.14	W	5.42	3.75
	②	4.72	7.16	WSW	3.98	2.90
	③	4.68	7.14	W	4.21	3.04

Source: Survey Team



Source: Survey Team

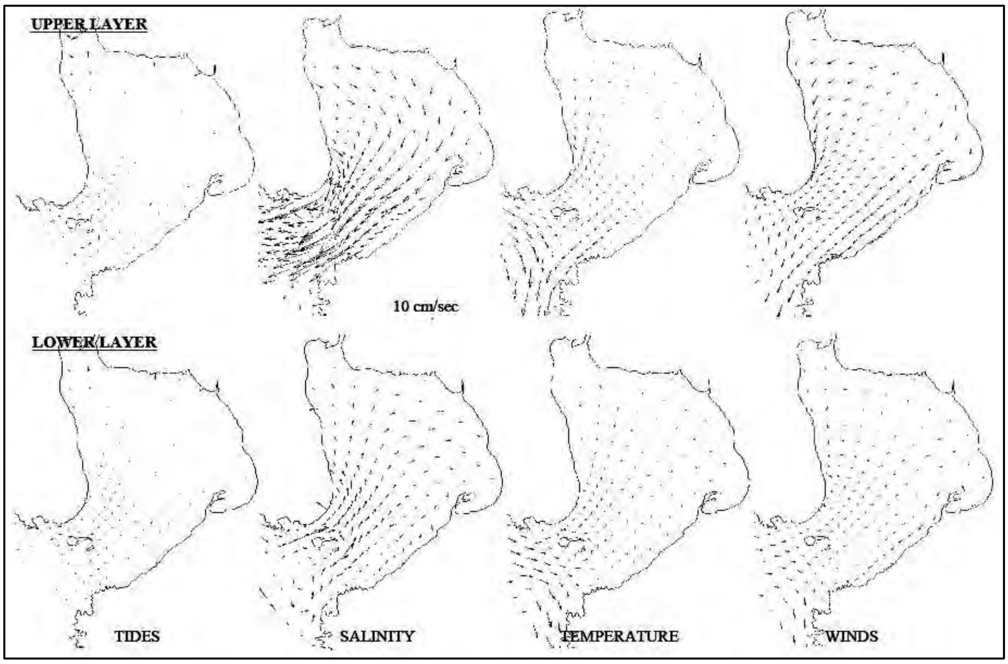
Figure 7.2-11 Coverages of Each Design Waves for Four (4) Prospective Sites

It is assumed that waves in Laguna Lake are most likely of ship generated waves in ordinal condition and of wind waves in extreme condition. The average depth of the Lake is only 3 meters, so that the wave heights are to be smaller and may become approximate 1-1.5 meters at most.

3) Currents

Commonly, the currents of the sea are comprised of i) ocean current which is macro sea water flows at the open sea areas, ii) tidal current generated by tidal movement, iii) nearshore currents such as longshore current, rip current, return flow and mass transport flow locally generated by waves within tens of kilometers from the shorelines, iv) current originated by river discharge, v) density current generated by difference of density of salinity and/or temperature, and vi) wind-driven current.

Figure 7.2-12 exhibits a numerical simulation result of resultant residual velocity fields (mean current) driven by separate contribution in Manila bay which was estimated by Pokavanich et al.(2006)[6]. As seen in the Figure, there are four (4) components such as tides, salinity, temperature and winds, and it is characterized that the salinity component is dominant especially at entrance of Manila Bay likely implying maximum more than 1 m/sec velocity, and the winds component is also moderately proportioned with prominent distribution approximately of 0.1-0.5 m/sec at Cavite coastal area, and Battan-Panpanga coastal area. Besides, temperature component is smaller than the said two (2) components but has distribution of 0.5-1 m/sec velocity at the outer entrance of Manila Bay, and tides component is comparatively smaller velocity as 0.1 to 0.3 m/sec which is mainly distributed the entrance of Manila Bay, and Cavite, Battan-Panpanga coastal areas. Pokavanich concluded in his paper that Manila Bay hydrodynamic nature is strongly controlled by the integrated effect from various external factors i.e. offshore tidal fluctuation, river discharges, water temperature change from solar radiation, and wind driven current, and the bay might probably be supplied with nutrient as well as sediment from the South China sea as there is a clear submerged residual flow toward the bay.

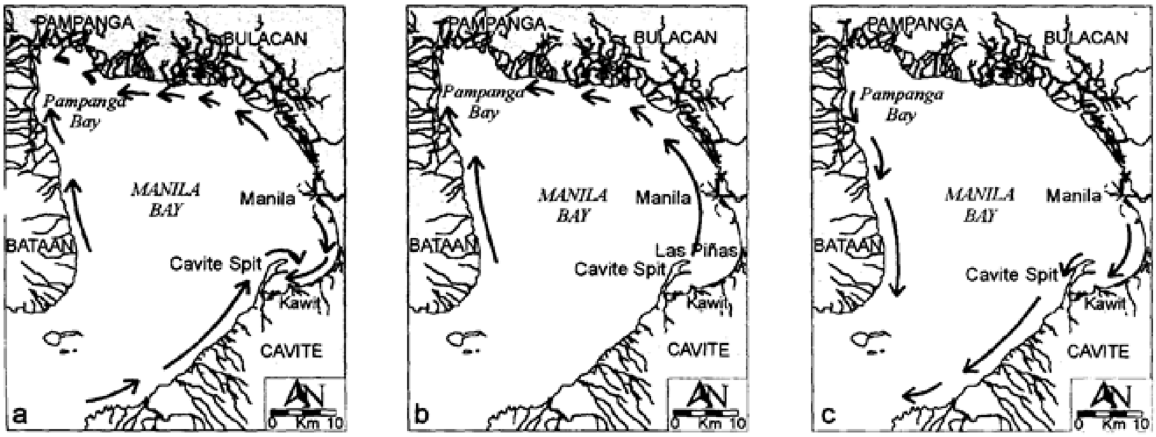


Source: Pokavanich and Nadaoka (2006)

Figure 7.2-12 Resultant Residual Velocity Fields Driven by Separate Contribution

[6] Pokavanich and Nadaoka (2006) *Three-Dimensional Hydrodynamics Simulation of Manila Bay*, Symposium on Infrastructure Development and the Environment 2006

Siringan et al. (1997)[7] diagram longshore currents associated with locally generated waves as presented in Figure 7.2-13. According to the Figure, Cavite coastal zone has two (2) typical nearshore currents from SW and NE. These currents seem to be divided at "Cavite Spit". At the point after Cavite Split north of Sanglely Point, there are three (3) typical nearshore currents toward Kawit coastal area into Bacoor Bay and Manila coastal area, and from Manila to Kawit coastal areas. It is commonly recognized that the above nearshore currents are to predominately affect sediment transport.



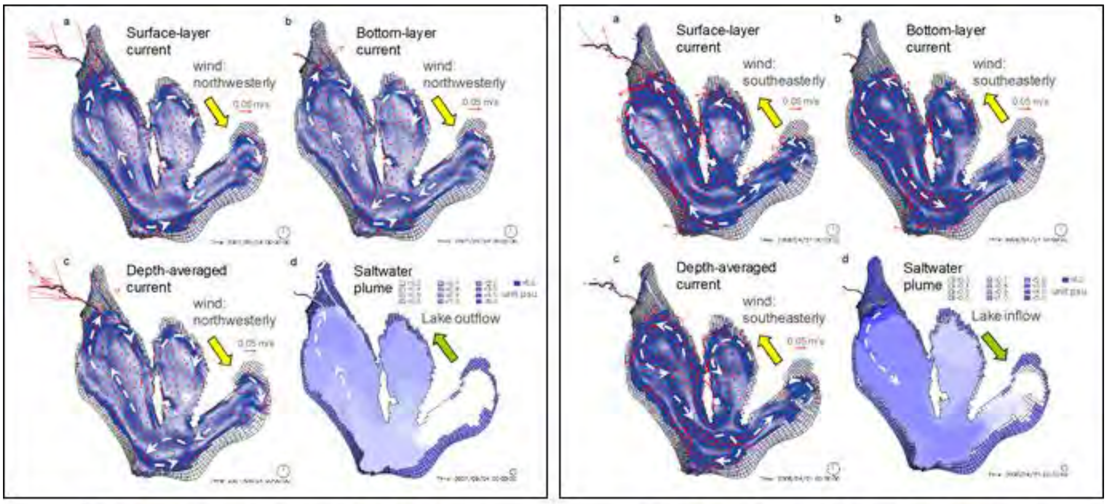
Note: a. southwester lines, b. southeaster lines, c. northeaster lines
Source: Siringan et al. (1997)

Figure 7.2-13 Longshore Currents Associated with Locally Generated Waves

Herrera et al.(2014)[8] assume that the Laguna Lake circulation is defined preliminarily by three (3) forcing factors; watershed river charge, tidal fluctuation and wind stress, and discharges from sub-watersheds surrounding Laguna Lake with a contribution of nearly 70 % of the total lake inflow significantly affect the general circulation of the Lake. Herrera et al. illustrate simulated Laguna Lake circulations for wet and dry seasons as presented in Figure 7.2-14. As described in the Figure, the current flow direction in wet season is basically clockwise except for south bay area and its characteristic is mostly same at surface and bottom layers. On the other hand, the current in dry season is generally anticlockwise except for south bay and north-west bay areas near of surface layer different from bottom layer. The both current patterns may be related to wind direction in each season (wet: northwesterly and dry: southwesterly). The velocities of the currents in wet season are smaller (mostly 0.02 m/sec but partially more than 0.05 m/sec at north-west bay where is connected to Napindan Channel and Marikina River at the both surface and bottom layers) than those in dry season (0.01 m/sec at all the centers of the bays but more 0.05 m/sec along west, south and central bays in surface layer, and more than 0.05 m/sec at west and south bays and along west-central bay but 0.01-0.02 m/sec at rest central bay and east bay).

[7] Siringan and Ringor (1997) *Predominant Nearshore Sediment Dispersal Patterns in Manila Bay*, The University of the Philippines, Sienc3 Diliman 9(1/2):29-40
[8] Herrera, Nadaoka, Blanco and Hernandez (2014) *Hydrodynamic Investigation of a Shallow Tropical Lake Environment (Laguna Lake, Philippines) and Associated Implications for Eutrophic Vulnerability*

For lake flow and salinity, wet season is of outflow and salinity concentration is lower, and dry season is of outflow and salinity concentration is higher.

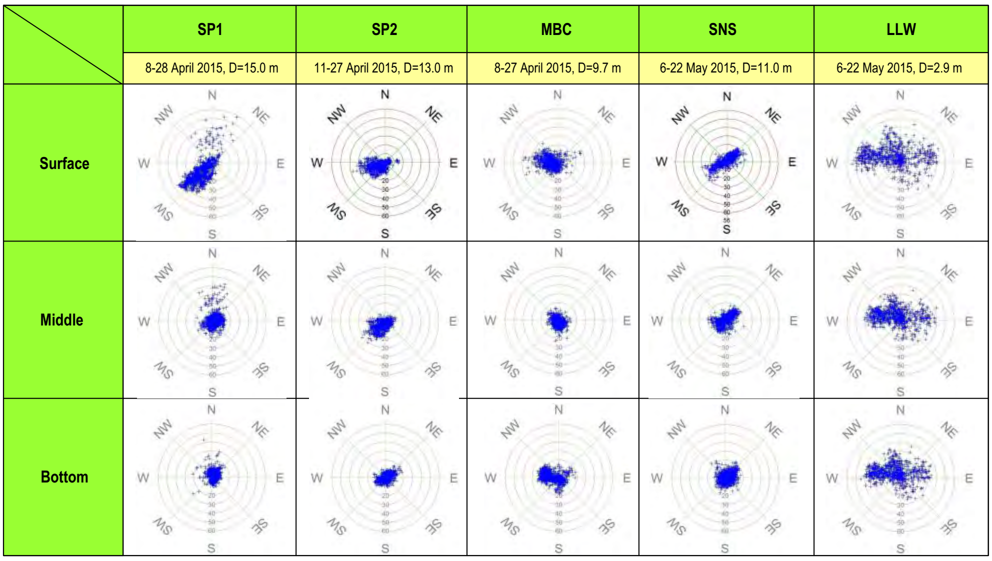


i) Wet Season Simulated Laguna lake Circulation ii) Dry Season Simulated Laguna lake Circulation

Source: Herrera et al. (2014)

Figure 7.2-14 Simulated Laguna Lake Circulations (Wet and Dry Seasons)

Figure 7.2-15 shows a summary of current observations for five (5) prospective sites based on the results of Current and Sedimentaiton Surveys carried out by rthe Survey Team.



Note: Unit of current velocity above shown is cm/seSource: Survey Team

Figure 7.2-15 Observed Current Velocities and Directions for Prospective Sites

The characteristics of each result are generallybriefed as follows:

i) SP1: the currents observed are of NE-SW direction at surface layer. However, the currents of middle and bottom layers do not have prominent tendency in direction and are mostly distributed on the center of the observation point. Excluding extreme current velocities, the maximum velocities are respectively 45 cm/sec at surface layer, 20 cm/sec at middle layer and 15 cm/sec at bottom layer.

ii) SP2: the currents observed are predominantly of ENE-WSW direction at surface layer and NE-SW direction at middle and bottom layers. The maximum velocities are respectively 40 cm/sec at surface layer, 35 cm/sec at middle layer, and 30 cm/sec at bottom layer.

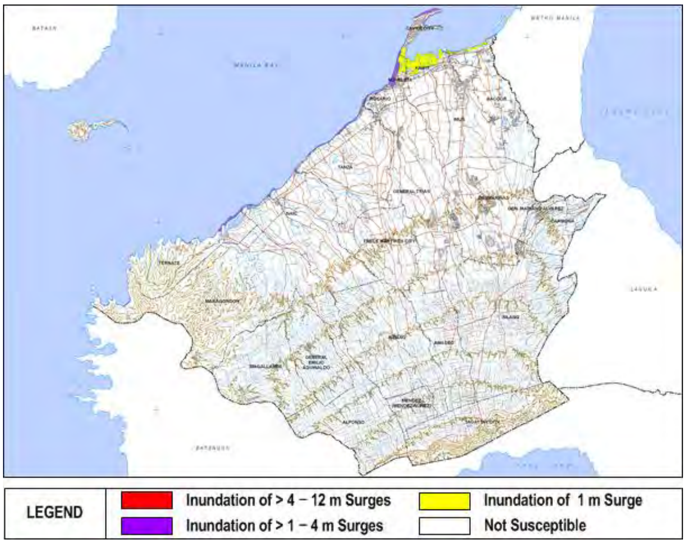
iii) MBC: the currents observed are predominantly of ESE-WNW direction at surface layer, SE-NW direction at middle layer, and ESE-WNW direction at bottom layers. The maximum velocities are respectively 40 cm/sec at surface layer, 25 cm/sec at middle and bottom layers.

iv) SNS: the currents observed are predominantly of NE-SW direction at all three layers. The maximum velocities are respectively 40 cm/sec at surface layer and 20 cm/sec at middle and bottom layers.

v) LLW: the currents observed are predominantly of E-W and SSE-NNW directions at all three layers. The maximum velocities are respectively 55 cm/sec at surface layer, 40 cm/sec at middle layer, and 45 cm/sec at bottom layers. The trend of the currents is similar to the simulated as previously presented in Figure 7.2-14. However, the values of the velocities are higher than those of other four (4) prospective sites in Manila Bay, which is under confirmation and verification by Survey Team.

4) Storm Surge

Storm surge is basically generated by two (2) amplified water level rise phenomena originated from higher pressure around low pressure and inshore wind. Based on numerical simulation, a hazard map of storm surge at Cavite Province was produced in NAMRIA-Ready Project as presented in Figure 7.2-16. As found in the Figure, although there is no indication of the rage between 4-12 meters inundation, it is anticipated that the shorelines near SNS, SP1, SP2 as well as MBC are exposed within the range between 1-4 meters inundation which may happen in the future.



Source: NAMRIA-Ready Project

Figure 7.2-16 Storm Surge Hazard Map at Cavite Province

5) Sea Level Rise

It is well known that Sea Level Rise (SLR) has been physically observed and seriously warned by IPCC (2013)[9] that introduces estimated Global Mean Sea Level Rise (GMSLR) for five (5) scenarios (refer to Table 7.2-5). Shown SRES A1B is commonly recognized as high-economic growth scenario with rapidly introducing new and high-efficient technologies in balanced emphasis on all energy sources. Other RCP scenarios newly introduced in the AR5 are of emission scenario corresponding to four (4) concentrations of greenhouse gas. As found in the Table, , in case of SRES A1B as consequently being middle case scenario, the estimated rate of GMSLR is average 8.1 mm per year and GMSLR in 2100 is predicted as average 0.6 meters.

Table 7.2-5 Global Mean Sea Level Rise in Several Scenarios in IPCC-AR5

	SRES A1B	RCP2.6	RCP4.5	RCP6.0	RCP8.5
Thermal expansion	0.21 [0.16 to 0.26]	0.14 [0.10 to 0.18]	0.19 [0.14 to 0.23]	0.19 [0.15 to 0.24]	0.27 [0.21 to 0.33]
Glaciers[a]	0.14 [0.08 to 0.21]	0.10 [0.04 to 0.16]	0.12 [0.06 to 0.19]	0.12 [0.06 to 0.19]	0.16 [0.09 to 0.23]
Greenland ice-sheet SMB[b]	0.05 [0.02 to 0.12]	0.03 [0.01 to 0.07]	0.04 [0.01 to 0.09]	0.04 [0.01 to 0.09]	0.07 [0.03 to 0.16]
Antarctic ice-sheet SMB[c]	−0.03 [−0.06 to −0.01]	−0.02 [−0.04 to −0.00]	−0.02 [−0.05 to −0.01]	−0.02 [−0.05 to −0.01]	−0.04 [−0.07 to −0.01]
Greenland ice-sheet rapid dynamics	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.04 [0.01 to 0.06]	0.05 [0.02 to 0.07]
Antarctic ice-sheet rapid dynamics	0.07 [−0.01 to 0.16]	0.07 [−0.01 to 0.16]	0.07 [−0.01 to 0.16]	0.07 [−0.01 to 0.16]	0.07 [−0.01 to 0.16]
Land water storage	0.04 [−0.01 to 0.09]	0.04 [−0.01 to 0.09]	0.04 [−0.01 to 0.09]	0.04 [−0.01 to 0.09]	0.04 [−0.01 to 0.09]
Global mean sea level rise in 2081–2100	0.52 [0.37 to 0.69]	0.40 [0.26 to 0.55]	0.47 [0.32 to 0.63]	0.48 [0.33 to 0.63]	0.63 [0.45 to 0.82]
Greenland ice sheet	0.09 [0.05 to 0.15]	0.06 [0.04 to 0.10]	0.08 [0.04 to 0.13]	0.08 [0.04 to 0.13]	0.12 [0.07 to 0.21]
Antarctic ice sheet	0.04 [−0.05 to 0.13]	0.05 [−0.03 to 0.14]	0.05 [−0.04 to 0.13]	0.05 [−0.04 to 0.13]	0.04 [−0.06 to 0.12]
Ice-sheet rapid dynamics	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.10 [0.03 to 0.19]	0.12 [0.03 to 0.20]
Rate of global mean sea level rise	8.1 [5.1 to 11.4]	4.4 [2.0 to 6.8]	6.1 [3.5 to 8.8]	7.4 [4.7 to 10.3]	11.2 [7.5 to 15.7]
Global mean sea level rise in 2046–2065	0.27 [0.19 to 0.34]	0.24 [0.17 to 0.32]	0.26 [0.19 to 0.33]	0.25 [0.18 to 0.32]	0.30 [0.22 to 0.38]
Global mean sea level rise in 2100	0.60 [0.42 to 0.80]	0.44 [0.28 to 0.61]	0.53 [0.36 to 0.71]	0.55 [0.38 to 0.73]	0.74 [0.52 to 0.98]
Only the collapse of the marine-based sectors of the Antarctic ice sheet, if initiated, could cause GMSL to rise substantially above the *likely* range during the 21st century. This potential additional contribution cannot be precisely quantified but there is *medium confidence* that it would not exceed several tenths of a meter of sea level rise.					

Notes:
[a] Excluding glaciers on Antarctica but including glaciers peripheral to the Greenland ice sheet.
[b] Including the height–SMB feedback.
[c] Including the interaction between SMB change and outflow.

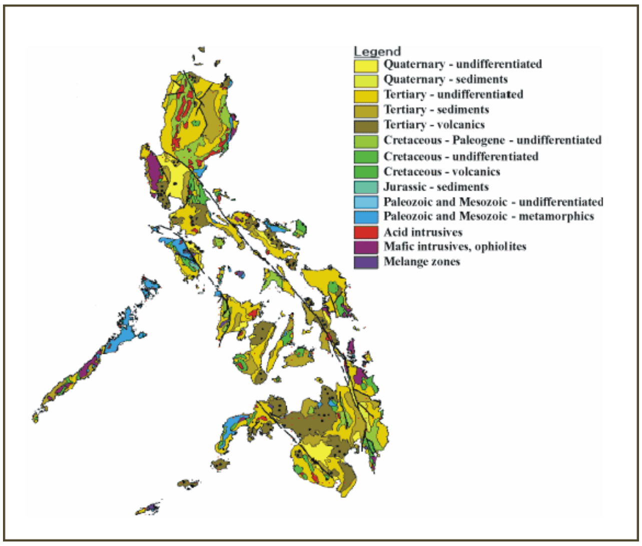
Source: IPPC AR5

7.2.5 Geotechnical Conditions

1) Geology

Figure 2.7-17 describes geological map of Philippines. As seen in the Figure, the area near SNS, SP1, SP2 and LLW are geologically classified as the formation of Tertiary-undifferentiated. The area near MBC seems different from the formation and is categorized as the formation of Tertiary-Sediments.

[9] IPCC (2013), *Climate Change 2013 The Physical Science Basis, Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 13 Sea Level* Change, Cambridge University Press



Source: DENR-Mines and Geosciences Bureau (MGB)

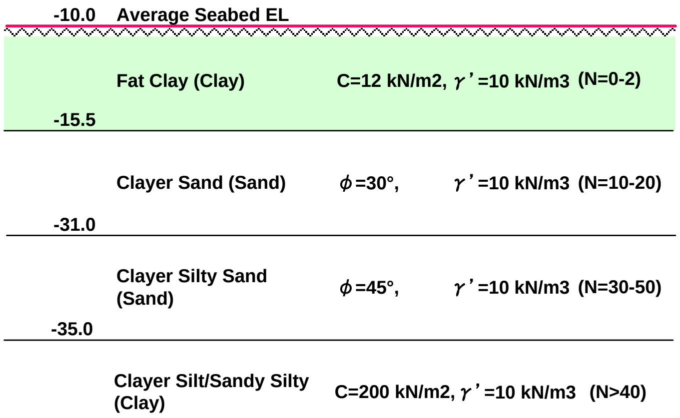
Figure 7.2-17 Geological Map in Philippines

2) Modeling of Subsoil Conditions for Each Prospective Sites

Based on the results of the geotechnical investigation carried out by the Survey Team, the subsoil conditions of each perspective site are summarized as follows. Further information of the investigation is presented in Appedix A3.

a) Sangley Point-1 (SP1)

Based on preliminary results of the offshore borings (6 boreholes for reclamation area and 3 boreholes for airport access) as well as field test carried out by the Survey Team, the modeled typical subsoil condition for SP1 is summarized as shown in Figure 7.2-18. The subsoil condition mainly represents four (4) types of soil layer such as very soft silt layer (Sandy Silt/Clayey Silt, Nav=2), compact sand layer (Silty Sand, N=10 to 20), compact to dense to very dense sand layer (Silty Sand, N=30 to 50), and hard silt layer (Clayey Silt/Sandy Silt, N>40). The very soft clay layer has approximate five (5) meters in thickness from the seabed and is likely to have consolidation settlement, in case of having overburden to be additionally loaded.

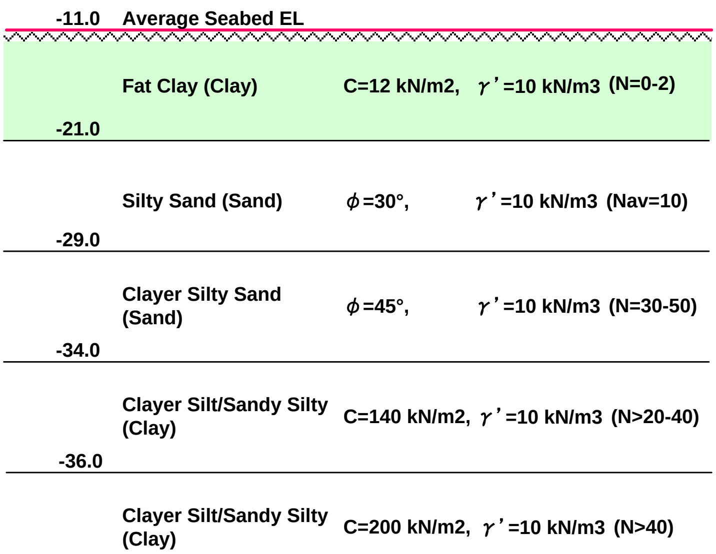


Source: Survey Team

Figure 7.2-18 Modelled Typical Sub-soil Condition (SP1)

b) Sangley Point-2 (SP2)

Based on preliminary results of the offshore borings (6 boreholes for reclamation area and 1 borehole for airport access) as well as field test carried out by the Survey Team, the modeled typical subsoil condition for SP2 is summarized as shown in Figure 7.2-19. The subsoil condition mainly consists of five (5) types of soil layer such as very soft clay layer (Fat Clay, N=0-2), loose to compact sand layer (Silty Sand, Nav=10), dense to very dense sand layer (Silty Sand, N=30-50), very stiff to hard silt layer (Clayey Silt/Sandy Silt, N=20 to 40), and hard silt layer (Clayey Silt/Sandy Silt, N>40). The very soft clay layer has approximate ten (10) meters in thickness from the seabed and is likely to have consolidation settlement, in case of having overburden to be additionally loaded.

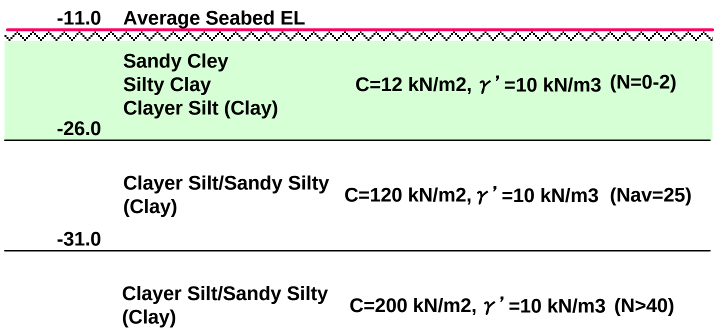


Source: Survey Team

Figure 7.2-19 Model Sub-soil Condition (SP2)

c) Manila Bay Center (MBC)

Based on the results of several hearings to private reclamation projects along the coastal area of Manila Bay, the assumed typical subsoil condition for MBC is summarized as illustrated in Figure 7.2-20. As seen in the Figure, the subsoil layers represented are respectively comprised of very soft clay layer (Sandy Clay/Silty Clay/Clayey Silt, N=0-2), very stiff clay layer (Clayey Silt/Sandy Silt, Nav=25), and hard silt layer (Clayey Silt/Sandy Silt, N>40). The very soft clay layer has approximate fifteen (15) meters in thickness from the seabed and is likely to have consolidation settlement, in case of having overburden to be additionally loaded.

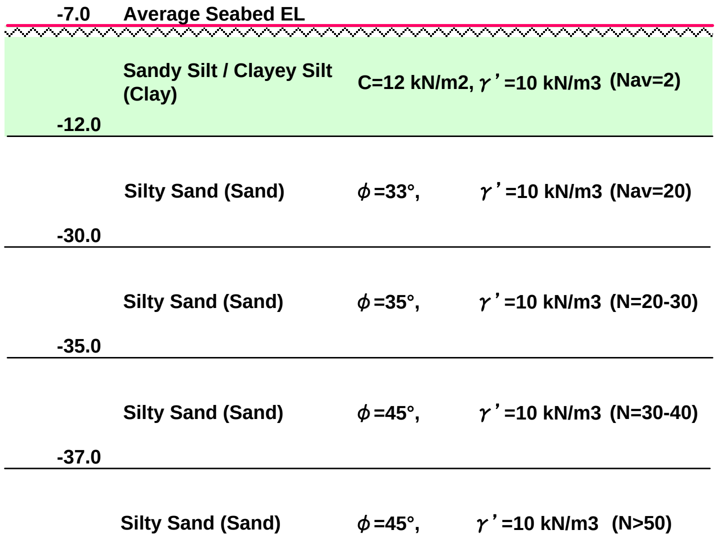


Source: Survey Team

Figure 7.2-20 Model Sub-soil Condition (MBC)

d) San Nicholas Shoals (SNS)

According to the results of soil boreholes nearest to the prospective site at SNS which was referenced from Pre-Feasibility Study for NAIA Sangley Point, the assumed typical subsoil condition for SNS is summarized as presented in Figure 7.2-21. As seen in the Figure, the subsoil layers represented are respectively composed of very soft silt layer (Sandy Silt/Clayey Silt, Nav=2), compact to dense sand layer (Silty Sand, N=20 to 40), and very dense sand layer (Silty Sand, N>50). The very soft silt layer has approximate five (5) meters in thickness from the seabed and is likely to have consolidation settlement, in case of having overburden to be additionally loaded.

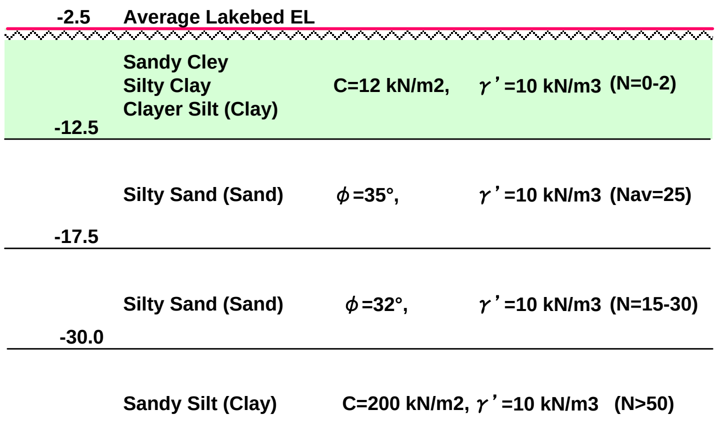


Source: Survey Team

Figure 7.2-21 Assumed Typical Sub-soil Condition (SNS)

e) Laguna lake west (LLW)

Based on the results of hearing to Laguna Lakeshore Expressway Project, the assumed typical subsoil condition for LLW is summarized as suggested in Figure 7.2-22. As found in the Figure, the typical subsoil layers are respectively categorized as very soft clay layer (Sandy Clay/Silty Clay/Clayey Silt, N=0-2), compact sand layer (Silty Sand, Nav=25), and hard silt layer (Sandy Silt, N>50). The very clay layer has approximate ten (10) meters in thickness from the seabed and is likely to have consolidation settlement, in case of having overburden to be additionally loaded.



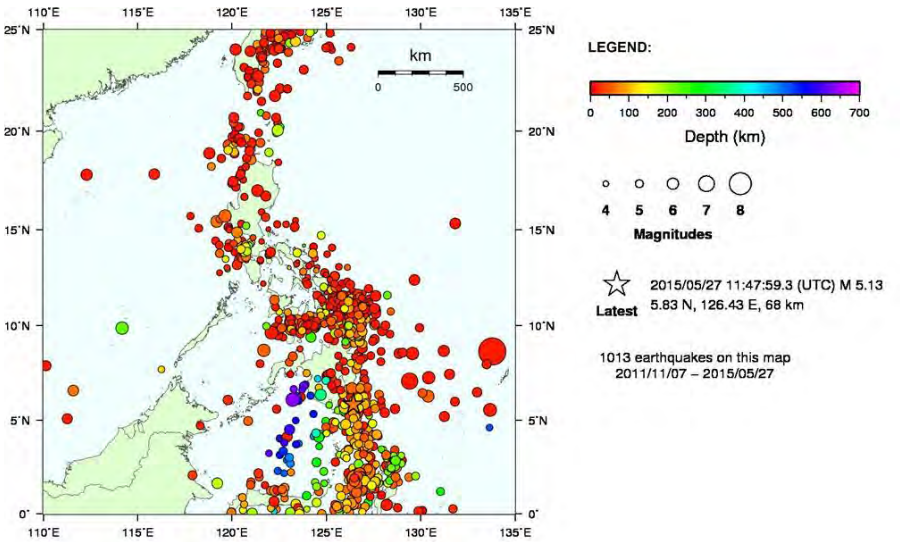
Source: Survey Team

Figure 7.2-22 Model Sub-soil Condition (LLW)

7.2.6 Earthquakes

1) Seismicity

Figure 7.2-23 presents a historical hypocenter distribution map around Philippines. There are three (3) characteristics in the distribution of the hypocenters; some hypocenters are concentrated from Visas to Mindanao Island along Pacific Ocean, a distribution belt of the hypocenters crossing Cebu Island exists, and two (2) hypocenter occurrences are grouped respectively around Manila Bay area and North-West Luzon Island. Locally, it seems that Manila Bay area has commonly confirmed the hypocenters of Magnitude 4 to 6 and their depths are varies from approximate 30 to 250 kilometers.

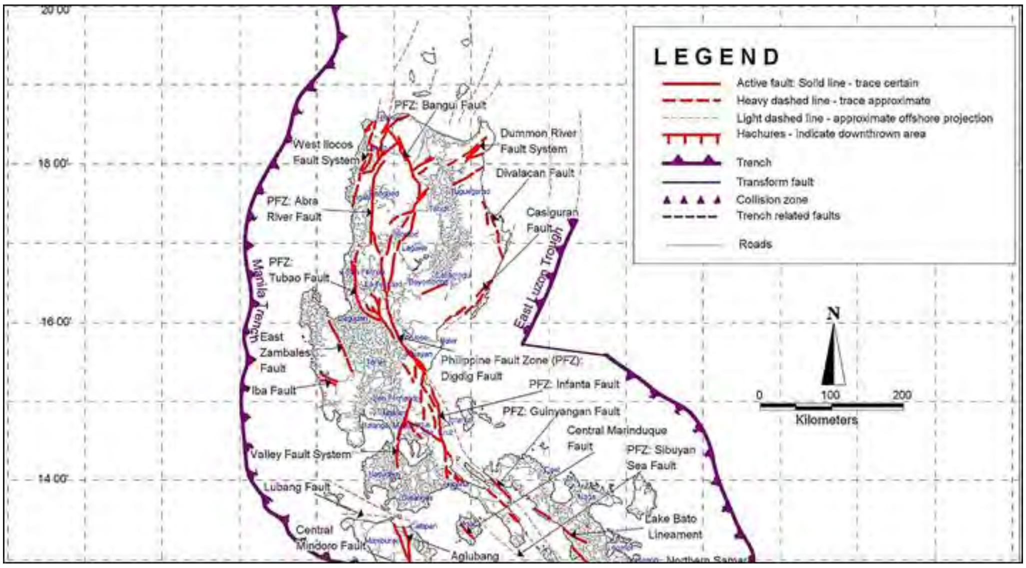


Source: PHILVOLCS

Figure 7.2-23 Historical Hypocenter Distribution Map around Philippines

2) Active Faults and Trenches

Figure 7.2-24 shows active faults and trenches recognized in Luzon Island. As shown in the Figure, there is no fault and trench under five (5) prospective sites in Manila Bay and Laguna Lake. However, it is confirmed that an active fault called as Valley Fault System is laid between Manila Bay and Laguna Lake to the extent from Rizal Province to Cavite Province. This is on-land fault nearest to the prospective sites of MBC and LLW. There is a significant trench named as Manila Trench which is located at west side of Luzon Island. The trench bears from north to south direction and is about 200 kilometers away from the entrance of Manila Bay.

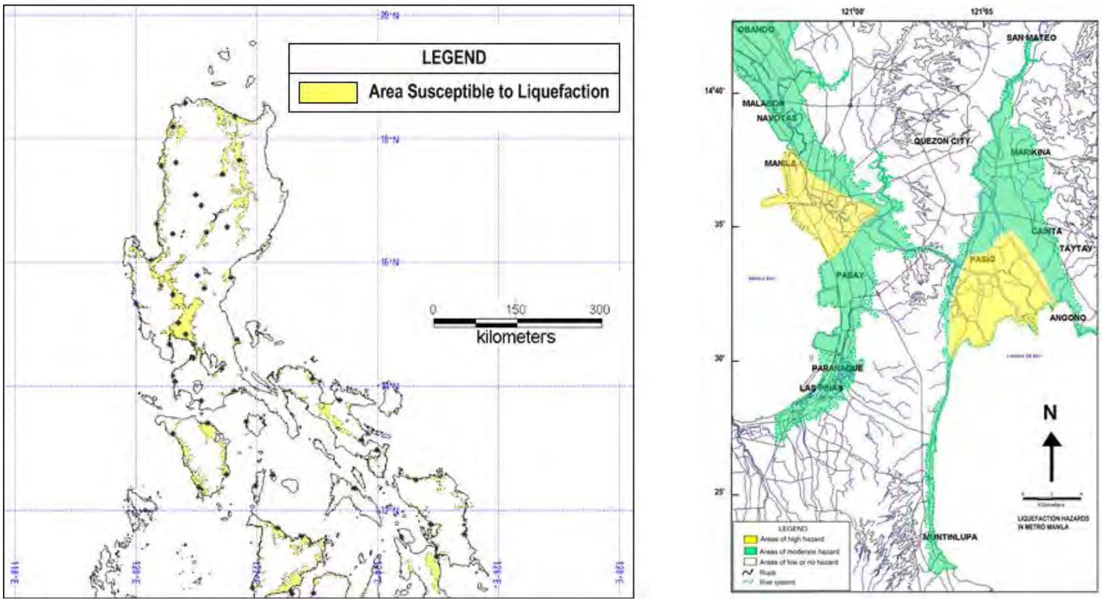


Source: PHILVOLCS

Figure 7.2-24 Active Fault and Trench Map in Philippines (Luzon Island)

3) Liquefaction

According to liquefaction susceptibility map at Luzon Island (see Figure 7.2-25 a)), it seems that north Manila Bay area is generally susceptible for liquefaction. Besides, locally, most shorelines of Metro Manila and Cavite Province, and lake shorelines of Laguna Province (and most likely Rizal Province) are categorized as high-moderate susceptible area for liquefaction (see Figure 7.2-25 b), and Figures 7.2-26 a) and b)). Form this susceptibility given, it is assumed that all five (5) prospective sites where silt and sand layers exists under Residual Water Level up to -20 meters from the seabed/lakebed are to possibly meet liquefaction based on past observation and monitoring surveys reported.

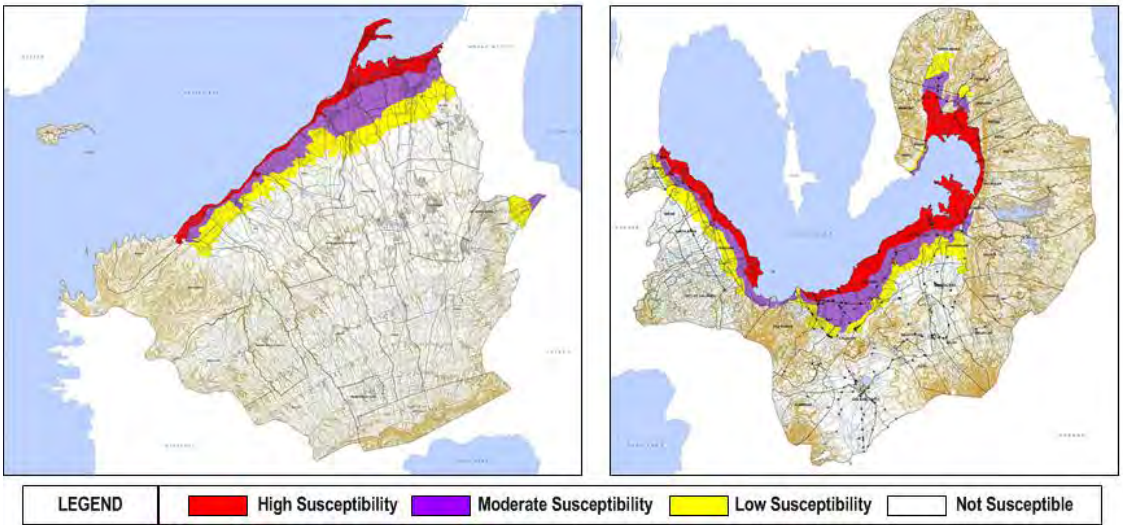


a) Liquefaction Susceptibility Map (Luzon Island)

b) Liquefaction Hazard Map (Metro Manila)

Source: PHILVOLCS

Figure 7.2-25 Liquefaction Susceptibility/Hazard Maps of Luzon Island and Metro Manila



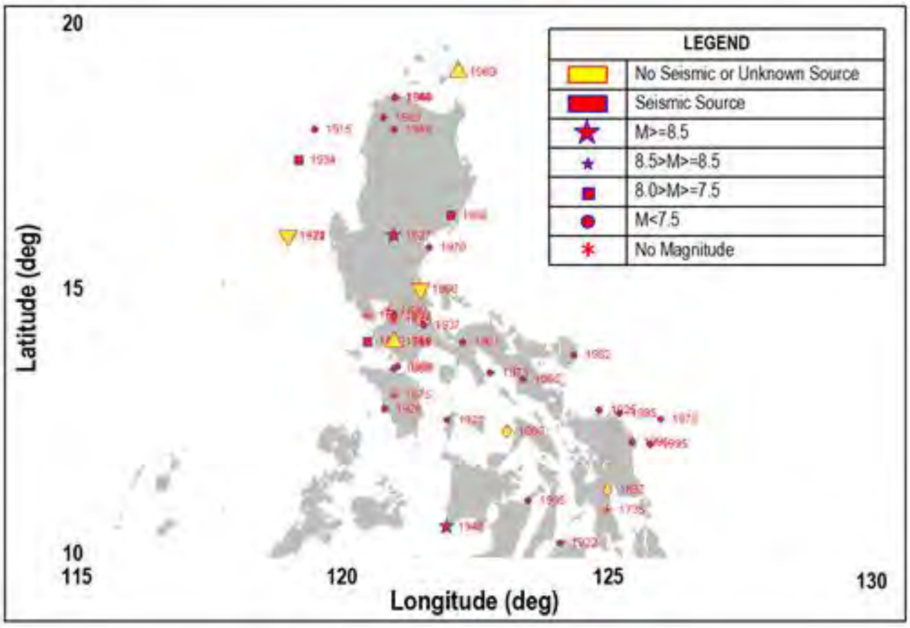
a) **Liquefaction Hazard Map (Cavite Province)** b) **Liquefaction Hazard Map (Laguna Province)**

Source: NAMRIA-Ready Project

Figure 7.2-26 Liquefaction Susceptibility/Hazard Maps for Cavite and Laguna Provinces

4) Tsunami

As described in Figure 7.2-27, there appear two (2) significant earthquakes in Manila Bay affected to generation of Tsunami respectively in 1828 and 1863. The former was occurred on 9 November in 1828 with magnitude 6.6, and the later happened on 3 June 1868 with magnitude 6.5, according to PHILVOCS.

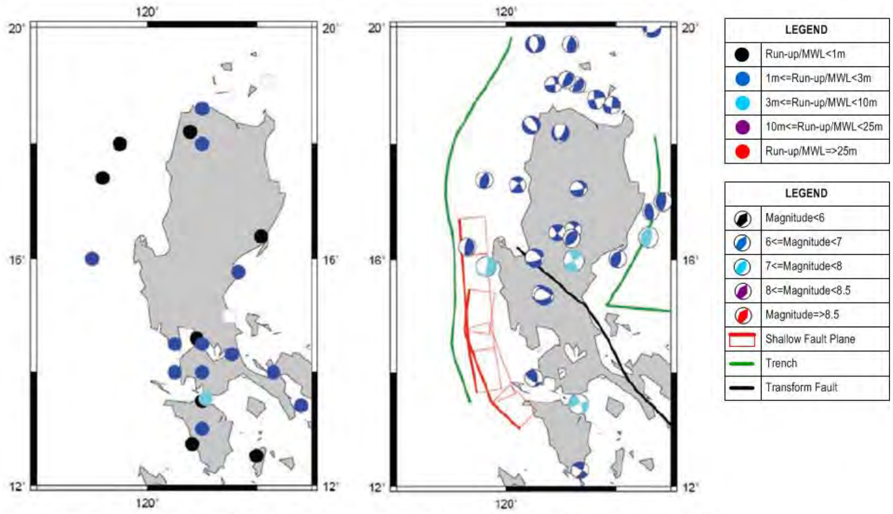


Source: NGI (2009)[10]

Figure 7.2-27 Recorded Earthquakes Caused of Historical Tsunami in Northern Philippines

[10] NGI (2009) *Tsunami Risk Reduction Evaluation for the Philippines-Tsunami Risk Reduction Measures Phase 2*, CCOP

The above introduced two (2) historical earthquakes in 1828 and 1868 generated Tsunami as illustrated in Figure 2.7-28. The one Tsunami wave height was less than 1 meter from Mean Water Level (MSL). The other was in the range between 1 to 3 meters from MWL (MSL). As found in the Figure, it is presumed that there has not been any earthquake originated of movement at Manila Trench especially west side of Manila Bay, but there is no scientific certain back data to be deniable for its occurrence.

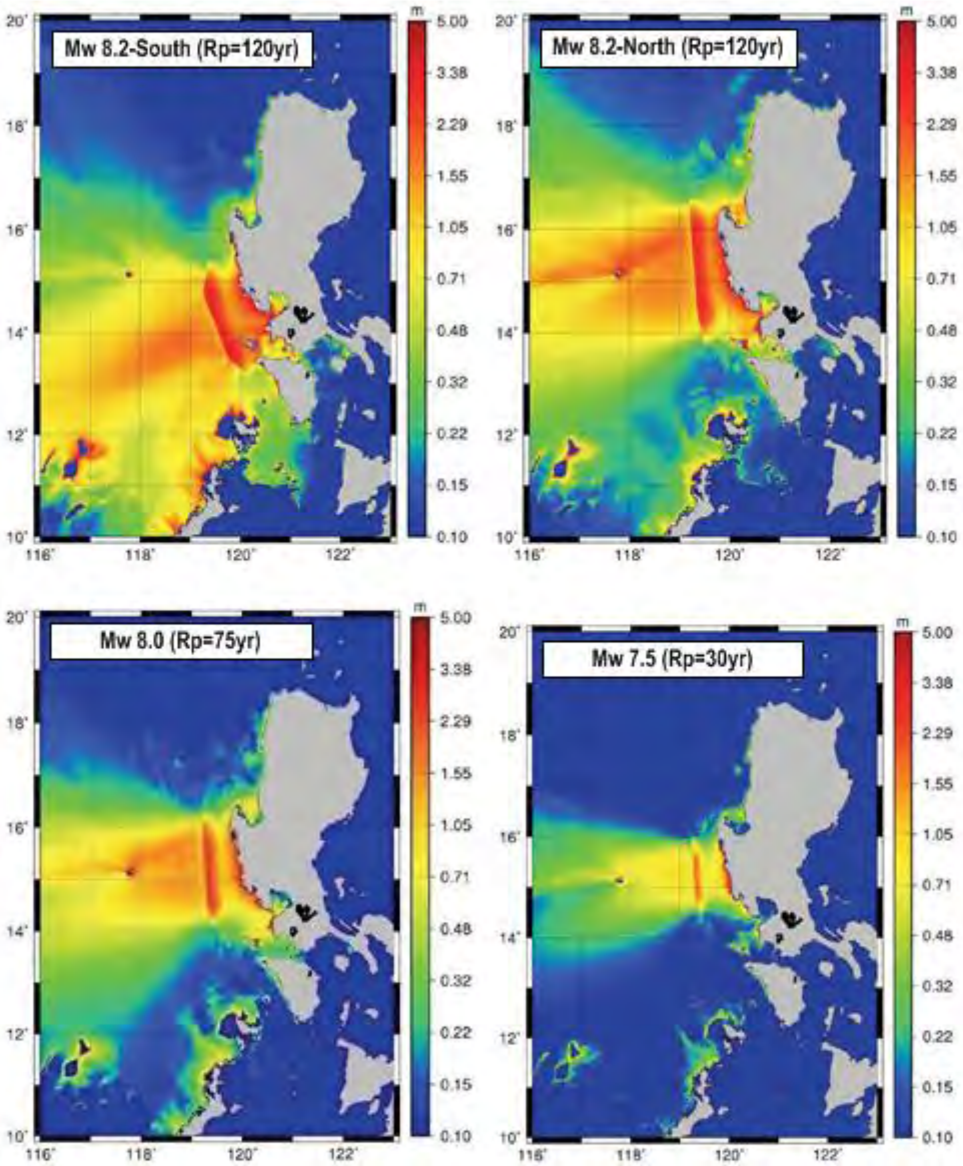


i) Historical Tsunami Wave Height Color-Coded ii) Map View of Fault Planes and CMT Solution (Magunitude)

Source: Summary Report for Tsunami Risk Reduction Evaluation for the Philippines

Figure 7.2-28 Historical Tsunami and Seismicity for Luzon Island

Figure 7.2-29 presents distribution maps of simulated maximum surface water elevation for four (4) Manila Trench Scenarios. The four (4) scenarios were suggested in the Summary Report of Tsunami Risk Reduction Evaluation for the Philippines, resulting north-south shrinkage of the fault plane. The upper left and right scenarios are respectively of a southern Magnitude 8.2 and of a northern Magnitude 8.2 with the return period of 120 years, the lower left is of a Magnitude 8.0 with the return period of 75 years and the lower right is of a Magnitude 7.5 with return period of 30 years. As seen in the Figure, the water surface elevations of Manila Bay south shoreline are in the range respectively between 1.0 to 5.0 meters from MWL (MSL) in case of southern/northern Magnitude 8.2, between 0.5 to 1.5 meters in case of Magnitude 8.0, and between 0.1 to 0.4 meters in case of Magnitude 7.5.



Source: Summary Report for Tsunami Risk Reduction Evaluation for the Philippines

Figure 7.2-29 Simulated Max. Surface Water Elevation for four (4) Manila Trench Scenarios

7.2.7 Flooding

According to LLDA, Laguna Lake historically had several extreme water level conditions as similar to flood situation. The extreme water level conditions are listed in Table 7.2-6.

Table 7.2-6 Historical Extreme Water Level Conditions of Laguna Lake

Water Level	LDBDL (m)	MSL (m)	MLLW (m)
Extreame Water Level (1919)	14.62	4.12	4.62
Extreame Water Level (1972)	13.96	3.46	3.96
Extreame Water Level (1978)	13.49	2.99	3.49
Extreame Water Level (1986)	13.29	2.79	3.29
Extreame Water Level (2009)	13.93	3.43	3.93
Annual Maximum Lake Water Level	12.50	2.00	2.50
Laguna Del Bay Datum (LDBDL)	0.00	-9.50	-10.00

Source: LLDA

7.2.8 Land Subsidence

Stringan, et al. (2010)[11], estimated the current land subsidence rate in Manila Bay area in his paper, which implies 2.0 cm per year. It is assumed that the subsidence is likely caused by drawing ground water initiated upon facilitation of economical and industrial activities at Metro Manila, and Cavite, Rizal and Laguna Provinces, and the rate may increase depending on the situation of activities without restriction to be made by governmental agencies. The rate of the land subsidence is to be considered as an additional margin for raising structure such as seawall or revetment bank.

[11] Stringan, Maria, Villanoy, Martin, David, Borja, Agganga, and Capistrano (2010) *Sea-level Changes in the Philippines: causes and some consequences*

7.3 Initial Baseline Conditions of Natural Environment

7.3.1 Water Quality

According to PRA report[12], PRA carried out a water quality survey in PRA Quarry Project for eight (8) locations away within 5 km from the coastline, such as Ternate 1 and 2, Naic 1 and 2, Tanza 1 and 2, and Rosario 1 and 2. The quality examined were Total Coliforms, Total Suspended Solids (TSS) and oils and grease. The results of the laboratory analysis are indicated in Table 7.3-1.

Table 7.3-1 Parameters of Water Quality near SNS

Station	Total Coliforms (MNP/100ml)	TSS (mg/l)	Oils and Grease (mg/l)
Ternate 1	1,300	<2.5	0.62
Ternate 2	17	3	0.71
Naic 1	240	3	0.6
Naic 2	3,500	6	0.64
Tanza 1	70	7	0.71
Tanza 2	240	8	0.58
Rosario 1	1,400	8	0.59
Rosario 2	1,600	9	0.73
DENR DAO 34	<1,000	-	2

Source: PRA Report (2015)

The results of the analysis highlight exceeding of value of Total Coliforms against DENR-DAO 34 especially at Naic 2, and Rosario 1 and 2, where are located respectively at offshore of each town that habitation is locally conglomerate. It seems that other parameters such as TSS, and Oils and Grease are more or less standard level.

For the rest four (4) prospective sites, i.e. SP1, SP2, MBC and LLW, the Survey Team conducted water quality survey. The water samplings were taken from the middle to the end of March 2015, and the laboratory test was undertaken after April 2015. Each location had six (6) points and every one (1) location was composed of two (2) layers (-0.5 m under the water surface and +0.5 m above sea/lakebed) for taking samples. The parameters of the water quality were water transparency, water temperature, pH, DO, COD, salt concentration, n-Hexane Extract, Total Coliforms and Total Zinc.

Figures 7.3-1 and 7.3-2 respectively exhibits snapshots of the results of water quality survey for SP1 and SP2, and for MBC and LLW. The following are outlines of the results of the survey for the prospective sites:

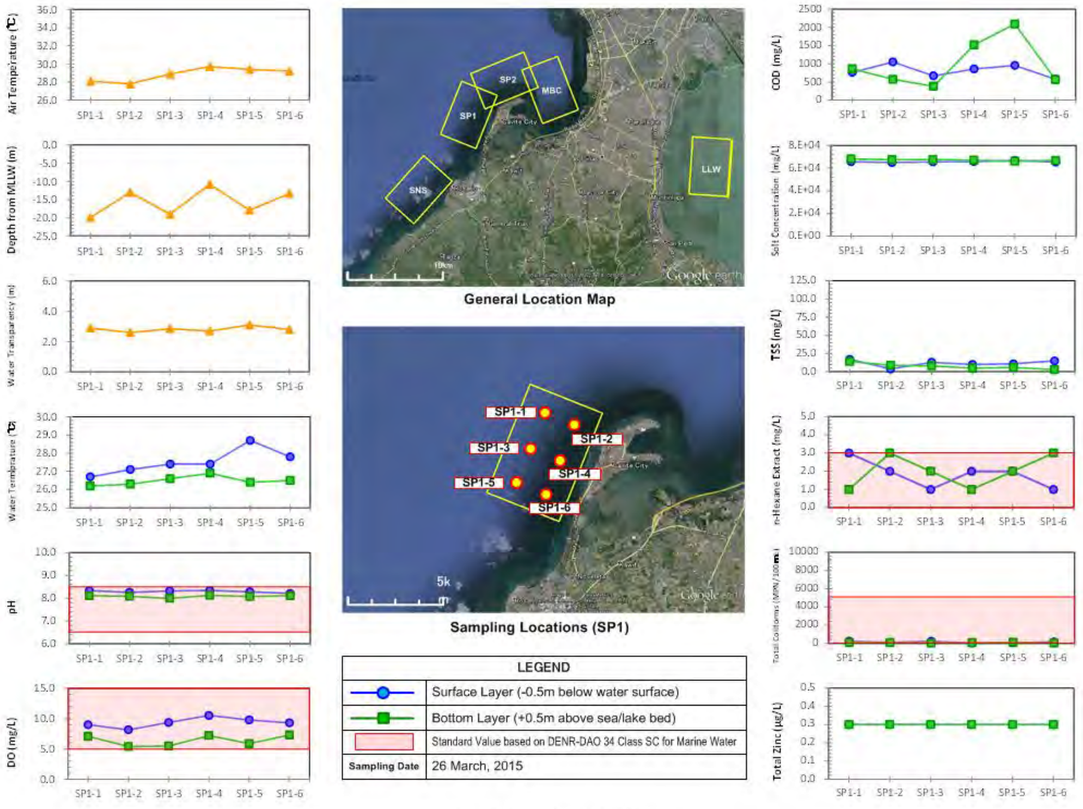
i) SP1: water transparency was mostly constant around 3 meters. Water temperature was averaged respectively as 27℃ at surface layer and 26℃at bottom layer. pH was in the range between 8.0 and 8.5 for the both layers within standard value of DENR-DAO 34 Class SC for Marine Water. DO was distributed between 5 and 10 mg/l categorized as the standard value and the one of surface layer was about 3-5 mg/l higher than the one of

[12] PRA (2015) *The New Manila Gateway: NAIA-SANGLEY POINT-A Pre-feasibility Study*

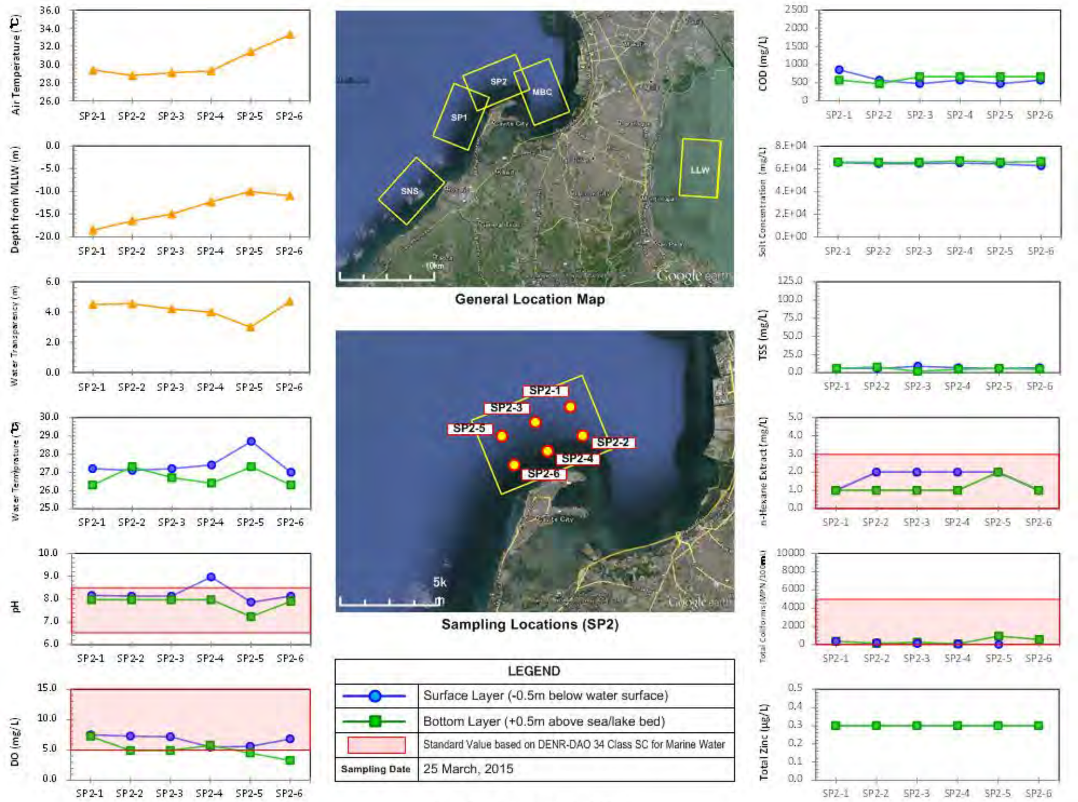
bottom layer. COD was generally fallen between 600-1,000 mg/l for both layers, but the one of SP1-3 and -4 at bottom layer respectively showed 1,500 and over 2,000 mg/l. Salt concentration was constantly distributed about 70,000 mg/l in all the points and layers. TSS was categorized between 0 and 25 mg/l and most likely constant for all the points and layers. N-Hexane Extract was all less than 3 mg/l specified in the standard value given. Total Coliforms was nearly 100 MPN/100ml and nonsignificant for all the points and layers. Total Zinc was less than 3 μg/l for all the points and layers.

ii) SP2: water transparency was mostly beyond 4 meters except for 3 meter at SP2-5. Water temperature was averaged respectively as 27.5℃ at surface layer and 26℃at bottom layer. There is the tendency to increase water temperature toward SP2-5 and -6 which may be correlated to water depth. pH was in the range between 7.0 and 8.5 for the both layers within standard value of DENR-DAO 34 Class SC for Marine Water, however one exemption appeared in the value of surface layer at SP2-4 (pH=9). DO was distributed between 5 and 8 mg/l recognized as the standard value but the value of bottom layer at SP2-2 is less than 5 mg/l out of the standard value specified. COD is generally fallen constantly between 400-900 mg/l for both layers. Salt concentration is constantly distributed between 60,000 and 65,000 mg/l in all the points and layers. TSS is categorized as less than 10 mg/l and most likely constant for all the points and layers. N-Hexane Extract was all less than 3 mg/l specified in the standard value given. Total Coliforms was in the range between 80 and 1,000 MPN/100ml and still under the standard value for all the points and layers. Total Zinc was less than 3 μg/l for all the points and layers.

iii) MBC: water transparency was averaged as 2 meters for all the points and layers. Water temperature had similar trend for the both layers but is 26-27℃ from MBC-1 to -4 and 27.5-28 5℃ from MBC-5 to -6. averaged respectively as 27.5℃ at surface layer and 26℃at bottom layer. The tendency of increasing the temperature may be correlated to variation of water depth. pH was mostly constant in the range between 8.0 and 8.5 for all the points and layers within standard value of DENR-DAO 34 Class SC for Marine Water. DO was distributed between 8 and 10 mg/l for surface layer at all the points categorized in the standard value but the one of bottom layer especially from MBC-2 to MBC-5 was 3-4 mg/l less than the standard value suggested. COD was generally fallen between 300-800 mg/l for both layers except for the one of MBC-3 and -4 for surface layer is noticeably jumped up to 2,000 mg/l. Salt concentration was constantly distributed nearly about 70,000 mg/l in all the points and layers. TSS was categorized as less than 10 mg/l constantly for all the points and layers. N-Hexane Extract was all less than 3 mg/l specified in the standard value given. Total Coliforms was commonly distributed between 350 and 1,600 MPN/100ml.



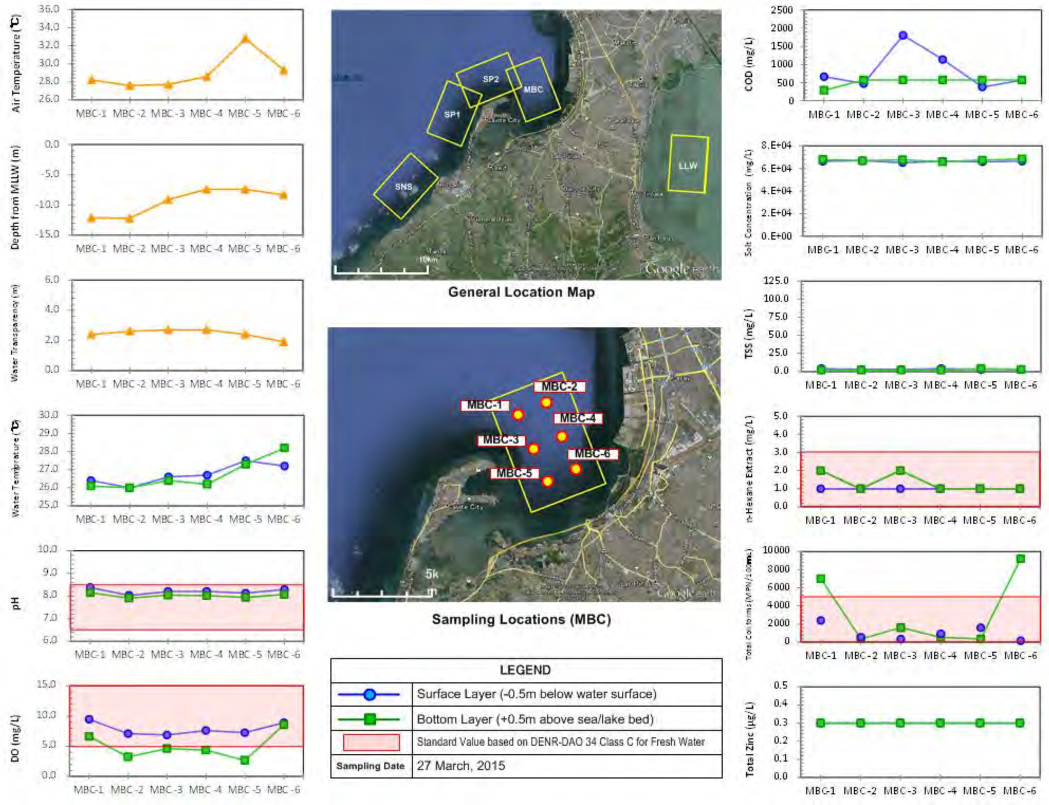
a) Sangley Point-1 (SP1)



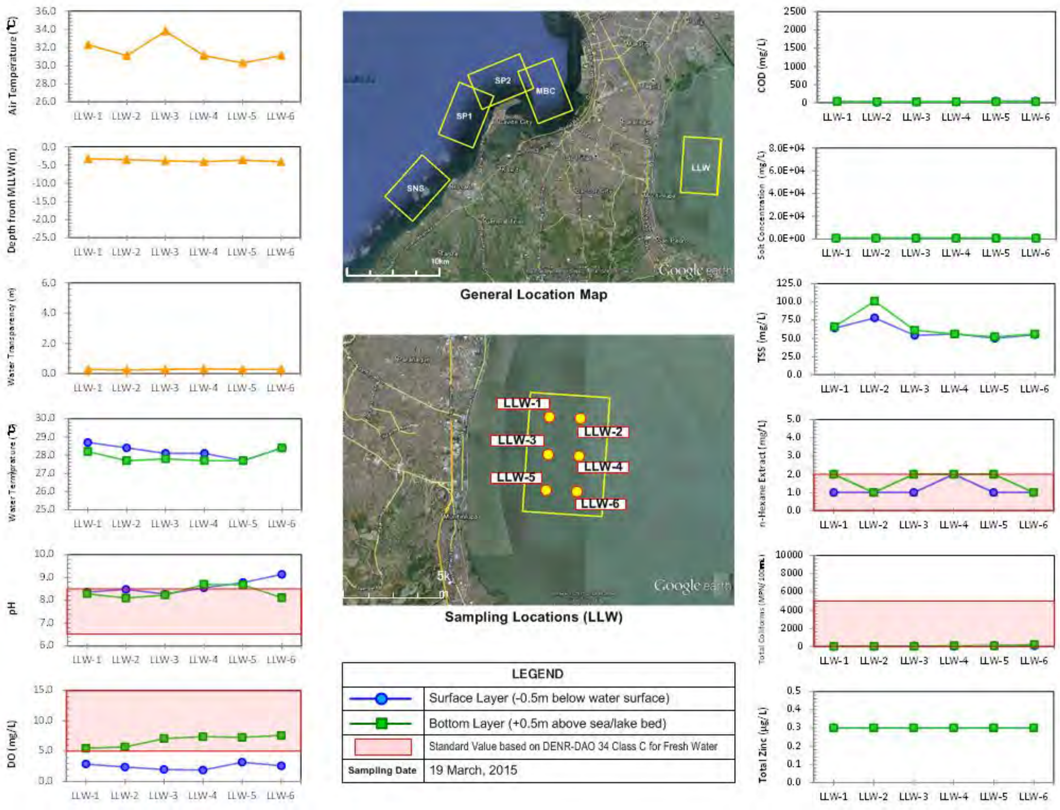
b) Sangley Point-2 (SP2)

Source: Survey Team, Location Maps made on Google Earth

Figure 7.3-1 Snapshots of the Results of Water Quality Survey (SP1 & SP2)



a) Manila Bay Center (MBC)



b) Laguna Lake West (LLW)

Source: Survey Team, Location Maps made on Google Earth

Figure 7.3-2 Snapshots of the Results of Water Quality Survey (MBC & LLW)

However, those of MBC-1 and -6 for bottom layer respectively showed 7,000 and 9,200 MPN/100ml beyond 5,000 MPN/100ml as the standard value. Total Zinc was less than 3 μg/l for all the points and layers.

iv) LLW: water transparency was less than 0.5 meters for all the points and layers. Water temperature had similar trend for the both layers to the extent of 28-29℃. pH was mostly averaged as 8.5 but the values at LLW-4, -5 and -6 for the both layers were beyond 8.5 consequently out of the standard value of DENR-DAO 34 Class C for Fresh Water. DO was distributed between 5 and 8 mg/l for surface layer at all the points categorized in the standard value but the one of all the bottom layers was indicated as below 3 mg/l less than the standard value introduced. COD was generally lower as below 50 mg/l for all the points and layers. Salt concentration was quite lower than the values of other locations in Manila Bay, which is averaged as 650 mg/l. TSS was categorized as more than 60 mg/l and the values of LLW-2 are respectively 80mg/l at bottom layer and 100mg/l at surface layer. N-Hexane Extract was all less than 3 mg/l specified in the standard value given. Total Coliforms was commonly distributed between 10 and 250 MPN/100ml classified within the standard value. Total Zinc was less than 3 μg/l for all the points and layers.

7.3.2 Sediment Quality

PRA significantly introduces in his report a fact that mean concentrations of heavy metals' such as cadmium, chromium and plumbum are exceedingly high in every site sampled in Manila Bay, and suggests that regular monitoring in the coast area is to be required so as not to aggravate conditions any further. The sediment distribution in Manila bay as previously presented in Figure 7.2-3 indicates shown "mud" component may include such heavy metal elements especially along the coastline and the distribution and deposit might increase widely in the Bay. As mentioned by PRA, the periodical monitoring is essential for detail examination as well as countermeasure to be taken by relevant authorities collaboratively.

In case of SNS, although there is no existing results of sediment quality in this area, it is presumed that SNS is not affected by such chemical contamination, because the area is located within sand sedimentation (refer to Figure 7.2-3) and faces on open-coast having certain waves and currents generated without such environment of deposit accumulation including chemical contamination. In case of other four (4) prospective sites, i.e. SP1, SP2, MBC and LLW, the Survey Team conducted initial sediment quality survey. The sediment samplings were taken from the middle to the end of March 2015, and the laboratory test was undertaken after April 2015. Each location had six (6) points. The parameters of the sediment quality were sample temperature, color, odor, pH, Particle Size (D50), TOC (for dried sample), Ignition Loss, Total Nitrogen, Organic Nitrogen Compound, Total Phosphorus and Organophosphorus Compound.

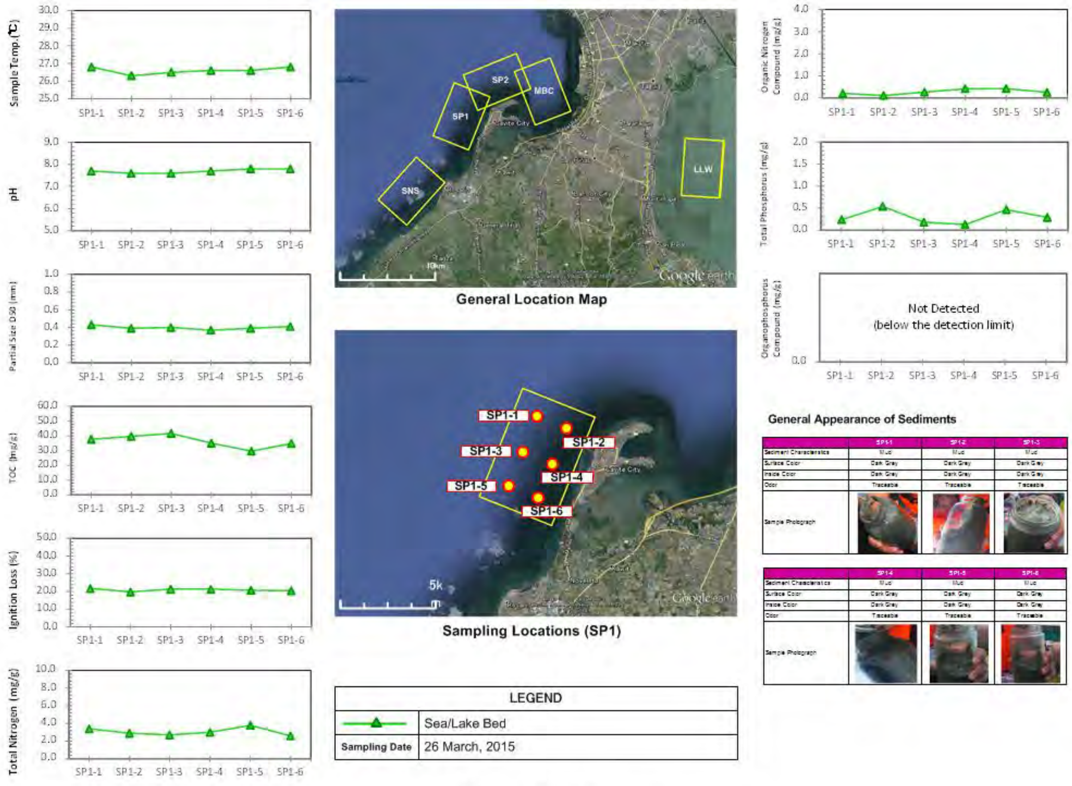
Figures 7.3-3 and 7.3-4 respectively exhibits snapshots of the results of sediment quality survey for SP1 and SP2, and for MBC and LLW. The following are outlines of the results of the survey for the prospective sites:

i) SP1: sample temperature was averaged as 26.5 ℃. Color of the samples obtained was dark greyish green and no odor was identified. pH was 7.6-7.8 in constant for all the points. Particle Size (D50) was in the rage between 0.37 and 0.43 mm. TOC was about 35 mg/g for all the points. Ignition Loss was categorized in the range between 19-21 %. Total Nitrogen indicated average 3 mg/g. Organic Nitrogen Compound was small value in the range between 0.1 and 0.4 mg/g. Total Phosphorus showed 2.5 mg/g in average for all the points. Organophosphorus Compound was not detected which is below the limit of detection.

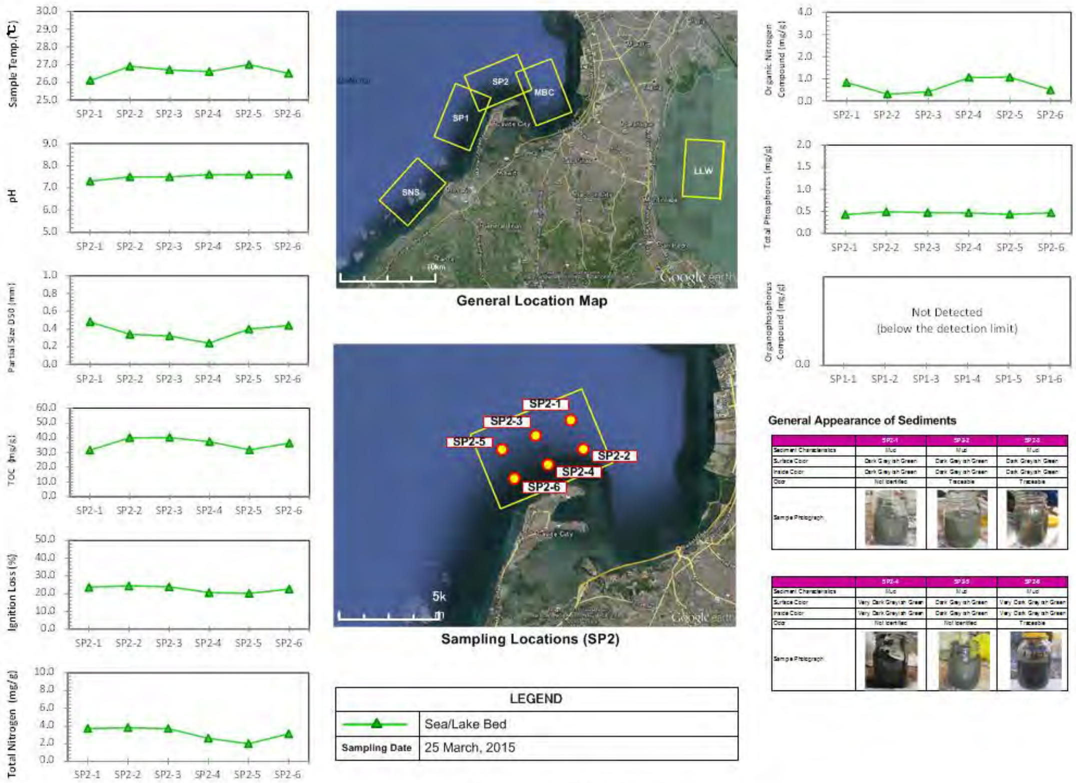
ii) SP2: sample temperature was averaged as 26.5 ℃. Color of the samples obtained was dark greyish green and very dark grayish green. No odor was identified. pH was 7.5 in constant for all the points. Particle Size (D50) was in the rage between 0.24 and 0.48 mm. TOC was about 40 mg/g averaged for all the points. Ignition Loss was categorized in the range between 20-25 %. Total Nitrogen indicated average 3 mg/g. Organic Nitrogen Compound was in the range between 0.3 and 1 mg/g. Total Phosphorus showed 0.45 mg/g in average for all the points. Organophosphorus Compound was not detected which is below the limit of detection.

iii) MBC: sample temperature was averaged as 26.5 ℃ in the tendency to increase the temperature toward MBC-5 and -6. Color of the samples obtained was dark greyish green, dark green and black. Odor was strong to very strong. pH was averaged as 7.5 in constant for all the points. Particle Size (D50) was in the rage between 0.4 and 0.46 mm. TOC was about 40 mg/g averaged for all the points but same trend of increase as the sample temperature. Ignition Loss was categorized in the range between 18-30 %. Total Nitrogen indicated average 3.5 mg/g. Organic Nitrogen Compound was in the range between 1.5 and 3 mg/g but same trend of increase as the sample temperature. Total Phosphorus showed 0.5 mg/g in average for all the points but the values were fluctuant. Organophosphorus Compound was not detected which is below the limit of detection.

iv) LLW: sample temperature was averaged as 28 ℃. Color of the samples obtained was dark grey. Odor was traceable. pH was 6.7 in average of all the points. Particle Size (D50) was in the rage between 0.33 and 0.42 mm. TOC was about 30 mg/g averaged for all the points. Ignition Loss was categorized in the range between 18 %. Total Nitrogen indicated average 4 mg/g. Organic Nitrogen Compound was in the range between 0.5 and 1.5 mg/g. Total Phosphorus showed 0.15 mg/g in average for all the points. Organophosphorus Compound was not detected which is below the limit of detection.



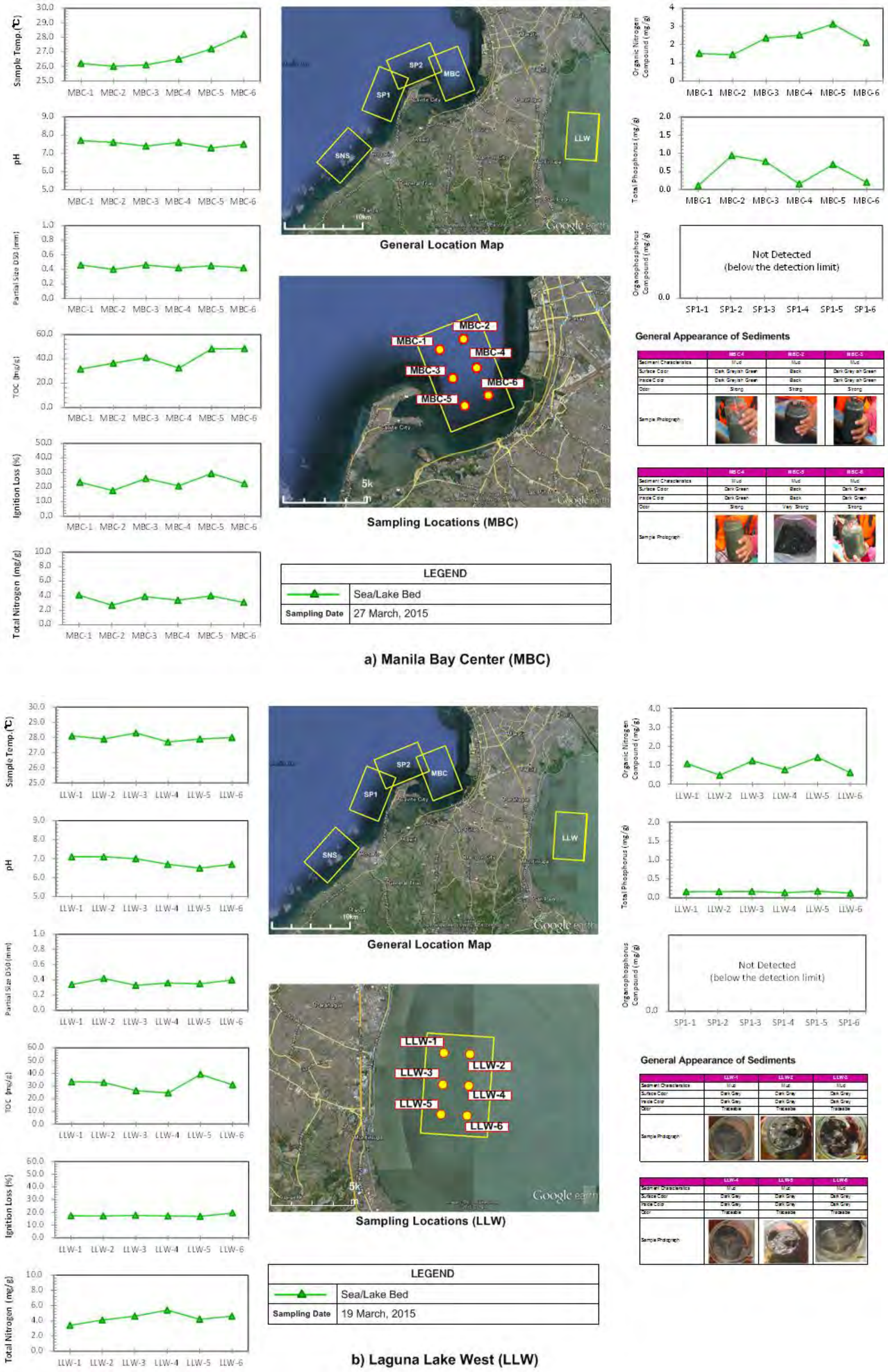
a) Sangley Point-1 (SP1)



b) Sangley Point-2 (SP2)

Source: Survey Team, Location Maps made on Google Earth

Figure 7.3-3 Snapshots of the Results of Water Quality Survey (SP1 & SP2)



Source: Survey Team, Location Maps made on Google Earth

Figure 7.3-4 Snapshots of the Results of Water Quality Survey (MBC & LLW)

7.4 Initial Baseline Conditions of Social Environment

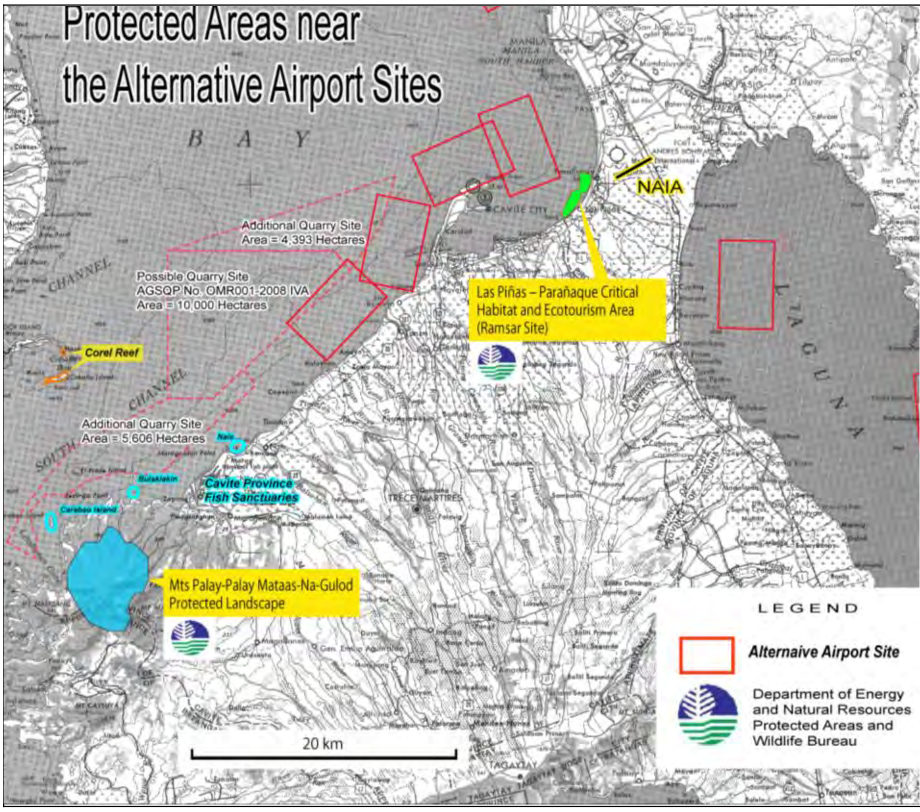
7.4.1 Biological Status

7.4.1.1 Manila Bay

Environmental Management Bureau cites as mangroves, wetlands, coral reefs and seagrass bed are the valuable ecosystem components in Manila Bay (Manila Bay Coastal Strategy, EMB). However, these productive characteristics are quickly diminishing in Manila Bay, especially in the alternative sites of the proposed airport.

Mangrove forests exist only at an estuary of Ilong-Ilong river in Noveleta and Kawit, and another one in Las Piñas-Parañaque Critical Habitat and Ecotourism Area (LPPCHEA) with plantation effort. Coral reefs and seagrass beds are remained at the mouth of Manila Bay only. In terms of corals, fishermen randomly interviewed report that there are already no sightings of live corals within the vicinity of the project site. This is in contrast to the findings of a 1992-1993 BFAR Ecological Assessment Study which confirmed that live corals reefs could still be found in Cavite and Corregidor, among others. An ICLARM report in 1996, mentioned that live coral ranged from 10.9% to 70.9% in Manila Bay. The same Report mentioned that live coral cover in Calumpang, a marine reserve in west of Cavite Province (Canopy International, EDRB-DENR Vol 26 No. 5, p4; Sep.-Oct. 2000).

Development pressure altered mangrove forests once existed into fishponds; and wetlands are occupied by residential houses or reclaimed, totally losing the productive lands. Thereby LPPCHEA became valuable "natural" wetland in the metropolitan area; it is designated as a protected area by Presidential Proclamation No. 1412 and No. 1412a in 2007 and 2008 respectively. Later it is also designated as Ramsar Site in March 15th, 2013. Distribution of protected sites by DENR and Cavite Provinve are shown in Figure 7.4-1.



[LPPCHEA]
175-hectare coastal wetland area, consisted of:
-Mudflats/Lagoons 114 ha.
- Mangrove area 30 ha.
- Mixed beach forest 20 ha.
- Fishponds 9.7 ha., supporting 82 species of birds, 37 species of macro benthos, and 80 species of plants

Figure 7.4-1 Protected Areas near Project Candidate Sites

Contamination of seawater is so serious that fecal coliform in shellfish collected from Bulacan, Bacoor, Kawit, Naic, and Parañaque exceeded the European Union guideline of 300 MPN/100g shellfish by 1.3 to 2,667 times (*Sustainable Development and Management of Manila Bay: A Focus on Water Quality* (2006) Vol 2, No.2, PEMSEA).

7.4.1.2 Laguna Bay Area

1) Present Status

Although there were 23 species of fish belonging to 16 families and 19 genera were found in Laguna Lake, now there are only 13 species and no record of endemic species (*Restoring Balance in Laguna Lake Region (2013) Ecological Footprint Report*, Global Foot Print Network, LLDA, MMDA). The diversity of the indigenous fish, crustacean, and mollusk species in the lake has considerably declined since the late 1950s. The introduction of exotic species, the destructive harvesting methods, chemical pollution from adjacent factories, and overall industrialization are hastening the conversion of natural habitats and the extirpation of many of the indigenous species in the lake basin (Ecosystems and People (2005) Environmental Forestry Programme College of Forestry and Natural Resources, University of the Philippines).

Photo by Reyes, R.B

Dominant Species in Laguna lake
(Silver perch): Therapon plumbeus

Photo by Phanara Thach

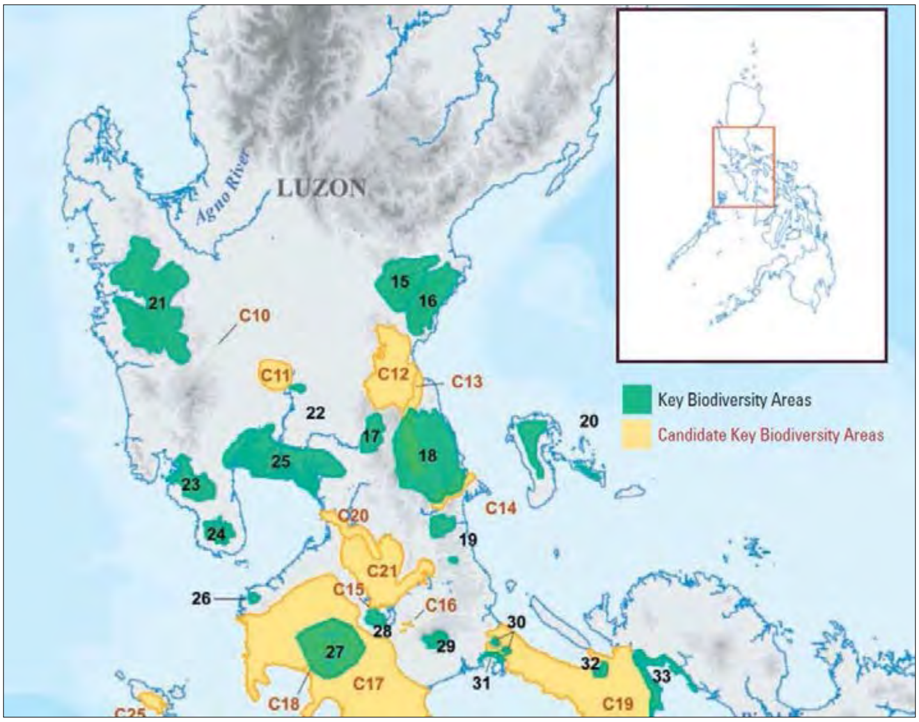
Important constituent in the lake:
Glossogobius giurus (white goby)

2) Effort for Conservation

Laguna Lake is identified as Conservation Priority Area (CPA) by Philippine Biodiversity Conservation Priority-setting Program, which identified 206 CPAs in the program. Later, environmentally-oriented NGO, Conservation International Philippines (CI Philippines), advocated KBA (Key Biodiversity Areas) system for nation-wide conservation method, and also designated Laguna Lake as "candidate" KBA. Locations of KBA near the project sites are shown I Figure 7.4-2.

CI Philippines has found 128 KBAs and 51 candidate KBAs in the Philippine archipelago. Laguna Lake is selected as a "candidate KBA". The candidate KBAs are separated from KBAs because there is no conclusive data for KBA identification, which also means that there is:

- No globally threatened species (Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) according to IUCN Red List) has found;
- No Restricted-range species (global population of one or more species with a limited global range size (provisionally set at 50,000 square kilometers) (RR) has found; and
- No Congregatory species (CC) a significant proportion (provisionally set at 1 %) of the global population of a congregatory species) has found in Laguna Lake.



Source: *Priority Sites for Conservation in the Philippines*, Concervation International, DENR

Figure 7.4-2 KBAs and Candidate KBAs near the Alternative Sites

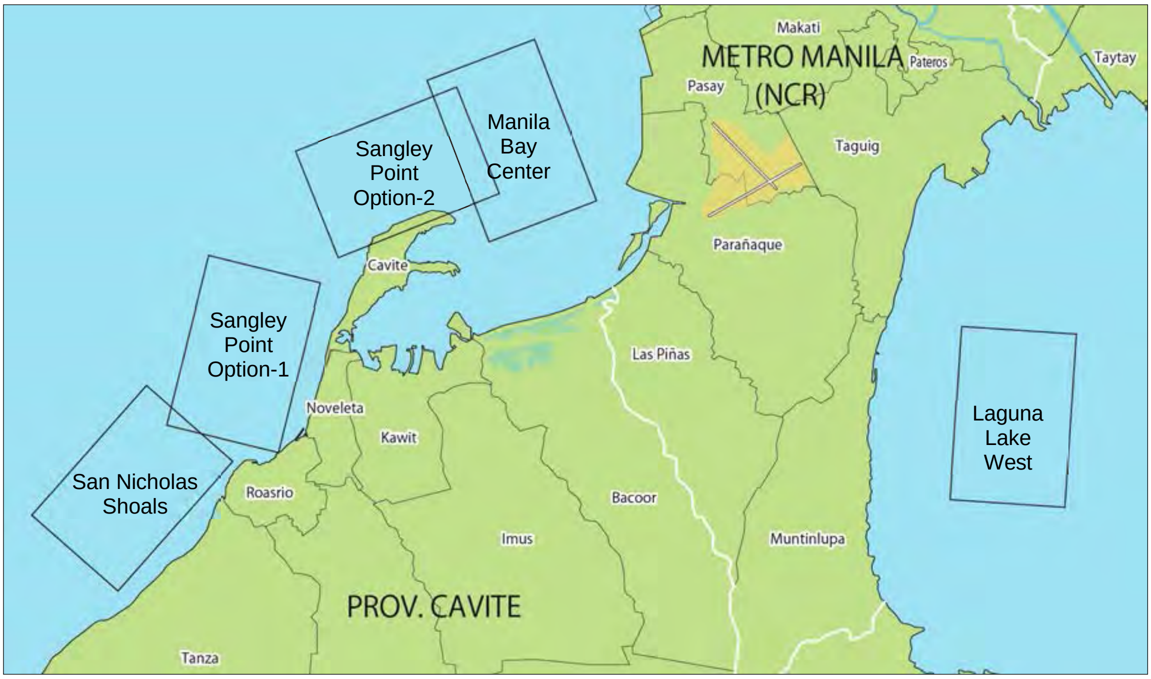
Table 7.4-1 Contents Designation of LagnaLake as KBA Candidate

No.	Name of Candidate KBA	Location		Area (ha)	Remarks
		Municipalities	Province/s		
C21	Laguna de Bay	San Pedro, Biñan, Sta. Rosa, Cabuyao, Calamba, Los Baños, Bay, Calauan, Victoria, Pila, Sta. Cruz, Lumban, Kalayaan, Paete, Pakil, Pangil, Siniloan, Famy, Mabitac, Jalajala, Pallilia, Tanay, Baras, Morang, Cardona, Binangonan, Angono, Taytay, Taguig, Muntinlupa	Laguna, Manila, and Rizal	89,914	Overlaps with CPA*36

*CPA: Conservation Priority Area. Philippine Biodiversity Conservation Priority-setting Program identified 206 CPAs.
Source: Candidate Key Biodiversity Areas (KBAs), Priority Sites for Conservation in the Philippines: Key Biodiversity Areas, Conservation International Philippines, DENR, Haribon Foundation for the Conservation of Nature, Critical Ecosystem Partnership Fund

7.4.2 Social Environment of Project Sites and the Surroundings

Socio economic conditions are summarized according to related the nearest local government unit (LGU). Location map is shown in Figure 7.4-3.



Source: JICA Study Team

Figure 7.4.3 Proposed Airport Sites and Location of LGUs

7.4.2.1 Cavite City

Related Alternative Sites: Sangley Option-1, Sangley Option-2, and Manila Bay Center

Cavite City has a population of 101,120 based on 2010 census with growth rate of 0.175 percent. The total labor force of the municipality is 64,484 or 63.76% of total population. Labor force in coastal barangays is more of fishing and aquaculture. Most are employed either in service industries locally, in Metro-Manila or neighboring cities and municipalities.

Cavite City's coastline length of 20.081 kilometers, and surrounded by three (3) bays the Manila Bay, Bacoor Bay and Cañacao Bay. The city's sea and water is used for navigation and as a fishing ground and aquaculture farm. The aquaculture/shellfish farm has about 4.5 hectares along Bacoor and Cañacao Bay. Table 7.4-2 tabulates the data of aquaculture and fishing industry of Cavite City.

The three (3) bodies of water surrounding the city remain to be polluted, degraded and are unsuitable for swimming and bathing.

Table 7.4-2 Data about Aquaculture and Fishing Industry of Cavite City

Description	Data
Brackish water Fish Ponds	4.5 ha (productive) cultured are bangus and sugpo. (located in Dalahican)
Fish pen/cages	40 (located in Manila Bay)
Mussel Farms	100 operators (located in Bacoor and Cañacao Bays) Average size - 50 sqm Average production - 2,000 gal/yr./100 sqm MT/ha./cropping = 22.0 MT meat – 2 cropping/yr
Oyster Farms	26 operators (located in Bacoor Bay) Average size: 50 sqm Average production: 2,000 gal/yr./100 sqm MT/ha. = 17.85 MT meat - one (1) cropping/year
Types of Fishing Gears Used	gill net, lift net, push net, spear and gun, hook and line, multiple set long line, zafra
Total Area of Fishing Grounds	16,051.82 hectares (Cavite City Proper) 15 km
Annual Fish Production	901.05 MT
Total No. of Fishermen	2,696
Total No. of Registered Fishing Boats Motorized Non-motorized Total	 480 (no commercial fishing boats) 243 723
List of Fishing Facilities	(3) Fish landing centers (Brgy 10-A, Brgy 10-B, Brgy 11, Brgy 48)

Source: Cavite City SEP 2013

7.4.2.2 Noveleta

Related Alternative Sites: Sangley Option-1

Noveleta has a population of 41,678 with projected labor force of 17,528 based on 2010 census. The municipality of Noveleta is classified as an urban area. Although being crowded out by the other sectors, agriculture plays a considerable role in the economic activity of the locality. The agricultural sector in the municipality is mainly comprised of crop production and fishery with several backyard livestock and poultry. However, the said agricultural activities are gradually decreasing due to urbanizing effect.

Municipality of Noveleta's municipal water area is 4,291 hectares with coastline length of 2.9 kilometers. Fishing annual production of Noveleta is the least among the coastal municipalities of Cavite Province, however, its inland fish production ranked 5th among all the Cavite municilities. Table 7.4-3 tabulates the data of aquaculture and fishing industry of Noveleta.

Table 7.4-3 Data about Aquaculture and Fishing Industry of Noveleta City

Description	Data
Fish Ponds	87.8 ha (productive) cultured are bangus and sugpo Annual Production = 64.68 MT
Types of Fishing Gears Used	gill net, spear and gun, hook and line, multiple set long line
Annual Fish Production	53 MT
Total Number of Fishermen	240
Total Number of Registered Fishing Boats	
Motorized Non-motorized Total	20 (no commercial fishing boats) 68 88

Source: Cavite Province SEPP 2013

7.4.2.3 Rosario

Related Alternative Sites: Sangley Option-1, San Nicholas Shoal

Rosario, Cavite has a population of 92,253 based on 2010 census. The total labor force (age 18 and above) of the municipality is 31,023 or 38.76% of total population. Average annual family income in 2009 is Php 206,000 while the average family expenditures is Php 176,000.00.

The technical description of Rosario's municipal waters was defined by the National Mapping and Resource Information Authority (NAMRIA) in 2010. It stretches 15 kilometers from shore to the sea and stretches 4.5 kilometers from the shorelines of Barangay Wawa II until Barangay Ligtong I covering an area of 6,764.03 hectares. It is bounded by the municipal waters of Tanza in the west, and Noveleta in the Nort-East. Table 7.4-4 summarizes the profile of the fishing industry of Rosario.

Table 7.4-4 Profile of Fishing Industry of Rosario

Description	Data
Types of Fishing Gears Used	lacynet, gillnet and hook and line
Total Area of Fishing Grounds	3,716.74 hectares
Annual Fish Production	3,200 metric tons (from commercial fishing boats) 675.6 metric tons (from municipal fishing boats) 3,875.6 metric tons (total)
Total Number of Fishermen	1,300 (commercial) 1,907 (municipal) 3,207 (total)
Total Number of Registered Fishing Boats Motorized Non-motorized Total	 847 (80 commercial fishing boats) 33 880
List of Fishing Facilities/industries	(2) Municipal Fish Port/Fish market (in Ligtong and Salinas); Fish net weaving/repair, boat making; and fish processing

Source: Rosario CLUP 2013

7.4.2.4 Tanza

Related Alternative Sites: San Nicholas Shoals

Municipality of Tanza, Cavite has a population of 188,755 based on 2010 census. The total labor force of the municipality is 115,068 which ages 15 and above.

Municipal water of Tanza has total area of 10,552.8 hectares and stretches 11.2 km seaward from the coastline of the municipality. This area serves as the fishing grounds of municipal fishermen of Tanza. Within the LGU's jurisdiction and management, the following are the portions of municipal waters of Tanza that are intended to serve special purposes:

- **Fish Sanctuary -** a portion of body of municipal waters declared as protective area for fish breeding and preservation of marine life with expressed prohibition for all fishing activities. The Municipal Fish Sanctuary of Tanza covers an area of 5.0 hectares within Barangay Julugan I and Julugan III located eight hundred fifty (850) meters from the shoreline, with approximate length of five hundred (500) meters parallel to the shoreline and one hundred (100) meters wide.
- **Municipal and Traditional Fishing Grounds -** Areas where the traditional forms of fishing is practiced with the use of gears, such as, fish nets (*lambat*), hook and line (*kawil*), snares (*panukot*), spear and spear gun (*pana, pamana*), scoop nets (*panalok*) and cover pot (*pangilaw*) for substinence.
- **Fishery Reserve -** an area designated by the municipality which is restricted to specific uses or purposes. The Municipal Fishery Reserve with an area of 40 hectares, located 650 meters from the shoreline with approximate length of 900 meters parallel to the shoreline and 500 meters wide. Table 7.4-5 summarizes relevant data regarding the fishing industry of Tanza.

Table 7.4-5 Profile of Fishing Industry of Tanza

Description	Data
Types of Fishing Gears Used	fish nets (*lambat*), hook and line (*kawil*), snares (*panukot*), spear and spear gun (*pana*, *pamana*), scoop nets (*panalok*) and cover pot (*pangilaw*)
Total Area of Fishing Grounds	10,507.8 ha
Total Number of Fishermen	2,044
Annual Fish Production	4,643.99 MT
Total Number of Registered Fishing Boats	106
List of Fishing Facilities/Industries	(11) Fish Sauce Making, and Fish Smoking and fish drying (1) Municipal Fish Landing Port (Julugan I)

Source: Tanza CLUP 2010

7.4.2.5 Bacoor City

Related Alternative Site: Manila Bay Center

The municipality of Bacoor registered an annual population growth rate of 4.04% for the period 1995-2000, increasing from 90,364 in 1980 to 250,821 in 1995, and 305,699 in 2000. The municipality has 57.36% of its labor force in which 91,000 are employed and 22,000 are unemployed. Bacoor is a first class municipality with total revenue of Php 230.9 million for the fiscal year 2000. Total revenues increased by an average of 32% over the 5-year period covering 1996 to 2000. Within a span of almost 20 years, the municipality has largely lost its agro-fishery base for residential, commercial, institutional and industrial purposes (Bacoor CLUP 2002-2013).

Bacoor municipal water area is 957 hectares with coastline length of 5.8 kilometers. Fishery production in Bacoor had been renowned for its mussel production. However, due to rapid urbanization, the economic contribution of the fishing industry to Bacoor's economy has declined over the years. In contrast, trade and service-oriented activities have increased in the municipality. Many agricultural lots, particularly fishponds, have been converted into subdivisions. Offshore and coastal fishing has also been affected by the construction of the Manila Cavite Coastal Road and Reclamation Project. As of now, Bacoor Bay is still used in mussels culture although it is in constant threat of red tide which has become more frequent. The city has 17 hectares of fishing grounds in coastal barangays devoted to the production of mussel, bangus, sugpo and tilapia Table 7.4-6 tabulates the data on aquaculture and fishing industry of Bacoor, Cavite.

Table 7.4-6 Data about Aquaculture and Fishing Industry of Bacoor

Description	Data
Fish Ponds	113.8 ha (cultured are bangus and sugpo) Annual Production: 124 MT Number of Operators: 71
Mussel Farms	211 ha Annual Production: 16,700 MT Number of Operators:334
Annual Fish Production	2,068.6 MT
Total Number of Fishermen	1,428
Total Number of Registered Fishing Boats	
Motorized	876
Non-motorized	196
Total	1,072

Source: Cavite Province SEPP 2013

7.4.2.6 Las Piñas City

Related Alternative Sites: Manila Bay Center

Las Piñas City's population was 551,886 in 2010 with annual growth rate of 1.7 percent and labor force of the city is 390,664 (Las Piñas CLUP 2009-2024).

Las Piñas has coastal length of 1.5 km, however no available data collected for the aquaculture and fishing industry of the city. Like other coastal cities and towns its municipal waters extend to 15 km from the Las Piñas section of Coastal Road towards the bay – a condition where all the surrounding towns and cities around the proposed site have overlapping jurisdictions. All the stretch is designated as LLPHEA (A wetland in Ramsar Treaty list).

7.4.2.7 Parañaque City

Related Alternative Sites: Manila Bay Center

The city's population is 588,126 with growth rate of 2.72 percent during the 2010 census. The total population of 15 years old and over in Parañaque is estimated at 472,159 persons but only 63.2 % or 298,404 are in the labor force or economically active persons and those not economically active persons (house-keepers, students, aged and others) are 36.8 % or 173,755 persons.

Parañaque City has coastal length of 6 km. Municipal fishing ground and aquaculture farms encompass 10 km from the coast of LPPCHEA.

Municipal fishing is the source of livelihood for five hundred (500) fishermen which are confined along coastal areas of Manila Bay. In 2012, the municipal fisheries production of mullet (banak), fringescale sardinella (salinyasi), buging, kapak, saltwater crab (alimasag), roundscads (galunggong), anchovies (dilis), spotted scat (kitang), spanish mackerel (tanigue), mussel and shrimp (hipon) reached to 1,103.60 MT. While 58,900 kilos of Bangus and 60,200 kilos of hipon were harvested by four operators on the fishpond production.

Other fishing activities like lift nets or zafra, mussel and oyster culture farms, and manual hook and line (long range) are also practiced. There are 23 safrahan owners and 15 mussel and oyster culture farm owners in Parañaque's coastal waters. All fish catch in the Parañaque municipal waters and other fishes from nearby coastal cities are auctioned in Parañaque Fish Port at the mouth of the Las Piñas River.

Table 7.4-7 summarizes the aquaculture and fishing industry of Parañaque City.

Table 7.4-7 Aquaculture and Fishing Industry of Paraňaque City

Description	Data
Fish Ponds	Annual Production -bangus: 58.9 MT -shrimp 60.2 MT Number of Operators = 4-5/unit
Mussel/Oyster	Number of Operators = 15/unit
Annual Fish Production	1,103.60 MT (total production for both aquaculture and fishing industry)
Total Number of Fishermen	500
Total Number of Safrahan Operators	23
Total Number of Registered Fishing Boats Motorized Non-motorized	 100 (25 commercial fishing boats) 80
Total	180

Source: Paraňaque City SEPP 2013

7.4.2.8 Muntinlupa City

Related Alternative Sites: Laguna West

Muntinlupa City's population as of 2010 census is 459,941 with average annual growth rate of 2.5%. The labor force of the city is 313,173 or 68.1 percent of the population.

1) Management System of the Lake Water

Laguna de Bay or Laguna Lake is used as fishing ground, location for aquaculture farms, transport routes, floodwater reservoir, recreation, irrigation, industrial cooling, waste sink, and source of potable water. Table 7.4-8 tabulates the economic use and benefits of Laguna Lake.

The proposed site of the new airport reclamation in Laguna Lake located at the West Bay of the lake, lakeshore of Muntinlupa City, is currently used as fishing ground and aquaculture farm of fishermen – sole proprietors, and corporations of Muntinlupa and surrounding municipalities as well. LLDA rents out the fish pen/fish farm areas at the rate of Php 1,400 per hectare per year. The Local Government Unit of Muntinlupa do not have authority in the granting lease contracts to fishpen/fish farm leases as this is the prerogative and exclusive mandate of LLDA. The LGU having administrative jurisdiction over the leased area of the lake benefits from the fish farm leaseholds through business tax and relevant permits that LGU imposes on the businessmen/fish farm operators.

Table 7.4-8 Economic Use and Benefits of Laguna Lake

Economic Use	Data
Aquaculture	57,805 MT *(10% of national production and 37% of Region IV brackish and freshwater production)*
Business Establishments	About 208,000 large, medium and small enterprises (LLDA 2003)
Transport	5,000 motorized and non-motorized watercrafts
Industrial Cooling	2.04 billion cubic meters of lake water yearly
Agriculture	Irrigation for 102,456 hectares of farmlands
Recreation	Fishing, boating, sailing, swimming
Floodwater Reservoir	Manggahan Floodway and Napindan Hydraulic Control System *(to reduce floodwater in Metro Manila)*

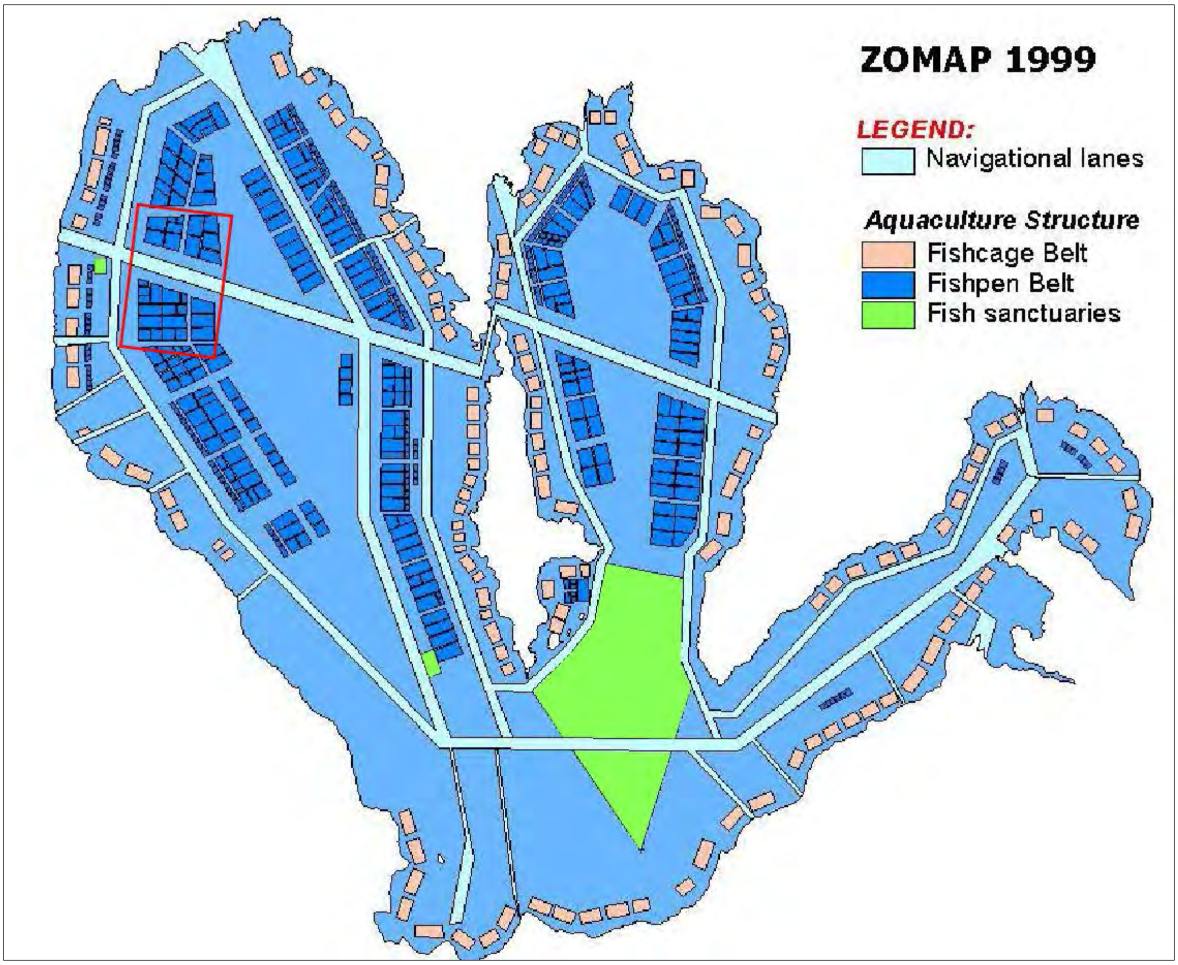
Source: www.llda.gov.ph

The west of the project site is mainly mixed industrial, commercial and residential areas of Muntinlupa City and part of Taguig. Offshore and to the west of the site is a project of the Department of Public works and Highways (DPWH) called Laguna Lake Expressway-Dike Project (LLEDP). This is a 47-kilometer expressway dike project that will run from Taguig to Los Baňos, Laguna. LLEDP comes ahead of a associated PPP project consisting of five (5) island reclamation which will cover 700 hectare of the lake area along the alignment of the LLEDP.

2) Fishing Industry

The city of Muntinlupa has 5,900 hectares of lake area in Laguna de Bay. Within the municipal waters of Muntinlupa, there are 624.21 hectares of fish pens owned by 40 registered fish pen operators and individuals. The City's management office is located in Laguna Lake and managed by Muntinlupal Lake Management Office (LMO). Fish production of the city is approximately 11,000 metric tons per year from both municipal fisheries and aquaculture production.

The city has a total of 636 registered fisher folks. A fish pen operator normally starts with 30,000 fingerlings of fish per hectare of fish pen. With a usual survival rate of 50%, an operator harvests 15,000 (approximately 3,750 kilos) of fish for the period of eight (8) months. The maximum allowable area allocation for corporate fish pen operator is 50 hectares, while cooperative operator is 25 hectares and individual operator is 5 hectares. Figure 7.4.4 shows the Zoning Plan of LLDA with proposed airport location.



Source: LLDA

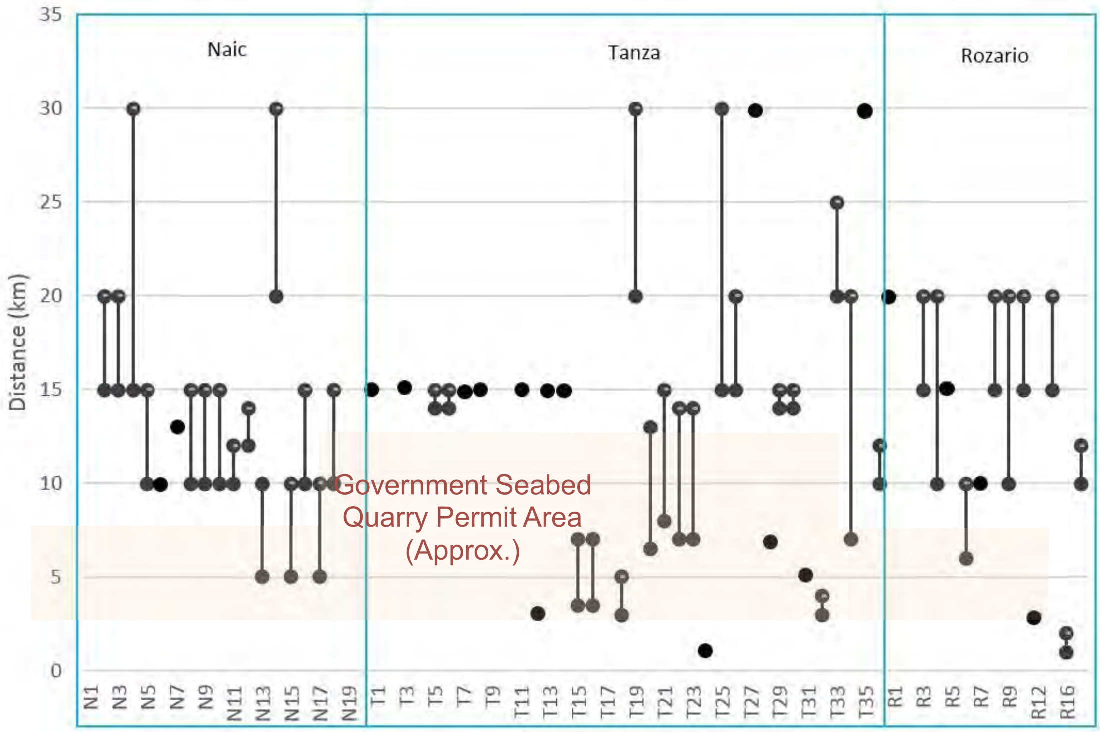
Figure 7.4-4 Laguna Lake Zoning Map and Airport Location

7.4.2.9 Fishery near Proposed Seabed Sand Quarry Site

An outline of fishing activities near PRA-proposed sand quarry site (GSQP OMR No.001, 2008 and the adjacent area) is described as follows.

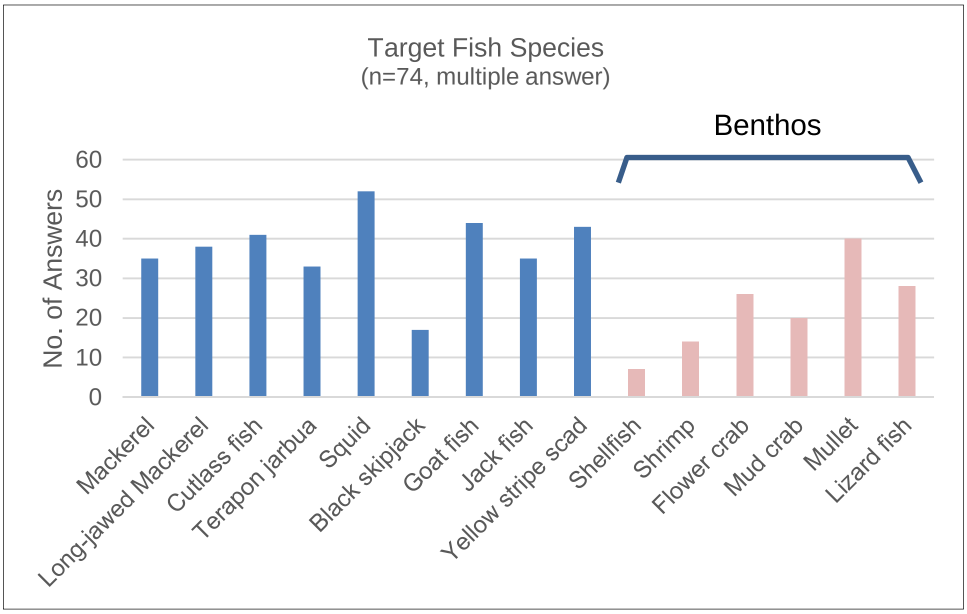
Fishing groounds are not limited to certain area, but is disparsed to wide area in Manila Bay, including GSQP OMR No.001, which is located five to 15 km from the shore of Naic, Tanza and Rosario. Figure 7.4-5 shows the fishing grounds of Tanza overlap with the GSQP area more than fishermens of Naic and Rosario.

Among their target species, benthos such as shrimp, cramb, shellfish, and lizard fish and mullet will receive significant impact by sand excavation (Figure 7.4-6). Bottom trawling is practices for those benthos fishing, in addition to saine net, gil net, hook and line as their ordinery practice. According to the JICA study, it is estimated that approximately 20% of fishermen are practicing bottom trawling (Figure 7.4-7). More than 95% of the fishermen's imcome is under 20,000 Php/mo., and majority of fishermen's earning falls between 2,000 and 5,000 php/mo (Figure 7.4-8). The most of fishermen's income are earned other than fishery, and the average is about 50%.



Source: JICA survey team

Figure 7.4-5 Relationship of Fishing Grounds (Naic, Tanza, and Rosario) and GSQP Area



Effective ansewers: 74 (multiple answer)

Figure 7.4-6 Target Fish

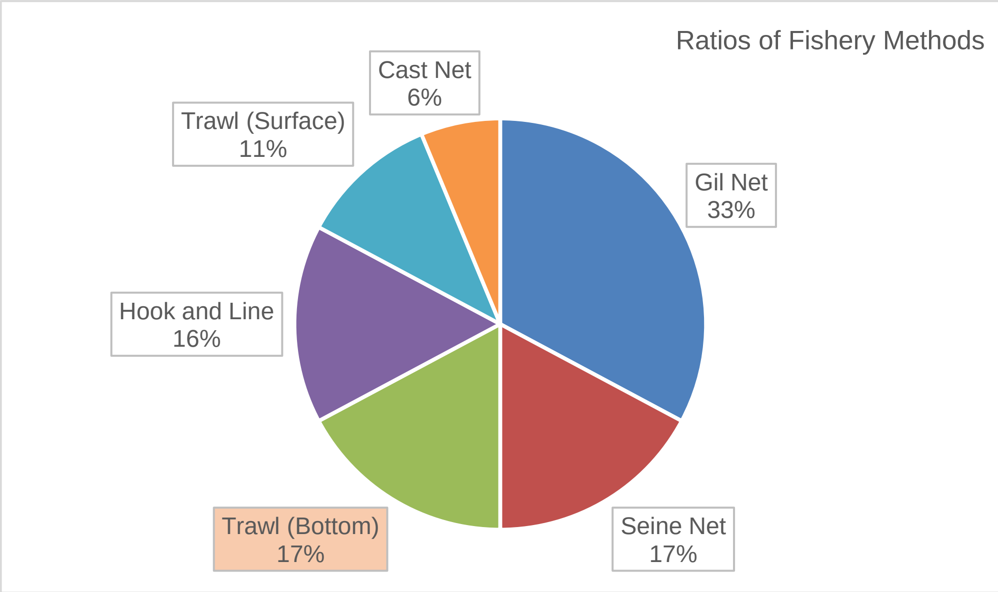


Figure 7.4-7 Type of Fishing Method Practiced

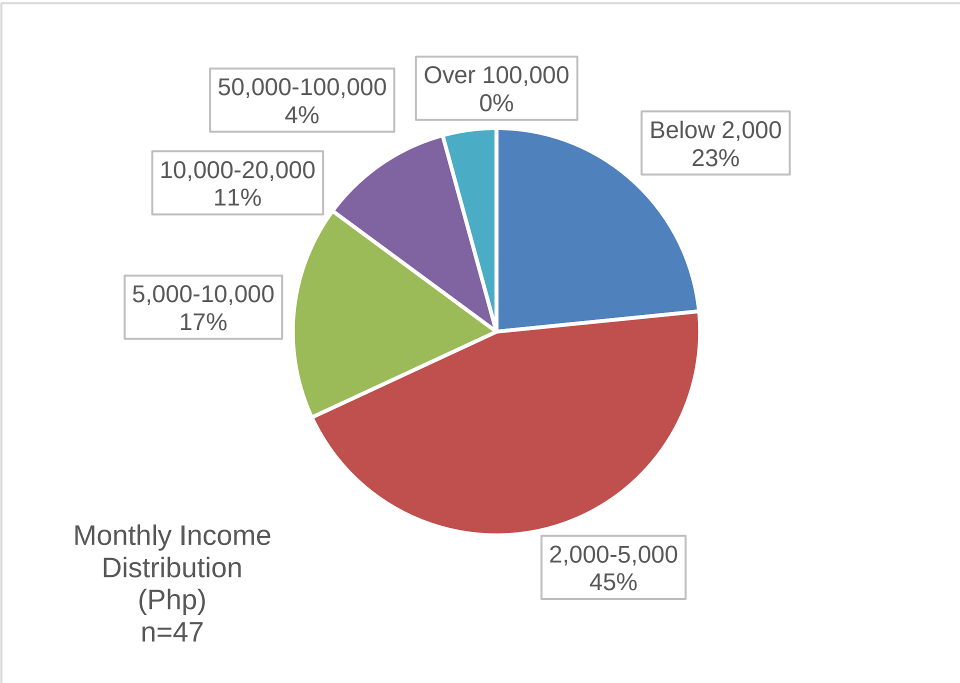


Figure 7.4-8 Fishermen's Monthly Income

7.5 Airport Access Traffic

1) Outline of Transportation Surveys

To overview the existing traffic situation of NAIA and surrounding areas, two (2) traffic surveys are conducted. Those are, a) Transportation Survey at NAIA, b) Traffic Survey and Road Inventory Survey in the Adjoining Areas of the Prospective Airport Sites.

a) Transportation Survey at NAIA

While traffic and transport situation at and around NAIA has been collected in the previous studies, update information on the traffic and transport related to NAIA are not sufficiently available. In order to supplement existing data in other studies such as MUCEP[13] and GCR Airport Study[14] as well as those available from related government agencies, seven types of surveys with direct focus on NAIA activities were conducted in this Study (see Table 7.5-1).

Table 7.5-1 Supplemental Surveys Conducted in this Study

Survey Type	Description	
1. Traffic Volume Count Survey	Objective	To get the traffic volume accessing and egressing to/from NAIA by vehicle type
	Methodology	Count the number of vehicles manually
	Location	At four passenger terminals and International Cargo Terminal (ICT) of NAIA with 17 survey stations which is at the entrance or exit of each terminals.
	Period	24 hours on one weekday and one weekend day
2. Vehicle Occupancy Survey	Objective	To get the average number of passengers per vehicle type
	Methodology	Visually count the number of passengers in vehicles with 30% sampling rate
	Location	At four passenger terminals and ICT of NAIA with 17 survey stations which is at the entrance or exit of each terminals.
	Period	16 hours (6AM – 10PM) on one weekday and one weekend day
3. OD Interview Survey	Objective	To identify the travel characteristics of airport users such as travel mode, origin/destination, No. of accompanies, travel time, etc.
	Methodology	Interview directly passengers and visitors at each passenger terminal with 10 – 20% sampling rate
	Location	At four passenger terminals and ICT of NAIA
	Period	24 hours on one weekday and one weekend day
4. Public	Objective	To get the available public transport mode to access to NAIA

13 Metro Manila Urban Transportation Integration Study Update and Capacity Enhancement Project, JICA, on-going.

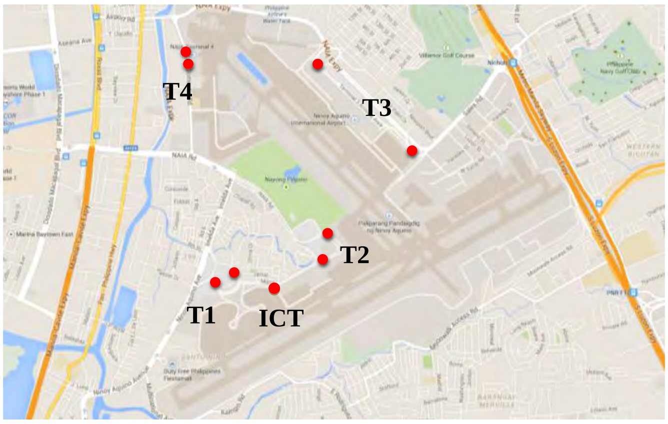
14 The Study on the Airport Strategy for the Greater Capital Region in the Republic of the Philippines, JICA, 2011

Transport Frequency Survey		and its operation frequency
	Methodology	Record the public transport type, origin and destination, and the frequency manually
	Location	At four passenger terminals of NAIA with 6 survey stations which is near the entrance or exit of each terminals.
	Period	24 hours on one weekday and one weekend day
5. Public Transport Occupancy Survey	Objective	To get the average number of passengers per public transport vehicle type
	Methodology	Visually count the number of passengers in vehicles with 30% sampling rate
	Location	At four passenger terminals of NAIA with 6 survey stations which is near the entrance or exit of each terminals.
	Period	16 hours (6AM – 10PM) on one weekday and one weekend day
6. Pedestrian Count Survey	Objective	To get the number of pedestrians accessing and egressing to/from NAIA
	Methodology	Count the number of pedestrians manually
	Location	At four passenger terminals of NAIA with 7 survey stations which is near the entrance or exit of each terminals.
	Period	24 hours on one weekday and one weekend day

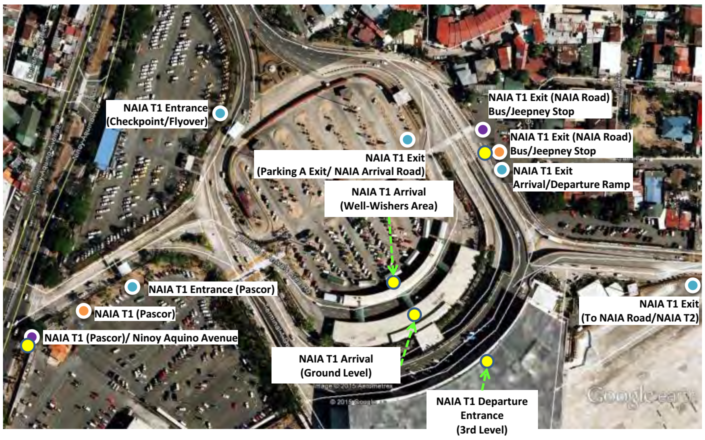
Source: JICA Study Team

The location of survey sites are shown in the following figures.

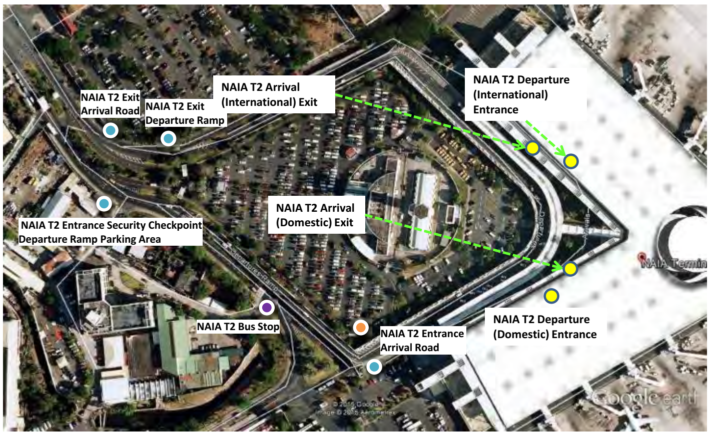
Location of Terminals in NAIA



Survey Location at Terminal 1



Survey Location at Terminal 2



Survey Location at Terminal 3 (1)

Survey Location at Terminal 3 (2)

Survey Location at Terminal 3 (3)

Survey Location at Terminal 4

Survey Location at ICT

- Traffic Vehicle Count/Vehicle Occupancy Surveys
- Public Transport Frequency/Occupancy Surveys
- Pedestrian Count Surveys
- OD Interview Survey

Source: JICA Study Team

b) Traffic Survey and Road Inventory Survey in the Adjoining Areas of the Prospective Airport Sites

Other from the survey at NAIA, two data collection surveys, one for traffic and the other for road inventory, are conducted to collect necessary information on the existing and planned roads located in the adjoining areas of the prospective airport sites in Cavite and Laguna provinces. The results of the survey are expected to be utilized for the assessment on access roads and traffic condition of the new airports and their adjoining areas and for identification of urban planning issues.

The survey items shall include the followings;

(i) Location of traffic survey
(ii) Year when the survey was conducted
(iii) Traffic volume by main vehicle type
(iv) Road name, classification and status (existing, ongoing, planned),
(v) Road length, number of lanes, structures
(vi) Typical cross section and photos
(vii) Typical type of land use along the roads
(viii) Other specific information useful for the study

The target areas of the collected data are summarized in the followings;

- NAIA Expressway Traffic Count Survey
- South Luzon Expressway Traffic Count Survey
- Cavite Laguna Expressway Traffic Count Survey
- Laguna Lake Expressway Dyke Project OD Survey

- National Traffic Counting Programme in National Capital Region

The collected data are compiled in a table format and linked with a road network data developed by MUCEP to analyze the existing condition of the road network.

2) Existing Transportation Characteristics

a) Characteristics of Access Traffic to NAIA

The access and egress traffic from NAIA ranges from 6,500 to 33,000 vehicles at passenger terminals and 1,000 to 7,000 vehicles at ICT depending on the terminals and days. Among four passenger terminals, Terminal 1 and Terminal 3 have relatively higher traffic volumes. No significant differences are seen between the traffic volumes between weekday and weekend. The main mode of transport is car including delivery van, pick up, SUV, and others which accounts about 80% of the total traffic volume. It is followed by motorcycle/tricycle and jeepneys (see Table 7.5-2 and Table 7.5-3).

Table 7.5-2 Traffic Volume at Each Terminal during Weekday

Terminal	Direction	No. of Vehicles							Share (%)						
		BC/ Pedicab	MC/TC	Car	PUJ	Bus	Truck	Total	BC/ Pedicab	MC/TC	Car	PUJ	Bus	Truck	Total
T1	In	203	2,533	18,469	1,365	706	190	23,466	0.9	10.8	78.7	5.8	3.0	0.8	100
	Out	102	1,380	16,725	1,341	633	77	20,259	0.5	6.8	82.6	6.6	3.1	0.4	100
T2	In	36	684	11,356	1,254	576	28	13,934	0.3	4.9	81.5	9.0	4.1	0.2	100
	Out	42	1,849	15,971	1,160	713	263	19,998	0.2	9.2	79.9	5.8	3.6	1.3	100
T3	In	45	746	18,970	1,894	338	13	22,005	0.2	3.4	86.2	8.6	1.5	0.1	100
	Out	31	630	17,910	1,872	302	47	20,792	0.1	3.0	86.1	9.0	1.5	0.2	100
T4	In	12	162	5,178	958	33	0	6,343	0.2	2.6	81.6	15.1	0.5	0.0	100
	Out	8	222	5,289	959	29	4	6,511	0.1	3.4	81.2	14.7	0.4	0.1	100
ICT	In	13	261	1,472	4	6	51	1,807	0.7	14.4	81.5	0.2	0.3	2.8	100
	Out	2	203	1,390	3	4	106	1,708	0.1	11.9	81.4	0.2	0.2	6.2	100
Total	In	309	4,386	55,445	5,475	1,659	282	67,555	0.5	6.5	82.1	8.1	2.5	0.4	100
	Out	185	4,284	57,285	5,335	1,681	497	69,268	0.3	6.2	82.7	7.7	2.4	0.7	100

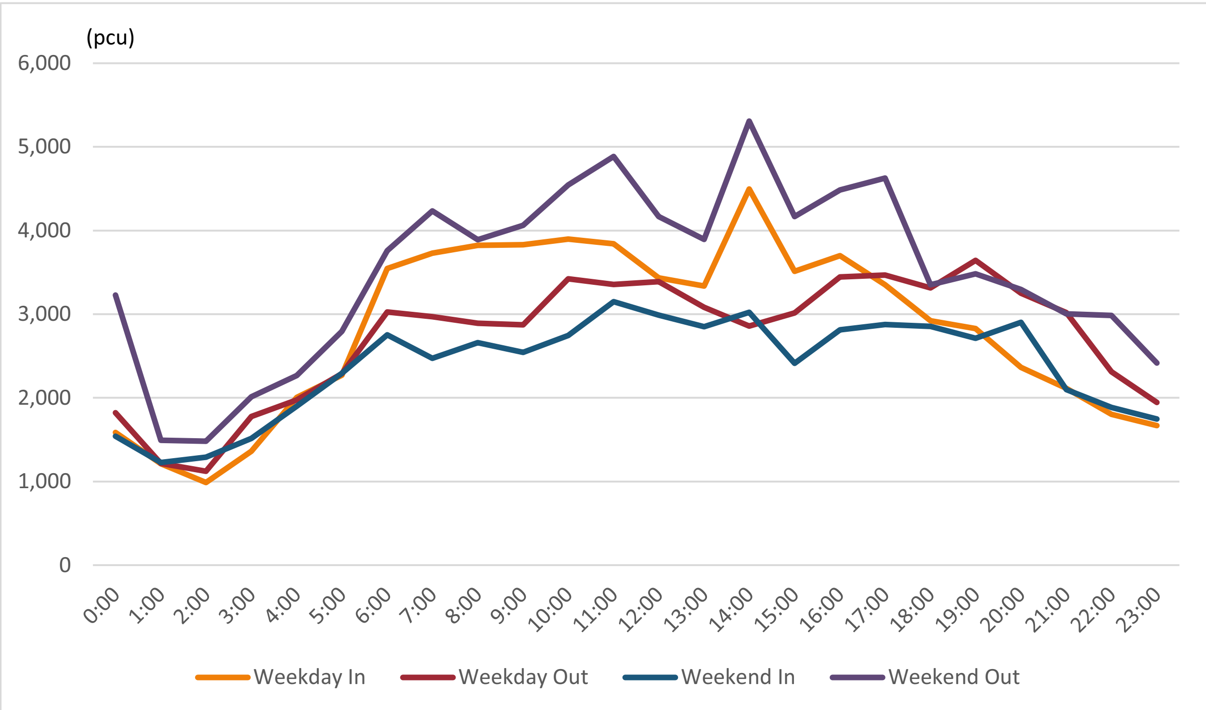
Source: JICA Study Team

Table 7.5-3 Traffic Volume at Each Terminal during Weekend

Terminal	Direction	No. of Vehicles							Share (%)						
		BC/ Pedicab	MC/TC	Car	PUJ	Bus	Truck	Total	BC/ Pedicab	MC/TC	Car	PUJ	Bus	Truck	Total
T1	In	94	1,704	20,421	1,886	341	62	24,508	0.4	7.0	83.3	7.7	1.4	0.3	100
	Out	22	1,025	17,416	1,853	216	21	20,553	0.1	5.0	84.7	9.0	1.1	0.1	100
T2	In	54	764	15,590	1,303	800	48	18,559	0.3	4.1	84.0	7.0	4.3	0.3	100
	Out	28	1,414	16,855	1,304	766	154	20,521	0.1	6.9	82.1	6.4	3.7	0.8	100
T3	In	47	824	28,296	3,060	353	15	32,595	0.1	2.5	86.8	9.4	1.1	0.0	100
	Out	22	729	23,895	3,062	237	12	27,957	0.1	2.6	85.5	11.0	0.8	0.0	100
T4	In	0	111	5,498	957	43	0	6,609	0.0	1.7	83.2	14.5	0.7	0.0	100
	Out	1	223	5,521	957	49	6	6,757	0.0	3.3	81.7	14.2	0.7	0.1	100
ICT	In	0	105	662	3	0	44	814	0.0	12.9	81.3	0.4	0.0	5.4	100
	Out	1	138	938	2	1	49	1,129	0.1	12.2	83.1	0.2	0.1	4.3	100
Total	In	195	3,508	70,467	7,209	1,537	169	83,085	0.2	4.2	84.8	8.7	1.8	0.2	100
	Out	74	3,529	64,625	7,178	1,269	242	76,917	0.1	4.6	84.0	9.3	1.6	0.3	100

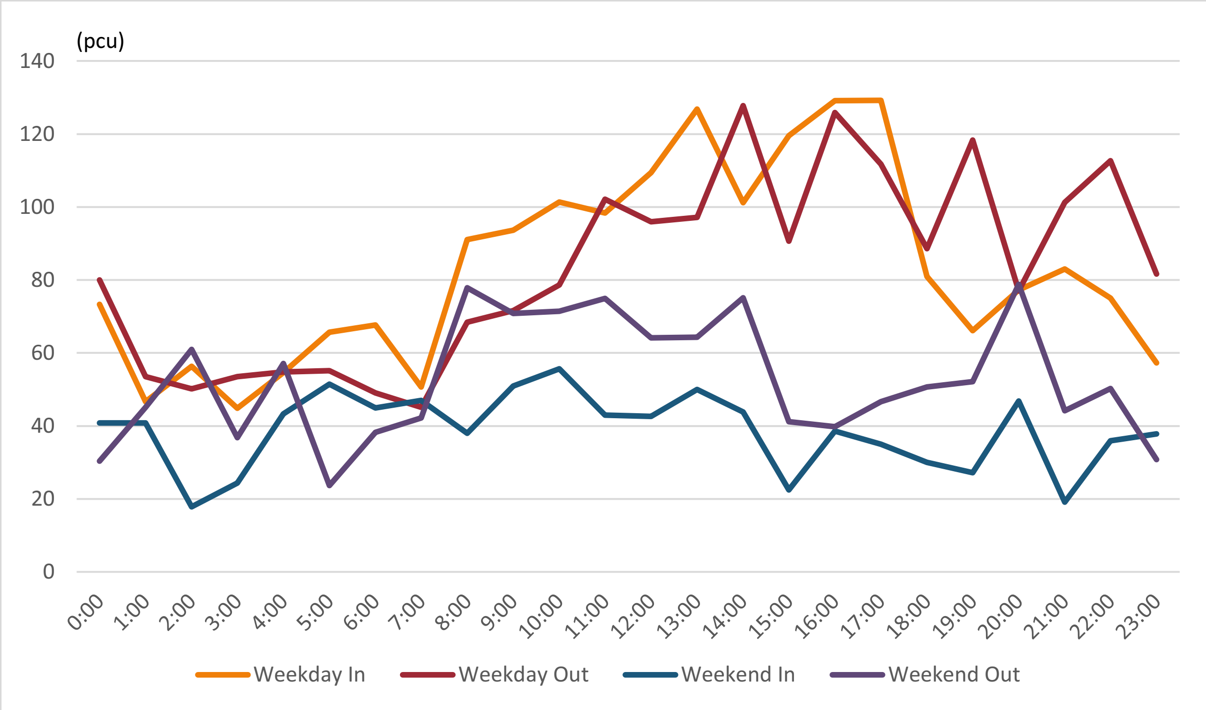
Source: JICA Study Team

At the passenger terminals, traffic peak can be seen around 10AM to 5PM. The peak hour traffic is about 4,000 – 5,000 pcu per hour which is about 6% of the total traffic volumes. At the cargo terminal, the traffic volume is more fluctuated than that of passenger terminal. However, it can be said that the traffic peak is 12PM to 10PM during weekday and 8AM to 2PM during weekend. The traffic volume at the cargo terminal is much less than those at passenger terminals. The peak hour traffic at cargo terminal is about 50 -130 pcu per hour.



Source: JICA Study Team

Figure 7.5-1 Hourly Traffic Distribution at Passenger Terminals



Source: JICA Study Team

Figure 7.5-2 Hourly Traffic Distribution at Cargo Terminals

The average numbers of passengers of airport access differ from those of the entire traffic in Metro Manila. While the average number of passengers of car for airport access is almost the same as that of the entire traffic in Metro Manila, jeepneys and buses accessing to the airport has much less passengers than those in other areas. On the other hand, truck has relatively higher number of passengers.

Table 7.5-4 Average Number of Passengers by Vehicle Type

	Car	PUJ	Bus	Truck
Airport Access	1.9	3.1	6.1	2.5
Metro Manila[1)]	1.7	10.2	35.3	1.0

Source: JICA Study Team

1) Roadmap for Transport Infrastructure Development for Metro Manila and Its Surrounding Areas (Region III and Region IV-A)

b) Characteristics of Airport Users at NAIA

The main travel modes of air passengers and well-wishers is car which accounts more than 80% of the total share. Other modes share less than 10%. On the other hand, only about 40% of airport workers use car, followed by jeepneys (30%) and motorcycles/tricycles (20%) (see Table 7.5-5).

Table 7.5-5 Modal Share by Airport User Types

Type	Modal Share (%)						Total
	BC/Pedicab	MC/TC	Car	PUJ	Bus	Truck	
Air Pax	0.2	2.6	80.8	9.1	6.8	0.4	100.0
Well-wisher	0.0	1.3	86.1	8.5	4.0	0.0	100.0
Workers	0.9	19.1	37.7	30.1	7.1	5.1	100.0
Others	0.0	14.1	37.6	27.9	17.1	3.2	100.0
Total	0.2	3.6	79.1	11.0	5.4	0.7	100.0

Source: JICA Study Team

About 60% of air passengers are from/to Metro Manila, followed by the north Luzon (i.e., Region I, Region II, Region III and CAR) (20%) and the south Luzon (Region IV) (20%). Tendency of well-wisher is similar to the air passengers. The dominant origin and destination is Metro Manila, but its share is relatively lower than that of air passengers (40%). On the other hand, most of airport workers are from/to Metro Manila (more than 80%), followed by Cavite (10%) (see Table 7.5-6).

Table 7.5-6 Origin/Destination of Trips from/to NAIA by Airport User Types

Origin/Destination from NAIA		Air Passenger			Well-wishers			Airport Workers	Total
		International	Domestic	Total	International	Domestic	Total		
North	Region I, II, III[1], CAR	16.9	8.8	12.6	25.7	10.5	20.0	2.3	15.7
	Bulacan (south) [2]	4.8	5.7	5.3	6.7	6.5	6.6	2.3	5.8
	Sub-total	21.7	14.5	17.9	32.4	17.1	26.6	4.6	21.5
Metro Manila	Manila	10.6	7.2	8.8	4.1	4.6	4.3	3.9	5.8
	North[3]	14.3	25.5	20.3	15.3	27.3	19.8	11.1	19.1
	Central[4]	20.9	21.6	21.3	11.5	17.4	13.7	31.1	18.0
	South[5]	6.5	8.1	7.3	4.7	7.3	5.7	36.8	9.4
	Sub-total	52.3	62.5	57.7	35.7	56.6	43.5	82.9	52.2
South	Cavite	11.2	10.4	10.8	11.4	12.2	11.7	9.8	11.2
	Rizal	5.0	6.2	5.6	6.6	7.2	6.8	1.4	5.9
	Laguna	2.1	0.9	1.5	2.7	0.9	2.0	0.0	1.6
	Other Provinces in Region IV	5.8	3.7	4.6	9.8	4.7	7.9	1.0	6.1
	Sub-total	24.1	21.2	22.6	30.5	25.1	28.5	12.3	24.9
Others		1.9	1.9	1.9	1.4	1.2	1.3	0.2	1.4
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: JICA Study Team

1) Except Bulacan (south)

2) Bulacan (south) is separately calculated from Region III to follow the study area of MUCEP. Since

it has different urban characteristics with the other areas in Region III.

3) San Juan/Quezon/Caloocan/Valenzuela/Malabon/Navotas

4) Pasay/Makati/Taguig/Mandaluyong/Marikina/Pasig/Pateros

5) Paranaque/Muntinlupa/Las Pinas

c) Capacity Assessment of Road Network

The road inventory and traffic volume data are linked with the road network data covering GCR.

Figure 7.5-3 shows the road network which is categorized by hierarchy of road functions consisting of expressway, primary, secondary, local and the other roads and overlaid with the location of the NAIA and the prospective airport sites. This map indicates the accessibility to each airport site. While NAIA is locating nearby city center with good access roads by expressway and primary road, the prospective airport sites in the westernside of Cavite have not enough accessibility. In addition, the road network lacks East to West connection.

Figure 7.5-4 shows the road network by capacity. The capacity can be calculated from the category and the number of lanes of the road. This map indicates the maximum traffic volume which the road can accommodate. The findings from the map is same with above, but lack of the capacity and East to West Connection in the southern areas are more obvious.

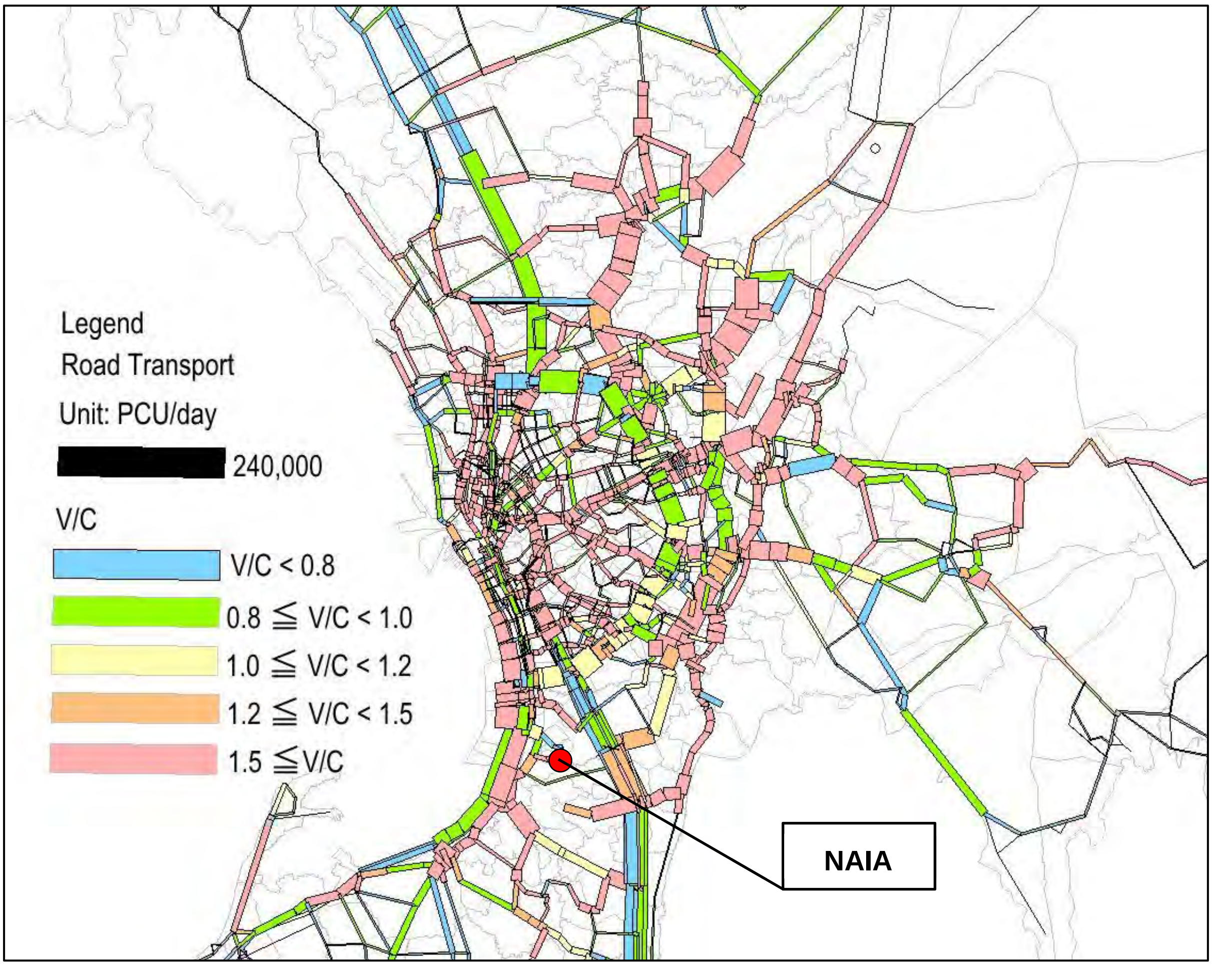
Source: JICA Study Team

Figure 7.5-3 Road Network by Category

Source: JICA Study Team

Figure 7.5-4 Road Network by Capacity

The traffic volume can be assessed compring to the road capacity and calculated in a volume per capacity ratio (V/C). Figure 7.5-5 shows the results and distribution of V/C. In case of V/C bellows 0.8, there is no congestion, in case of V/C equal to or above 1.0, the road is saturated. This map indicates which section requires the capacity improvement.



Source: MUCEP, JICA, 2015

Figure 7.5-5 Assessment of Traffic Volume per Road Capacity (V/C) in 2014