Kingdom of Tonga
Ministry of Infrastructure

DATA COLLECTION SURVEY ON AIRPORT DEVELOPMENT IN PACIFIC REGION (TONGA)

FINAL REPORT

February 2021

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ADAMIS LTD.
ORIENTAL CONSULTANTS GLOBAL CO., LTD.

SUMMARY

1. Outline of the Survey

Objectives of the Data Collection Survey are:

- to gather and analyze basic information on existing facilities, future demand forecast and necessary improvements;
- to formulate the project scope, construction schedule, and approximate cost estimation; and
- to conduct preliminary evaluation of candidate project.

It must be noted that the Survey does not mean commitment of JICA for cooperation on projects in the future. The Survey Team commenced the Survey in March 2020, submitted an Inception Report (May 2020), Interim Report (September 2020), Draft Final Report (December 2020), and conducted discussions with the Tongan side remotely due to the pandemic of COVID-19.

2. Surrounding Situation of the Project

In order to grasp the background of the Project, the following data/information are gathered:

- Socio-economic conditions, i.e. population, gross domestic products (GDP), inflation rate of the last 10 to 11 years
- Situation of tourism sector, including number of tourist arrivals, major source market, major purpose of visit, and "Tonga Tourism Sector Roadmap 2014-2018"
- Situation of aviation sector, including airlines operating scheduled flights, air transport networks, and air traffic volume of the last 11 years
- Development strategy in "Tonga Strategic Development Framework 2015-2025", "Tonga National Infrastructure Investment Plan 2013-2023", and "Ministry of Infrastructure Corporate Plan 2019/20-2021/2022"
- Related organizations, including Ministry of Infrastructures, its Civil Aviation Division, Tonga Airports Limited (TAL), and Air Terminal Services (Tonga) Limited
- Local construction industry

3. Air Traffic Demand Forecast

Air traffic demands are forecasted based on regression analyses of the air traffic volume and GDP in the last 11 years, GDP forecast by International Monetary Fund, and forecast of Revenue Passenger Kilometer vs. GDP (expected recovery from COVID-19) by International Air Transport Association. Results of the forecasts are summarized in the following table.

Table-1 Summary of Demand Forecast

				2019	2030	2040
Fua'amotu	International	Number of Passengers	Annual	213,296	252,465	344,548
			Busy Hour - One-way	340	351	ditto
		Number of Flights	Annual	1,075	1,219	1,615
			Busy Hour - One-way	B737-800:1 A321:1	ditto	ditto
			Longest haul	TBU-SYD	ditto	ditto
		Cargo (ton)	Annual	1,212	1,366	1,448
	Domestic	Number of Passengers	Annual	62,291	64,970	77,565
			Busy Hour - One-way	50	50	ditto
		Number of Flights	Annual	2,056	2,024	2,417
			Busy Hour - One-way	SAAB340:1 Y12E:1 BN-2A:1	ditto	ditto
		Cargo (ton)	Annual	125	201	275

Table-1 Summary of Demand Forecast (continued)

				2019	2030	2040
Vava'u	International	Number of Passengers	Annual	7,716	9,164	12,507
			Busy Hour - One-way	57	61	ditto
		Number of Flights	Annual	120	143	194
			Busy Hour - One-way	ATR72-600:1	ditto	ditto
			Longest haul	VAV-NAN	ditto	ditto
		Cargo (ton)	Annual	0.041	0.042	0.043
	Domestic	Number of Passengers	Annual	39,550	44,522	54,137
			Busy Hour - One-way	46	43	ditto
		Number of Flights	Annual	928	967	1,176
			Busy Hour - One-way	SAAB340:1 Y12E:1	ditto	ditto
		Cargo (ton)	Annual	101	135	220

4. Improvement of Fua'amotu International Airport

1) Current Conditions

The Survey Team obtained data/information on the current conditions of the facilities and equipment, on-going and planned projects and assistance of other donors, surrounding infrastructures and airport access, natural conditions, and land use mainly through TAL and various documents.

2) Review of Airport Improvement Plant

The project proposal for Fua'amotu International Airport prepared by the Government of Tonga includes (i) extension of Runway 11/29 by 360m x 45m and (ii) development of a new international terminal as outputs of the project. A study on the improvement of airport facilities is conducted on these two facilities at first.

The following points are basic policies for the planning improvement of Fua'amotu International Airport.

- The airport facilities should be improved to cater to the traffic demand expected in 2030 in accordance with not only national standards but also international standards and good practices.
- The master plan for TBU, i.e. "Strategic Development Plan" in 2010, and its review in 2018, i.e. "Desktop Review", should be reviewed by focusing on "whether there will be excessive facilities", and respect the existing plan as much as possible.
- Expansion and improvement of the existing passenger terminal building should be planned with phased developments to continue airport operations during construction period.
- The terminal facility improvement should be planned in consideration of barrier-free, eco-friendliness, and required functions in the event of a disaster.

As a result of the review, the proposed extension of Runway 11/29 is to be considered beyond year 2030, because B787-9 and A350-900 can takeoff for Eastern-Asia and the west coast of the US with a full passenger payload from the existing runway by allowing overload on the pavement.

A revised terminal facility improvement plan, including expansion of the existing international passenger terminal building and conversion to consolidated passenger terminal, expansion of apron and taxiway, expansion of the existing car park, etc., is developed. Figure-1 shows the proposed terminal area layout plan.

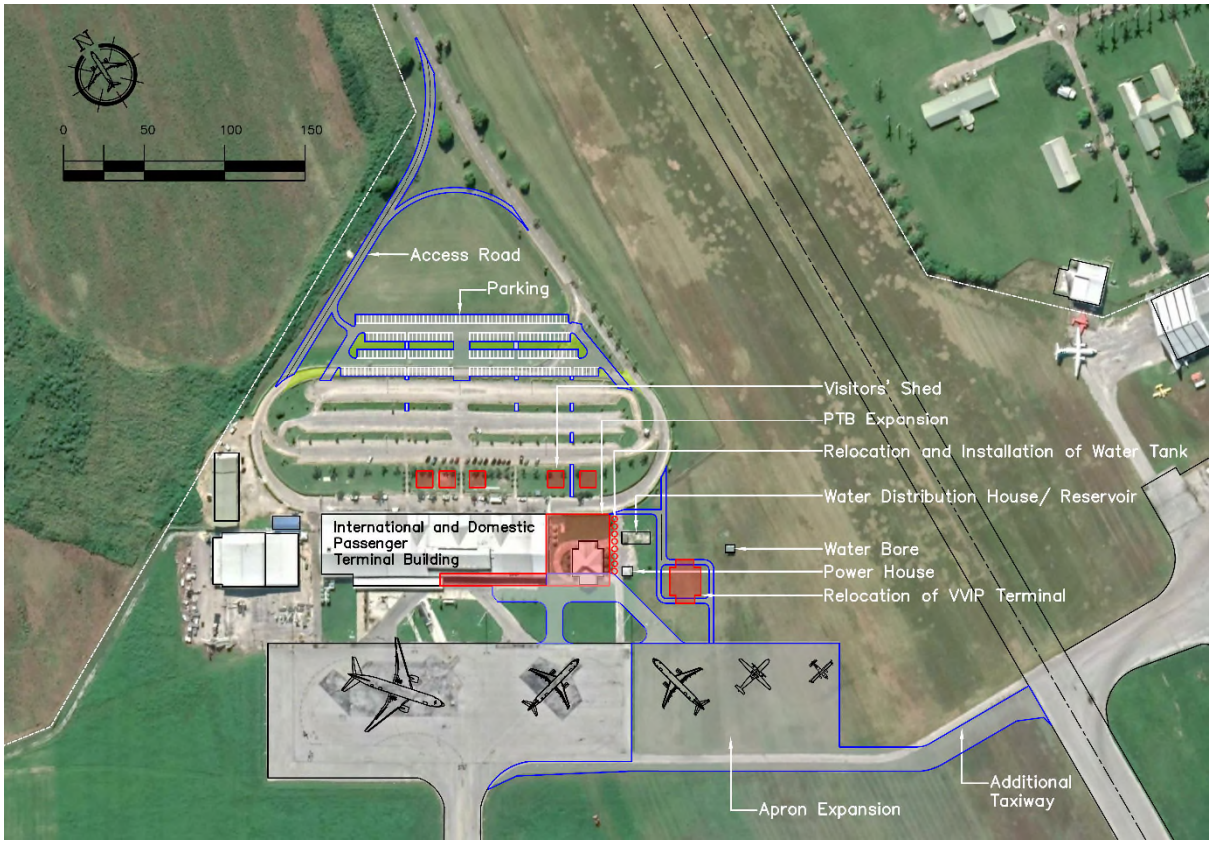


Figure-1 Proposed Terminal Area Layout Plan

3) Candidate Project for Japanese Assistance

The objectives of the Project are to expand and convert the existing international passenger terminal at Fua'amotu International Airport to a consolidated passenger terminal in order to handle both international and domestic air traffic demand expected in 2030 at an appropriate level of service standards, thereby contributing to the socio economic development of the country.

The following improvements are identified as the main components of the Project for the improvement of Fua'amotu International Airport.

- Expansion of the existing international passenger terminal building and conversion to consolidated passenger terminal
- Expansion of apron and taxiway
- Expansion of the existing car park

The following points are associated to the above-mentioned components of the Project. Among them, relocation of VVIP terminal and guard house may be done separately prior to the works of main components.

- Relocation of VVIP terminal
- Relocation of guard house
- Construction of Visitors' Sheds
- Addition apron flood lights, taxiway edge lights and information signs
- Addition of street lights
- Relocation and addition of water tanks
- Upgrade of power house
- Addition of septic tank

4) Expected Construction Schedule

Phased construction of the passenger terminal building is planned to maintain the airport operations. Total duration of construction, including relocation of VVIP terminal, is estimated to be 19.5 months,

and the expected construction schedule is shown in Table-2.

Table-2 Expected Construction Schedule

ID	Task Name	Dura-tion	Month																				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Preparation Works	1.5																						
2	Relocation of VVIP Terminal	2.8																						
3	Passenger Terminal Building Expansion	16.0																						
4	Apron Expansion and New Taxiway	9.0																						
5	Carpark and Circulation Road	6.0																						

5) Approximation of Project Cost

Approximate cost of the project is estimated to be about JPY 2,572 million.

6) Environmental and Social Considerations

New land acquisition will not be required and the Project is unlikely to cause any major negative environmental or social impacts. Possible negative impacts related to the Project, such as noise and vibration, are expected to be confined to the construction phase. Normal mitigation measures of irreversible impacts, if any, will be designed readily. Thus, the project can be clarified as a Category B project under JICA's environment classification.

The Environmental Impact Assessment Act requires that all major development projects submit an appropriate environmental impact assessment report that will include a review of all relevant impacts as determined by the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications from time to time.

5. Improvement of Vava'u International Airport

1) Current Conditions

The Survey Team obtained data/information on the current conditions of the facilities and equipment, on-going and planned projects and assistance of other donors, surrounding infrastructures and airport access, natural conditions, and land use mainly through TAL and various documents.

2) Review of Airport Improvement Plant

The project proposal for Vava'u International Airport by the Government of Tonga includes (i) extension of Runway 08/26 by 1,200m x 45m and (ii) a new airport terminal. A study on an airport facility improvement plan is to be conducted by placing priority on these two facilities.

The following points are the basic policies for planning improvement of Vava'u International Airport.

- The airport facilities should be improved to cater to the traffic demand expected in 2030 in accordance with international standards and good practices.
- Terminal development plan that meets the required development scale should be planned within the area where land acquisition is unnecessary or easy.
- Propriety of runway extension should be judged considering the influence of obstacles on aircraft operations.
- Expansion and improvement of the existing passenger terminal building should be planned with phased developments to continue airport operations during the construction period.
- The terminal facility improvement should be planned in consideration of barrier-free, eco-friendliness and required functions in the event of a disaster.

As a result of the review, the proposed extension of the runway is considered premature, because Air New Zealand (ANZ) has not seriously considered the potential of a direct flight from/to Auckland, and only about 550m of runway extension will be sufficient for the direct flight of A320-200 to Auckland. Instead, a starter extension of 225m toward the west is planned to relax the take-off weight restrictions on ATR72-600 flight to Fiji as shown in Figure-2.

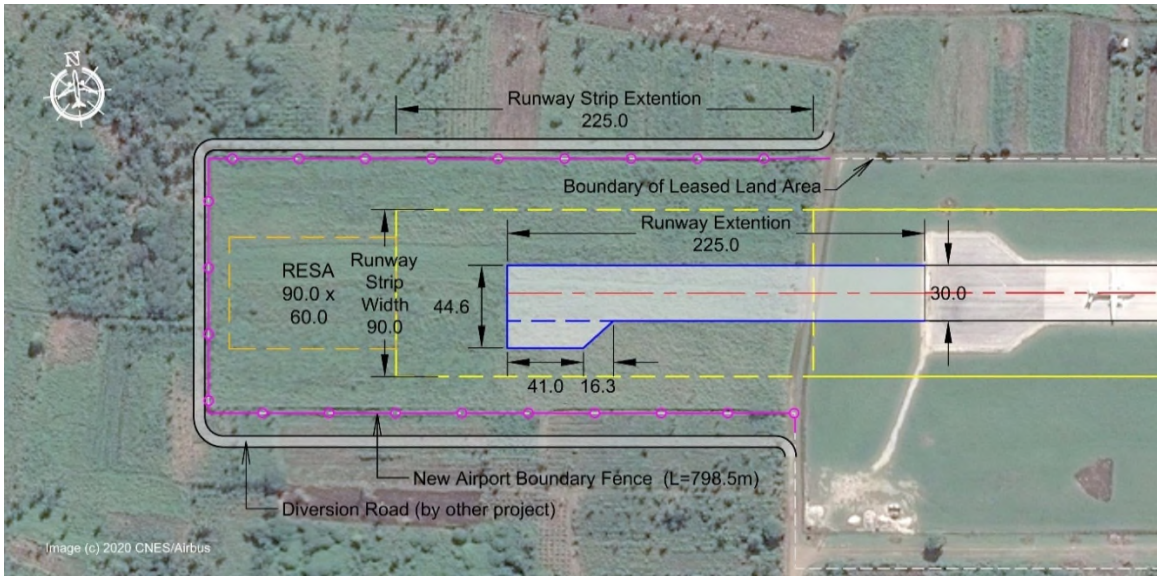


Figure-2 Layout Plan of Runway Extension toward West

The terminal facility improvement plan, including the expansion of the existing passenger terminal building and car park, is developed as shown in Figure-3.

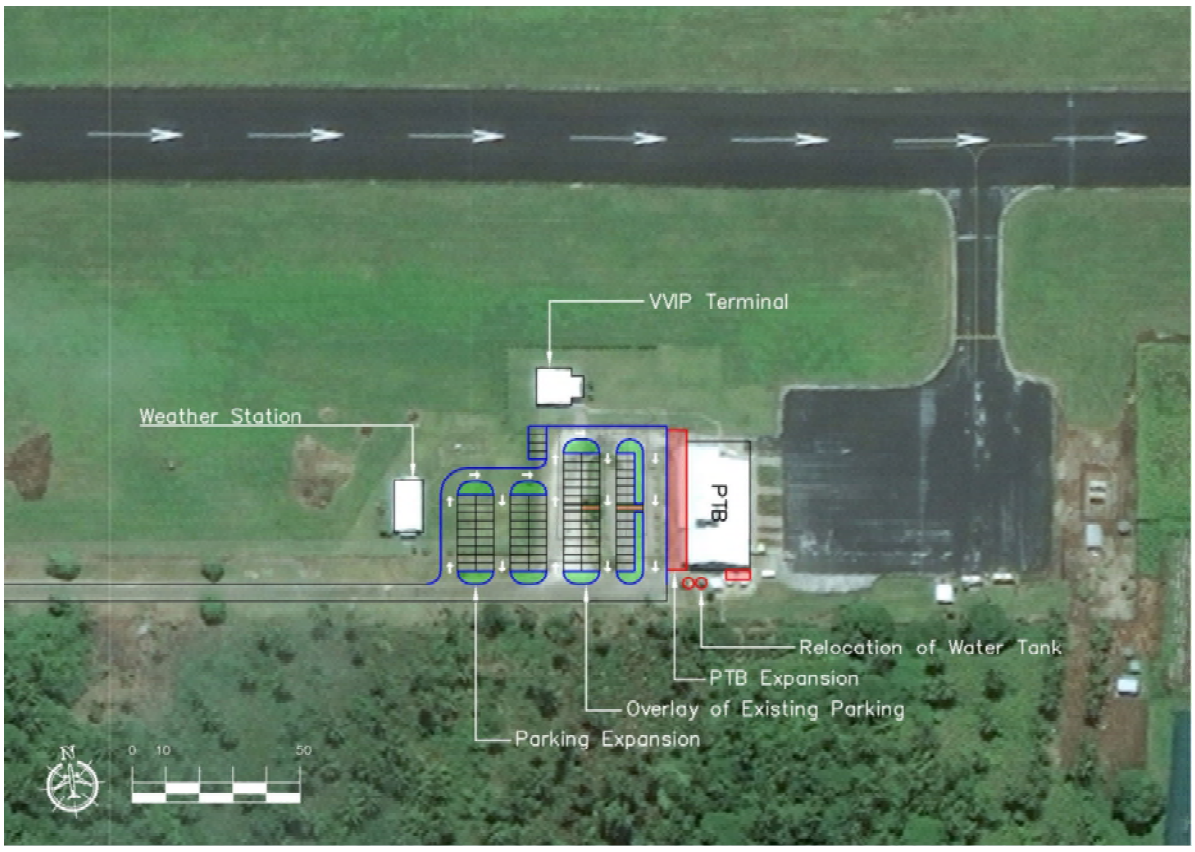


Figure-3 Proposed Terminal Area Layout Plan

3) Candidate Project for Japanese Assistance

The objectives of the Project are to improve the existing runway and expand the existing passenger terminal at Vava'u International Airport in order to handle the air traffic demand expected in 2030 at an appropriate level of service standards, thereby contributing socio economic development of Vava'u sub-division.

The following improvements are identified as the main components of the Project for the

improvement of Vava'u International Airport.

- Starter extension of the runway by 225m on the west
- Expansion of the existing passenger terminal building
- Expansion of the existing car park area

The following points are associated with the above-mentioned components of the Project. Among them, airfield lights are considered to be closely related to the starter extension, and better to be done by a single contractor. However, the remaining three, i.e., water tank, fence between the car park and airside, and the electrical conduit, may be done separately prior to the work of the main components.

- Addition and relocation of airfield lights
- Relocation of water tanks
- New security fence between car park and air side
- Relocation of electrical conduit

Diversion of the existing road on the west of the runway crossing the leased land is expected to be done as a part of an on-going project for provision of the runway end safety area prior to the Project.

4) Expected Construction Schedule

Total duration of the construction is estimated to be 8.5 months, and the expected construction schedule is shown in Table-3.

Table-3 Expected Construction Schedule

ID	Task Name	Dura-tion	Month									
			1	2	3	4	5	6	7	8	9	10
1	Preparation Works	1.0										
2	Passenger Terminal Building Expansion	5.0										
3	Runway Extension	7.0										
4	Carpark	2.5										

5) Approximation of Project Cost

Approximate cost of the project is estimated to be about JPY 564 million.

6) Environmental and Social Considerations

Diversion of the existing road on the west of the runway crossing the leased land is a prerequisite of the runway extension. Even if this diversion road is regarded as a part of the project, required land acquisition will be small, and no resettlements as well as demolition of existing building will be required. Therefore, the project is unlikely to cause any major negative environmental or social impacts. Possible negative impacts related to the Project, such as noise and vibration, are expected to be confined to the construction phase. Normal mitigation measures of irreversible impacts, if any, will be designed readily. Thus, the project can be clarified as a Category B project under JICA's environment classification.

The Environmental Impact Assessment Act requires that all major development projects submit an appropriate environmental impact assessment report that will include a review of all relevant impacts as determined by the Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications from time to time.

6. Preliminary Evaluation of Candidate Project

1) Relevance to the Government Policy

"Ministry of Infrastructure Corporate Plan 2019/20-2021/2022" states, as its organizational outputs of the Civil Aviation Division, "achieving a safer and more affordable domestic and international air transportation supporting growth of economic activity in the aviation sector". Both projects for Fua'amotu and Vava'u are in line with this statement. Therefore, the two projects are relevant to the ministry's policy. However, the project for Fua'amotu may be considered more relevant because the Corporate Plan identifies "New Fua'amotu International Terminal (extension and refurbish of existing terminal)" as one of the new initiatives.

"Country Assistance Policy for Kingdom of Tonga" (April 2012) states "Japan promotes development

of infrastructures, maintenance, and human resource development in order to create a sound environment to promote industries, including agriculture and fisheries as well as tourism, which are the core industries of the Kingdom of Tonga." The two projects are relevant to this policy.

2) Effectiveness of the Project

Numbers of direct and indirect beneficiaries of the project for Fua'amotu are 5.8 and 5.4 times of that for Vava'u respectively. Since Fua'amotu is the international gateway and domestic hub of the Kingdom, the total population of the Kingdom, i.e., 100,651, may be regarded as the indirect beneficiary. In that case, indirect beneficiaries of the project for Fua'amotu are 7.3 times of that for Vava'u. Therefore, the project for Fua'amotu is considered to be more effective.

Table-4 Comparison of Number of Beneficiaries

Item	Fua'amotu	Vava'u
Main Direct Beneficiary (Baseline Annual Passengers)	275,587	47,266
Main Indirect Beneficiary (Population of the Island)	74,611	13,738

Source: Survey Team

The approximate project cost for Fua'amotu (JPY 2.57 billion) is within the range of amounts of Japan's Grant Aid to Tonga since the year 2000, and that for Vava'u (JPY 0.56 billion) is a little less than the minimum. Although the approximate cost of the project for Fua'amotu is 4.6 times of that for Vava'u, the project cost per direct and indirect beneficiary of the project for Fua'amotu is about 0.8 times of that for Vava'u. If the total population of the Kingdom is used as the indirect beneficiary, the project cost per indirect beneficiary of the project for Fua'amotu is about 0.6 times of that for Vava'u. Therefore, the project for Fua'amotu is considered to be more cost effective.

3) Operation and Effect Indicators

The number of air passengers and aircraft movements can be used as the operation and effect indicators. Table-5 shows the baseline and target values of the project for the improvement of Fua'amotu and Vava'u International Airports.

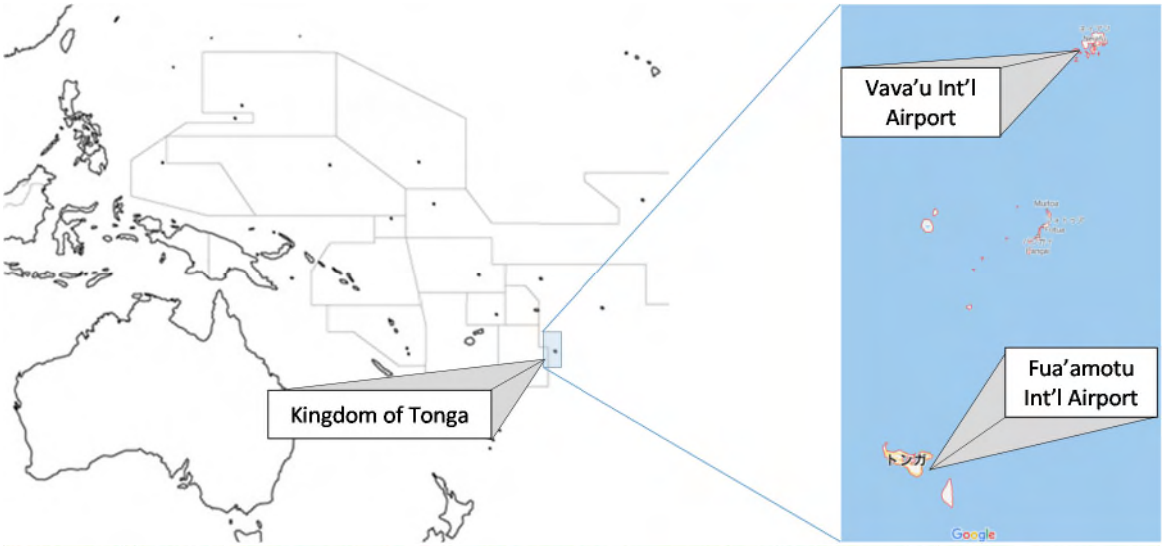
Table-5 Operation and Effect Indicators

Operation and Effect Indicators	Fua'amotu		Vava'u	
	Baseline (Year 2019)	Target (Year 2025)	Baseline (Year 2019)	Target (Year 2025)
Number of Annual Passengers	275,587	316,947	47,266	53,685
Number of Annual Aircraft Movements	4,006	4,375	1,048	1,110

Source: Survey Team

4) Priority of Candidate Projects

As stated in the previous sections, the two projects are relevant to the policies of the Tongan and Japanese Governments, but the project for Fua'amotu may be considered more relevant. In terms of effectiveness, the project for Fua'amotu is considered to be more effective. Therefore, the Survey Team put higher priority on the Project for Improvement of Fua'amotu International Airport.



Fua'amotu International Airport

Vava'u International Airport

Project Location Map

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Figure Table List

Abbreviations

AC	Asphaltic Concrete
ACN	Aircraft Classification Number
AGL	Aeronautical Ground Lighting
AIP	Aeronautical Information Publication
AKL	Auckland
ANZ	Air New Zealand
APU	Auxiliary Power Unit
ASU	Air Starter Unit
AWOS	Automatic Weather Observation System
ATC	Air Traffic Control
ATS	Air Terminal Services (Tonga) Limited
ATS	Air Traffic Service
BAA	British Airports Authority
MEIDECC	Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications
CAD	Civil Aviation Department
CAANZ	Civil Aviation Authority of New Zealand
CBR	California Bearing Ratio
CCR	Constant Current Regulator
CHC	Christchurch Airport
EIA	Environmental Impact Assessment
FAA	Federal Aviation Administration
FJI	Fiji Air
GDP	Gross Domestic Product
GPU	Ground Power Unit
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LED	Light Emitting Diode
MOI	Ministry of Infrastructure
MSL	Mean Sea Level
MSU	Mobile Storage Units
MTOW	Maximum Take Off Wight
NAN	Nandi Airport
ODA	Official Development Aid
OLS	Obstruction Limitation Surface
PAIP	Pacific Aviation Investment Program
PCN	Pavement Classification Number
PTB	Passenger Terminal Building
PV	Photovoltaics
RESA	Runway End Safety Area
SARPs	Standards and Recommended Practices
SJ	Small Jet
TAL	Tonga Airports Limited
TBU	Fua‘amotu International Airport
TCC	Tonga Communication Corporation
TOP	Tonga pa'anga
TOW	Take Off Weight
TP	Turbo Prop
TPL	Tonga Power Limited
TSDF	Tonga Strategic Development Framework
VAV	Vava'u International Airport
VVIP	Very Very Important Person
WB	World Bank

CHAPTER 1
OUTLINE OF THE SURVEY

CHAPTER 1 OUTLINE OF THE SURVEY

1-1 Background of the Survey

Kingdom of Tonga (herein after referred to as "Tonga") is an island nation located in Polynesia, consisting of about 170 islands scattered 800km north to south. As an island country, air transport plays important roles not only in tourism, inter-island and international commerce, but also in social, educational and medical services. There are two international airports, namely Fua'amotu and Vava'u International Airports.

Fua'amotu International Airport (hereinafter referred to as "TBU"), located on Tongatapu, which is also the location of Nuku'alofa, the capital of Tonga, was developed by the Japan's Grant Aid project, about 30 years ago. The facilities of TBU are aging and there are issues to be addressed in terms of aircraft and passenger processing capacity, as well as aviation security and safety of the airport. Therefore, the World Bank (hereinafter referred to as "WB") provided support as a part of the Pacific Aviation Investment Program (hereinafter referred to as PAIP) to improve the runway, taxiway, apron, arrival part of the international passenger terminal building (hereinafter referred to as "PTB") and the air traffic control tower, and Tonga Airports Limited (hereinafter referred to as "TAL") expanded the international arrival terminal by its own budget. However, improvement of the departure part of the international PTB was not carried out and is becoming narrow. The old PTB is used as a domestic PTB, located away from the international PTB, which makes it inconvenient for passengers.

Vava'u International Airport (hereinafter referred to as "VAV"), located in Vava'u islands, 10km north of Neiafu, the second largest city in Tonga, also experienced improvement by PAIP for runway pavement and PTB. However, more improvements such as extension of runway and construction of a new PTB are expected.

In this context, the Government of Tonga hopes to obtain support of Japan's Grant Aid in order to implement runway extension and development of new international terminal at TBU and runway extension and expansion of PTB at VAV.

1-2 Objectives of the Survey

Objectives of the Data Collection Survey are:

- to gather and analyze basic information on existing facilities, future demand forecast and necessary improvements;
- to formulate the project scope, construction schedule and approximate cost estimation; and
- to conduct preliminary evaluation of candidate project.

Note: The Survey does not mean commitment of JICA for cooperation on projects in the future.

1-3 Survey Area

Areas of the Survey are Fua'amotu International Airport and its surroundings on Tongatapu Island and Vava'u International Airport and its surroundings on Vava'u Island.

1-4 Method of the Survey

The Data Collection Survey has been carried out by the following members.

Mr. Toru SHIMADA:	Chief Consultant/Airport Planner/Aviation Demand Forecast
Mr. Katsuya TERABAYASHI:	Deputy Chief Consultant/Airport Planner/Airport Equipment Planner
Mr. Hidehisa YOSHIDA:	Airport Facility Planner
Mr. Masato SIMOOZONO:	Airport Building Renovation Planner

The work flow and survey schedule are shown in Figure 1-4-1 and Table 1-4-1 respectively.

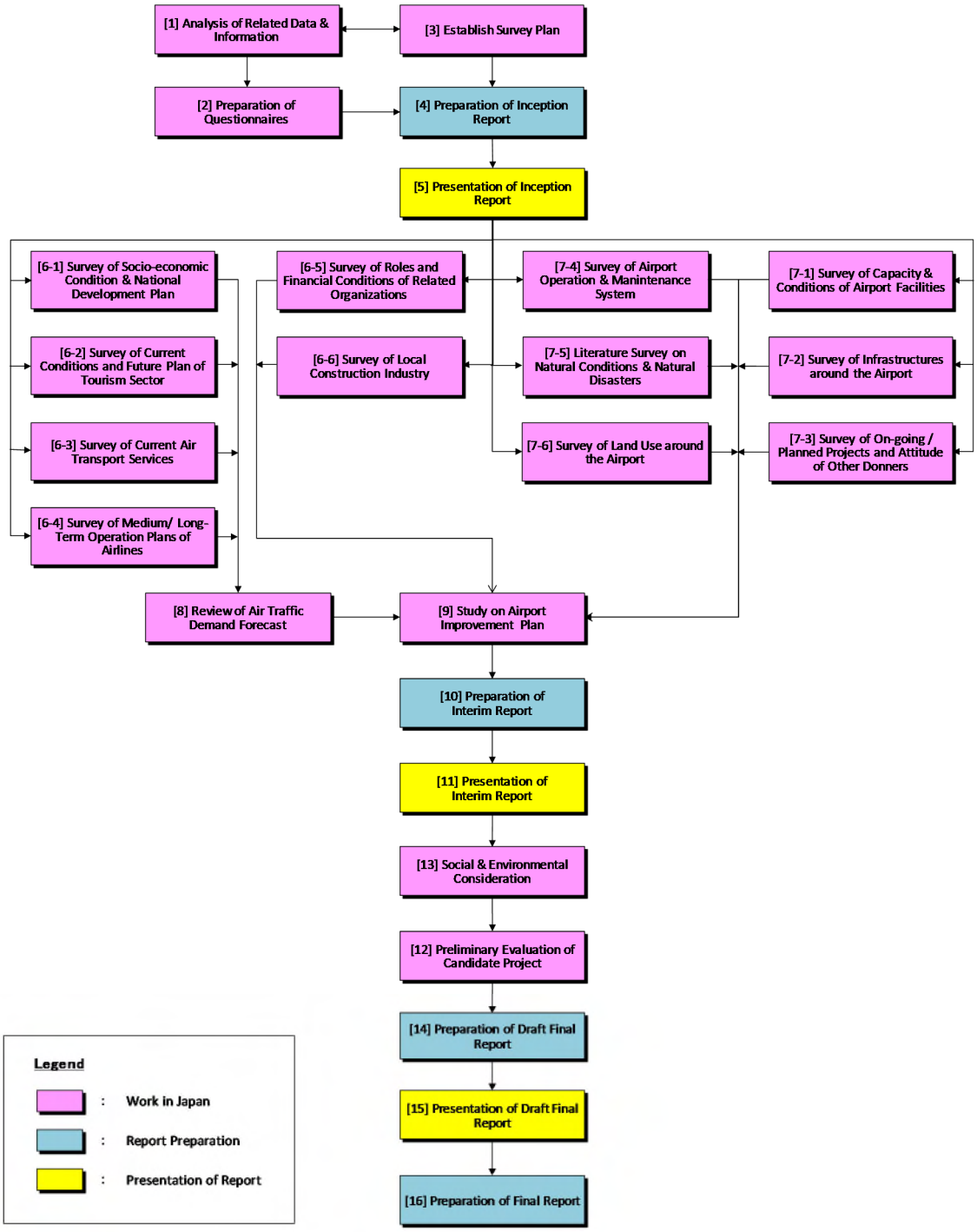


Figure 1-4-1 Work Flowchart

Table 1-4-1 Survey Schedule

	2020										2021	
	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep,	Oct	Nov.	Dec.	Jan	Feb
[1] Analysis of Related Data & Information	▬											
[2] Preparation of Questionnaires	▬		▬									
[3] Establish Survey Plan	▬	▬										
[4] Preparation of Inception Report	▬		▬									
[5] Presentation of Inception Report			△									
[6] Confirmation of Background & History		▭	▭	▭				▭				
[7] Survey of Existing Airport Facilities		▭	▭	▭				▭	▭			
[8] Review of Air Traffic Demand Forecast		▭	▭	▭	▭			▭				
[9] Study on Airport Improvement Plan					▭	▭	▭	▭	▭			
[10] Preparation of Interim Report						▭	▭					
[11] Presentation of Interim Report							△					
[12] Preliminary Evaluation of Candidate Project								▭	▭			
[13] Social & Environmental Consideration		▭	▭	▭				▭				
[14] Preparation of Draft Final Report									▭	▭		
[15] Presentation of Draft Final Report											△	
[16] Preparation of Final Report										▭	▭	

Legend : ▬ Preparation ■ Work in Abroad ▭ Work in Japan △ Presentation/Discussion

CHAPTER 2
SURROUNDING SITUATIONS OF THE PROJECT

CHAPTER 2 SURROUNDING SITUATIONS OF THE PROJECT

2-1 Socio-Economic Situations

The population of Tonga was about 103,197 people in 2018[1] and about 70% of the population is on Tongatapu and 14% on Vava'u[2]. Table 2-1-1 shows the population of Tonga in the last 10 years.

Table 2-1-1 Population of Tonga

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Population	103,890	103,986	103,562	102,737	101,768	101,028	100,781	101,133	101,998	103,197
Growth (%)	0.49	0.09	-0.41	-0.80	-0.95	-0.73	-0.24	0.35	0.85	1.17

Source: World Bank

The main industries of Tonga are agriculture (copra, coconut oil and pumpkin) and fishery. Gross Domestic Products (GDP) and its growth rate were TOP 1,028 million at year 2017 constant price and 0.732% respectively in 2019[3]. Table 2-1-2 shows the GDP of Tonga in the last 11 years. Gross National Income per capita was US$ 4,300 in 2018[1].

Table 2-1-2 GDP of Tonga (million Pa'anga)

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GDP	822	829	885	893	895	914	924	985	1,018	1,021	1,028
Growth (%)	-5.199	0.803	6.818	0.823	0.312	2.019	1.172	6.571	3.322	0.302	0.732

Source: International Monetary Fund

Table 2-1-3 shows the percent change of the average consumer prices of Tonga in the last 11 years[3].

Table 2-1-3 Inflation Rate of Tonga

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inflation (%)	1.427	3.535	6.271	1.148	2.110	1.171	-1.054	2.580	7.369	3.628	4.651

Source: International Monetary Fund

2-2 Situations of Tourism Sector

Tourist arrivals to Tonga in 2019 were 93,016 visitors, of which 72% traveled by air. The major source markets were New Zealand (47.5%) followed by Australia (18.9%) and the USA (15.4%), and major purposes of visit were holiday/vacation (41.8%) and visiting relative/friends (37.9%)[4].

"Tonga Tourism Sector Roadmap 2014-2018" (August 2013) set the following five key strategies.

- To increase awareness of Tonga and demand for its tourism products in priority markets
- To provide an enabling environment to support growth of tourism related business
- To facilitate tourism investment that maximizes the contribution to Tonga's economic, social and cultural wellbeing
- To support the delivery of quality tourism products that reflect Tonga's unique environmental and cultural heritage
- To increase destination competitiveness through increased accessibility, infrastructure use and viability

The roadmap recognized "Air transport is clearly a vital component of the tourism supply chain" and "A significant investment program is already underway in the airports sector, which will include the resurfacing of Fua'amotu and Vava'u", then expressed the needs of improvements of domestic air services.

[1] Source: World Bank Open Data https://data.worldbank.org/country/tonga
[2] "Project Information Document (PID)", November 2019, Ministry of Infrastructure
[3] Source: World Economic Outlook Database October 2020, International Monetary Fund
[4] Statistical Bulletin on International Arrivals and Departures 2019, Statistical Department

2-3 Situations of Aviation Sector

2-3-1 Airlines

As of March 2020, one national airline, i.e., Real Tonga, and four foreign airlines operate scheduled air transport services in Tonga. The restructuring of airlines is going on due to socio-economic situations under COVID-19, but airline names as of March 2020 are used in this study. Types of aircraft used in Tonga are shown in Table 2-3-1.

Table 2-3-1 Type of Aircraft Used in Tonga

Airline	Aircraft Type
Real Tonga	SAAB340B (3C), MA-60 (3C), Y12E (1B), BN-2A/B (1A)
Air New Zealand	B777-300ER/200ER (4E), B787-9 (4E), A320 (4C), A321Neo (4C)
Virgin Australia	B737-800 (4C)
Fiji Airways	A330 (4E), B737-800 (4C), ATR-72 (2C)
Talofa Airways	Turbo Commander 690B (2A)

Note: Number and letter in ( ) show ICAO aerodrome reference code

2-3-2 Air Transport Network

International services are provided mainly at Fua'amotu International Airport and limited services at Vava'u International Airport. Real Tonga has been providing domestic air transport services since 2013, and currently operates flights between five islands, i.e., Tongatapu, 'Eua, Ha'apai, Vava'u, Niuatoptap and Niuafo'ou. Table 2-3-2 shows destinations of scheduled international services currently provided at Fua'amotu and Vava'u International Airports. Figure 2-3-1 and 2-3-2 show international and domestic air transport networks.

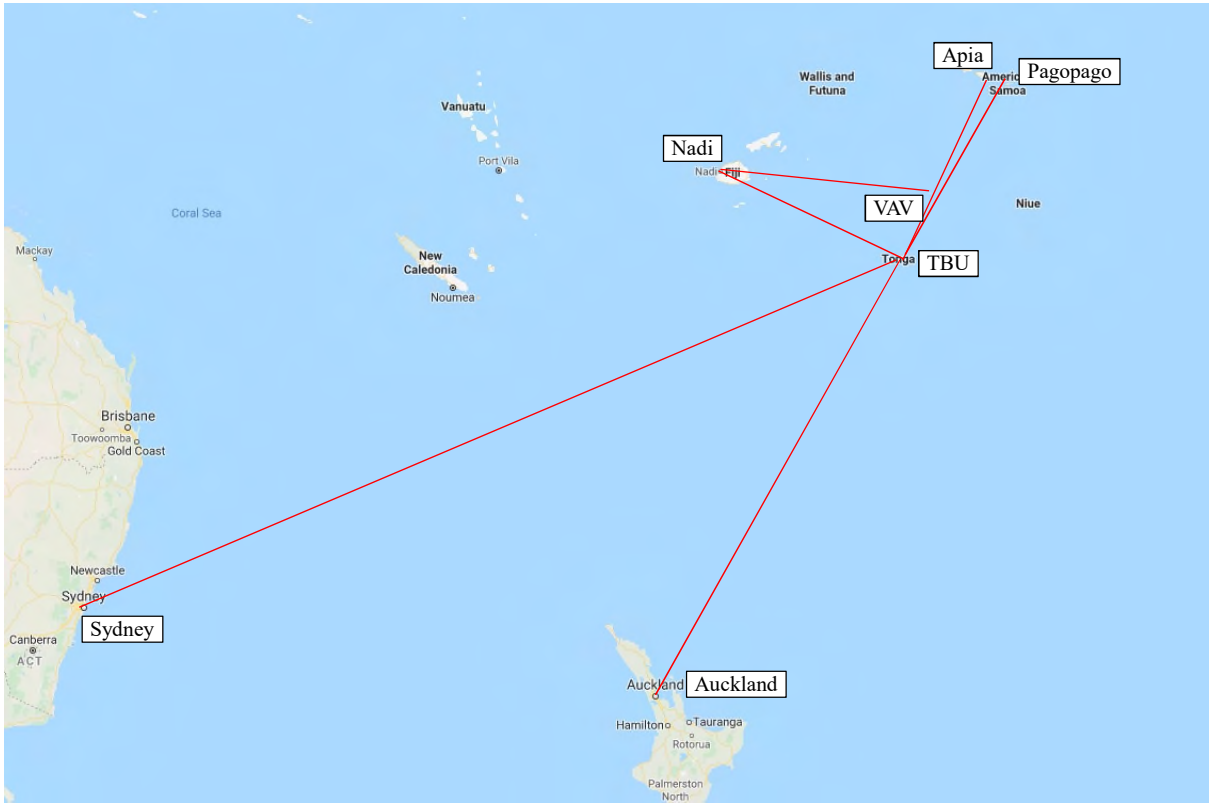


Figure 2-3-1 International Air Transport Network

Table 2-3-2 Destinations of International Services

Airport	Major Destination	Frequency*
Fua'amotu	Auckland/New Zealand	10.4/week
	Sydney/Australia	2.0/week
	Nadi/Fiji	5.1/week
	Apia/Samoa	0.6/week
	Pagopago/American Samoa	0.4/week
Vava'u	Nadi/Fiji	1.4/week

*Average of Dec. 2019 and Jan. 2020

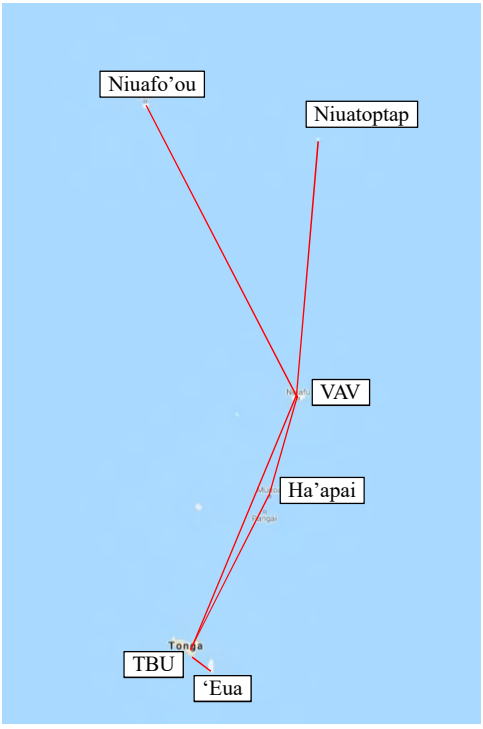


Figure 2-3-2 Domestic Air Transport Network

2-3-3 Air Traffic Volume

Number of air passengers, number of flights (round trips) and volume of air cargo at airports of Tonga in the last 10 years are shown in Tables 2-3-3, 2-3-4 and 2-3-5 respectively. It is considered that the volume of domestic traffic decreased around 2012 and 2013 was due to change the name of the domestic air operator from Chathams Pacific to Real Tonga.

Table 2-3-3 Number of Air Passengers

Year	Fua'amotu		Vava'u		'Eua	Ha'apai	Niuatoptap	Niuafo'ou
	Int'l	Dom.	Int'l	Dom				
2009	144,725	53,324	-	37,062	6,762	24,083	674	45
2010	144,290	51,374	-	34,958	6,712	20,012	618	187
2011	144,999	48,898	-	39,893	9,155	13,571	753	217
2012	145,509	47,960	-	37,208	7,726	14,831	518	152
2013	150,349	39,413	-	25,592	5,017	10,507	256	118
2014	157,012	47,537	-	33,282	7,103	12,715	601	265
2015	178,177	52,774	-	35,123	5,430	16,770	570	221
2016	193,325	62,286	3,558	39,707	7,565	18,423	631	242
2017	200,018	61,271	7,333	41,510	6,732	20,921	605	237
2018	208,078	52,915	7,503	35,759	5,348	24,592	630	196
2019	213,296	62,291	7,716	39,550	8,250	20,644	579	210

Source: ATS

Table 2-3-4 Number of Flights

Year	Fua'amotu		Vava'u		'Eua	Ha'apai	Niuatoptap	Niuafo'ou
	Int'l	Dom.	Int'l	Dom				
2009	780	1,609	-	866	542	715	64	7
2010	783	1,759	-	864	582	702	53	19
2011	733	1,965	-	912	771	627	63	28
2012	761	1,821	-	881	630	670	50	19
2013	762	1,873	-	787	514	739	33	14
2014	798	1,665	-	810	351	716	44	21
2015	891	1,924	-	1,078	316	790	35	16
2016	931	2,122	57	1,021	510	755	38	18
2017	1,022	1,907	123	868	594	683	34	14
2018	1,009	1,563	111	751	472	600	33	12
2019	1,075	2,056	120	928	643	684	33	13

Source: ATS

Table 2-3-5 Volume of Air Cargo (ton)

Year	Fua'amotu		Vava'u		'Eua	Ha'apai	Niuatoptap	Niuafo'ou
	Int'l	Dom.	Int'l	Dom				
2009	2,165	114.697	-	81.753	0.989	25.746	0	0.007
2010	1,321	123.664	-	70.842	2.380	24.851	0.541	0.019
2011	1,262	69.169	-	63.644	2.350	15.526	1.018	0.028
2012	1,078	71.576	-	46.422	6.683	17.743	1.070	0.019
2013	1,056	51.629	-	30.545	4.898	13.777	0.229	0.014
2014	1,291	64.977	-	45.188	5.052	19.355	0.912	0.021
2015	1,403	68.356	-	44.705	4.680	23.639	0.297	0.016
2016	1,340	87.887	0	59.529	5.396	26.794	0.558	0.018
2017	1,224	107.250	0.041	74.100	6.832	35.067	1.814	0.014
2018	1,219	117.319	0	92.126	5.034	35.176	2.530	0.012
2019	1,212	125.496	0	101.144	7.733	27.191	3,324	0.013

Source: ATS

2-4 National Development Strategy

2-4-1 Tonga Strategic Development Framework 2015-2025

"Tonga Strategic Development Framework 2015-2025" (TSDF II) is prepared based on recent developments and the lessons learnt from TSDF I as well as the understanding of future uncertainties and risks. It builds a more integrated planning and budgeting system and shows an integrated vision of direction over the next 10 years. It aims at "A more progressive Tonga supporting higher quality of life for all" and set the following seven national outcomes:

- ✓ *Outcome A: dynamic & knowledge based economy*
- ✓ *Outcome B: balanced urban & rural development across island groups*
- ✓ *Outcome C: empowering human development with gender equality*
- ✓ *Outcome D: responsive good governance*
- ✓ *Outcome E: successful provision & maintenance of infrastructure & technology*
- ✓ *Outcome F: effective land & environment management & resilience to climate & risk*
- ✓ *Outcome G: consistent advancement of our external interests, security & Sovereignty*

As a target for Outcome A, it is aimed at "*the real GDP average annual growth rate reaches 2.5-4% per year*". "*100% ground aviation operation certification meet National and ICAO requirements*" is set as one of the targets of Organizational Outcome for Ministry of Infrastructure under National Outcome E. This project contributes to the achievement of Outcome E.

2-4-2 Tonga National Infrastructure Investment Plan 2013-2023

"Tonga National Infrastructure Investment Plan 2013-2023" outlines the priorities and plans for major initiatives in economic infrastructure. It states "*The first priority is to successfully complete projects that are already underway and committed*" and "*Pacific Aviation Investment Program (PAIP), which aims to improve operational safety and oversight in the international air transport sector through investment (including resurfacing of Fua'amotu and Vava'u airport runways) and capacity building (supported by the WB)*" is one such project, and lists "Resurface the runway at Salote Pilolevu Airport (Ha'apai)" and "New Control Tower for Fua'amotu Airport" as priority investment projects under the theme of "Connecting Tonga" and "Upgrading and capacity development in aviation safety" as one of the complementary initiatives under the theme of "Sustainability, Safety, Resilience".

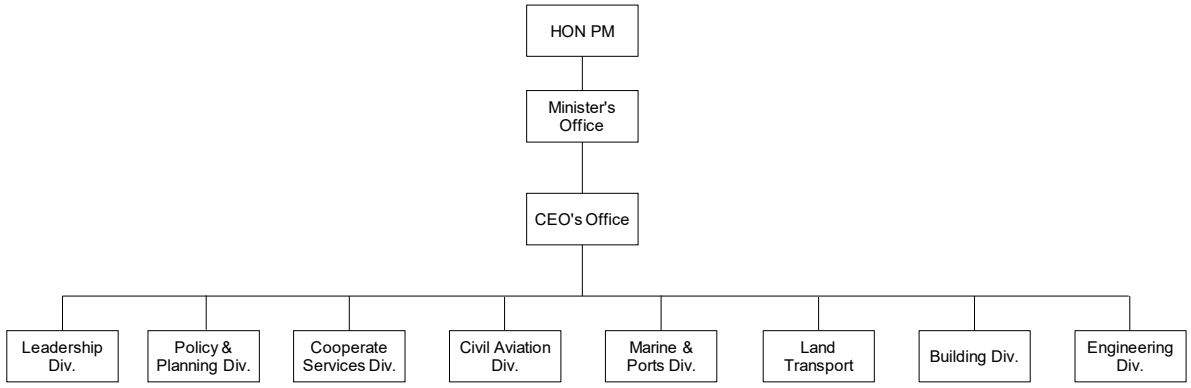
2-4-3 Ministry of Infrastructure Corporate Plan 2019/20-2021/2022

The purpose of the Ministry of Infrastructures (MOI) Corporate Plan is "*strengthening the Ministry's strategic alignment to the set of National Outcomes that is being accountable to, in the TSDFII*[5]". MOI, as its organizational outputs of Civil Aviation Division, states that "*achieving a safer and more affordable domestic and international air transportation supporting growth of economic activity in the aviation sector*". As new initiatives with regard to airport developments, the corporate plans addresses the ongoing repair and maintenance of outer island airports/air strips, new Fua'amotu international terminal (extension and refurbish of existing terminal), and extension of Fua'amotu international runway.

2-5 Related Organizations

2-5-1 Ministry of Infrastructures

The aviation sector in Tonga is administered by the Ministry of Infrastructure (MOI). The mission of MOI is "*Through developing of quality (innovative, timely and evidence-based) infrastructure related policies supported by proactive deliveries of a more sustainable and resilience, safe and affordable infrastructure and transport system*". MOI is responsible for policy making and implementation for infrastructure development. There are eight divisions, including Civil Aviation Division under MOI. The MOI organization chart is shown in Figure 2-5-1.



Source: MOI

Figure 2-5-1 Organization Chart of MOI

2-5-2 Civil Aviation Division

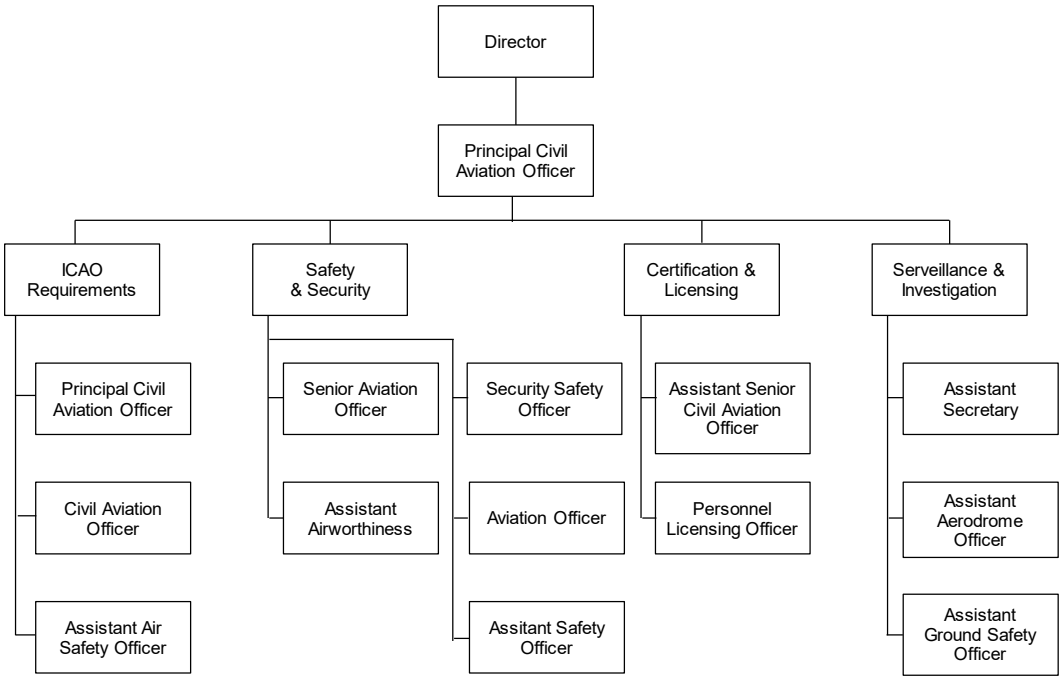
Civil Aviation Division (CAD) belongs to MOI and is responsible for policy, planning and regulation for the aviation sector based on the Civil Aviation Act 2014. The prime function of the CAD is to

[5] Tonga Strategic Development Framework II

undertake activities that promote safety in civil aviation at a reasonable cost. The specific functions of CAD include:

1. Developing and providing civil aviation safety and security policy advice;
2. Developing safety and security standards for the civil aviation system and monitoring adherence to these standards;
3. Performing entry and exit control over participants in the civil aviation system;
4. Measuring and reviewing the performance of the system from a safety point of view, including the investigation of incidents, occurrences and some accidents as the aviation safety regulatory authority; and
5. Promoting aviation safety and security through the provision of information and education programs.

CAD organization chart is shown in Figure 2-5-2.



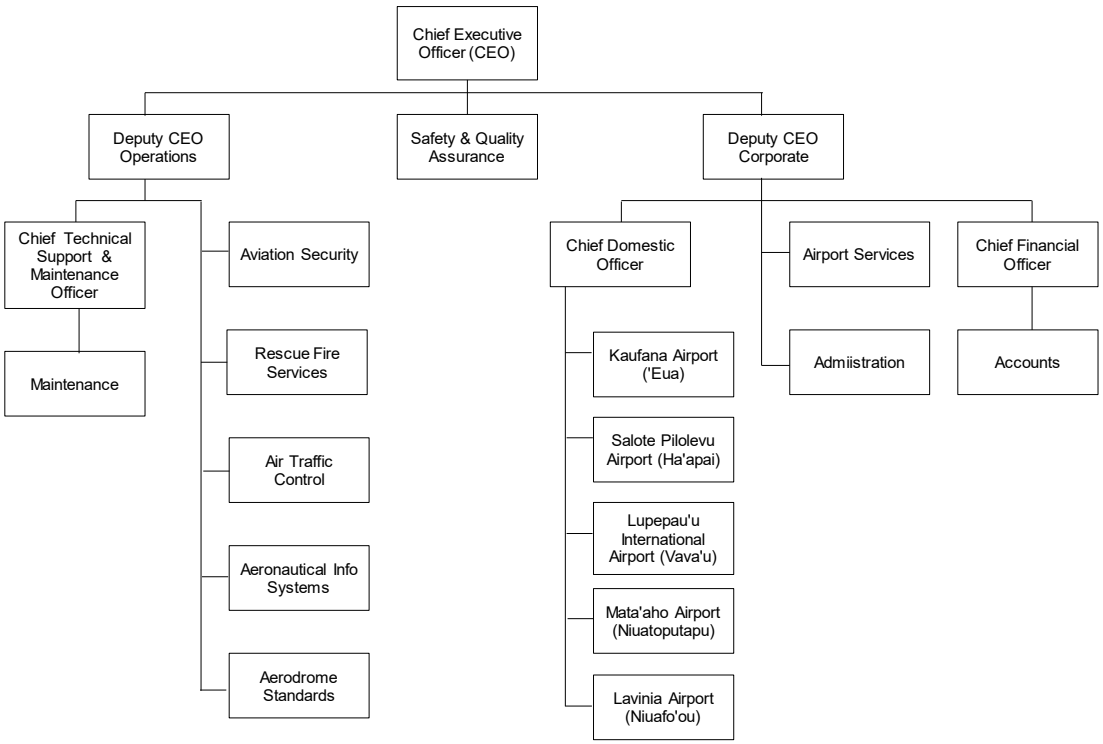
Source: MOI Corporate plan 2019

Figure 2-5-2 Organization Chart of CAD

2-5-3 Tonga Airports Limited

Tonga Airports Limited (TAL) was established in July 2007, under the governing legislation of the Public Enterprises Act 2002, and the authority granted by the Instrument of Delegation under section 5 of the Civil Aviation Act 1990. TAL is responsible for the operation and maintenance of six airports and air navigation service in Tonga, namely Fua'amotu Int'l Airport, Lupepau'u (Vava'u) Int'l Airport, Salote Pilolevu (Ha'apai) Airport, Kaufana ('Eua) Airport, Mata'aho (Niuatoputapu) Airport, and Lavinia (Niuafo'ou) Airport. TAL currently has approximately 216 employees. The TAL organization chart is shown in Figure 2-5-3.

Income and expenses of TAL in the last five years is shown in Table 2-5-1. Aeronautical revenue accounts for approximately 80% of total income and the revenue is leveling since 2016. With regard to the expenses, salaries & wages and depreciation are major items and account for approximately 70% of total expenses. Profit before income tax in 2019 was 2.5 million TOP.



Source: TAL

Figure 2-5-3 Organization Chart of TAL

Table 2-5-1 Income and Expenses of TAL for the Past 5 Years

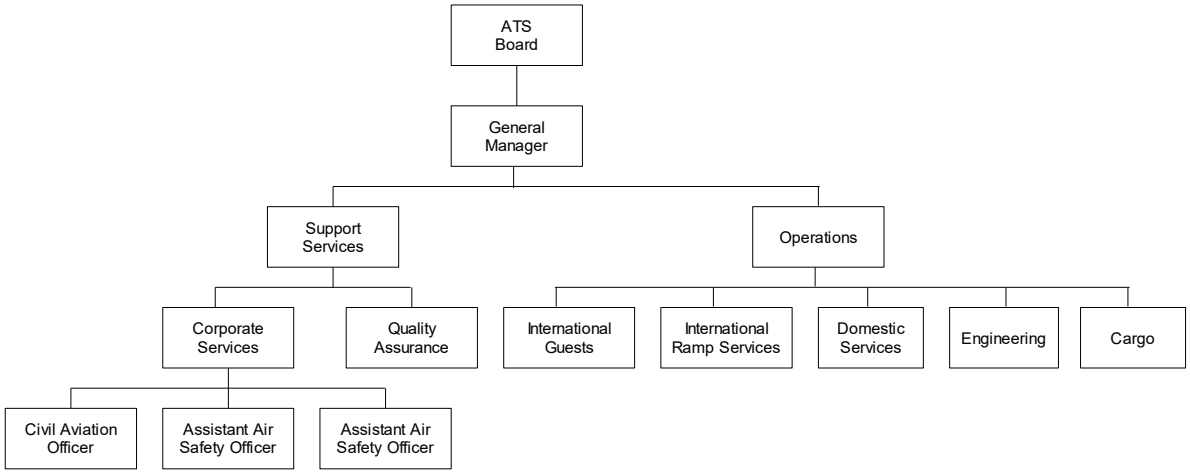
Unit: TOP

Income	2015	2016	2017	2018	2019
Aeronautical - international	8,116,005	9,730,035	9,999,372	9,317,673	9,992,206
Aeronautical - domestic	792,269	800,926	935,903	839,019	832,585
Non - aeronautical	1,159,544	1,238,334	1,202,298	1,439,761	1,670,064
Total operational income	**10,067,818**	**11,769,295**	**12,137,573**	**11,596,453**	**12,494,855**
Add other income					
Amortisation of deferred income	88,296	658,273	1,850,093	1,850,093	1,850,093
Total income	**10,156,114**	**12,427,568**	**13,987,666**	**13,446,546**	**14,344,948**
Expenses					
Salaries and wages	2,842,589	3,093,412	3,446,342	3,537,164	3,782,919
Depreciation	2,344,197	3,010,958	4,334,033	4,275,988	4,334,883
Fuel	235,812	209,423	125,064	428,875	545,950
Utilities	434,078	452,392	508,036	505,575	522,532
Repairs	53,448	214,623	199,682	261,775	234,965
Cleaning	226,214	236,745	277,967	249,475	228,286
Travelling	160,863	234,314	236,803	283,503	414,399
Training	0	88,237	163,546	103,000	179,355
Board expenses	122,109	200,713	296,591	222,253	118,099
Land lease	267,742	194,849	3,348	195,466	212,165
Others	1,109,004	886,065	1,046,362	1,609,972	1,265,240
Total expenses	**7,796,056**	**8,821,731**	**10,637,774**	**11,673,046**	**11,838,793**
Profit before income tax	**2,360,058**	**3,605,837**	**3,349,892**	**1,773,500**	**2,506,155**

Source: TAL

2-5-4 Air Terminal Services (Tonga) Limited

Air Terminal Services (Tonga) Limited (ATS) is a private company founded in 2004 and the sole licensed airport ground handler in Tonga. ATS provides passenger services, baggage and cargo handling services, load control and dispatch services, and ramp handling services for both scheduled and non-scheduled carriers. The ATS organization chart is shown in Figure 2-5-4.



Source: ATS

Figure 2-5-4 Organization Chart of ATS

2-6 Local Construction Industry

1) Local Construction Company

According to the information obtained from Japanese and Local Construction Companies working in Tongatapu and in JICA's project reports in the past, there are multiple companies, including one based in New Zealand, three from Tonga and some Chinese-owned companies in Tongatapu. They have been involved in the public construction works as well as Japanese ODA projects in Tongatapu and have sufficient capability to carry out large-scale construction project.

The Survey Team found that two local construction companies in Tongatapu have their branch offices in Vava'u. Although there are also plural local construction companies based in Vava'u, their construction experience is limited to medium-sized commercial developments.

2) Construction Equipment

The local construction companies in Tongatapu have a significant amount of plant and general construction equipment, such as 0.7 cu.m excavators, 10-ton dump trucks, and 25-ton cranes. On the other hand, the number and types of construction equipment in Vava'u are limited.

3) Construction Materials

Course/fine aggregates and crusher sand are locally available in Tongatapu. There are a few concrete plants supplying ready-mixed concrete in Tongatapu. Although general construction materials such as re-bars, timbers and nails is available in local markets, those materials are all imported from abroad, such as from New Zealand. The amount and kinds of construction materials in the Tongatapu market are insufficient for the large-scale project, and most of the construction materials will most probably be imported from abroad.

In Vava'u, the usual building materials are masonry blocks made on the island or timber imported or from a plantation on Eau Island. There is no ready mixing concrete plant in Vava'u, and all concrete used in construction is currently made on the site with small scale concrete mixers. There were four quarries identified by TAIP in 2016 within the island as a source of aggregate supply, and two of them

are still providing sand, aggregate and rock for the vast majority of construction projects in Vava'u. Both quarries have their own excavators, loaders and dump trucks.

CHAPTER 3
AIR TRAFFIC DEMAND FORECAST

CHAPTER 3 AIR TRAFFIC DEMAND FORECAST

3-1 Demand Forecast for Fua'amotu

3-1-1 Annual International Air Passengers

1) Regression Analyses

Since the main source markets of tourist arrivals are New Zealand and Australia as stated in "2-2 Situations of Tourism Sector", the Survey Team selected the GDP of Tonga, New Zealand and Australia as potential explanatory variables of air passenger demand of TBU, and conducted regression analyses on the data from 2009 to 2019. Table 3-1-1 summarizes the results of regression analyses, i.e., equation and adjusted R-Squared (R2) obtained from the analyses. R2 is more than 0.85 in all cases. However, Cases 2, 3, 5 and 6 are judged inappropriate because the coefficients of Tonga and Australia GDPs are negative (it means that the demand decreases, if GDP increases). Therefore, Cases 1 and 4 will be used for future demand forecast.

Table 3-1-1 Results of Regression Analyses

Study Case	Adjusted R2
Case 1: Tonga Real GDP, Linear Regression $Y = 358276.7\ X - 161787$	0.888262
Case 2: Tonga & New Zealand Real GDPs, Linear Regression $Y = -96654.8\ X_1 + 1519.7025 X_2 - 75169$	0.959740
Case 3: Tonga, New Zealand & Australia Real GDPs, Linear Regression $Y = -1776.6\ X_1 + 2501.814\ X_2 - 204.836\ X_3 - 33861$	0.983941
Case 4: Tonga Real GDP, Full Logarithm Regression $Log\ (Y) = 1.8959\ log(X) + 5.290949$	0.875214
Case 5: Tonga & New Zealand Real GDPs, Full Logarithm Regression $Log\ (Y) = -0.646569\ log(X_1) + 2.042687\ log(X_2) + 0.421367$	0.955590
Case 6: Tonga, New Zealand & Australia Real GDPs, Full Logarithm Regression $Log\ (Y) = -0.089575\ log(X_1) + 3.340846\ log(X_2) - 2.076897\ log(X_3) + 4.101015$	0.982669

Source: Survey Team

2) Forecast of Explanatory Variables

The International Monetary Fund (IMF) forecast annual growth rates of GDPs up to year 2025 is shown in Table 3-1-2.

Table 3-1-2 GDP Growth Rate Forecast

Year	Tonga	New Zealand	Australia
2020	-2.539%	-6.066%	-4.159%
2021	-3.546%	4.356%	2.953%
2022	4.016%	2.6%	2.804%
2023	3.008%	2.553%	2.575%
2024	2.451%	2.491%	2.609%
2025	1.812%	2.478%	2.542%

Source: IMF World Economic Outlook Database, October 2020

Future GDP in constant price and national currency are calculated as shown in Table 3-1-3 based on these growth rates and assuming the same growth rates after 2025.

Table 3-1-3 Forecast of GDP in constant price and national currency (unit: billion)

Year	Tonga	New Zealand	Australia
2030	1.181	314.511	2,365.82
2035	1.292	355.459	2,682.19
2040	1.413	401.738	3,040.88

Source: Survey Team

However, according to an analysis of the impact of COVID-19 on global GDP and Revenue Passenger Kilometers (RPK) by the International Air Transport Association (IATA), it is predicted that RPK will

return to the 2019 level about one and a half years behind the recovery of the GDP (see the figure below).

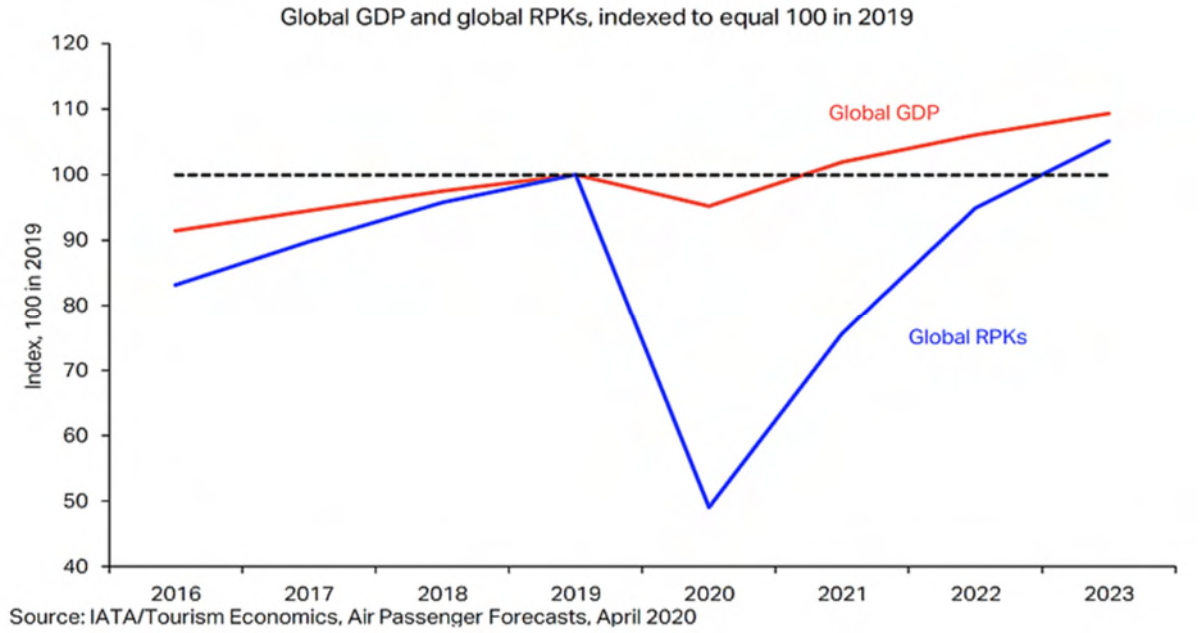


Figure 3-1-1 IATA Forecast of Revenue Passenger Kilometer vs. GDP

In order to take account of this delay in the demand forecast, the GDP forecast values are postponed by one and a half years for convenience, e.g., an average of the forecast GDP of 2023 and 2024 is to be used as the forecast GDP of 2025. Table 3-1-4 shows adjusted the GDPs for air traffic demand forecast.

Table 3-1-4 Adjusted GDP in constant price and national currency (unit: billion)

Year	Tonga	New Zealand	Australia
2025	1.049	268.252	2009.159
2030	1.150	303.172	2,278.391
2035	1.258	342.643	2,583.080
2040	1.376	387.253	2,928.510

Source: Survey Team

3) Future Demand Forecast

Future demand of international air passengers is forecasted as shown in Table 3-1-5 and Figure 3-1-2 by applying adjusted GDPs in Table 3-1-4 to equations in Table 3-1-1. The results are lower than the base case of the forecast in "Fua'amotu Airport Master Plan Desktop Review". This is because (i) the actual number of passengers of 2019 was lower than the 2018 estimate in the Desktop Review, (ii) Tongan GDP is expected to decrease in 2020 and 2021 due to COVID-19, and (iii) recovery of international passenger traffic is expected to be delayed by about one and a half years after recovery of GDP.

Table 3-1-5 International Air Passenger Forecast

Year	Case 1	Case 4	Average
2025	214,045	213,962	214,004
2030	250,231	254,698	252,465
2035	288,925	301,949	295,437
2040	331,201	357,895	344,548

Source: Survey Team

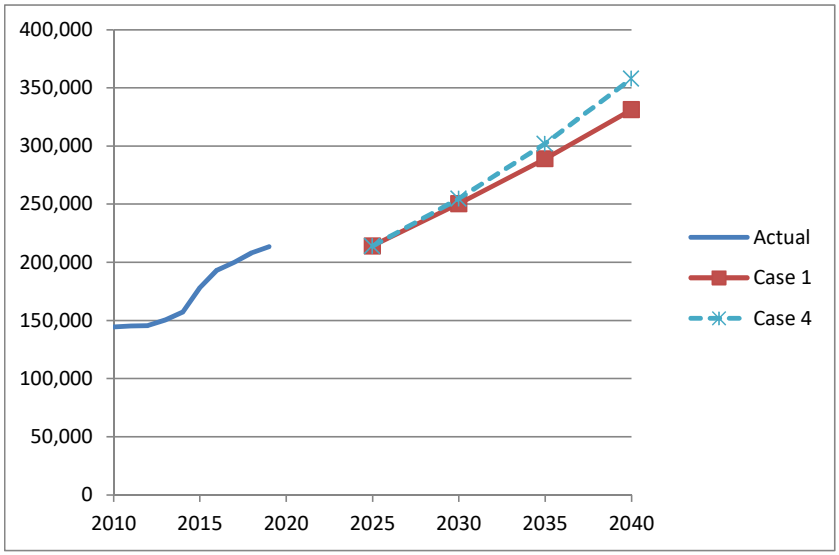


Figure 3-1-2 International Air Passenger Forecast

Since the USA is the third major source country of visitor arrivals, there is a potential of a direct flight to/from the west coast of USA. The existing runway length is good for operating such a flight with a full passenger payload. However, there was no such a flight observed in the last high season, i.e., during December 2019 and January 2020. Therefore, it is considered premature to expect operation of direct flights to/from USA with the Maximum Take-Off Weight until such time that non-scheduled/ charter flights are operated. It is considered too optimistic to expect scheduled flights from/to USA based on the fact that no other airline than Fiji Airways operate such flights at Nadi, where tourist arrivals are more than ten times that of Tonga.

3-1-2 Annual Domestic Air Passengers

The number of domestic air passengers is forecasted in the same way as the international air passengers, although R2 is about 0.3 and lower. The results are shown in Table 3-1-7 and Figure 3-1-3, and are lower than the base case of the forecast in the Desktop Review for the same reasons as in the case of international air passengers.

Table 3-1-6 Results of Regression Analyses

Study Case	Adjusted R2
Case 1: Tonga Real GDP, Linear Regression Y = 57784.91 X - 924	0.300304
Case 4: Tonga Real GDP, Full Logarithm Regression Log (Y) = 0.961628 log(X) + 4.750599	0.240296

Source: Survey Team

Table 3-1-7 Domestic Air Passenger Forecast

Year	Case 1	Case 4	Average
2025	59,692	58,963	59,327
2030	65,528	64,412	64,970
2035	71,769	70,219	70,994
2040	78,587	76,542	77,565

Source: Survey Team

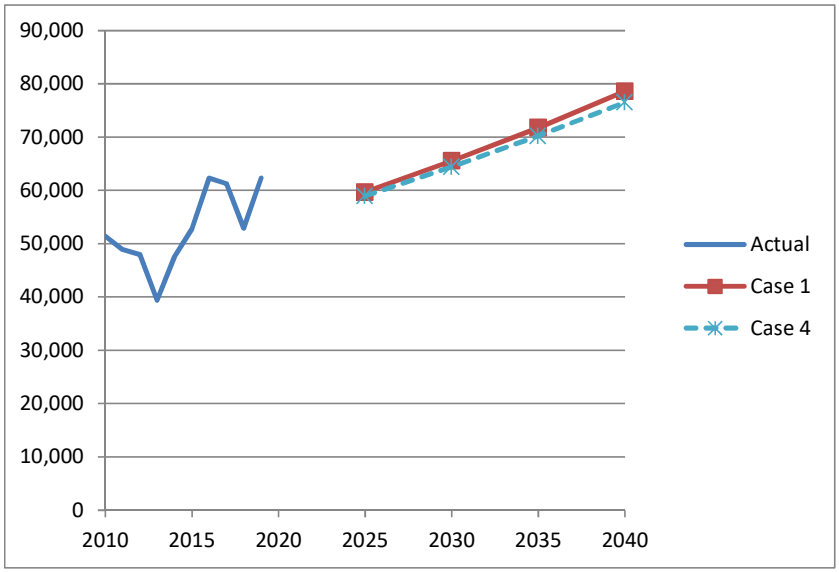


Figure 3-1-3 Domestic Air Passenger Forecast

3-1-3 Annual Aircraft Movements

The Survey Team conducted regression analyses of international and domestic flights (round trips) by using numbers of international and domestic passengers respectively as the explanatory valuables. As shown in Table 3-1-8, the result of the analysis of international flights shows high R2. Future demand of international flights is forecasted as shown in Table 3-1-9 and Figure 3-1-4 by applying the average of international air passenger forecast in Table 3-1-5, and is almost within the rage of the forecast in the Desktop Review. The number of domestic flights is forecasted by assuming the number of passengers per flight will stay at the current level, because R2 is very low.

Table 3-1-8 Results of Regression Analyses

Study Case	Adjusted R2
Case 1: International Flights and Passengers, Linear Regression Y = 0.004301 X + 132.6856	0.960246
Case 2: Domestic Flights and Passengers, Linear Regression Y = 0.010684 X + 1278.811	0.085674

Source: Survey Team

Table 3-1-9 Forecast of Flights

Year	International	Domestic
2025	1,053	1,849
2030	1,219	2,024
2035	1,403	2,212
2040	1,615	2,417

Source: Survey Team

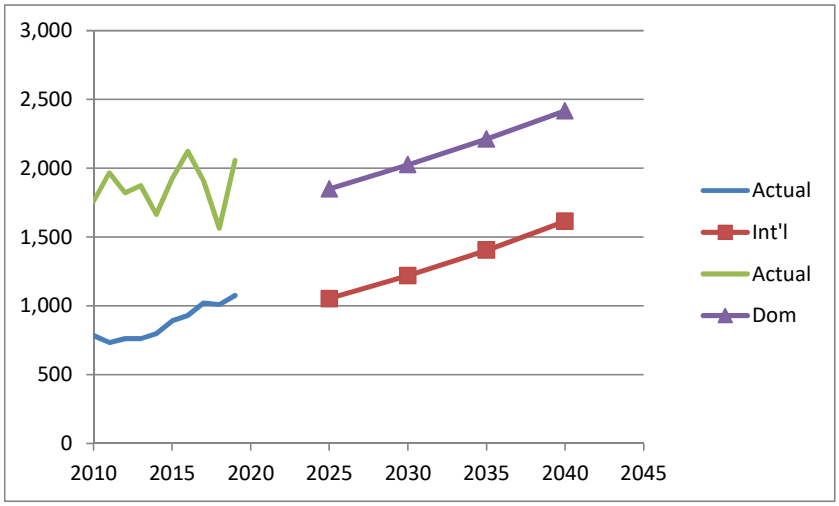


Figure 3-1-4 Number of Flights

3-1-4 Annual Air Cargo

Volumes of international and domestic air cargo were decreased from 2009 to 2013. The reasons for such decreases may be explained by (i) ban of the export of aquarium fish and "live" rock for aquariums, (ii) cessation of flights from Auckland to Los Angeles via Tonga and Apia, (iii) taking over of domestic services from Chathams Pacific to Real Tonga, etc. Therefore, the Survey Team conducted regression analyses of international and domestic air cargo and Tonga real GDP from 2013 to 2019. Table 3-1-10 summarizes result of the analysis of domestic air cargo. Future demands of international and domestic air cargo are forecasted as shown in Table 3-1-11 and Figure 3-1-5 by applying the adjusted GDP in Table 3-1-4.

Table 3-1-10 Results of Regression Analyses

Study Case	Adjusted R2
Case 1: International air cargo and Tonga Real GDP, Linear Regression Y = 79.868129 X + 1172	-0.19799
Case 2: Domestic air cargo and Tonga Real GDP, Linear Regression Y = 491444.6 X - 387362	0.953037

Source: Survey Team

Table 3-1-11 Forecast of Cargo (ton)

Year	International	Domestic
2025	1,329	168
2030	1,366	201
2035	1,405	236
2040	1,448	275

Source: Survey Team

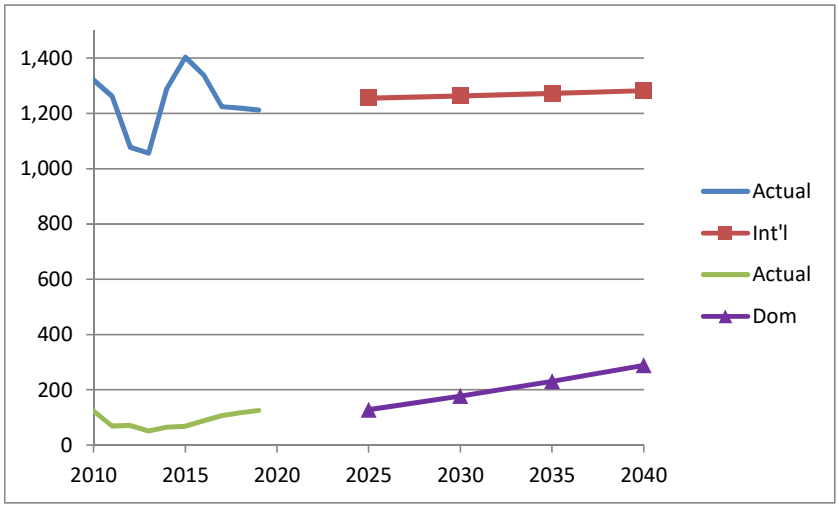


Figure 3-1-5 Volume of Air Cargo (ton)

3-1-5 Busy Hour Forecast

There are several definitions of "peak period" for airport planning as shown below:

- the second busiest day in an average week during the peak month (IATA)
- the peak hour of the average day in the peak month (FAA)
- 30th or 5% busiest hour (BAA)

It should be noted that IATA states in Airport Development Planning Manual "Planning for the absolute peak would suggest infrastructure that would be impractically designed and over-sized to meet a level of traffic that is rarely observed."

1) International Busy Hour

Figure 3-1-6 shows 60 min departure passengers in the latest high season, i.e., December 2019 and January 2020.

Air New Zealand (ANZ) and Virgin Australia (VOZ) operated 72 and 18 flights to Auckland (AKL) in these two months, i.e., eight and two flights a week (6-day operations in a week, except Sunday) on average. There were 11 cases of two flight departures in two months, i.e., 1.2 times per weeks on average. Eight cases were overlapping of NZ977 (A321, 214 seats) and VA60 (B737-800, 176 seats) to AKL on the nights of Tuesday and Thursday, and such overlap is selected as the typical busy hour. The maximum number of passengers was 340 on Tuesday, 19 December. ANZ sometimes used B777-200 (312 seats) and B787-9 (302 seats) as NZ273, of which the departure time was around noon. The maximum number of passengers on these flights was 301 on Friday, 05 December.

As demand is expected to increase to 1.18 times in 2030, it is expected that ANZ operations to AKL increase to 10 flights a week (one daily flight plus 4 flights a week) and VOZ operations to AKL less than 3 flights a week and overlap 1.4 times per week. Therefore, the busy hour international operations are forecasted to be one each of A321 and B737-800, and busy hour one-way passengers will be (214 + 176) x 90% = 351, and 702 for two-way. In 2040, it is expected that ANZ operations to AKL increase to 13 flights a week (two daily flights plus 1 flight a week) and VOZ operations to AKL 3 flights a week and overlap 1.9 times per week. ANZ may operate one each of A321 and B787 (or B777) daily, but it is assumed that B787 (or B777) will be operated around noon based on past experience. In these cases, the busy hour international operations and busy hour passengers will be the same as that in 2030. The Desktop Review assumed one each of 300- and 180-seater aircraft in 2028 and one each of 300-, 210- and 180-seater aircraft in 2038 as scenarios without detailed justifications. Three flights in 2038 may be ANZ, VOZ and FJI, but it is unlikely for FJI to operate in the current busy hour 20:30-21:30 because it is short haul (about one hour) and they can fly during the daytime more conveniently.

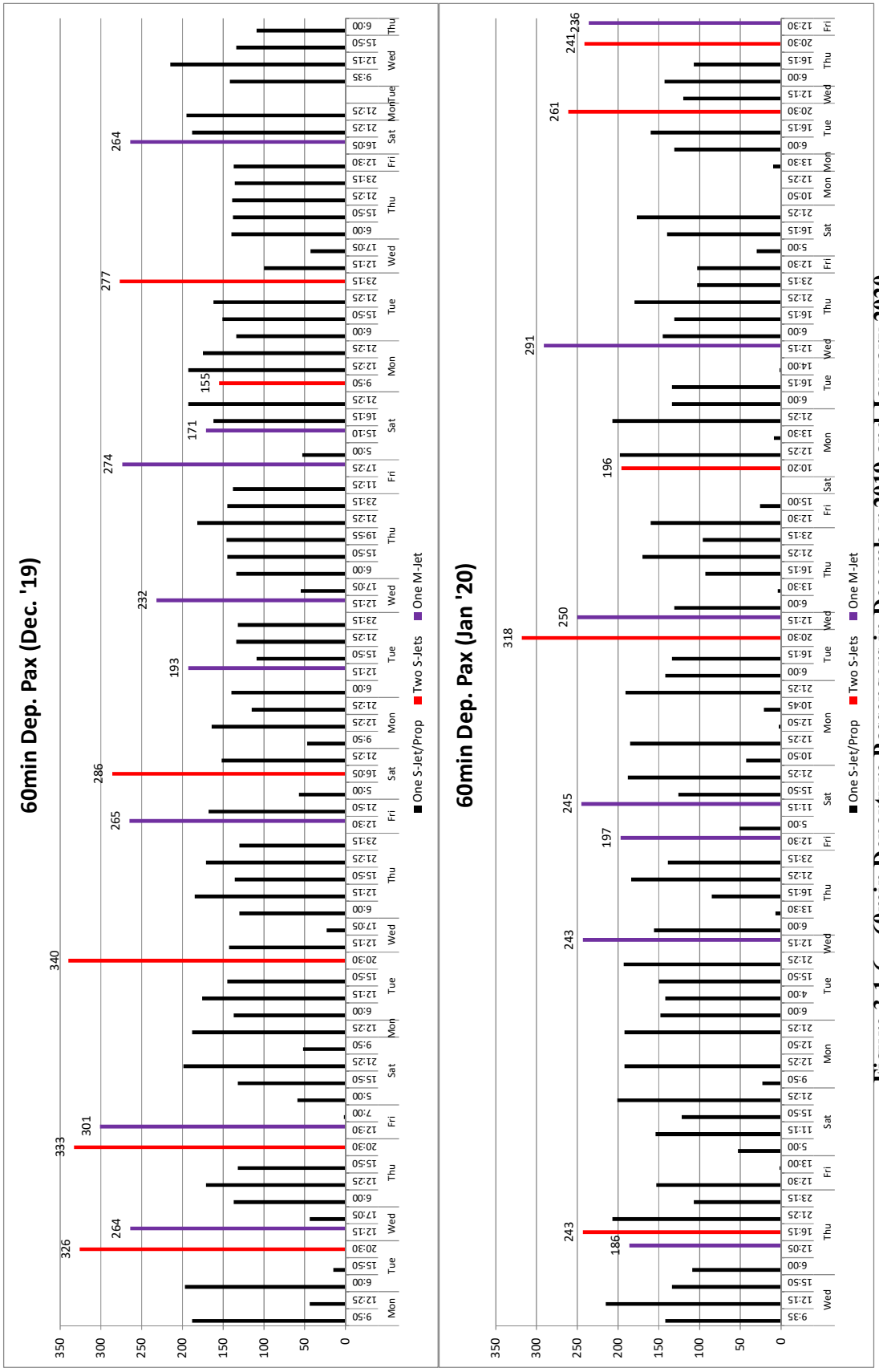


Figure 3-1-6 60min Departure Passengers in December 2019 and January 2020

Table 3-1-12 Summary of International Busy Hour

	Annual Pax	Increase Ratio	Occurrence per Week	Aircraft Movements	Number of Pax One-way
Last High Season	213,296	-	1.2 times	B737-800 x 1 A321 x 1,	340 pax
Forecast for 2030	252,465	1.18	1.4 times		351 pax
Forecast for 2040	344,548	1.62	1.9 times		351 pax

Source: Survey Team

2) Domestic Busy Hour

There were 11 cases, i.e., 1.2 times per weeks on average, of three flight departures in 60 min in the latest high season, i.e., December 2019 and January 2020. They are one each of SAAB340B, Y12E and BN-2A (total 20-50 pax). As demand is expected to increase to 1.24 times in 2040, this overlap is expected to be increased to 1.3 times per week. Therefore, busy hour one-way passengers will be (32 + 16 + 8) x 90% = 50 up to 2040 and 100 for two-way. The Desktop Review assumed one each of 60-, 34- and 16-seater aircraft in 2028 and one each of 70-, 50- and 19-seater aircraft in 2038 as scenarios without detailed justifications.

Table 3-1-13 Summary of Domestic Busy Hour

	Annual Pax	Increase Ratio	Occurrence per Week	Aircraft Movements	Number of Pax One-way
Last High Season	62,291	-	1.2 times	SAAB x 1, Y12E x 1, BN-2A x 1	50 pax
Forecast for 2030	64,970	1.04	1.2 times		50 pax
Forecast for 2040	77,565	1.24	1.3 times		50 pax

Source: Survey Team

3) Combined Busy Hour

During December 2019 and January 2020, there were only four cases of overlapping domestic departures in the international busy hour, i.e., 20:30-21:30. Even if domestic and international operations increase to 1.62 and 1.24 times respectively in 2040, the overlapping of domestic departures in the international busy hour will be less than 10 times in a high season. Therefore, the combined busy hour passengers will be dominated by the international busy hour, and the combined busy hour passengers will be 351 for one-way and 702 for two-way up to 2040.

3-1-6 Summary of Forecast

Table 3-1-14 Summary of Demand Forecast

			2019	2030	2040
International	Number of Passengers	Annual	213,296	252,465	344,548
		Busy Hour - One-way	340	351	ditto
	Number of Flights	Annual	1,075	1,219	1,615
		Busy Hour - One-way	B737-800:1 A321:1	ditto	ditto
		Longest haul	TBU-SYD	ditto	ditto
	Cargo (ton)	Annual	1,212	1,366	1,448
Domestic	Number of Passengers	Annual	62,291	64,970	77,565
		Busy Hour - One-way	50	50	ditto
	Number of Flights	Annual	2,056	2,024	2,417
		Busy Hour - One-way	SAAB340:1 Y12E:1 BN-2A:1	ditto	ditto
	Cargo (ton)	Annual	125	201	275

Source: Survey Team

3-2 Demand Forecast for Vava'u

3-2-1 Annual Air Passengers

Table 3-2-1 shows the annual air passengers of Fua'amotu and Vava'u and their ratios in the last three years.

Table 3-2-1 Comparison of Annual Air Passengers

Year	International Passengers			Domestic Passengers		
	TBU	VAV	Ratio	TBU	VAV	Ratio
2017	200,018	7,333	0.0367	61,271	41,510	0.6775
2018	208,078	7,503	0.0361	52,915	35,759	0.6758
2019	213,296	7,716	0.0362	62,291	39,550	0.6349
		Average	0.0363		Average	0.6627

Source: Survey Team

Annual international and domestic passengers of Vava'u are forecasted as shown in Table 3-2-2 by multiplying these ratios to the average of annual international and domestic passengers of Fua'amotu in Tables 3-1-5 and 3-1-7.

Table 3-2-2 Forecast of Annual Passengers

Year	International	Domestic
2025	7,768	40,399
2030	9,164	44,522
2035	10,724	49,079
2040	12,507	54,137

Source: Survey Team

Currently only international flights from/to NAN are operated. Therefore, visitors to VAV from New Zealand, the largest source market for Tonga, most likely travel AKL-TBU-VAV at present. They are potential passengers on AKL-VAV direct flights, if operated. Due to the absence of data on such transfers, it is assumed that the number of potential AKL-VAV passengers is about 2 times of NAN-VAV passengers based on the following observations:

- Market of ANZ is 1.4 times of FJI, even if visitors from the countries other than New Zealand and Australia use FJI; and
- Number of departing passengers carried by ANZ in January 2020 was 3.0 times that of FJI.

If potential AKL-VAV passengers are realized, international and domestic passengers will be as shown in Table 3-2-3.

Table 3-2-3 Forecast of Annual Passengers with Direct Flight to/from AKL

Year	International	Domestic
2025	23,473	24,694
2030	27,692	25,994
2035	32,405	27,398
2040	37,792	28,852

Source: Survey Team

However, it should be noted that ANZ has not seriously considered such potential yet. This is probably because (i) the existing runway of VAV is too short for their operation and (ii) they don't see the benefit to improve convenience for their passengers going to VAV since there is little competition with other airlines.

3-2-2 Annual Aircraft Movements

Annual aircraft movements of Vava'u are forecasted in the same manners as of Fua'amotu. Tables 3-2-4 and 3-2-5 summarize the results of regression analyses and forecast.

Table 3-2-4 Results of Regression Analyses

Study Case	Adjusted R2
Case 1: International Flights and Passengers, Linear Regression Y = 0.015275 X + 3.043205	0.943351
Case 2: Domestic Flights and Passengers, Linear Regression Y = 0.015244 X + 326.4916	0.437219

Source: Survey Team

Table 3-2-5 Forecast of Flights (Base Case)

Year	International	Domestic
2025	122	878
2030	143	967
2035	167	1,067
2040	194	1,176

Source: Survey Team

3-2-3 Annual Air Cargo

Table 3-2-6 shows the annual air cargo of Fua'amotu and Vava'u and their ratios in the last three years.

Table 3-2-6 Comparison of Annual Air Cargo

Year	International Air Cargo			Domestic Air Cargo		
	TBU	VAV	Ratio	TBU	VAV	Ratio
2017	1,224	0.041	0.000033	107.250	74.100	0.6909
2018	1,219			117.319	92.126	0.7853
2019	1,212			125.496	101.144	0.8060
		Average	0.000033		Average	0.7607

Source: Survey Team

Annual international and domestic air cargo of Vava'u are forecasted as shown in Table 3-2-7 by multiplying these ratios to the average of annual international and domestic air cargo of Fua'amotu in Table 3-1-10.

Table 3-2-7 Forecast of Annual Air Cargo (ton)

Year	International	Domestic
2025	0.042	97
2030	0.042	135
2035	0.043	176
2040	0.043	220

Source: Survey Team

3-2-4 Busy Hour Forecast

1) International Departure Busy Hour

During December 2019 and January 2020, there were 12 operations of FJ275/274 (ATR72) from/to NAN. This is equal to 1.3 flights a week. As demand is expected to increase about 1.62 times in 2040, operation of FJ275/274 will be increased to 2.1 flights a week. Therefore, the busy hour one-way passengers will be 68 x 90% = 61 and 122 for two-way up to 2040.

Table 3-2-8 Summary of International Busy Hour

	Annual Pax	Increase Ratio	Occurrence per Week	Aircraft Movements	Number of Pax One-way
Last High Season	7,716	-	1.3 times	ATR72 x 1	57 pax
Forecast for 2030	9,164	1.19	1.5 times		61 pax
Forecast for 2040	12,507	1.62	2.1 times		61 pax

Source: Survey Team

If direct flights from/to AKL is operated by A320, the busy hour passengers will be 168 x 90% = 151 for one-way and 302 for two-way.

2) Domestic Departure Busy Hour

There were seven cases of two flight departures in 60 min in the latest high season, i.e., December 2019 and January 2020. In the total of seven cases (0.8 time per week), three cases were one each of ATR72 and Y-12E (total 8-16 pax), four cases were one each of SAAB 340B and Y-12E (total 23-46 pax). Therefore, the overlap of SAAB 340B and Y-12E (max 46 pax) is selected as the typical busy hour. As demand is expected to increase to 1.37 times in 2040, such overlap is expected to be increased to 1.1 times per week. Therefore, the busy hour one-way passengers will be (32 + 16) x 90% = 43 up to 2040, and 86 for two-way.

Table 3-2-9 Summary of Domestic Busy Hour

	Annual Pax	Increase Ratio	Occurrence per Week	Aircraft Movements	Number of Pax One-way
Last High Season	39,550	-	0.8 times	SAAB x 1 Y12E x 1	46 pax
Forecast for 2030	44,522	1.13	0.9 times		43 pax
Forecast for 2040	54,137	1.37	1.1 times		43 pax

Source: Survey Team

3) Combined Departure Busy Hour

During December 2019 and January 2020, there were only two cases of overlapping international and domestic departures in 60 min, i.e., one each of ATR72 and Y12E. Even if international and domestic operations increase to 1.6 and 1.3 times respectively in 2040, the overlapping of international and domestic departures in 60 min will only be about 20 times in a year. Therefore, the combined busy hour passengers will be dominated by the international busy hour, and the combined busy hour passengers will be 61 one-way and 122 two-way up to 2040 without a direct flight from/to AKL and 151 and 302 with the direct flight.

3-2-5 Summary of Forecast

Table 3-2-10 Summary of Demand Forecast

			2019	2030	2040
International	Number of Passengers	Annual	7,716	9,164	12,507
		Busy Hour - One-way	57	61	ditto
	Number of Flights	Annual	120	143	194
		Busy Hour - One-way	ATR72-600:1	ditto	ditto
		Longest haul	VAV-NAN	ditto	ditto
	Cargo (ton)	Annual	0.041	0.042	0.043
Domestic	Number of Passengers	Annual	39,550	44,522	54,137
		Busy Hour - One-way	46	43	ditto
	Number of Flights	Annual	928	967	1,176
		Busy Hour - One-way	SAAB340:1 Y12E:1	ditto	ditto
	Cargo (ton)	Annual	101	135	220

Source: Survey Team

CHAPTER 4
IMPROVEMENT OF FUA'AMOTU INTERNATIONAL AIRPORT

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4-1 Applicable Standards

Tonga Civil Aviation Rules, 2016 revised edition, Part 139 "Aerodromes - Certification, Operation and Use" adopts, basically, the rules contained in New Zealand Civil Aviation Rules Part 139. Therefore, airport facilities shall comply to these rules and should (is recommended to) comply to the Advisory Circular AC139-6 "Aerodrome Design Requirements" issued by the Civil Aviation Authority of New Zealand (CAANZ). In addition, the Standards and Recommended Practices (SARPs) of International Civil Aviation Organization (ICAO) are referred to.

4-2 Current Conditions

4-2-1 Facilities and Equipment

1) Layout of Major Facilities

Figure 4-2-1 shows the layout of airport major facilities, and Figure 4-2-2 enlarges the international and domestic terminal areas.

2) Runway, Runway Strip and Runway End Safety Area

(1) Runway

The dimensions of the main runway RWY11/29 at Fua'amotu International Airport (TBU) are 2,671m x 45m. Although it is categorized as a non-precision instrument approach runway for Code 4D in Aeronautical Information Publication (AIP), the largest aircraft currently in operation (B777) is Code 4E. The 45m wide RWY11/29 is capable of accommodating Code E aircraft. However, the existing shoulders, i.e., 4.5m wide at the western part of about 657m length and about 2m wide at the remaining part of about 2,000m length are desirable to be widened to 7.5m for full compliance with CAANZ recommendations. "Fua'amotu Airport Master Plan Desktop Review, Deliverable 3 Final Report, December 2018" (Desktop Review) assumed that shoulders should be provided comprising a minimum 3m wide sealed section on both sides of the main runway for two-engine Code E aircraft, and the remaining 4.5m wide section could consist of well-maintained grass.

Runway turning pads were constructed by the Tonga Aviation Investment Program (TAIP) in 2016 at each end of RWY11/29 which suitably accommodated the turning of Code E aircraft such as a B777-300ER.

The secondary runway RWY17/35 crossing at RWY29 threshold is 1,500m x 30m and classified as Code 2B in AIP. It is a predominately grass runway and only about a 400m portion, which links the main runway and the domestic apron, is paved. Whilst RWY17/35 has very limited use, it would remain operational to provide a cross wind alternative for small aircraft and provide a back-up runway in the case of an emergency.

Table 4-2-1 Declared Distance of Runway at TBU

RWY	TORA (m)	TODA (m)	ASDA (m)	LDA (m)
11	2,671	2,791	2,731	2,671
29	2,671	2,731	2,671	2,671
17	1,155	1,155	1,500	1,260
35	1,260	1,260	1,500	1,155

Source: AIP Tonga (21 May 2020)

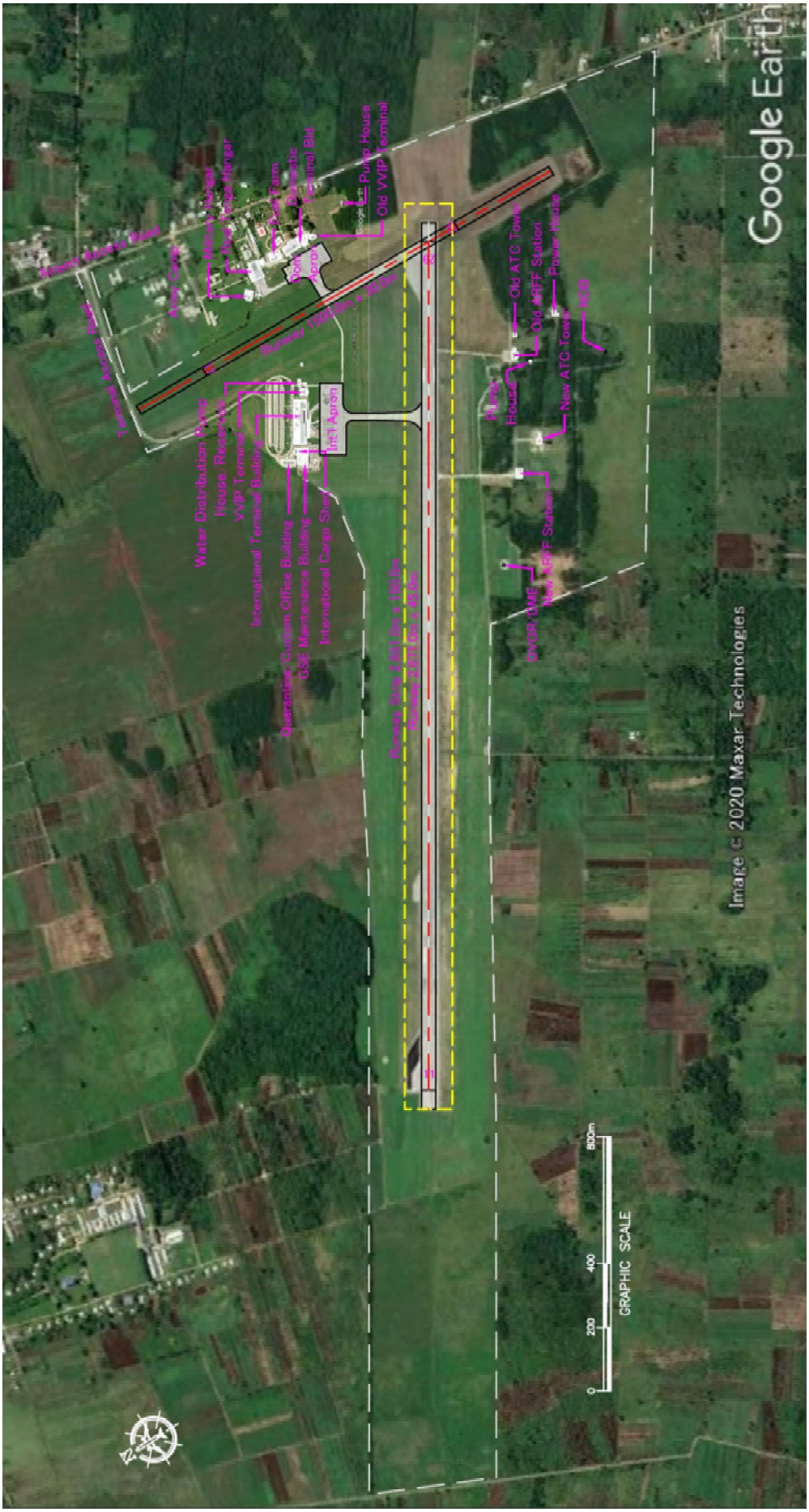


Figure 4-2-1 Layout of Major Facilities of Fua'amotu International Airport

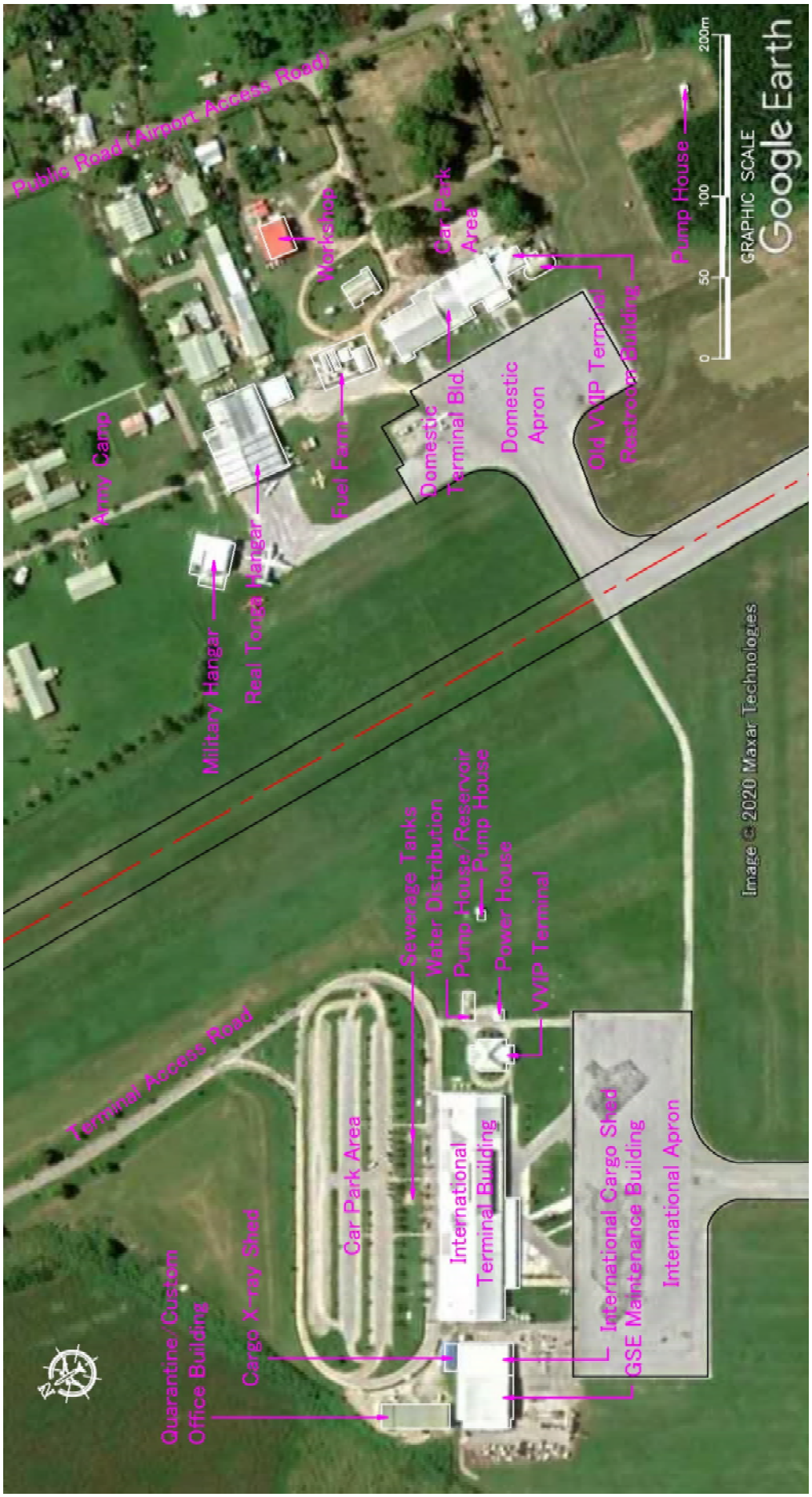


Figure 4-2-2 Layout of Major Facilities in Terminal Area

View from RWY29 THR

Condition of Pavement Surface

Figure 4-2-3 Current Conditions of RWY11-29

View of RWY17 THR

Condition of Paved Surface at RWY17/35

Figure 4-2-4 Current Conditions of RWY17-35

(2) Runway Strip

The existing runway strip for RWY11/29 is 2,851 m x 150m (75m each side) and meets CAANZ standards for a non-precision instrument approach runway. Generally, 150m on either side of the runway centerline fits within the current boundary except for the north-west side where land acquisition may be necessary, if it is to be upgraded to precision approach. The runway strip for RWY17/35 is 1,560m x 80m and meets CAANZ standards for non-instrument approach runway.

(3) Runway End Safety Area (RESA)

The RWY11/29 has 90m x 90m RESAs at both ends. The dimensions of RESAs meet the minimum requirements of CAANZ. The Desktop Review recommended to extend 240m long as per AC139 of CAANZ. There are no RESAs on the RWY17/35.

3) Taxiways and Apron

(1) Taxiways

The stub taxiway (TWY-A) that connects the RWY11/29 to the international apron is 23m wide and is suitable to accommodate Code E aircraft. The taxiway links to the domestic apron (TWY-B) is also 23m wide. Both taxiways have no paved shoulders. It is desirable to provide 15.0m wide shoulders on each side of the TWY-A in order for full compliance with CAANZ recommendations for Code-E aircraft operation on the taxiway.

Since both aprons only have a single connection to the runway, head-to-head situation will occur between arriving and departing aircraft on the taxiway when deviation from scheduled time for

arrival/departure occurred.

(2) Apron

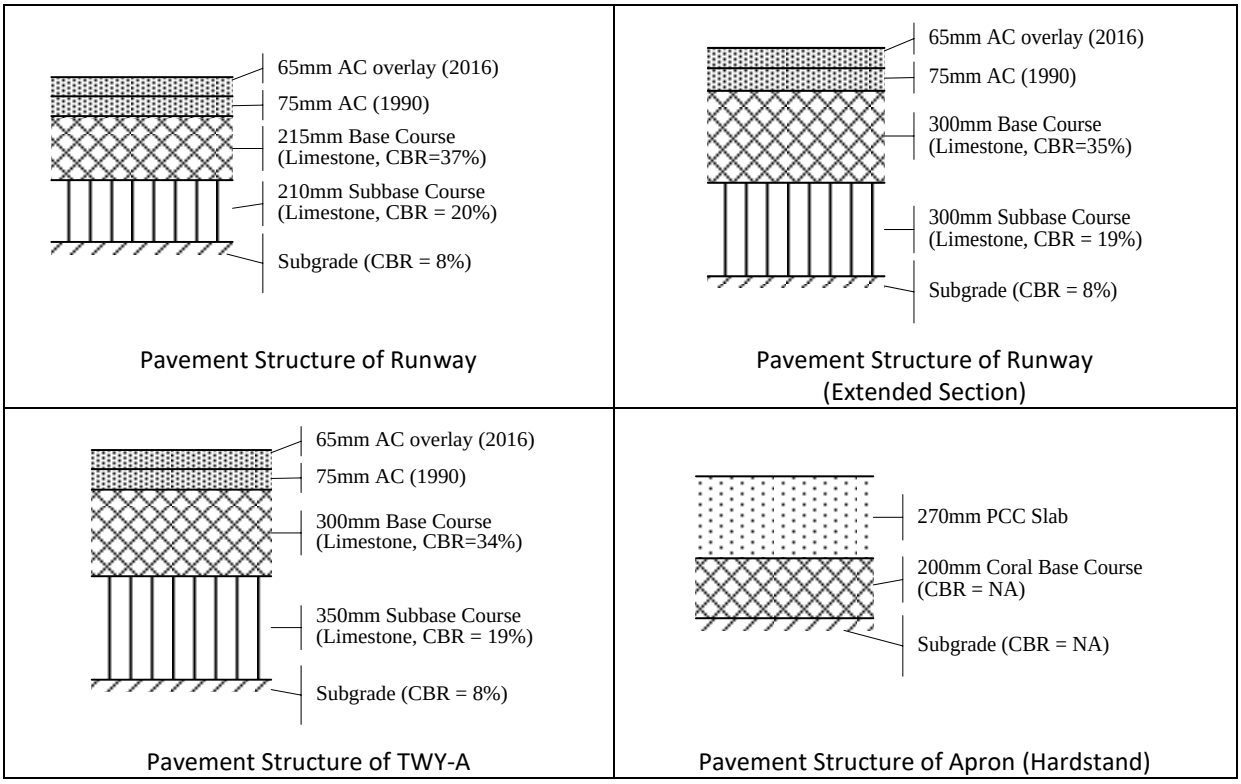
The existing international apron was partially expanded of 2,150 m^2 by TAIP in 2016 and can accommodate 3 x Code C (B737-800/A320/A321) or 1 x Code C + 1 x Code E (B777/B787) aircraft. Geometry of paved area is about 223m width x 71m/81m depth after the expansion. All aircraft should spot-in/out to parking position by self-maneuvering. The expansion enabled a Code-E aircraft to enter/exit to the apron while a Code-C aircraft is parking on the apron. Although the apron area is enough for current aircraft demand, deviation of the scheduled time for arrival/departure on Code E aircraft will cause a shortage of aircraft parking space.

The existing domestic apron has the dimensions of about 120m width and 60m depth, which are sufficient to accommodate 4 x Code-C (turbo-prop) aircraft simultaneously.

4) Airside Pavement Strength

The airside pavements in TBU comprises the main runway, the international apron and the domestic apron with a taxiway to each apron. The original airfield was constructed in the 1960s and the runway was extended by 600m to the west in 1990 with the entire airfield resurfaced with asphaltic concrete (AC) at the same time. Further overlay was undertaken by TAIP in 2016 to most of the runway (excluding the 1990's extension area of the runway) and taxiway. According to the AIP (21 May 2020), all PCNs of the airside (runway, taxiways and apron) pavements are 70/F/C/X/T.

Figures of typical pavement sections based on FWD testing in 2013 and tender drawing of overlay works in 2016 appear below:



Source: Airport PCN Study Report – Fua'amotu (2013)
Drawings for Fua'amotu International Airport Long Term Runway Rehabilitation (2013)

Figure 4-2-5 Typical Structures of Existing Airside Pavement in TBU

According to answers to the questionnaire from the TAL and site observation result by the Survey Team, the runway, taxiway and international apron pavements are generally in good condition.

5) Storm Water Drainage System

There is no trunk storm drainage system at the airport. Runoff from the runway is flows into the grassy areas of the runway strip. These areas slope gently away from the runway into shallow swales running parallel to the runway, and the rain water soaks away. According to TAL, standing water on the runway quickly dissipates. The international apron is the only area provided with a piped collection system which directs runoff to soakage pits adjacent to the edges of the apron. TAL indicated that all the pits with the exception of the car park soakage pits, which had been renewed, are performing badly. Standing water is observed particularly in the northwest corner of the apron when it rains heavily. Standing water dissipates quickly however when the rain stops.

6) Obstacle Limitation Surfaces

According to the report of "Obstacle Limitation Surface Surveys (2017)", the number of obstacles penetrating from the approach surface for RWY11 and RWY29 were 61 and 300 respectively. Most of those penetrating obstacles were natural objects such as trees or coconut, and a few of them were artificial objects such as power poles and a house. There were also 14 obstacles penetrating from the transitional surface. The locations of the penetrating obstacles appear in the following figure:

Note: Dots with cyan color show the location of artificial obstacles

Figure 4-2-6 Location of Obstacles Penetrating from OLS at TBU

7) Communication, Navigation, Visual Aids and Meteorological Systems

(1) Navigation Aids

A VOR/DME and an NDB is installed in TBU. The VOR/DME is located in the south side of RWY11/29 and the NDB is located the east side of it. The main navigation aids systems installed in TBU are shown in the table below:

Table 4-2-2 Main Navigation Aids System in TBU

Item	Manufacturer	Model name	Year of installation	Working Status
VOR	INTERSCAN	DVOR VRB-520	2005	Good
DME	INTERSCAN	LDB-102 1KW	2005	Good
NDB	AMPLIDAN	-	1992	Very old
ADS-B	INDRA	-	2018	Not working well

Source: TAL

(2) ATS Communication Equipment

Air Traffic Services (ATS) provided at TBU are flight information service, approach control, aerodrome control, and surface movement control. Frequencies used for each service are shown in the table below. ATS communication equipment was installed in 2019, when the new ATC tower was built. The Jotron transceiver is adopted for VHF communications and Barrett Communications' transceiver is adopted for HF. SITTI is adopted for Voice Communication Control System.

Table 4-2-3 ATS Radio Frequency in TBU

	Frequency
Flight Information Service	13261, 11339, 8995, 8867, 8846, 6553, 5832, 5643, 3425, 3226kHz
Approach Control	118.5MHz
Aerodrome Control	118.5MHz
Surface Movement Control	121.9MHz

Source: AIP

(3) Aeronautical Ground Lighting

The following Aeronautical Ground Lighting (AGL) systems are installed in TBU. The substation is located at the south side of RWY11/29 and cables are drawn from the substation with the direct buried method. The aeronautical ground lighting was updated in 2017.

- Simple Approach Lighting System (RWY11)
- Precision Approach Path Indicator (PAPI)
- Runway edge light
- Runway threshold/end light
- Wing bar
- Taxiway edge light
- Runway hold position light
- Sign
- Aerodrome beacon
- Apron flood lighting

The power is supplied from four Constant Current Regulators (CCRs) to all lights. Each capacity is 10kVA. (i) PAPIs and wing bars, (ii) Runway edge lights and threshold/end lights, (iii) Approach lights, and (iv) Taxiway edge lights and information signs are supplied with one CCR each. The circuits of the approach lights and runway lights are not interleaved to increase the integrity of the lighting system. The control system of the AGL is shown in Figure 4-2-7.

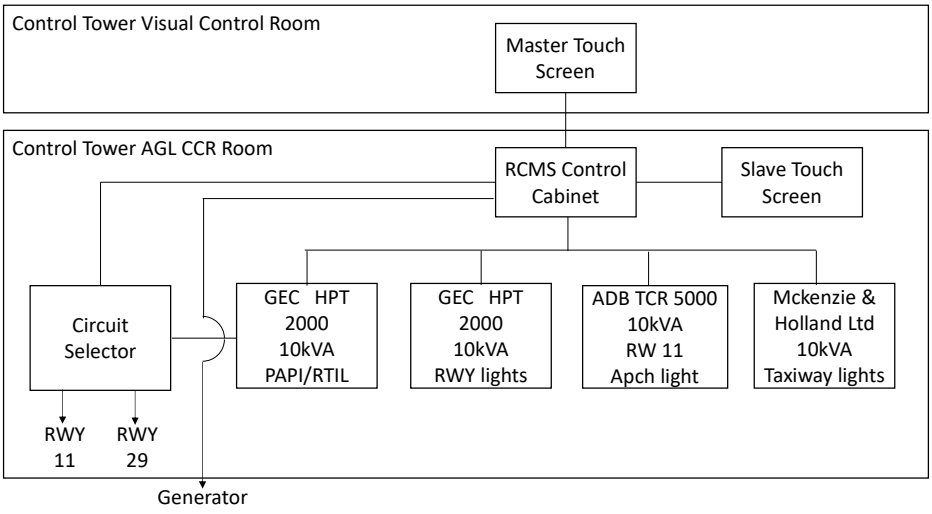


Figure 4-2-7 Control System Diagram of AGL at TBU

(4) Meteorological Observation System

An Automatic Weather Observation System (AWOS) manufactured by All Weather Inc. was installed in 2017. The sensors are installed at RWY11 side and wind direction/velocity, temperature, relative humidity, visibility, ceiling and lightning/thunder storm are measured. Data are sent to ATC tower from VOR/DME station by radio link. Data can be observed by monitors installed in the ATC cabin, office on the first floor and equipment room. The system diagram of AWOS is shown in Figure 4-2-8.

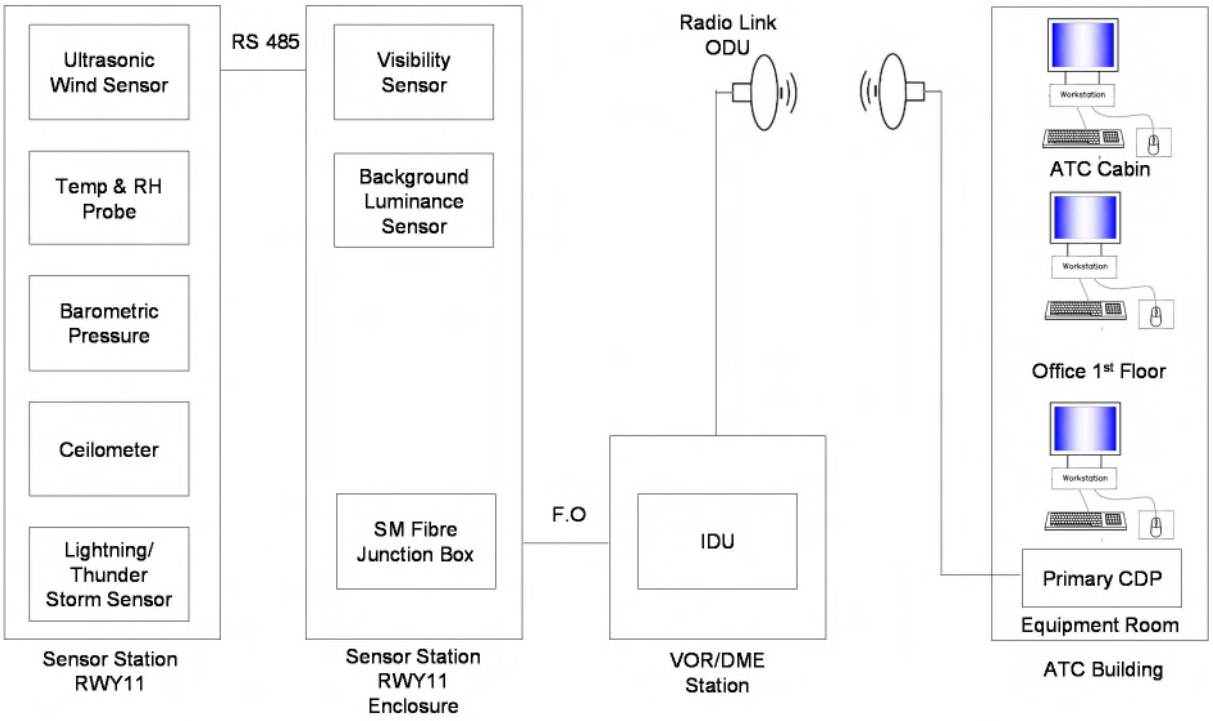


Figure 4-2-8 AWOS System Diagram

8) Rescue and Fire Fighting Facilities

The existing fire station is located on the southern side of the airfield northwest of the new control tower. The category of Rescue and Fire Fighting Services (RFFS) is CAT 9 at the maximum, according to AIP, being adjusted as appropriate to aircraft type based on the approved schedule. The fire vehicles deployed at TBU are shown in Table 4-2-4.

Table 4-2-4 Fire Vehicles Deployed in TBU

	Manufacture	Model	Year of Procurement	Capacity
1	Kronenberg	4x4 Cat 5	1990 Refurbished 2009	Water 5,540L Dry powder:250kg
2	-	6 x 6 Cat 9 Responder	2006	Water 9,610L Dry powder 225kg
3	-	6 x 6 Cat 9 Responder	2010	Water 10,000L Dry powder 225kg

Source: TAL

Currently a minimum of 10 fire fighters per shift provide RFFS to meet the CAT 9 requirements. However, when only domestic flights operate, the CAT is reduced to commensurate with the CAT coverage for the aircraft type CAT 5. The shift work of fire fighters is shown in Table 4-2-5.

Table 4-2-5 Shift for Fire Fighter

Mon, Wed, Fri, Sat	Tue, Thu
1st Shift: 6am-2pm 2nd Shift: 2pm-10pm	1st Shift: 10pm-6am 2nd Shift: 6am-2pm 3rd Shift: 2pm- 11pm

Source: TAL

9) Power Supply and Telecommunication System

(1) Power Supply

Power is supplied by Tonga Power Limited (TPL). 11kV transmission line runs along the road on the east side of the airport, and electricity is supplied from the transmission line to the passenger terminal

area, and the airport fire station and air traffic control tower area on the south side of the runway. The capacities of transformers are 300kVA for the International Passenger Terminal Building (PTB) and 200kVA for air traffic control tower area. One 312kVA standby generator is installed in the International PTB. With approximately 82% of capacity operation, the generator provides the existing power demand of the PTB. Two 133kVA standby generators are installed in the air traffic control tower area for the old control tower and aeronautical ground lighting, and one 250kVA for the new control tower. According to TAL, the frequency of blackout is not so often, about 10 times per year.

Main Transformer for Int'l PTB, 300kVA

Electrical Building for Int'l PTB

Standby Generator for Int'l PTB 312kVA

Figure 4-2-9 Electrical Facilities at TBU

Figure 4-2-10 shows the electrical bill of the last one year. Power consumption is increased during the summer and passenger peak season of December.

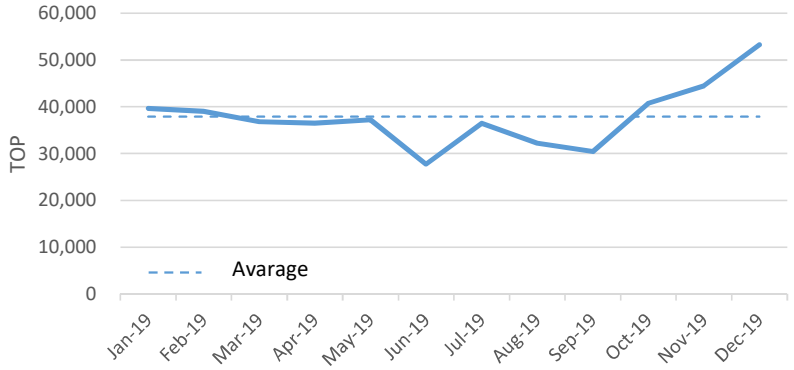


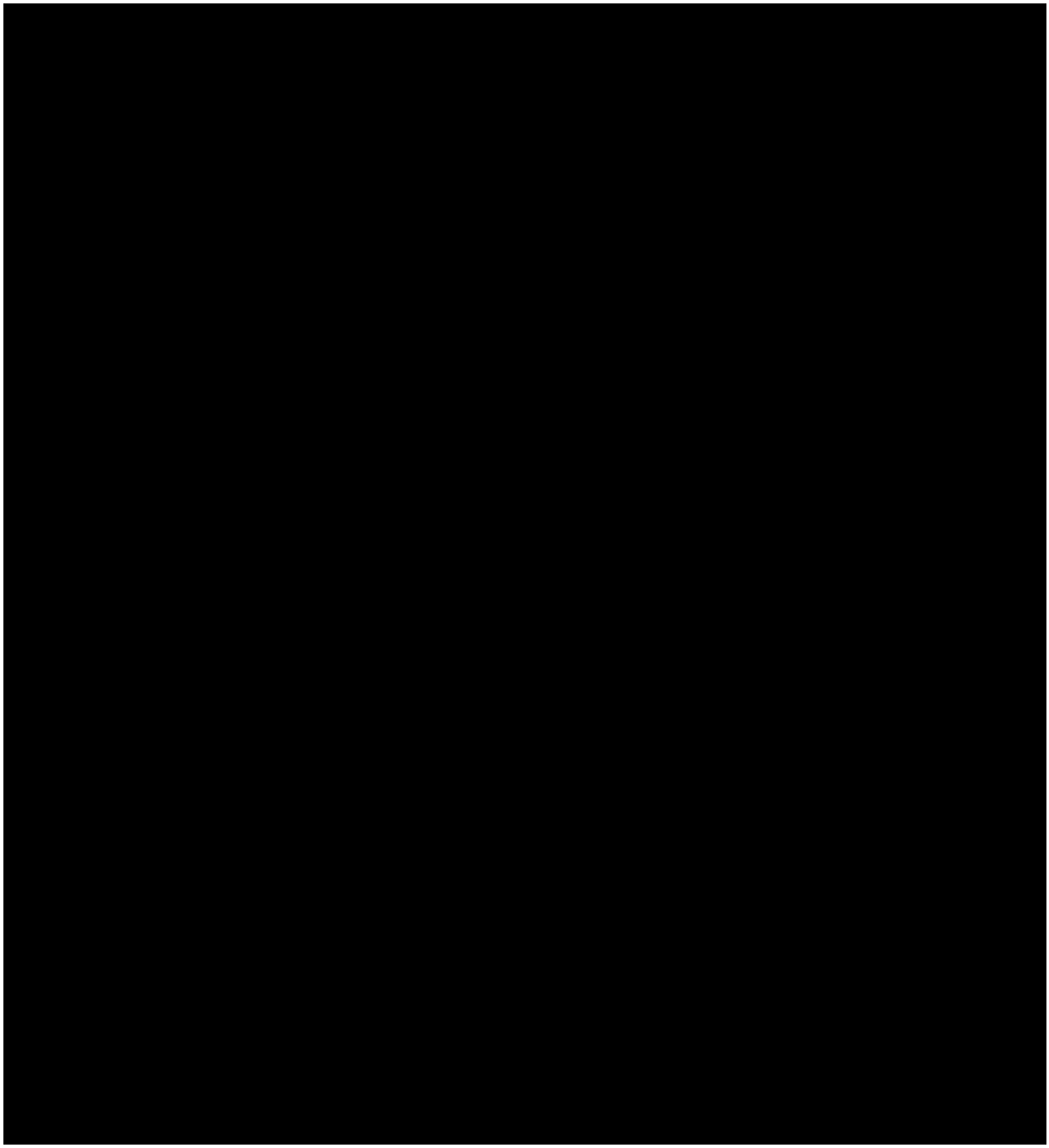
Figure 4-2-10 Power Bill by Month

(2) Telecommunications

Telephone services are provided by Tonga Communication Corporation (TCC) through 10 lines for the international PTB and four lines for the air traffic control area. In addition, mobile telephone and internet connection services are provided by Digicel and TCC.

10) Airport Security System

[redacted]



11) Fuel Supply System

The existing aviation fuel supply facilities are owned and operated by Pacific Energy. The fuel farm is located on the north of the domestic terminal and is comprised of two 50,000 liter ground tanks and one 7,000 liter tanker truck. The jet fuel is supplied to the international apron via a hydrant system and a mobile pump. A fuel tanker truck is also in service for both international and domestic aircraft. According to the Desktop Review, Pacific Energy was planning to install two additional 50,000 liters tanks increasing the storage capacity to 200,000 liters. The development plan showed expansion to the east of the existing fuel storage tanks to accommodate this increased storage capacity.

Aviation Fuel Farm

Fuel Tanker

Figure 4-2-12 Fuel Supply Facilities at TBU

12) Water Supply, Sewerage and Solid Waste Disposal System

(1) Water Supply System

The airport is supplied with ground water from three bore holes. The groundwater supply for the international PTB is sourced from a bore hole and associated water reservoir on the eastern side of the terminal adjacent to the VVIP facility. The groundwater is pumped up by 1 x 15 kw submersible pump and stored in the underground water reservoir near the distribution pump house. Then, the water is pressurized by 2 x 1.5 kw pumps and distributed to the PTB, the irrigation system for the grassy car park areas and the aircraft septic discharge area for wash-down purposes. In addition to bore holes, a rainwater harvesting system is installed at the existing international PTB. Rainwater is collected and stored in the plastic water storage tanks at the east and west of the PTB. The total capacity of water tanks is 165,000 liters. Some of the tanks are connected to the PTB and supply water when the main system is not working.

The 2nd bore hole is located at about 120 m south from the domestic terminal's car park, where there are 1 x15 kw submersible pump and 2 x 9 kw distribution pumps with 45,000 liters storage tanks. The 3rd bore hole is located adjacent to the old Airport Rescue and Fire Fighting (ARFF) building.

Rainwater Storage Tank at Int'l PTB

Bore Hole at Domestic Terminal Area

Figure 4-2-13 Water Supply Facilities at TBU

According to the Desktop Review, the ground water was not treated or filtered before being distributed throughout the airport. No water quality testing was available at that time, and TAL advised that this water supply was not considered suitable as a source of drinking water. Current daily water consumption at the international and domestic terminals are reported as about 15,000 and 4,000 liters respectively by TAL.

(2) Sewerage System

The existing sewerage system at the international PTB is a gravity system that collects and transports effluent from the terminal to two septic tanks (60m³ capacity) located to the east and west of the terminal curb front. Liquid effluent is discharged from each tank, via a weir, to a liquid dispersion ("soakage") pit immediately adjacent to the tanks. The third septic tank of 10m³ capacity is located airside adjacent to the western side of the apron and is connected to the aircraft effluent discharge chamber. The functionality of the septic tanks at the apron is unknown.

Effluent from the domestic terminal is discharged to septic tanks in the unpaved parking area to the east of the terminal. It was assumed in the Desktop Review that the dispersion field was also located in the same area. Since several very large trees are located in this area, the root systems of which could potentially damage and block the soakage field pipes.

Sewage Tank at Terminal Front

Soak Pit and Sewage Tank

Figure 4-2-14 Sewerage Facilities at TBU

(3) Solid Waste Disposal System

Solid waste from the buildings at the airport are collected with 200 liters portable trashcans by TAL and delivered to the Tapuhia landfill located 7.5 km northeast from the airport. In addition, solid waste from aircraft are collected and disposed by the quarantine department.

13) International Passenger Terminal Buildings

The existing International PTB was originally constructed under the Grant Aid by Japan in 1991. The footprint was 91m x 35.5m and expanded by 9m to the east, departure side, in 2015, and 39m to the west, arrival side, in 2018, i.e., now a total of 139m. The total floor area is now approximately 5,800 m^2 (see Figure 4-2-15). It is a one-story/partly two-story building with a steel structure. The terminal concept is the 'single level' system. The ground floor was refurbished in 2018.

Figure 4-2-16 shows the current situation of the PTB, and Table 4-2-7 summarizes the current situation of the PTB.

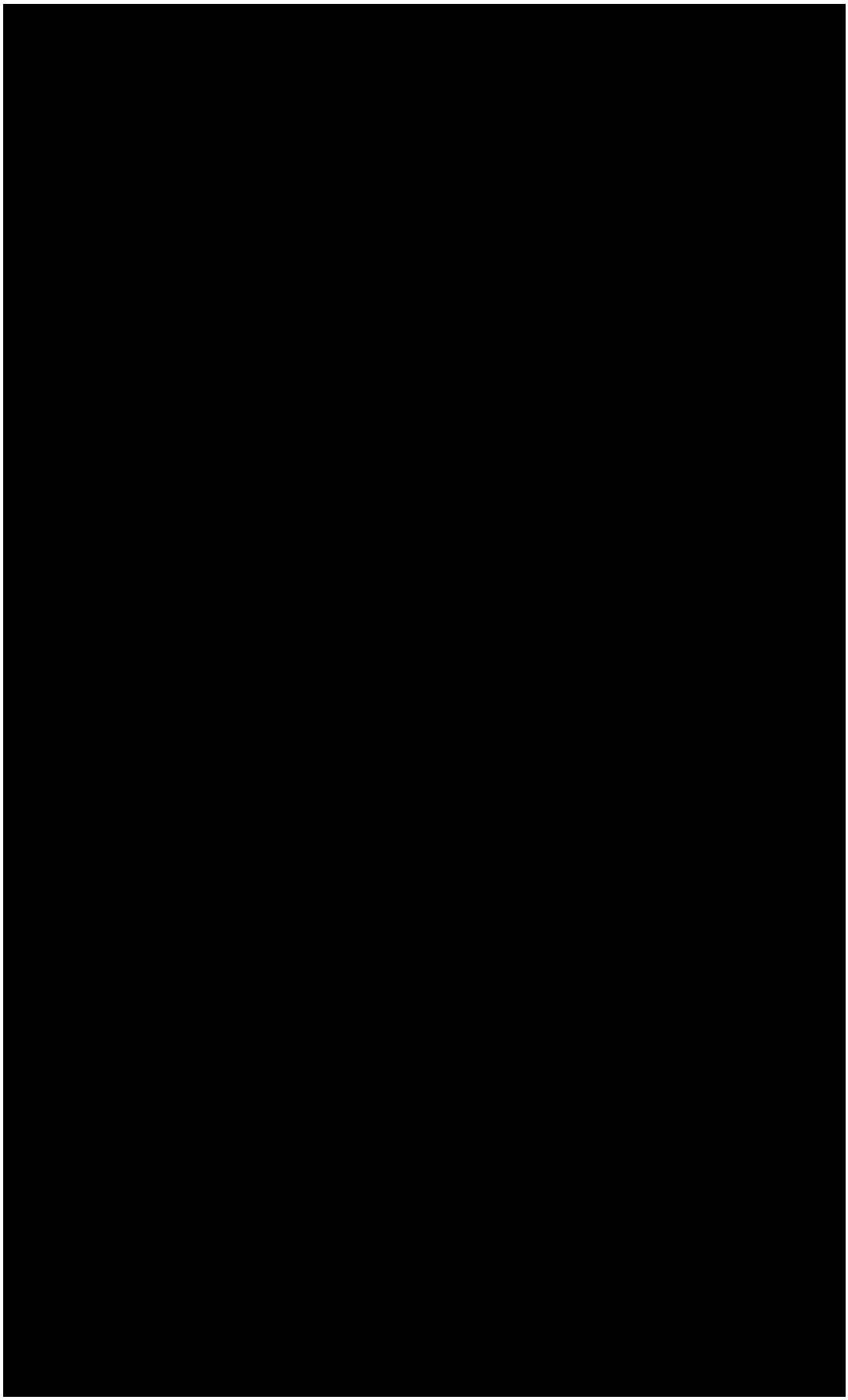
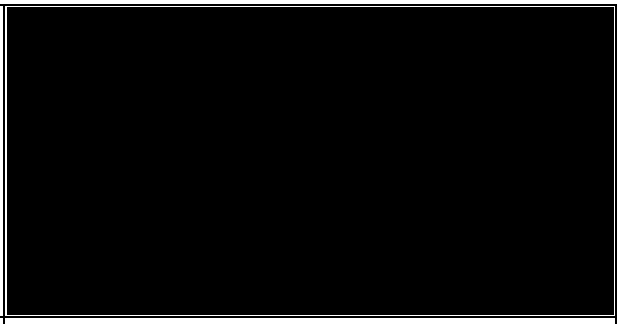


Figure 4-2-15 International Passenger Terminal Building Floor Plan

Check-in Lobby



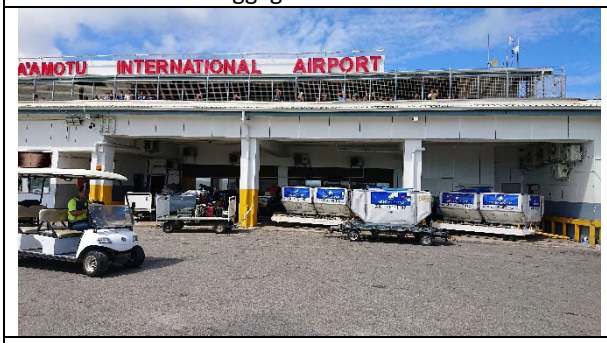
Security Check Area

Departure lounge

Passport control arrival

Baggage claim area

Customs (left) and Quarantine (center)



Baggage make-up area

Baggage break-down area

Observation deck

Public space

Figure 4-2-16 Current Situation of International Passenger Terminal Building

Table 4-2-7 Current Situation of International Passenger Terminal Building

Room	Area (m^2)	Current Situation
Check-in counter and check-in lobby	374	Ten check-in counters provided, baggage conveyor behind the counters. The ceiling is 9.5m high. Ventilation is poor, although there are windows at the top and ceiling fans are provided. Well-wishers are not allowed to enter. It is currently overcrowded in the peak-hour.
Baggage make-up area	171	One baggage conveyor from check-in area. Operated with roller conveyors for loading baggage. X-ray machine is placed between the check-in counters and make-up area. Access of baggage containers is not easy.
Security area and passport control departure		
Departure lounge	423	Three boarding gates provided. Air coolers on the ceiling, and ventilation fan is provided on the exterior wall
Passport control arrival	243	Six passport control counters, air coolers on the ceiling, and ceiling fans provided. The room is overcrowded in the peak-hour. Ventilation is insufficient.
Baggage claim area	855	Two baggage claim devices with 30m pick-up length each are provided. The ceiling fan is provided, outside air flows, since this space is connected with the curbside void area.
Baggage break-down area	377	Two baggage claim devices with 18m loading length each are provided. The whole area is covered by the roof, including the space for baggage containers.
Customs	154	Two customs counters provided.
Quarantine	-	Counter in the baggage claim area.
VIP lounge for departure	66	The business class lounge operated by TAL. Customers go through security and passport control with all other passengers.
VIP lounge for arrival	131	The business class lounge operated by TAL. Customs services are provided for lounge customers.
Concession	451	There are; one DFS, one shop and one café in the departure lounge, one DFS in arrival hall, several counters including one money-exchange counter in the curbside, and one café in the observation deck.
Office	381	The airline, ATS and TAL offices are located on the ground and second floor separately.
Passenger toilets	190	One place each for male, female and those with disabilities in the departure lounge and the arrival hall.
Staff toilets	3	One in Airport Manager's Office.
Public toilets	78	Two places for male, female and the disabled on the ground floor.
Observation deck	163	3 m-high fence with spikes provided.
Public space	1,086	Semi-outdoor space covered with a roof. Chairs provided. Since the arrival exit is narrow, this space is over-crowded and well-wishers overflow to the curbside.

Source: Survey Team

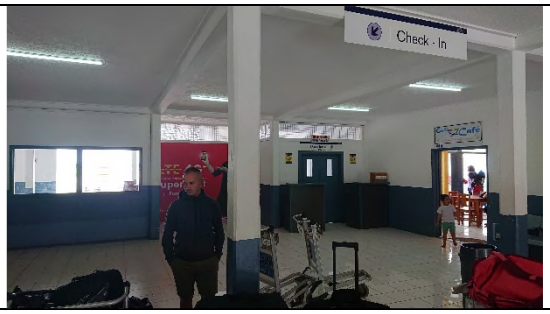
14) Domestic Passenger Terminal Buildings

This is a one-story, reinforced concrete building constructed in 1978, and expanded with steel structure framing in 1985. The total floor area is now approximately 1,600m^2 (see Figure 4-2-17). The southern 1/4 part of the building is used as the domestic passenger terminal, while another 1/4 is used as the meteorological and other offices. The northern half is used as a quarantine building that treats fruits and vegetables before exporting overseas (heat treatment force air). Figure 4-2-18 shows the current situation of the Domestic PTB, and Table 4-2-8 summarizes the current situation of the Domestic PTB.

Figure 4-2-17 Domestic Passenger Terminal Building Floor Plan

Exterior view

Check-in counter



Departure/arrival lobby

Public area

Figure 4-2-18 Current Situation of Domestic Passenger Terminal

Table 4-2-8 Current Situation of Domestic Passenger Terminal

Room	Area (m^2)	Current situation
Departure and arrival lobby		
Departure lounge		
Arrival hall	54	No baggage claim device.
Concession	66	Café is located adjacent to the arrival lobby
Office	410	Airline, Notional Metrological Office and TAL have offices separately. ATS has an office at an adjoining building just beside the check-in counter.
Passenger toilet	140	One space near the check-in counter. One place along the curbside as the independent facility Toilet for disabled people is not provided.
Staff toilet	43	One place on the first floor

Source: Survey Team

15) Cargo Terminal and Other Buildings

(1) International Cargo Shed Building

The International Cargo Shed Building was constructed on the east of the GSE garage and ATS office in 2019. It is a one-story steel structured building with a footprint of 22m x 30m, with a total floor area of 660 m^2. According to IATA Airport Development Reference Manual, the handling capacity of the non-automated cargo terminal building is 5 ton/m^2/annum, and thus the annual handling capacity of this building is estimated at approximately 3,300 tons/annum. .

Exterior view 1

Exterior view 2 (right)

Figure 4-2-19 Current Situation of International Cargo Shed Building

(2) Air Traffic Control Tower

The existing Air Traffic Control Tower was constructed by TAIP in 2019, and there is no issue. According to Desktop Review, the height of VFR room was to be approximately 21.2m above the ground to provide required line of sight to each of the runway thresholds.

Exterior view

Figure 4-2-20 Current Situation of Air Traffic Control Tower

(3) VVIP Terminal Building

The existing VVIP Terminal Building is a one-story building with a flat shape of 14m x 12m (floor area: approximately 173m^2) built by the Government of Tonga in 1990. It is primarily used by the King and State Guests. A rough floor layout of the building was surveyed by the Survey Team and drawn as shown in Figure 4-2-21 and Figure 4-2-22.

Figure 4-2-21 Floor Layout of VVIP Terminal Building

Exterior view (Airside)

Exterior view (Landside)

Figure 4-2-22 Current Situation of VVIP Terminal Building

16) Roads and Car Park

A terminal access road of about 1 km length is provided between the international terminal and the nearest main road which run from Fua'amotu town to the north. The access road has one lane per direction with 6.0m width asphalt pavement. The domestic terminal is directly connected to the main road.

The car park in front of the International PTB was originally constructed together with the PTB with the capacity of 200 lots and expanded to about 500 lots. The car park in front of the domestic PTB has the capacity of about 40 lots. According to TAL, illegal parking along the road in the International Terminal Area is observed during peak hours due to congestion of the car park.

According to the site observation by the Survey Team and the answers to the questionnaire by TAL, pavement of the access road for international PTB is in good condition. In the meantime the bitumen material of the top coat at both car parks and the road in the domestic terminal area has been deteriorated and aggregate materials are exposed on the pavement surface.

Terminal Access Road

Car Park at Int'l Terminal

Figure 4-2-23 Road and Car Park at TBU

4-2-2 Maintenance and Operation

1) Organization Structure

(1) Maintenance

Airport facilities are maintained by TAL. The organization of Maintenance Division of TAL is shown in the figure below. Under the Chief Technical Support & Maintenance Officer, general, electrical, communication, mechanical, carpentry & plumbing specialists are located. The total number of staff is 29.

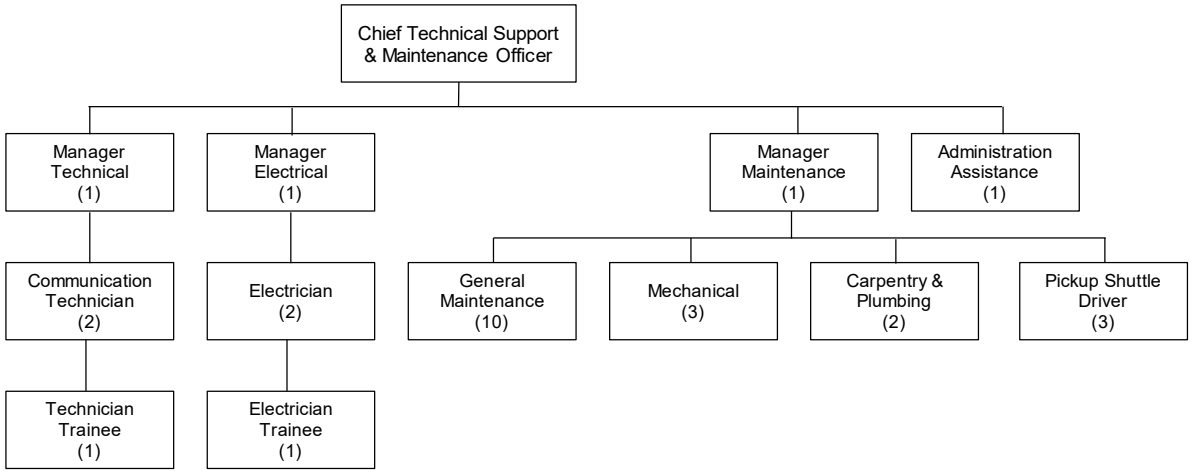


Figure 4-2-24 Organization of Maintenance Division

(2) Operations

TAL operates the entire airport, including the provision of aeronautical information, rescue & fire fighting, aviation security, and terminal operation services. Under a service agreement with TAL, ground handling services are provided by ATS. ATS provides a wide range of services, including ramp services such as marshalling for aircraft parking, passenger guide, aircraft cleaning, passenger baggage and cargo transportation, and aircraft weight and balance calculation. ATS also provides passenger services that include passenger check-in, ticketing, baggage control and immigration processing. Aviation fuel supply is provided by Pacific Energy.

2) Maintenance Equipment

The existing airport maintenance workshop is located at the north-east of the domestic terminal, and provides maintenance and repair service for machineries, such as mower and tractors.

3) Budget

Expenditures on training and maintenance in the last five years are shown in Table 4-2-9.

Table 4-2-9 Expenditure on Training and Maintenance by TAL

Unit : TOP

	2014	2015	2016	2017	2018
Training	0	88,237	163,546	103,000	179,355
Repairs	53,448	214,623	199,682	261,775	234,965

Source: TAL

4-2-3 On-going and Planned Projects and Assistance of Other Donors

Procurement of a Category 9 fire truck is on-going. Once it arrives, one of the existing fire trucks will be sent to VAV. There is no planned project other than this project.

Assistance of other donors in the last 10 years includes the following:

- The World Bank have implemented the Tonga Aviation Investment Project (TAIP) having atotal project cost of US$ 37.7 million from 2011 to 2019. Key components of the project at Fua'amotu airport were renovation of the international terminal, expansion of the international apron, improvement of the runway and taxiway pavements, construction of the new cargo shed, and construction of the new Air Traffic Control Tower. The amount of the key components on terminal and building developments are summarized in Table 4-2-10.

Table 4-2-10 Key Components of TAIP in TBU

Component	Year Completed	Contract Amount
Renovation of International Terminal	2019	US$ 2,517,340
New Cargo Shed	2019	TOP 690,385 (US$ 300,167)
New Air Traffic Control Tower	2019	US$ 8,073,666
Aircraft Passenger Boarding Gangways	2018	US$ 116,645

Source: TAIP

- The government of New Zealand provided NZ$800,000 (US$ 520,000) in 2017 under the Pacific Islands Civil Aviation Safety and Security Treaty to purchase X-ray machines, walk-through metal detectors, and explosive trace devise for Fua'amotu and Vava'u airports.

4-2-4 Surrounding Infrastructures and Airport Access

1) Road Network around the Airport

The main airport access road from Nuku'alofa, the capital of the Kingdom, is a one-lane per direction paved road. There is no constant traffic congestion on the access road because the road traffic on the entire island is small. Traffic congestion, however, occurs in the populated areas during the morning and evening rush hours. The pavement condition is relatively good.

2) Public Transportation System

Most air passengers use taxis or private cars as transportation to/from the airport. Although airport taxis are available for international and domestic flights at each terminal, most of the tourists use the shuttle services provided by hotels with minivans or sedans. For other public transportation, public buses run every two hours on the main road at the east of the airport, but they don't come in the terminal areas. There is no public transportation for transit passengers between international and domestic terminals.

3) Issues on Airport Access

TAL raised the shortage of the number of lane and street lights on the main access road as issues on airport access.

4-2-5 Natural Conditions

1) Geography

Tongatapu Island is rather flat, and most of the ground elevations are below 35m above the Mean Seal Level (MSL). The area at the south of the airport, Fua'amotu and Nakolo towns, is the highest area on the island (the highest elevation of the island is 65m above MSL). At the steep coast of the south, heights reach an average of 35m at around the airport gradually decreasing towards the north. The aerodrome elevation at Fua'amotu Airport is 39.3m above MSL.

2) Geology

Tongatapu Island is one of the western islands of Tonga archipelago, which runs parallel to the Tonga ridge created from the subduction of western-moving Pacific plate under the Australia-India plate at the Tonga Trench. The islands are formed by volcanic origin and coral reef development. Due to such geology, the islands experienced large earthquakes frequently in the past, the same as Japan.

Tongatapu Island is a limestone capped island. The limestone is covered discordantly by reddish brown soil that originated from volcanic ash. According to the result of soil investigations report prepared under the JICA Study in 1989[1], soil property of the existing international terminal area was observed as the following;

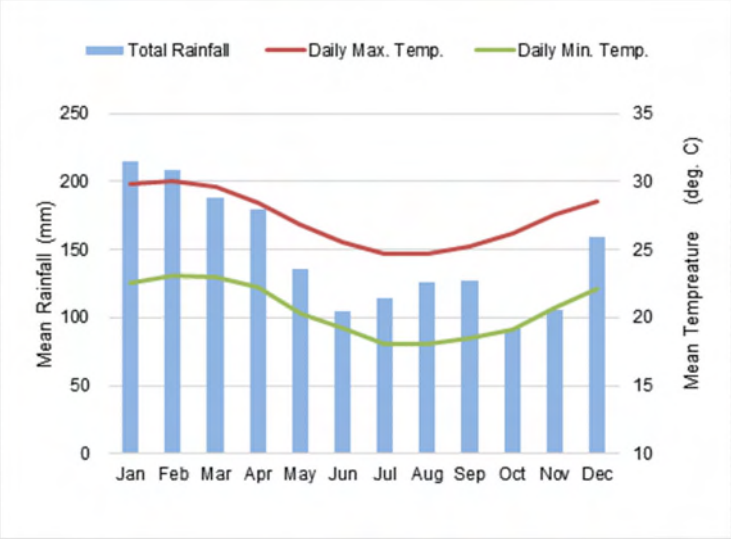
- Top soil covers about 20cm thickness
- About 2m below the surface consists of coral stratum
- A hard clay soil lays over the coral stratum
- Limited numbers of CBR test results showed the soil strength is 8~11% with nearly optimized moisture contents
- Although the soil behaved in a very stiff property in an undisturbed condition, the soil became unsuitable for backfill material after the soil is disturbed once
- Although the result of the dynamic cone penetration test varied depending on test location over the existing terminal area, the soil strength of the clay soil was assumed about CBR=5~6%

Based on the observation in above, structures of the extended runway and existing terminal area were designed based on the soil strength of CBR=6%. In addition, 10 hand auger boring holes of 2.5m depth and 4 plate bearing tests were conducted for the design of a new air traffic control tower in 2016. These survey results showed the same soil properties as the JICA's survey results and the modules of subgrade reaction obtained from the plate bearing test were 17-40 kPa/mm (equivalent CBR = 2~6%). No groundwater was observed at any boreholes.

3) Climate Conditions

The following graph shows the historical records of temperature and rainfall at Fua'amotsu Airport in the past 30 years:

[1] Basic Design for Fua'amotu International Airport Terminal Facility Deployment Project (1989)



Source: Tonga Meteorological Services

Figure 4-2-25 Historical Weather Records (1981-2010) at TBU

(1) Temperature

Tonga's climate is an oceanic climate influenced significantly by the ocean weather. The aerodrome reference temperature published in AIP is 30°C, and average temperature at TBU is 22 to 27°C. The differences in daytime temperatures throughout the year are quite small, but as one of the characteristics of a typical tropical and oceanic climate, the temperature differences between daytime and nighttime is quite large.

(2) Rainfall

The seasons in Tonga are generally divided into the wet season (November to April) and the dry season (May to October). Approximately 60-70% of the total annual rainfall occurs during the wet season. The mean average rainfall in wet season is 160-210mm/month.

(3) Wind Strength and Directions

According to the hourly wind observation records from 2009-2018 at TBU, the wind strength of 27% of total observations is less than 3 knots, and of 88% is less than 10 knots. The results of wind coverages analysis with 20 knots cross winds and 5 knouts tail winds show that the coverages of RWY11 and RWY29 are 96.03% and 63.47% respectively.

(4) Visibility

The Survey Team analyzed hourly visibility observation records in the last five years at TBU and found that more than 98% of the time the visibility satisfies the longest visibility minima of all GNSS approach procedures at the airport, i.e., 2,800 m.

4) Natural Disaster

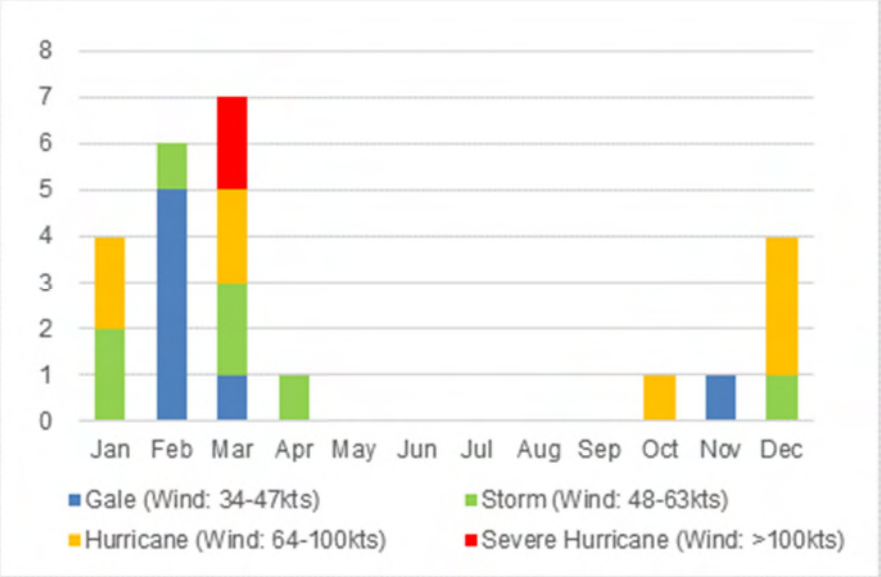
(1) Earthquake

Tonga is located in a region of the Pacific Ocean, where earthquakes occur frequently. There were two major earthquakes in 1997 and 2006. The moment magnitude scales of these earthquakes were 8.0 and 8.1 respectively. These earthquakes caused particular damages on Tongatapu, 'Eua and the

Ha'apai Islands, and the total economic damage of 2006's earthquake reached to US$ 9.5 million according to the Emergency Events Database[2].

(2) Cyclone

The number, strength and produced month of tropical cyclone affected at Tongatapu and 'Eua Area from 1960 to 2006 are summarized in Figure 4-2-25. The data show that the tropical cyclones were produced only during the wet season and were more likely to occur from January to March in this area.



Source: JICA Survey Team based on Data from Tonga Meteorological Services

Figure 4-2-26 Number, Strength and Produced Month of Tropical Cyclone Affected at Tongatapu and Eua Area

The recent damages caused by cyclones are listed in Table 4-2-11.

Table 4-2-11 Recent Damage Caused by Cyclone in Tonga

Year	Name (Category)	Major Damage
2020	Harold (5)	Damage to houses, food crops and water supplies occurred in 'Eua and Tongatapu.
2019	Gita (5)	The most intense tropical cyclone to impact Tonga since reliable records began. 119 homes destroyed and 1,131 damaged in Nuku'alofa. Domestic terminal at TBU also severely damaged.
2014	Ian (5)	90% power lines was lost in Ha'apai, 1,130 buildings were effected and 2,300 people were left homeless.
2012	Jasmin (4), Cyril (2)	Heavy rain and flooding, 400 people were evacuated in Nuku'alofa

Source: Survey Team

4-2-6 Land Use

The east side of the airport land faces the airport's main access road that connects Horonga and Fua'amotu from north to south, and the Taliai military camp is located on the northeast side of the airport land. Although some residences are located along the main access road, other areas outside the airport land are predominantly used for agriculture with crops of potato, maize, corn and squash to the north; coconut plantations to the south; and dairy farming to the west of the airport.

[2] The Emergency Events Database - Universite Catholique de Louvain (UCL)

4-3 Review of Airport Improvement Plan

4-3-1 Airport Improvement Policy

The project proposal for Fua'amotu International Airport prepared by the Government of Tonga includes (i) Extension of Runway 11/29 by 360m x 45m and (ii) Development of new international terminal as outputs of the project. Study on the improvement of airport facilities is conducted on these two facilities at first.

The following points are basic policies for planning improvement of Fua'amotu International Airport.

- The airport facilities should be improved to cater to the traffic demand expected in 2030 in accordance with not only national standards but also international standards and good practices.
- The master plan for TBU, i.e., "Strategic Development Plan" in 2010, and its review in 2018, i.e., "Desktop Review", should be reviewed by focusing on "whether there will be excessive facilities", and respect the existing plan as much as possible.
- Expansion and improvement of the existing PTB should be planned with phased developments to continue airport operations during construction period.
- The terminal facility improvement should be planned considering barrier-free, eco-friendliness and required functions in the event of a disaster.

4-3-2 Review of Improvement of Runway 11/29

Strategic Development Plan states "the existing 2,671m main runway at Fua'amotu International Airport will accommodate Code E aircraft with possibly some weight restrictions for specific aircraft to some destinations", and proposed only a strengthened 7.5m shoulder on both sides of the main runway. Desktop Review stated "Although the aircraft in the study are not able to take off from Fua'amotu's 2,671m runway at maximum take-off weight (MTOW), they are able to reach Eastern-Asia and the West Coast of the Americas with a full passenger payload. With a runway extension in place, the aircraft are able to fly further into Asia and the Americas. An extension to approximately 3,200-3,300m is considered for protection in this master plan to service up to B777-300ER at MTOW."

1) Runway Length

The JICA Survey Team re-study the required runway length for large size jet aircraft, i.e. B777-300ER, B787-9, and A350-800, which were studied in the "Desktop Review", and confirms that the existing runway length is sufficient for these large jet aircraft to fly to the West Coast of the US with a full passenger payload (see figure below). As stated in Chapter 3, it is considered premature to expect operation of direct flights to/from US with the MTOW by 2030. Therefore, it is reasonable that the runway extension, as described in the Desktop Review, is considered to extend beyond the year 2030 in this improvement plan.

Source: Survey Team

Figure 4-3-1 Flight Range from TBU by Selected Aircraft with Full Passenger Payload

2) Pavement Strength

In this section, sufficiency for future traffic demand of the existing airside pavement strength is confirmed by ACN-PCN method. An airside improvement plan will be proposed, if needed.

According to the result of air traffic demand forecast in Chapter 3, the heaviest aircraft in the target year of 2030 will be B787-9 or B777-200ER/300ER, which is introduced to the existing route bound for Auckland (AKL). Besides, B777-300ER and A350-900 were expected to operate at TBU for charter flights in the "Desktop Review" report. Hence, the sufficiency of existing pavement for B787-9, A350-900 and B777-300ER (which is heavier than -200/300) is studied.

The following table summarizes the ACN and Takeoff Weight (TOW) for each aircraft with full passengers and 13 tons of cargos bound for AKL, and MTOW limited by the existing runway length of 2,761m. A cargo volume of 13 tons is assumed based on the maximum volume in the cargo logs during December 2019 and January 2020.

Table 4-3-1 ACN and TOW for Selected Aircraft at TBU

Aircraft	Operational Condition of Aircraft			
	Full Pax + 13t Cargo to AKL (alt. CHC)		MTOW at RWY=2,761m	
	ACN	TOW (,000 kg)	ACN	TOW (,000 kg)
B777-300ER	53	252	76	318
B787-9	61	200	78	235
A350-900	59	216	78	268

Source: Survey Team

As compared with each ACN and PCN = 70 at TBU, the Survey Team finds that the existing pavement strength is sufficient for all of the selected aircraft bound for AKL. There are, however, some operational restrictions as the followings, if longer haul flights are to be operated:

- ACN of B777-300ER at MTOW for the existing runway exceeds PCN at TBU, but does not exceed 10%, i.e., ACN=77. Therefore, occasional operations will be acceptable in accordance with Clause 20.1 of ICAO Anex-14.

- Since ACN of B787-9 and A350-900 at MTOW for the existing runway length exceeds ACN=77 at TBU, the take-off weight of these aircraft should be limited to ACN=77 even if the number of flights will be occasional (see table in below for TOW of each aircraft).

Table 4-3-2 TOW at ACN=77 for Selected Aircraft at TBU

Aircraft Type	B787-9	A350-900
TOW (kg)	234,507	267,000

Source: Survey Team

The flight ranges for B787-9 and A350-900 shown in Figure 4-3-1 are revised based on MTOW limited by ACN=77 to evaluate the effect of those operational restrictions. As observed in the following figure, all of selected aircraft at ACN=77 will be able to reach Eastern-Asia and the West Coast of the US with a full passenger payload. Thus, it is considered that improvement of pavement strength is unnecessary until such time when the flights for those destinations become frequent beyond the year 2030.

Source: Survey Team

Figure 4-3-2 Flight Range from TBU by Selected Aircraft with ACN≦77

3) Runway and Runway Shoulder Widths

The width of RWY11/29 (45m) is suitable to accommodate Code E aircraft. It is desirable to widen the existing shoulders, that is, 4.5m wide at the western part of about 657m length and about 2m wide at the remaining part of about 2,000m length, to 7.5m in accordance with CAANZ recommendations. However, it is not considered as an urgent issue since no safety concern was raised from any airlines operated at TBU.

4-3-3 Review of Improvement of Terminal

Figure 4-3-3 shows the apron layout (free maneuvering) for FY 2038 proposed in the Desktop Review, and Figure 4-3-4 shows the terminal layout for FY2028 proposed in the Desktop Review. Although the project proposal prepared by MOI does not explain the expansion of the apron, additional taxiway and improvement of the road and car park, these facilities are studied as a potential part of the project in this section.

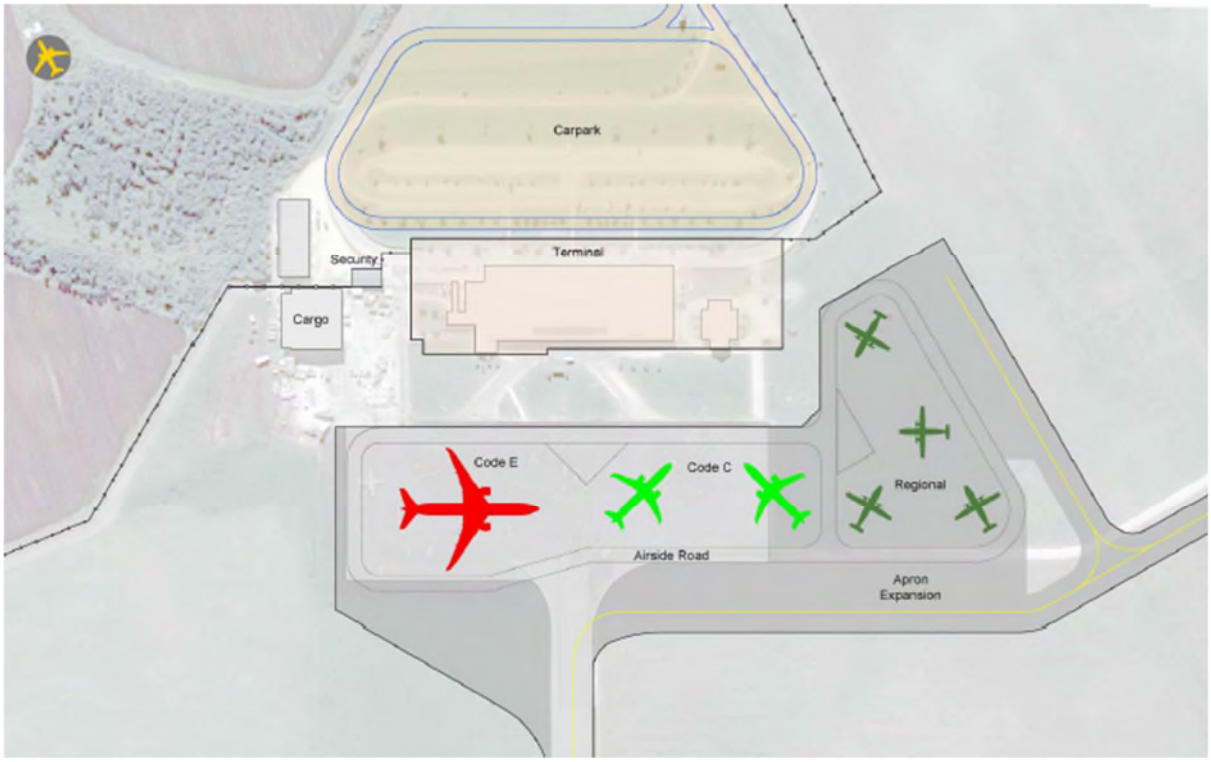


Figure 4-3-3 Apron Layout (Free Maneuvering) for FY2038 in Desktop Review

[redacted]

Figure 4-3-4 FY2028 Terminal Layout in Desktop Review

1) Passenger Terminal Building

Floor areas and busy hour passengers of a consolidated PTB for FY2028 and 2038 proposed in the Desktop Review are summarized in Table 4-3-3.

Table 4-3-3 Floor Area, Busy Hour Passenger and Floor Area per Passenger of Conceptual Plan

	Floor Area	Peak Hour Pax.	Floor Area per Pax
FY2028	9,800 m^2	486	20.2 m^2
FY2038	12,400 m^2	684	18.1 m^2

Source: Survey Team

Using 20.2 - 18.1 m^2/pax and 401 (= 351 + 50) pax as forecasted in Chapter 3, the target floor area of the PTB is set at 8,100 - 7,260 m^2. The required scale of various facilities in the PTB is estimated as shown in Table 4-3-4 based on 401 busy hour passenger, planning parameters[3], such as check-in processing time per pax, and rules of thumb in the Airport Development Reference Manual, IATA. The total area including a 15% design margin is estimated to be 7,598m^2, that is, within the abovementioned target.

Table 4-3-4 Facility Requirements of Passenger Terminal Building

Facility		Area (m^2)	No.	Remarks
Departure Concourse		500	-	3 friends/pax 30% in PTB
International	Check-in	254	15	180 sec/pax, MQT: 20 min
	Baggage Make Up	287	-	
	Security	52	1	12 sec/pax, MQT: 5 min
	Emigration	84	4	60 sec/pax, MQT: 10 min
	Gate Lounge	499	-	80% seated
	VIP Lounge	166	-	Proportionated area of Desktop Review
	Health Check	10	2	10 sec/pax
	Immigration	189	9	60 sec/pax, MQT: 10 min
	Baggage Claim	423	1	20 min/flight
	Baggage Break Down	253	-	
	Customs	64	4	25% checked, 2 min/pax
Domestic	Check-in	48	3	90 sec/pax, MQT: 10 min
	Baggage Make Up	46	-	
	Security	38	1	12 sec/pax, MQT: 5 min
	Gate Lounge	72	-	80% seated
	Baggage Claim	126	1	20 min/flight
	Baggage Break Down	53	-	
Arrival Hall		538	-	Pax: 10min, Friend: 40 min, 3 friends/pax 30% in PTB
Concessions		398	-	Proportionated area of Desktop Review
Observation Deck		163		Existing
Offices		414	-	Proportionated area of Desktop Review
Toilet, Storage, Circulation, etc.		1,439	-	20% of total floor area
Design Margin		1,079	-	15% of total floor area
Total		7,194	-	

Source: Survey Team

The conceptual floor plan is developed as shown in Figure 4-3-5 based on the abovementioned facility requirements. Table 4-3-5 compares facility requirements and facilities planned in the conceptual floor plan.

[3] It was not possible to conduct a passenger survey, because there was little traffic due to COVID-19. Therefore, the parameters are taken from the Desk Top Review.

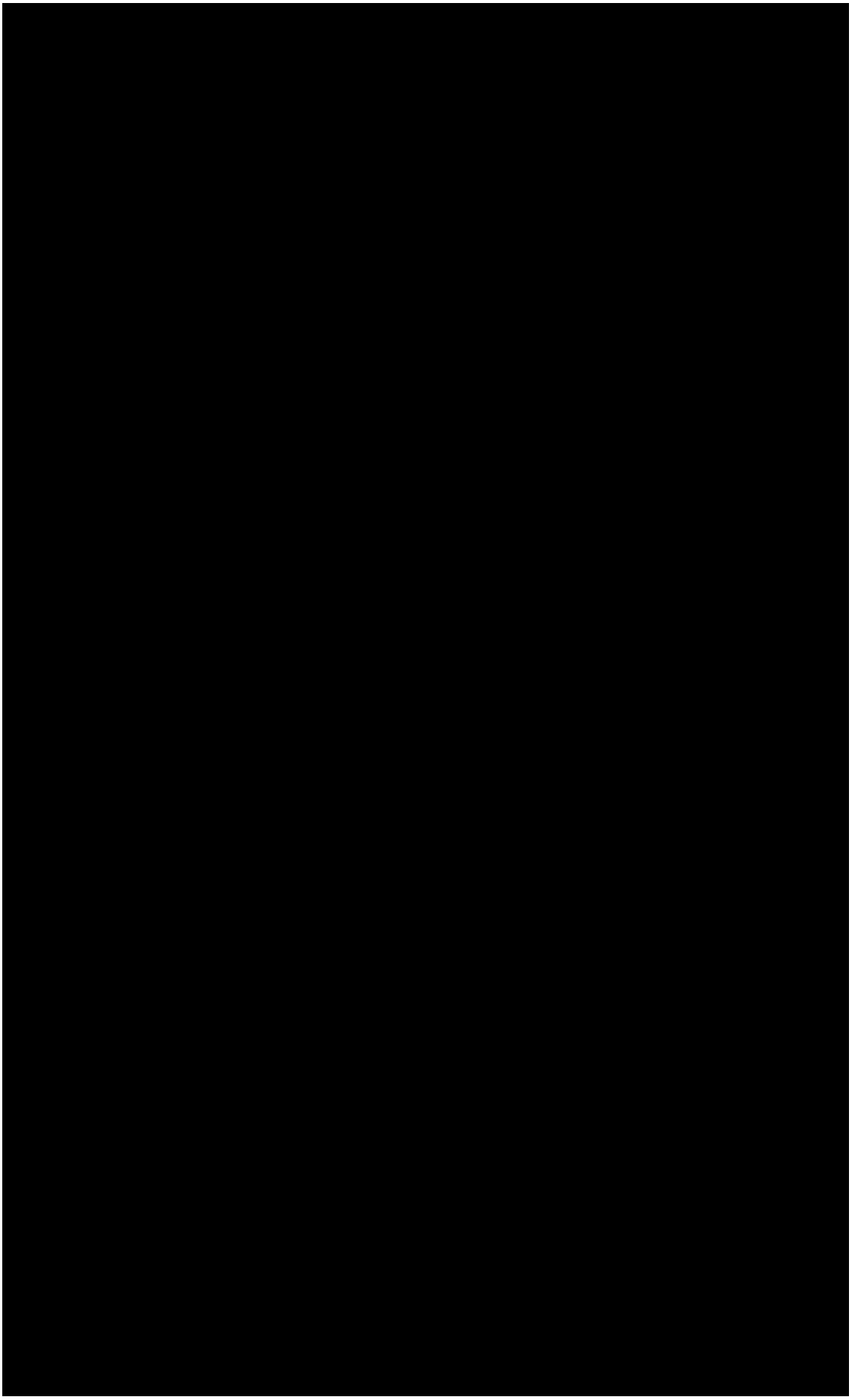


Figure 4-3-5 Conceptual Floor Layout Plan

Table 4-3-5 Comparison of Required and Planned Facilities

Facility		Requirements		Planned		Remarks
		Area (m^2)	No.	Area (m^2)	No.	
Departure Concourse	Public Area	500	-	2035	-	Increased friends in PTB from 30% to 60%/pax
Arrival Hall		538	-			
Check-in	Int'l	254	15	312	18	
	Dom.	48	3			
Baggage Make Up	Int'l	287	-	355	-	Including Hold Baggage Screening.
	Dom.	46	-			
Security	Int'l	57	1	143	2	
	Dom.	19	1			
Emigration		71	4	81	4	
Gate Lounge	Int'l	499	-	606	-	
	Dom.	72	-			
VIP Lounge		166	-	223	-	
Health Check		10	2	16	2	
Immigration		189	9	241	10	Counter is to be even number.
Baggage Claim	Int'l	423	1	553	3	Two claim devices are maintained for international.
	Dom.	126	1			
Baggage Break Down	Int'l	253	-	462	-	
	Dom.	53	-			
Customs		64	4	68	4	
Concessions		398	-	641	-	Including duty free, F&B, retail.
Observation Deck		163	-	163	-	
Offices		414	-	517	-	Including office of C.I.Q.S.
Storage		1,483	-			
Toilet				446	-	
Plant				-	-	
Circulation				1,196	-	
Design Margin		1,079	-	-	-	
Total		7,194	-	8,058	-	Within target of 8,100 - 7,260 m^2.

Source: Survey Team

Figure 4-3-6 shows the flows of international/domestic and departing/arriving passengers in the new consolidated PTB.

Figure 4-3-6 Passenger Flow

After presenting the conceptual floor plan in Figure 4-3-5 in the Interim Report, the Tongan side suggested locating the domestic gate lounge and domestic baggage claim together at the eastern end of the new PTB. Then, the alternative plan shown in Figure 4-3-7 was prepared.

Figure 4-3-7 Original and Alternative Plans

Major differences between the two plans are summarized in Table 4-3-6. Discussions were made between the Survey Team and the Tongan side, but it was difficult to finalize the conceptual floor plan at this stage. Since differences in project cost and implementation schedule of the two plans would be negligible, it was agreed to wait for a final decision until the preparatory survey was conducted, if JICA took the project as a candidate for Japanese assistance. Some details of discussions are included in Appendix-1 for reference in the future. It was also agreed to use the Original Plan for the sake of completion of the Data Collection Survey, such as description of staged construction.

Table 4-3-6 Major Differences between Original and Alternative Plans

Item	Original Plan	Alternative Plan
1. Security concern on crossing flows of dom. and int'l pax on airside	Potential crossing will happen, if there are simultaneous departure of dom. and int'l or simultaneous dom. arrival and int'l departure, but it will be rare. If ever crossing is predicted, it can be avoided by holding int'l departures for a while when dom. pax are walking.	There will be no possibility of mixing.
2. Distance between dom. aircraft parking stand and dom. arrival/ departure gates	Distance is about 100m longer than the alternative plan. However, this disadvantage can be lessened by using an int'l parking stand adjacent to the dom. stand, which is vacant in most of the time, for dom.	Distance is about 100m shorter than the original plan. This is a benefit for both pax and transport of baggage.

	parking.	
3. Separation of Baggage Make-up and Breakdown Areas	Distance between domestic baggage make-up and breakdown is about 60m. As it will take about one minute only by walking, it should not be a big issue.	Domestic baggage make-up and breakdown areas are next each other. This is convenient for ramp crew.
4. Smooth transfer between domestic and international	Walking distance for transfer pax (estimated to be about 9,300 pax/year, 30% of arrivals) from dom. to int'l is about 50m longer through the public area. Public area will not be so congested, because it is usually not in the int'l busy hour.	Walking distance for transfer from dom. to int'l is about 50m shorter. It will be smooth without passing through congested public areas.
5. Provision of services on landside for arrival pax, such as information counter, hotel reservation, car rental, taxi, bus, etc.	Such services can be located conveniently at one place near the int'l and dom. arrival area.	Provision of such services at two locations, near the int'l and dom. arrival areas, is desirable. Otherwise, some pax should walk about 100m longer to find the services.
6. Security screening for departing passengers	Common use of X-ray scanners and walk-through metal detectors for both dom. and int'l is planned. This will make efficient use of security staff and screening equipment.	Currently no security screening equipment for dom. operations. Manual search with or without hand-held metal detector can be applied for dom. operations.
7. Flexible use of departure gate lounge for domestic and international operations	Flexible use of dom. gate lounge for int'l can ease congestions of int'l pax during excessive peak hours expected in the night, when there is no dom. operations. More than 351 pax/hour are expected to occur about 30 times/year in the night, when there is no dom. departure.	Flexible use is not planned. Some congestion during excessive peak hours are allowed in the internationally accepted planning practice.
8. Flexible use of baggage claim for domestic and international operations	Flexible use of dom. baggage claim for int'l peak hours in the night, when there is no dom. operation, is an option to deliver baggage faster.	Flexible use is not planned.

Source: Survey Team

2) Apron and Taxiway Expansion

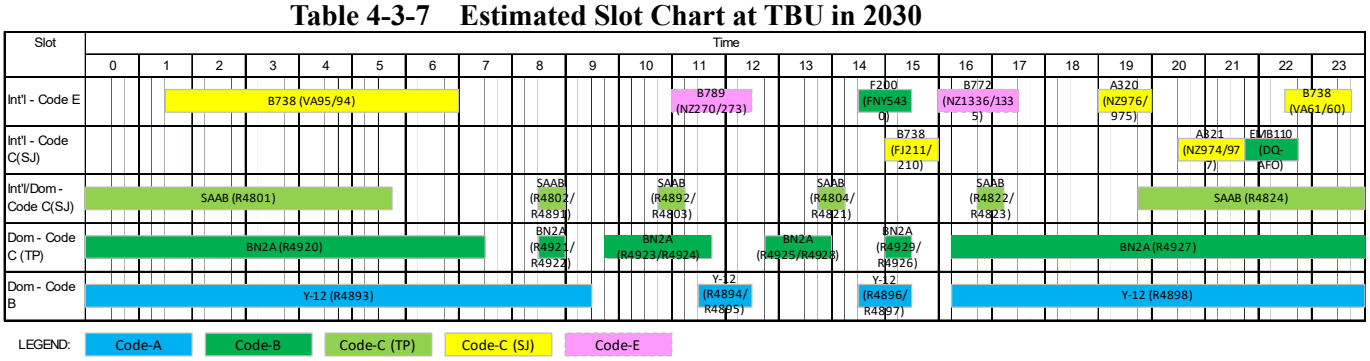
The apron layout in Figure 4-3-3 is reviewed based on the result of air traffic demand forecast described in Chapter 3. The Survey Team develop anticipated slot charts for the new apron to estimate the required slot numbers in 2030. The following steps are made to estimate the slot demand in the future:

1. The numbers of flights on the busiest day for both domestic and international flights (including charter flights) from Dec. 2019 until Jan. 2020 are adopted as the baseline of slot demand estimate.
2. Since the past flight log indicated that two Code-E aircraft of international flights were operated in a day, two Code-E aircraft of international flights are additionally considered to represent the traffic growth during the peak season in the future.
3. It is assumed that the daily flight schedule of domestic flights will be basically unchanged and the frequency of flights per week will be increased in the future.
4. The past flight log also indicated that some domestic flights of Code-B aircraft were alternatively operated with Code-C (turbo-prop) aircraft due to maintenance or repair. Thus, the size of aircraft stands for domestic flights is increased to the next larger size of aircraft, assuming that one each of Code-A and Code-B aircraft are substituted by Code-B and Code-C (turbo-prop) aircraft respectively.

5. Finally, a slot size of Code-C (turbo-prop) aircraft for domestic flights is increased to that of Code-C (small jet) aircraft to accept an unexpected or delayed international flight.

The estimated slot chart in 2030 appears in Table 4-3-7. According to the charts, the number of aircraft stands in 2030 should be one Code-E, two Code-C (small jet) and one each of Code-C (turbo-prop) and Code-B. Therefore, the plan is to expand the existing international apron to accommodate all aircraft stands listed above. With regard to the night stay demand, it is assumed to use the existing domestic apron if necessary.

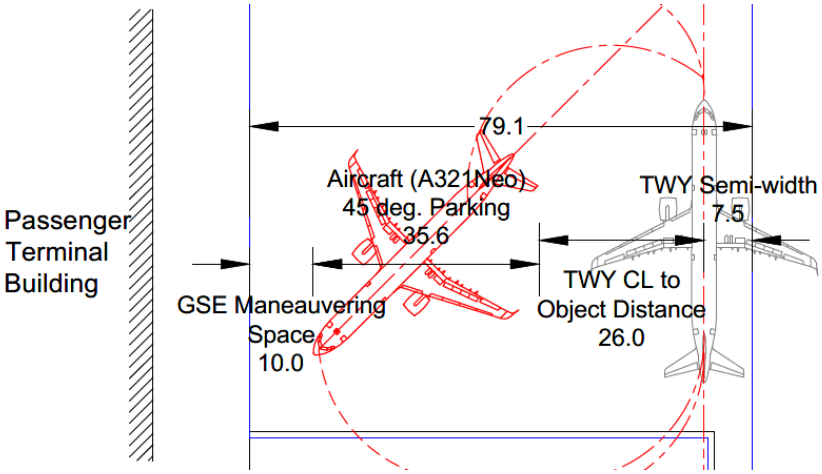
Table 4-3-7 Estimated Slot Chart at TBU in 2030



Source: Survey Team

The geometry of the passenger loading apron to be expanded is planned based on the dimension of the largest size of aircraft for each aircraft code, i.e., A777-300ER for Code-E, A321Neo for Code-C (SJ), ATR-72-600 for Code-C (TP) and DHC-6 (substitute for Y-12B) for Code-B.

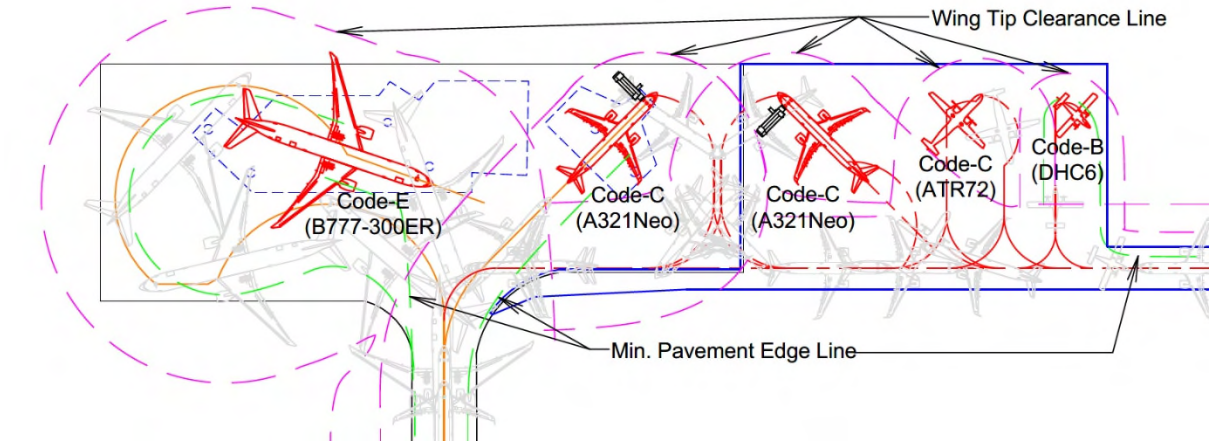
The required area of the apron expansion is estimated with aircraft parking layouts assuming self-maneuvering, in which no aircraft towing tractor would be required. The depth of the apron is designed considering a 10m width of GSE maneuvering space between parked aircraft and PTB, the same as the aircraft parking layout of the existing international apron.



Source: Survey Team

Figure 4-3-8 Depth of New Apron

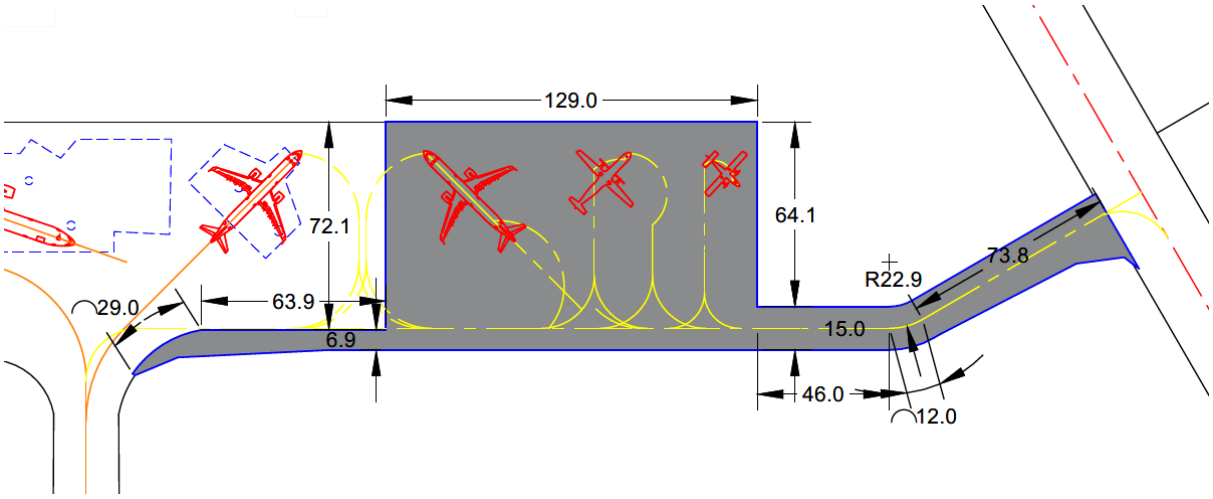
The width of the new apron is designed so that aircraft are able to maneuver on the apron with the required clearance between the aircraft and objects stipulated in CAANZ standards. While maintaining the aircraft parking positions on the existing apron, the aircraft parking layout on the new apron are planned so as to minimize the pavement area. The following figure shows the maneuver lines of each design aircraft with the designated aircraft parking layout;



Source: Survey Team

Figure 4-3-9 Aircraft Maneuvers on New Apron

Besides, a new taxiway connecting with the expanded apron and existing domestic apron is planned. The new taxiway will also provide circular flow of aircraft on the ground between the new apron and RWY11/29 to avoid traffic congestion on existing TWY-A. The geometry of taxiways and its fillet are planned in accordance with the requirements for Code-C of FAA Advisory Circular. Figure 4-3-10 shows the major dimensions of the new apron and taxiway.



Source: Survey Team

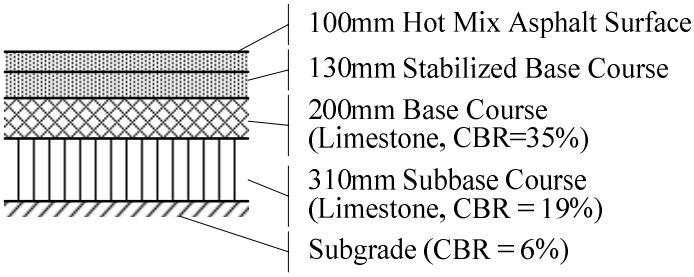
Figure 4-3-10 Major Dimensions of New Apron and Taxiways

The flexible (asphalt) pavement is selected for the type of new airside pavements, the same as the existing pavements because partially using a different type (ridged) of pavement in some areas will cause irregularity of surface due to uneven settlement and invoke hair cracks on overlaid asphalt layer of rehabilitation work in the future. No paved shoulder is planned, the same as the existing taxiway. Pavement structure of new taxiway and apron is planned based on a 20 years life period and future air traffic volume in 2035 which is the middle of the design life period. Anticipated air traffic volume for the pavement design and pavement structure of the new apron and taxiway appear in Table 4-3-8 and Figure 4-3-11 respectively. PCN of the new pavement will be 57 F/C/X/T.

Table 4-3-8 Anticipated Air Traffic Volume for Pavement Design

Aircraft Type	Substituted Aircraft	Gross Wt. (lbs)	Annual Departures
A320	A320-200 Twin opt	172,842	173
A321Neo	A321-200 std	197,093	520
B737-700	B737-700	155,000	47
B737-800	B737-800	174,700	693
SAAB340B	Saab 340B	29,000	710
ATR72	D-50	50,000	252
Y-12	S-12.5	12,500	790
BN2A	S-5	5,000	727

Source: Survey Team



Source: Survey Team

Figure 4-3-11 Pavement Structure for New Apron and Taxiways

3) VVIP Terminal

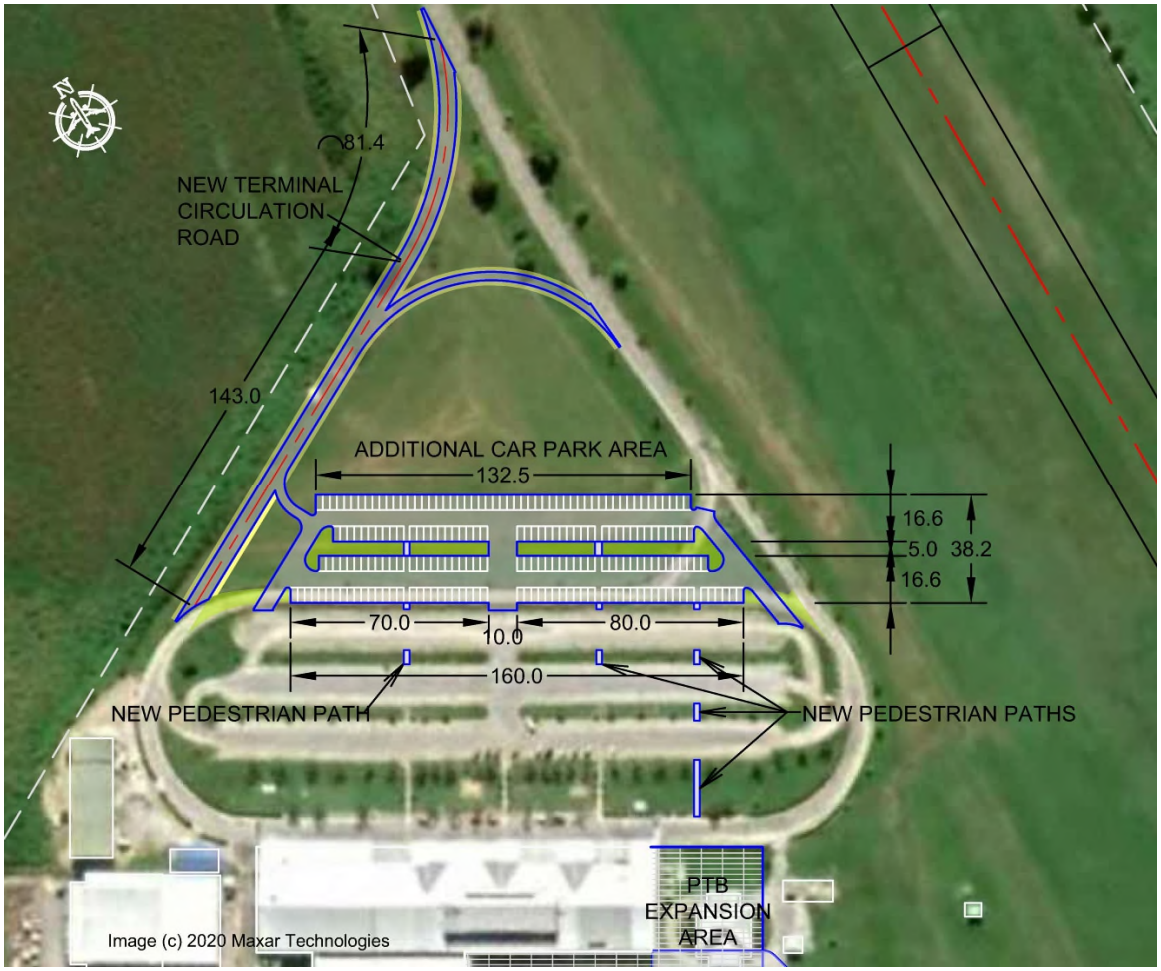
The new VVIP Terminal will have the same floor area as that of the existing one, that is 173 m^2. The floor layout will also be the same as the existing one as shown in Figure 4-2-21.

4) Visitors' Sheds

In order to supplement the public space in the PTB, five sheds of 10m x 10m with benches will be built in the green area of the car park.

5) Roads and Car Park

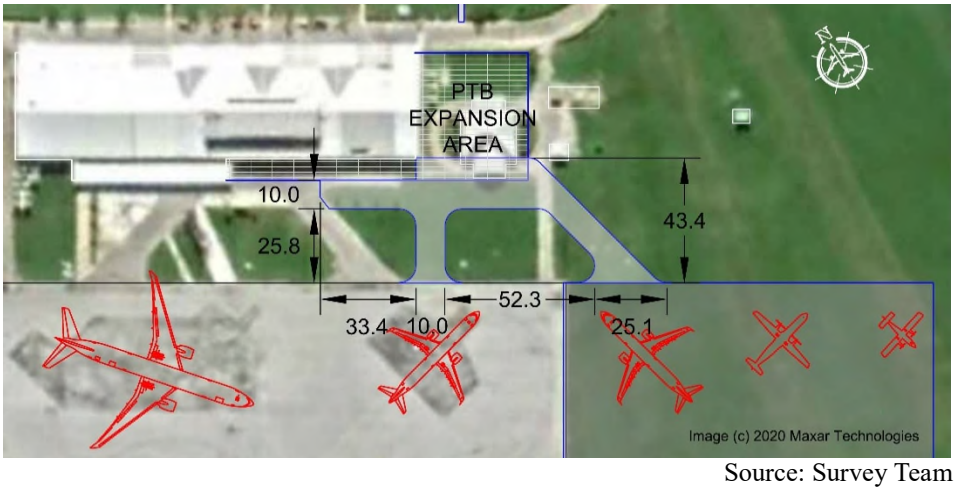
An additional car park area will be provided to accommodate about 184 parking lots (684 in total) at the north side of the existing car park of the international terminal area. The existing terminal circulation road at the north of the existing car park will be altered to the northwest of the new car park area so as to minimize roadway crossing by pedestrians. The geometries of roads and the car park are planned in accordance with design parameters applied for design of existing road. The layout plan of the additional car park and new terminal circulation road at the international terminal area is shown in Figure 4-3-12.



Source: Survey Team

Figure 4-3-12 Layout Plan of Additional Car Park Area and New Terminal Circulation Road

In addition, a new GSE service road is planned to provide access between the expanded baggage make-up area of PTB and aircraft parking stands as shown in Figure 4-3-13.



Source: Survey Team

Figure 4-3-13 Layout Plan of New GSE Service Road

6) Ancillaries

In relation to the abovementioned development, ancillary facilities listed in Table 4-3-9 should be developed.

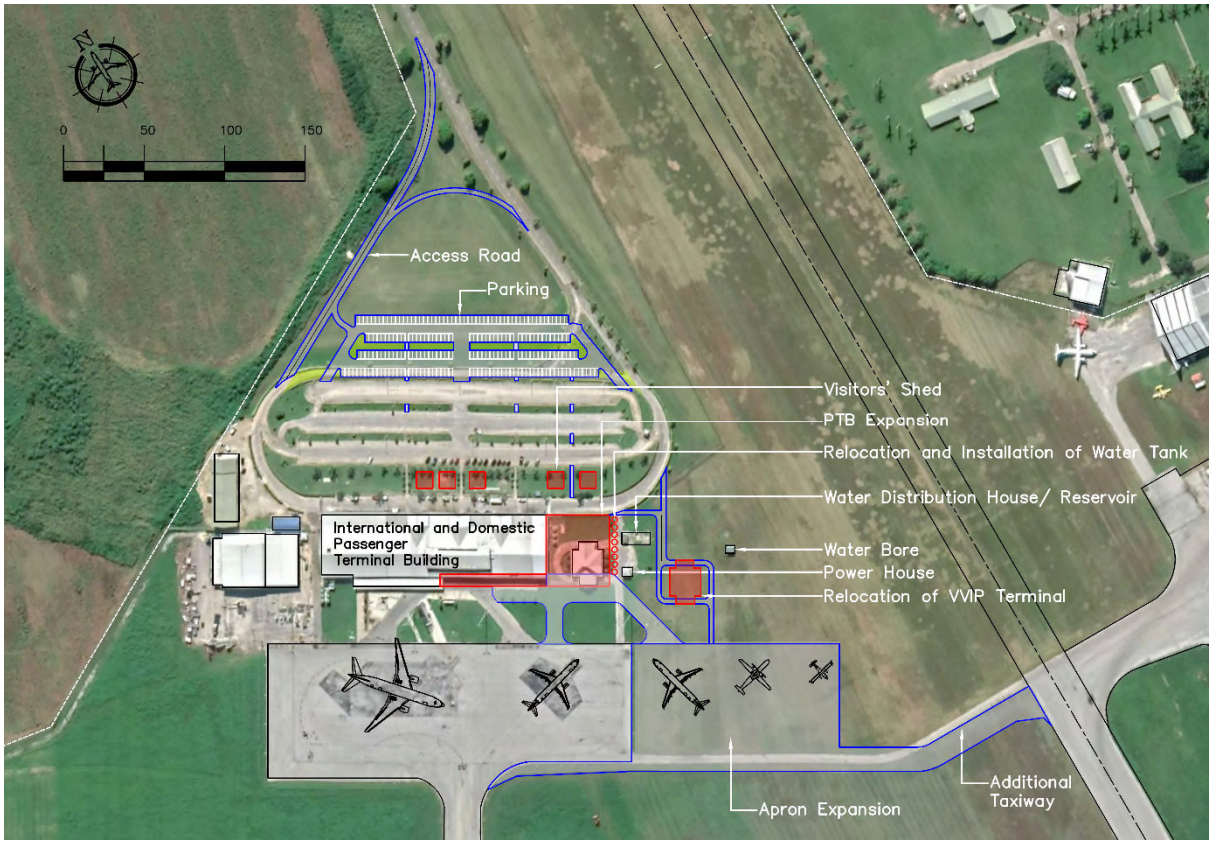
Table 4-3-9 Development of Ancillary Facilities

Facility	Q'ty	Description
Apron Flood Lights	4 nos.	Four poles for the expanded aircraft stands. Height of the pole at the easternmost will be restricted to approx. 8m height due to Transitional Surface of RWY17/35.
Taxiway Edge Lights	28 nos.	Alongside the new TWY and east edge of expanded apron. Power will be supplied from one of the seven existing 10kVA CCRs.
Information Sign	6 nos.	Including 2 Mandatory Signs
Guard House	1 no.	Guard house for the VVIP terminal.
Streetlights	17 nos.	Approx. 50m interval in the access road and 10lx for the new parking area
Water Tank	8 nos.	The existing three 10kL tanks for rain water harvesting on the east of the International PTB will be relocated. Five tanks will be added to cater to the expanded roof.
Power House	1 lot	The existing transformer and power receiving facilities will be upgraded to cater for the expanded PTB.
Septic Tank	1 lot	Additional septic tank and soak field will be developed to cater to the expanded PTB.

Source: Survey Team

7) Proposed Terminal Area Layout Plan

Figure 4-3-14 shows the proposed terminal area layout plan.



Source: Survey Team

Figure 4-3-14 Proposed Terminal Area Layout Plan

4-3-4 Needs of Improvement of Other Facilities

The needs for the improvement of other major facilities are evaluated based on the air traffic demand forecast described in Chapter 3.

1) Aerodrome Reference Code

The AIP, effective 21 May 2020, indicates the aerodrome reference code 4D for RWY11/29. It should be revised to 4E to reflect current condition properly in accordance with the standard of CAANZ.

2) Runway Strip

The existing runway strip of RWY 11/29 is in compliance with the standard of CAANZ, and there is no need of improvement in this project. However, as a part of long-term improvements, it is worthwhile to consider widening from the existing 150m wide to 280m wide as recommended by ICAO for non-precision instrument runway where the code number is 4. If a precision approach is introduced in the future, it shall be widened to 300m in compliance with the standard of CAANZ.

3) Runway End Safety Area

The existing runway end safety areas of RWY 11/29 are in compliance with the standards of CAANZ, and there is no need of improvement in this project. However, as a part of long-term improvements, it is worthwhile to consider extension from the existing 90m to 240m, if practicable, as recommended by both CAANZ and ICAO.

4) Airfield Lighting System

A Simple Approach Lighting System (SALS) is provided only on RWY11. It is recommendable to consider the installation of SALS on RWY29 as well to improve the runway usability in case of westerly wind condition.

5) Ground Service Equipment

In order to reduce use of the Auxiliary Power Unit (APU) of an aircraft while parked on the apron, it is recommendable to consider provision of Air Starter Unit (ASU), Ground Power Unit (GPU), and Aircraft Cooling Unit (ACU).

6) Fuel Supply Facility

In order to supply aviation fuel, expansion of the existing fuel supply system may be needed depending on the policy/strategy of the fuel supply company. If the hydrant system is to be expanded to the apron expansion area, close coordination will be necessary.

4-4 Candidate Project for Japanese Assistance

4-4-1 Outline of the Project

1) Objectives of the Project

The objectives of the Project are to expand and convert the existing international passenger terminal at Fua'amotu International Airport to a consolidated passenger terminal in order to handle both international and domestic air traffic demand expected in 2030 at an appropriate level of service standards, thereby contributing to the socio-economic development of the country.

2) Scope of the Project

As a result of "4-3 Review of Airport Improvement Plan" the following improvements are identified as main components of the Project for improvement of Fua'amotu International Airport.

- Expansion of the existing international passenger terminal building and conversion to consolidated passenger terminal
- Expansion of apron and taxiway
- Expansion of the existing car park

The following points are associated to the above-mentioned components of the Project. Among them, relocation of VVIP terminal and guard house may be done separately prior to the works of main components, as site preparation by the recipient country.

- Relocation of VVIP terminal
- Relocation of guard house
- Construction of Visitors' Sheds
- Addition apron flood lights. Taxiway edge lights and information signs
- Addition of streetlights
- Relocation and addition of water tanks
- Upgrade of power house
- Addition of septic tank

Improvements of other facilities described in Section 4-3-4 are not intended to be parts of the Project.

4-4-2 Design Concept

1) Eco-friendliness

In addition to conventional measures, such as use of natural ventilation, solar blinds and rainwater, environmental consideration technologies, such as the installation of solar photovoltaic (PV) renewables generation and utilization of photocatalytic ceramic tiles as self-cleaning materials for the floor of the toilet will be introduced in the Project. PV panels can be installed on the expanded roof of the PTB. Application of other environmental consideration technologies should be further studied in the succeeding design stage.

2) Barrier-free

The following points are taken into account for the review of the existing plan:

- Toilet stalls for people with disabilities are planned at restrooms on the landside.
- Provision of parking lots for people with disabilities near the PTB. Location and access path to/from the PTB should be reviewed and designed in the succeeding design stage.

Application of design elements to achieve the barrier free airport, such as access slope at curbside, braille blocks and audible signage, should be studied in the succeeding design stage.

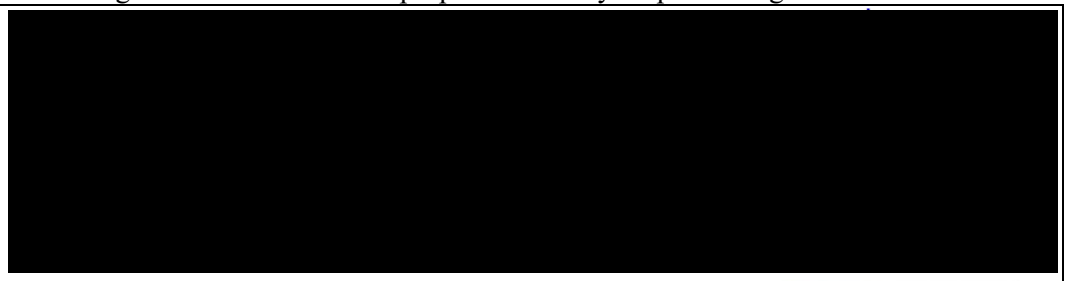
3) Disaster Relief

TBU, as the main gateway of international air transport and the base of domestic air transport, is required to function as a disaster relief base for transporting peoples and goods in the event of a disaster. The airport terminal will be a focal point of such activities. Therefore, it shall be designed to withstand strong earthquakes and cyclones. There is low risk of tsunami for TBU, situated approximately 40m above the mean sea level.

4-4-3 Phased Construction Plan of Passenger Terminal Building

In order to keep operations of PTB during expansion and renovation works, phased construction is planned as shown in Figure 4-4-1 based on the proposed PTB layout plan in Figure 4-3-5.

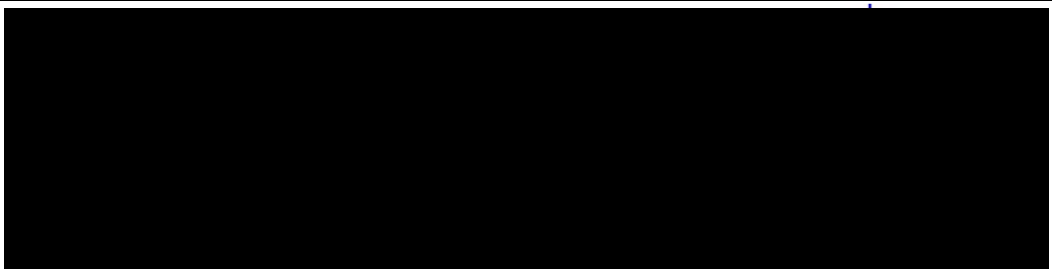
Phase 1-1



① Construction of New Check-in Area
② Conversion of a part of Gate Lounge to Toilet
③ Conversion of Duty Free and Arrival Hall to Immigration Area

:Construction
:Airport Operation

Phase 1-2



① Construction of New Check-in Area
② Conversion of a part of Gate Lounge to Toilet & VIP Lounge
③ Conversion of Immigration Area, etc. to Duty Free, Customs Area and others

Phase 2-1

① Conversion of Check-in Area, etc. to Emigration, Gate Lounges, Dom. Baggage Claim, etc.
② Conversion of VIP Lounge to Corridor, etc. and modification of Toilet
③ Relocation of existing Hold Baggage Scanner to New Check-in Area
④ Conversion of Corridor to Concession Area

Phase 2-2

① Conversion of Check-in Area, etc. to Gate Lounges, Dom. Baggage Claim, etc.
② Construction of Gate Lounge Extension Area
③ Expansion of Duty Free and conversion of Duty Free to F&B

Source: Survey Team

Figure 4-4-1 PTB Phased Construction Plan

4-4-4 Expected Construction Schedule

The expected construction schedule, based on the phased construction as described above, is shown in Table 4-4-1. Total duration of the construction, including relocation of VVIP terminal, is estimated as 19.5 months.

Table 4-4-1 Expected Construction Schedule

ID	Task Name	Dura-tion	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Preparation Works	1.5																						
1 1	Temporary Office	0.5																						
1 2	Relocation of Existing Utilities	1.0																						
2	Relocation of VVIP Terminal	2.8																						
2 1	VVIP Building	1.5																						
2 2	Clearing & Earthworks for VVIP area	0.3																						
2 3	Pavement Works for VVIP area	0.2																						
2 4	Demolition and Clearing of ex. VVIP Area	1.0																						
3	Passenger Terminal Building Expansion	16.0																						
3 1	Expansion of PTB (Phase 1-1)	2.0																						
3 2	Expansion of PTB (Phase 1-2)	6.0																						
3 3	Renovation of PTB (Phase 2-1)	3.0																						
3 4	Renovation of PTB (Phase 2-2)	5.0																						
3 5	Visitors' Shed	2.0																						
4	Apron Expansion and New Taxiway	9.0																						
4 1	Demolition and Clearing	2.0																						
4 2	Earthworks	1.5																						
4 3	Pavement Works	4.5																						
4 4	Drainage, Pavement Markings, Sodding	1.0																						
4 5	Airfield Lighting System	2.5																						
4 6	Clearing & Earthworks for GSE Road	0.3																						
4 7	Pavement Works for GSE Road	0.3																						
5	Carpark and Circulation Road	6.0																						
5 1	Demolition and Clearing	0.5																						
5 2	Earthworks	1.5																						
5 3	Pavement Works	3.0																						
5 4	Drainage, Pavement Markings, Sodding	1.0																						
5 5	Road Lighting	1.0																						

Source: Survey Team

4-4-5 Approximation of Project Cost

The approximate cost of the Project, including price escalation, physical contingency, and consulting services, is estimated to be JPY 2,572 million as shown in Table 4-4-2 with the following conditions:

- Time of Estimation: December 2020
- Exchange Rate: TOP 1 = JPY 49.9120 (Tonga Development Bank, 2020/12/02 TTB)
- Price Escalation: 2.0%/(3.6% to local currency for 1.5 year up to June 2022, assuming the local currency portion of 45% in the construction cost and 50% in the consulting service cost)
- Physical Contingency: 10%

Unit prices of each construction item are mainly estimated based on the estimated unit price of the new ferry terminal construction project in Tongatapu, adjusted with unit prices of manpower, construction equipment, materials and transportation collected from local contractors. Besides, indirect construction cost is estimated based on the JICA's project cost estimation practice. The estimated approximate construction cost is shown in Appendix 2.

Approximate cost by components is shown in Table 4-4-3.

Table 4-4-2 Approximate Project Cost

ITEM			JPY (million)
I.	Construction Cost (A+B+C+D+E)		2,404
	A.	Direct Construction Cost	1,662
		i. Passenger Terminal Building	1,107
		ii. Car Park and Circulation Road	100
		iii. Visitors' Shed	24
		iv. Apron and Taxiway	349
		v. VVIP Building	82
	B.	Indirect Construction Cost	309
	C.	Management and Overhead	171
	D.	Price Escalation (A+B+C) x 2%	43
	E.	Contingency (A+B+C+D) x 10%	219
II.	Consulting Service Fee (F+G+H)		168
	F.	Consulting Fee A x 9%	150
	G.	Price Escalation F x 2%	3
	H.	Contingency (F+G) x 10%	15
III.	Total Project Cost		2,572

Source: Survey Team

Table 4-4-3 Approximate Project Cost by Components

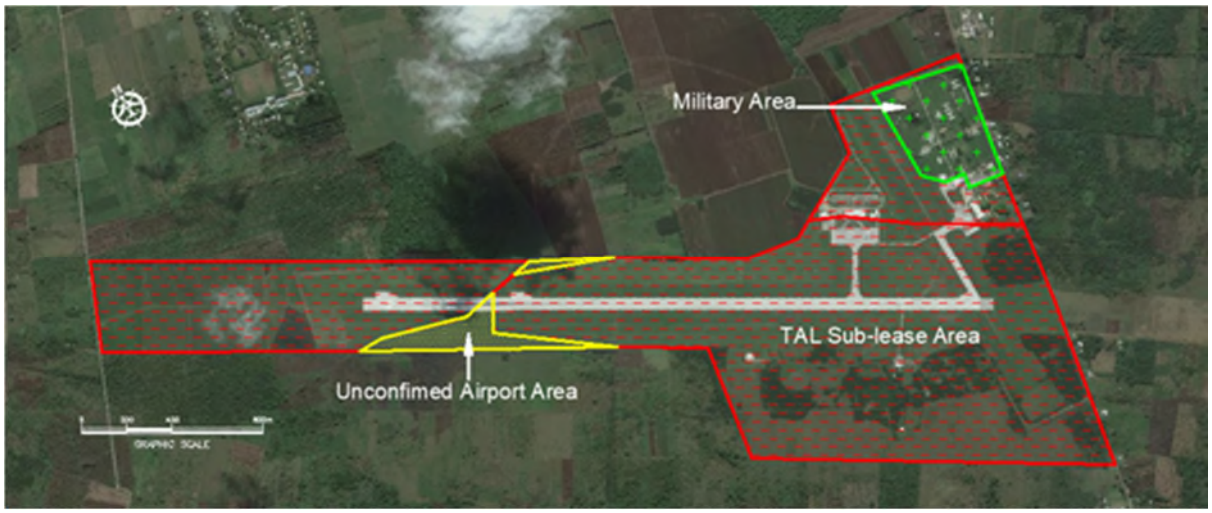
Component	JPY (million)
Passenger Terminal Building, Apron & Taxiway	2,253
Car Park, Circulation Road & Visitors' Shed	192
VVIP Terminal	127
Total	2,572

Source: Survey Team

4-5 Environmental and Social Considerations

4-5-1 Land Acquisition Status

The Land Act of Tonga stipulates that all land is the property of the Crown. According to the information from TAL, the land areas of TBU shown by red lines in the figure below are sub-leased from MOI to TAL since 2013 with a 50 years contract. Airport land for the runway extension and the south part of land where the control tower is located is already expanded from the former airport land boundary appeared in the "Desktop Review" report. No land acquisition will be required for the improvement plan described in Section 4-3-3.



Source: Produced by Survey Team based on data provided by TAL

Figure 4-5-1 Boundary of Sub-leased Area at TBU

4-5-2 Environmental Categorization

1) Regulations and Relevant Guidelines

According to the EIA reports on the past projects in Tonga, legislation concerning the environmental and social protection and preservation is varied and is the responsibility of a number of different Ministries according to their focus. Amongst these are the following key legislations:

- Environmental Impact Assessment Act 2003
- Environmental Impact Assessment Regulations 2010
- Environmental Management Act 2010
- Environmental Management (Amendment) Act 2015
- Marine Pollution Prevention Act 2002
- Parks and Reserves Act 1988
- Fisheries Management Act 2002
- Aquaculture Management Act 2003
- Birds and Fish Preservation Act 1988
- Public Health Act 1992

The Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC) is the principal agency responsible for the management of the environment, and in administering environmental-related legislation in Tonga. It provides environmental assessments, reports and recommendations to the responsible Ministry, as well as being mandated to require environmental impact assessments (EIA) and impose conditions for development projects under EIA Act 2003 and EIA Regulation 2010.

2) Environmental and Social Conditions

The project site is within the existing international terminal area of TBU. TBU is situated in a sparsely populated area on the island of Tongatapu. The airport is surrounded primarily by open fields with some tropical trees and some small farms growing crops for local markets. There are both primary and secondary schools situated about 2 km from the airport terminal. The secondary school includes a park. Fua'amotu village of approximately 2,000 people is situated about 2km from the airport terminal. Aloft Airport Accommodation and Scenic Hotel Tonga, which have been closed recently, are located in front of the domestic terminal area and at the entrance of international terminal access road respectively.

There are no official biological protected areas, or any sites or structures of known cultural significance anywhere near the project site. Wastewater is directed to a septic system and there is a government approved waste disposal site on the island.

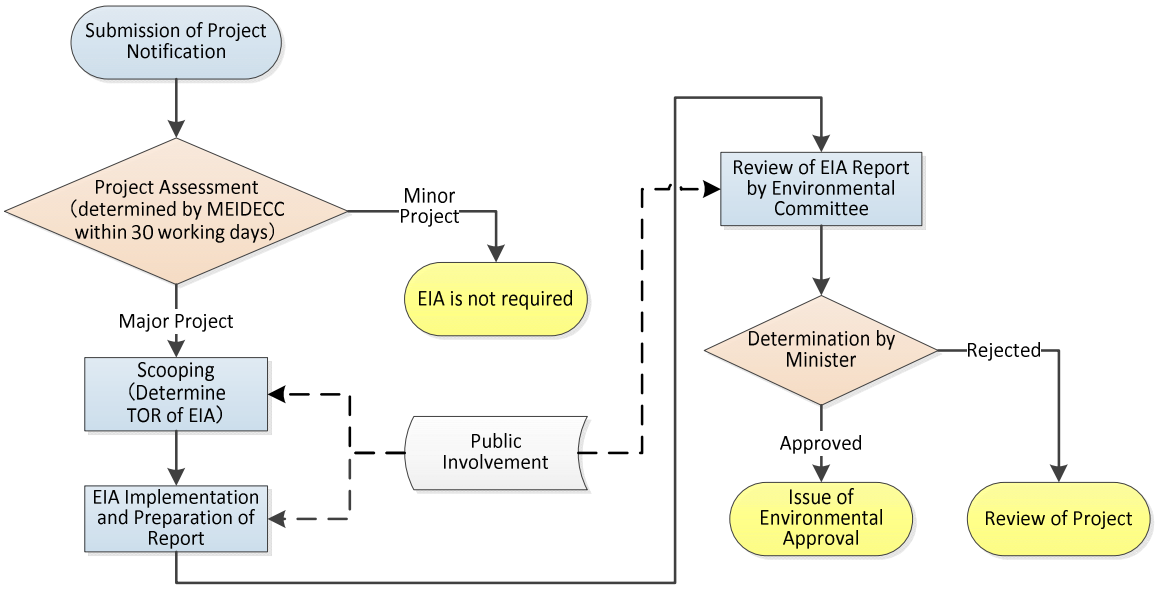
3) Screening and Categorization of the Project

New land acquisition is not required, and the project is unlikely to cause any major negative environmental or social impacts. Possible negative impacts related to the project are expected to be confined to the construction phase. Freshwater will be required for workers and some construction activities (e.g., dust suppression, concrete and bitumen production, etc.). Noise and vibration disturbances are particularly likely during construction related to the transportation of construction materials from the quarry and operation of equipment. Potential adverse impacts from quarrying or mining are high, if uncontrolled.

Normal mitigation measures of irreversible impacts, if any, will be designed readily. Thus, the project can be clarified as Category B project under JICA's environment classification. JICA's environmental screening form is in Appendix 3.

4-5-3 Further Considerations and Procedure

The Environmental Impact Assessment Act requires that all major development projects submit an appropriate environmental impact assessment (EIA) report that will include a review of all relevant impacts as determined by the MEIDECC from time to time. Figure 4-5-2 shows the flowchart of the EIA process in Tonga.



Source: Preparatory Survey Report on the Project for Upgrade of Wharf for Domestic Transport (JICA, 2015).

Figure 4-5-2 Flowchart of EIA Process in Tonga

CHAPTER 5
IMPROVEMENT OF VAVA'U INTERNATIONAL AIRPORT

CHAPTER 5 IMPROVEMENT OF VAVA'U INTERNATIONAL AIRPORT

5-1 Applicable Standards

Please refer to Section 4-1.

5-2 Current Conditions

5-2-1 Facilities and Equipment

1) Layout of Major Facilities

Figure 5-2-1 shows the layout of major airport facilities, and Figures 5-2-2 enlarges the terminal area.

2) Runway, Runway Strip and Runway End Safety Area

(1) Runway

The existing runway (RWY08/26) at Vava'u International Airport (VAV) is 1,700m x 30m and classified as a non-precision instrument approach runway for Code 3C in AIP. Turning pads (900m^2) were constructed by TAIP in 2016 at each end of the runway to accommodate Code-C turboprop (ATR72 or similar) aircraft operations. Due to high terrain at the west side and to the north-east of the airport, thresholds of both approach runways are displaced (504m at RWY08 and 300m at RWY26). The runway declared distances data for both runways are shown in Table 5-2-1.

Table 5-2-1 Declared Distance of Runway at VAV

RWY	TORA (m)	TODA (m)	ASDA (m)	LDA (m)
08	1,700	1,700	1,700	1,196
26	1,700	1,700	1,700	1,400

Source: AIP Tonga (21 May 2020)

(2) Runway Strip

Published dimensions of the runway strip are 1,860m length and 90m width. It satisfies the standard for non-instrument approach runway for Code 2, i.e., 80m width, but does not satisfy CAANZ standard for non-precision instrument approach runway classified in AIP, i.e., 150m. It is noted from a satellite image that perimeter fences of the north side and south side are located at about 70m and 60m from runway centerline respectively and that runway holding position marking is installed at the distance of 75m from the runway centerline.

(3) Runway End Safety Area

According to the AIP, Runway End Safety Area is not provided at the airport.

3) Taxiways and Apron

The width of the taxiway between the runway and apron was 13.5m and expanded to 15m for accommodating Code C aircraft by TAIP in 2016. Dimensions of the aircraft parking apron are 82m width and 57m depth, and have two aircraft stands for Code-2C such as DHC-8 and ATR42 (note that ATR72 currently operated by FJI is Code 3C).

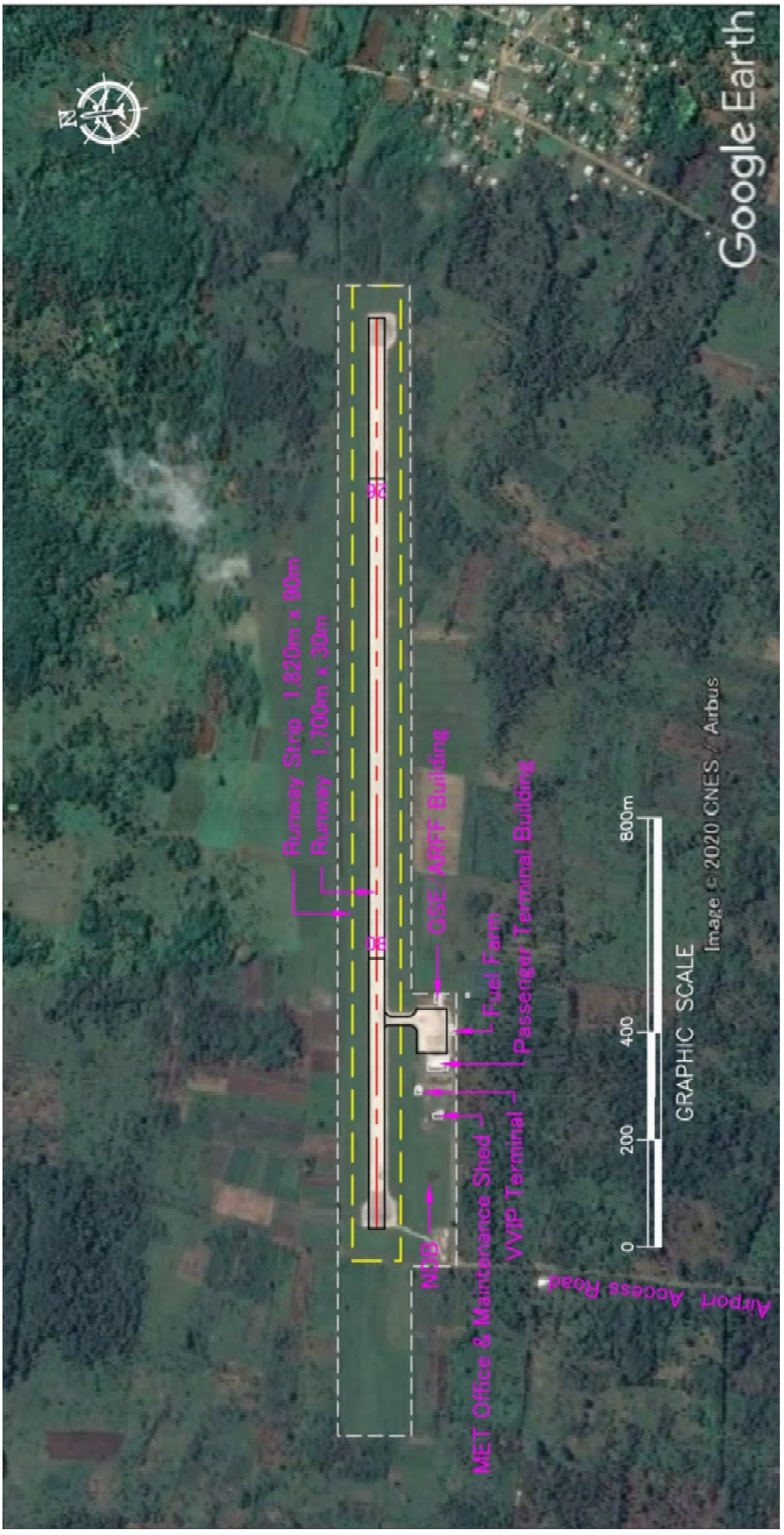


Figure 5-2-1 Layout of Maior Facilities of Vava'u International Airport

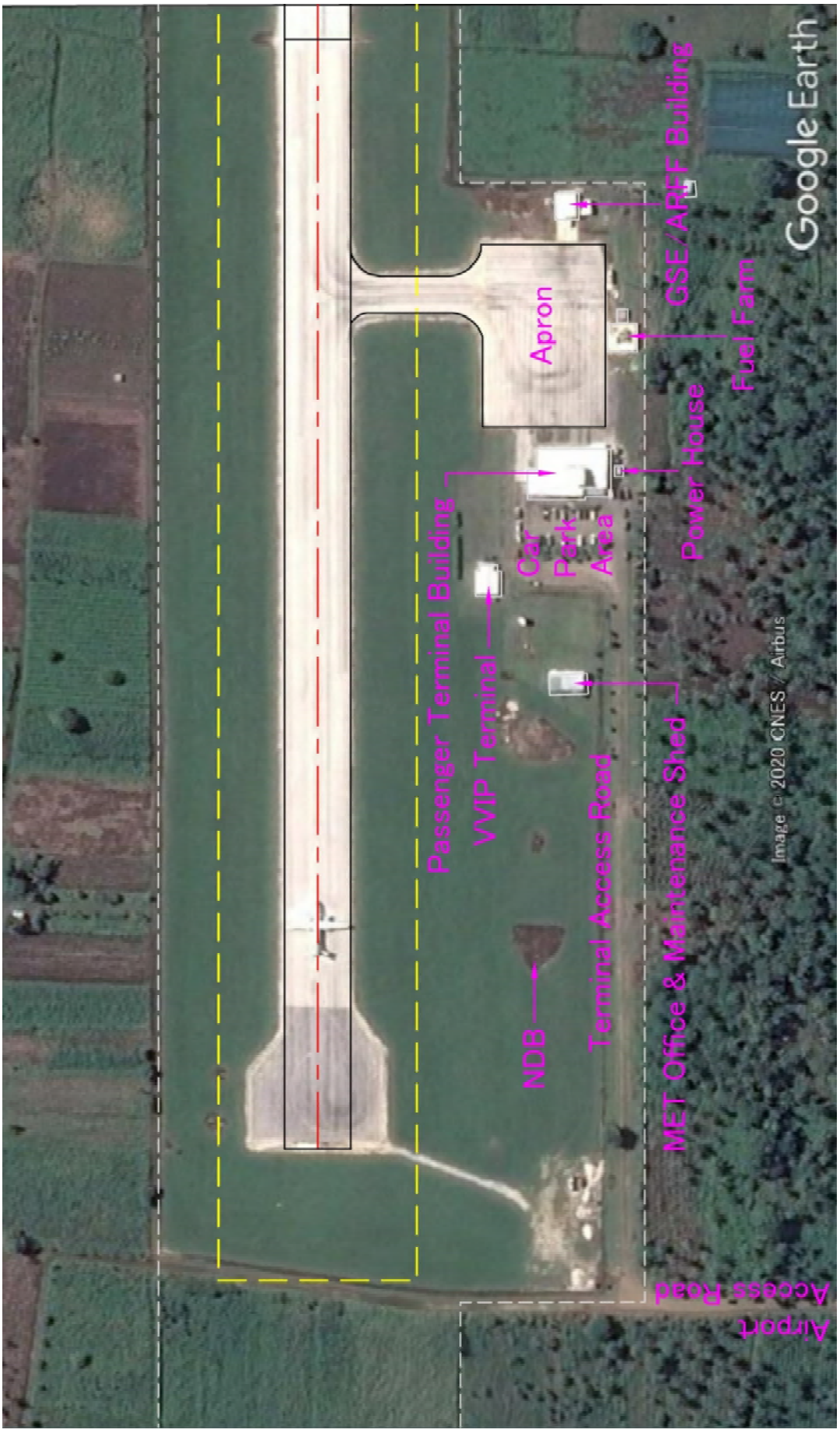


Figure 5-2-2 Layout of Major Facilities in Terminal Area

View from the Taxiway to RWY08 THR

View from the Taxiway to RWY26 THR

Figure 5-2-3 Current Conditions of Runway at VAV

View from the ATC cabin to Apron

View from Apron to Stub Taxiway

Figure 5-2-4 Current Conditions of Apron and Taxiway at VAV

4) Airside Pavement Strength

The airside pavements in VAV are comprised of a runway, an apron and a stub taxiway to the apron. The original airfield was constructed in 1994/1995 under EU funding and a basaltic grit slurry seal locking coat and a basaltic aggregate spray seal were applied on the top surface in 1999. In addition, the runway, taxiway and apron areas were re-surfaced with a slurry coat over the original chip seal by TAIP in 2016. Resurfacing layers consisted of a coarse/fine (t=14mm/7mm) two coat chip seal, i.e., the fine aggregate top coat interlocking into the coarse lower base coat. According to the AIP (21 May 2020) PCNs of all airside pavements are 31/F/C/X/T.

Drawing of the typical pavement section is as shown in Figure 5-2-5;

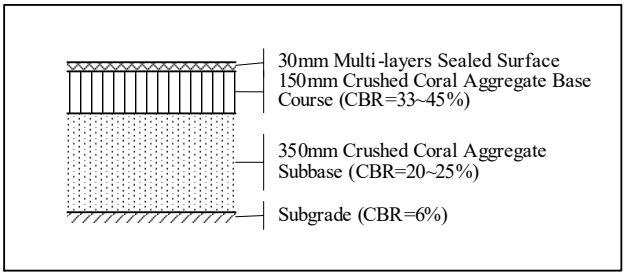


Figure 5-2-5 Typical Pavement Section at VAV

5) Storm Water Drainage System

Two new soak-away sumps were installed along the northern runway flank along with shallow swale interceptor drains by TAIP in 2016 to help reduce standing water on the grass strip.

Septic Tank at the North East of Car Park

Soak-away Sump at the Northern Runway

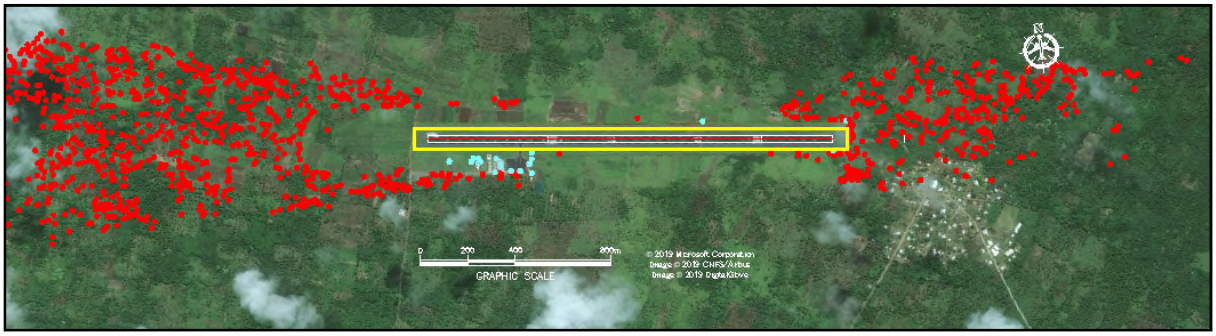
Figure 5-2-6 Sewerage and Drainage System at VAV

6) Obstacle Limitation Surfaces

Due to the hilly terrain situation at the west and north-east of the airport and an obstacle rich environment near the existing runway strip, there were many penetrating obstacles from OLS. It is noted that some or all of the trees which obstructed the approach areas have been removed in 2019. However, it is observed from the following figures that vast areas of terrain penetrate the approach (2.5% slope) and transitional surfaces. There are artificial objects penetrating the transitional surface including HF antenna and VVIP building. According to Fiji Airways, the take-off weight of their ATR72-600 flights to Nandi should be restricted to, for example 20.4 ton at 28ºC, in order to clear the obstacles. This is approx. 2.9 ton less than the Maximum Takeoff Weight.

Although both approach runways provide straight-in instrument approach procedure using GNSS, the three final approach profiles (3 degrees) are not coincident with PAPI angle (3.5 degrees).

Figure 5-2-7 Perspective of OLS at VAV



Note: Dots with cyan color show the location of artificial obstacles

Figure 5-2-8 Location of Obstacles penetrating from OLS at VAV

7) Communication, Navigation, Visual Aids and Meteorological Systems

(1) Navigation Aids

An NDB is installed in VAV. The NDB antenna is located at the west side of the passenger terminal building. The main navigation aids systems installed in VAV are shown in Table 5-2-2.

Table 5-2-2 Main Navigation Aids System in VAV

Item	Manufacturer	Model name	Year of installation	Working Status
NDB	NAUTEL	ND250	2012	Poor
ADS-B	INDRA	INDRA 2	2018	Not working

Source: TAL

(2) ATS Communication Equipment

The Air Traffic Services (ATS) provided at VAV are flight information service, aerodrome flight information service, and surface movement information. The radio frequencies used are shown in Table 5-2-3.

Table 5-2-3 ATS Radio Frequency in VAV

	Frequency
Flight Information Service	3226, 5832, 8995kHz
Aerodrome Flight Information Service	118.1MHz
Surface Movement Information	121.9MHz

Source: AIP

(3) Aeronautical Ground Lighting

The following aeronautical ground lighting systems are installed in VAV:

- Precision Approach Path Indicator
- Runway edge light
- Runway threshold/end light
- Wing bar
- Taxiway edge light
- Aerodrome beacon
- Apron flood lighting

The power is supplied from two Constant Current Regulators (CCRs). Each capacity is 10kVA. PAPI is supplied with one CCR and the rest of the lights including runway edge lights, runway threshold/end lights, wing bars and taxiway edge lights are supplied with one CCR. Figure 5-2-9 shows two CCRs installed in the old standby generator room of the passenger terminal building.

CCR in the Standby Generator Room in PTB

Figure 5-2-9 Existing Constant Current Regulators at VAV

(4) Meteorological System

AWOS manufactured by All Weather Inc. was installed in 2018. However, it is not fully working according to TAL.

8) Rescue and Fire Fighting Facilities

The category of RFFS is CAT 4 according to AIP. This is sufficient for current operations, that is ATR72 is operated only a few times per week. The fire vehicles deployed at VAV are shown in the table below.

Table 5-2-4 Fire Vehicle Deployed at VAV

	Manufacture	Model	Year of procurement	Capacity
1	Hino	4x4 Cat 4	2007	Water 2,800L Dry powder:225kg

Source: TAL

Currently a total of eight fire fighters are working with a minimum of four fire fighters per shift.

9) Power Supply and Telecommunication System

(1) Power Supply

The primary power is supplied by TPL. Power is reticulated to the airport by an overhead line. The line is terminated at a pole mounted 200kVA transformer located at the entrance of the car park. A 60kVA standby generator is located in the generator building on the south of the terminal and supplies power to the terminal and airside electrical facilities. According to TAL, the frequency of blackout is less than 10 times per year. The following table shows the electrical bill of the past one year.

Generator Building at the South of PTB

60kVA Standby Generator

Figure 5-2-10 Generator Building and Standby Generator

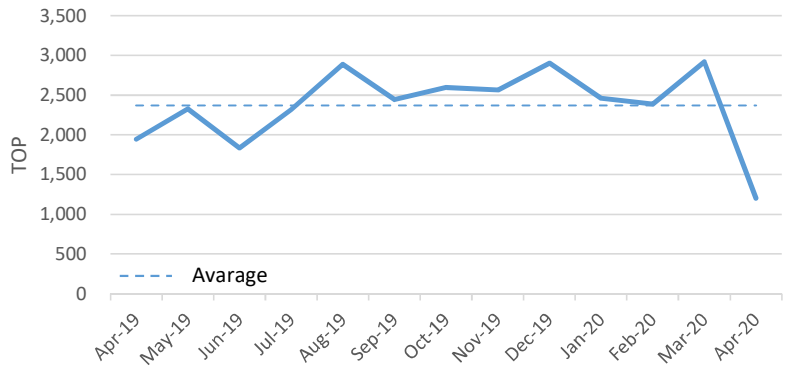


Figure 5-2-11 Power Bill by Month

(2) Telecommunications

Telephone services are provided by TCC through copper wire, on a total of 12 lines. Mobile telephone and internet connection services are provided with microwave by Digicel and TCC. TAL uses VSAT for ATC related communications.

10) Airport Security System

[redacted]

11) Fuel Supply System

The existing fuel facilities are owned and operated by TAL. The fuel farm is located immediately south of the apron and is comprises of two 10,500 liter ground tanks. There are also two 23,000 litter tank containers that were used to transport and replenish the ground tanks by TAL and Real Tonga respectively. The jet fuel is supplied to aircraft by fuel hose from a fueling cabinet. A fuel trailer is used for backup and delivery from Nuku'alofa on local ships. TAL has no plan to expand the fuel storage facility at present.

View from Tower Cabin

View from Apron

Figure 5-2-12 Fuel Supply Facilities at VAV

12) Water Supply, Sewerage and Solid Waste Disposal System

(1) Water Supply System

The existing water supply to the Terminal Building and ARFF operation is drawn from an existing bore hole by a 1.2kw submersible pump to two 10,000 liters holding tanks beside the Terminal Building. The bore hole is on the southern side of the apron near the mobile aviation fuel tanks. There was a plan to collect rainwater from the roof and drained into the two holding tanks by TAIP in 2016, but it was not implemented due to budget constraints. The existing 2.6kW distribution pump transfers the water from the holding tanks to a sink at the Control Tower. According to TAL, daily consumption of water is about 1,500 liters and increases to 6,000 liters when the ARFF vehicle needs to be refilled.

Existing Bore Hole

Water Holding Tanks

Figure 5-2-13 Current Conditions of Water Supply System at VAV

(2) Sewerage System

All waste water drains into the existing septic tanks located on the left and right sides of the terminal building.

(3) Solid Waste Disposal System

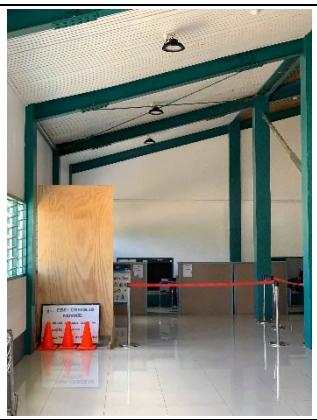
Solid wastes from the terminal building are collected with 200 liters portable trashcans by TAL and delivered to Kalaka final disposal site at Okoa located about 7 km south from the airport. Besides, all solid wastes from aircrafts are collected, carried to the outside of the airport and disposed by the quarantine department.

13) Passenger Terminal Buildings

The existing Passenger Terminal Building is one-story/partial two-story, mixed structure of steel and reinforced concrete, expanded to the north, the departure side, in 2019. The total floor area is 730 m^2 (see Figure 5-2-14). The terminal concept is the 'single level' system, and an international-domestic common passenger terminal building. Figure 5-2-15 shows the current situation of the Passenger Terminal, and Table 5-2-6 summarizes the current situation of the Passenger Terminal.

Figure 5-2-14 Passenger Terminal Building Floor Plan

	
Exterior view	Public space

		
Check-in lobby and counter	Passport control departure	Walk-through metal detector

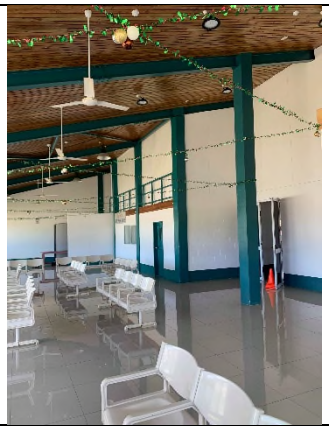
		
Departure lounge 1	Departure lounge 2	Toilets in departure lounge

Figure 5-2-15 Current Situation of Passenger Terminal Building

Table 5-2-6 Current Situation of Passenger Terminal Building

Room	Area (m^2)	Current Situation
Check-in counter and lobby	132	Three Counters, no baggage conveyor. High ceiling, no air-conditioner.
Baggage storage	[redacted]	[redacted]
Baggage make-up area		
Security check area and passport control departure		
Departure lounge	151	Two boarding gates, high ceiling, ceiling fans are provided.
Passport control arrival	47	One counter
Baggage claim area	70	Baggage is handed at the 'baggage counter' from the airside.
Baggage break-down area	—	Baggage is handed via 'baggage counter' to the baggage claim area.
Customs	17	One counter
Quarantine	9	Quarantine office is provided facing the check-in lobby. A service desk is provided in the arrival lounge beside the exit door.
Concession	39	One place each in departure lounge, baggage claim, & public space
Office	8.5+	TAL Office on the First floor of ATC tower & ATS Office above Aviation Security Office.
Passenger toilets	59	One place in the departure lounge, one place in baggage claim, one place in the public space. Toilets for the disabled are provided in the departure lounge and baggage claim.
Air traffic control tower	8.5	The maximum height of ATC tower: 10.9m, The floor level of VFR room: 7.4m.

Source: Survey Team

14) Other Buildings

There are a VVIP Terminal Building and a Meteorological Office & Maintenance Shed to the northwest and west of the Passenger Terminal Building respectively.

There is no cargo facility.

VVIP Terminal Building

MET Office & Maintenance Shed

Figure 5-2-16 Other Buildings

15) Roads and Car Park

Airport access is through a road running from Leimatua town to the west end of the airport. It has one lane per direction with 5.5 m width of chip-sealed pavement. An entrance road of about 320 m length is provided between the terminal building area and the airport access road. Car park in front of PTB has about 20 lots capacity at two 26m x 5m areas. According to TAL, the capacity of the car park is insufficient for current demand and cars are parked alongside entrance road during peak hours. Photographs taken at the site indicate that the pavement of the access road and car park is generally in poor condition. Most of the bitumen material in the top coat has deteriorated and aggregate materials are exposed on the pavement surface. Standing water on the pavement surface is observed in many locations after rain.

View of Car Park

View from ATC Cabin to Car Park

Entrance Road to the Airport

Main Access Road

Figure 5-2-17 Current Conditions of Road and Car Park at VAV

5-2-2 Maintenance and Operation

Two technical staff for electrical and communication and three general maintenance staff for maintenance of ground, building and infrastructure are deployed in VAV. The annual budget for maintenance is approximately TOP200,000-.

TAL operates the entire airport, including provision of aeronautical information, rescue & fire fighting, aviation security, aviation fuel supply, and terminal operation services. Under a service agreement with TAL, ground handling services are provided by ATS.

5-2-3 On-going and Planned Projects and Assistance of Other Donors

A Government funded project for the removal of obstacles (trees) from the approach areas of RWY08 (West) and RWY26 (East) at Vava'u is on-going. The work was completed, but compensation is yet to be made to the landowners. Compensation payment is pending approval from Cabinet, and it is expected to complete soon, as of August 2020. A project for the establishment of RESA at both ends of the runway is also on-going, and TAL is waiting for handover of the land.

There is no planned project other than this project. Assistance of other donors in the last 10 years appears in the following:

- The World Bank has implemented the Tonga Aviation Investment Project (TAIP) having a total project cost of US$ 37.7 million from 2011 to 2019. Key components of the project at VAV were the refurbishment and improvement of the terminal building, improvement of the runway and taxiway pavements, upgrading of the airport fence and installation of a VSAT system. The amount of the key components on terminal developments are summarized in Table 5-2-7.

Table 5-2-7 Key Components of TAIP in VAV

Component	Year Completed	Contract Amount
Terminal Building Refurbishment	2015	AUD 77,044 (US$ 53,134)
Terminal Building Improvement	2019	TOP 781,017 (US$ 304,160)
Airport Fence Upgrading	2019	TOP 569,945 (US$ 247,800)

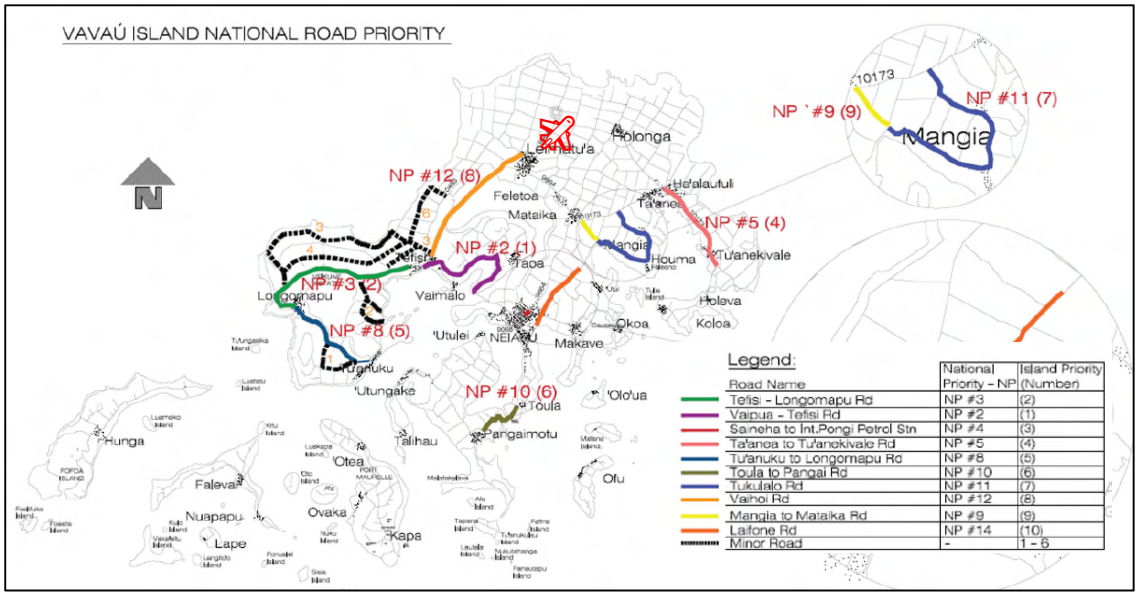
Source: TAIP

- The government of New Zealand provided NZ$800,000 (US$ 520,000) in 2017 under the Pacific Islands Civil Aviation Safety and Security Treaty to purchase six X-ray machines, walk-through metal detectors, and explosive trace devise for TBU and VAV.

5-2-4 Surrounding Infrastructures and Airport Access

1) Road Network around the Airport

A two-way road is provided between the airport and Neiafu, the capital of Vava'u, via Leimatua and Mataika. According to TAL, there is no issue on pavement conditions. Some parts of the airport access road, such as Vaihoi and a part of Tui Roads, will be improved soon under a World Bank's project.



Source: Environmental & Social Impact Assessment Report (World Bank, 2018)

Figure 5-2-18 Location Map of Road Rehabilitation under the World Bank Project

2) Public Transportation System

There is no public transportation between the airport and downtown, except for taxis. Most of the visitors use airport shuttle services provided by hotels or taxis waiting for customer only when there is an arriving flight.

3) Issues on Airport Access

TAL suggested widening of the existing access road. TAL also suggested to provide appropriate road markings to the terminal building with designated areas for arrival, departure, and disabled persons.

5-2-5 Natural Conditions

1) Geography

Vava'u is the island group of one large island ('Utu Vava'u) and 40 smaller ones. Unlike Tongatapu Island, Vava'u Island has a rugged terrain. The highest hill on the west side of the island is 178m (587ft) above MSL. VAV is located approximately 1.2 km south of the northern coastline and the aerodrome elevation is 71 m above MSL.

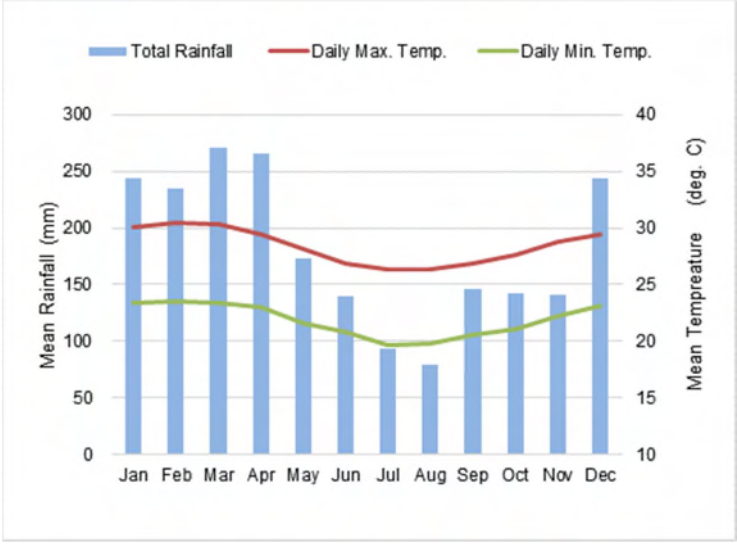
2) Geology

The geology is also different from that of Tongatapu Island, and there is no volcanic rock on Vavau Island. Vava'u Island is generally composed from the surface layer of a loam that changed from volcanic ash and coral reef limestone below. The topsoil is clayey soil similar to Tongatapu Island. According to the "Environmental Management Plan – Lupepau'u Airport (2013)", the ground conditions at the airport consists of volcanic ash (firm to stiff, reddish brown clayey silt with some sand) over coral reef formation (limestone). The limestone is shallowest at the eastern runway end (1.3m) and dips deeper in south-westerly direction (depth unknown >3m). Because the in situ ash soils (topsoil) have very low infiltration characteristics, the runway strip used to have major flooding issues with water reportedly pooling up to the runway edge before the installation of a subsoil drain system by TAIP in 2016.

According to the Dynamic Cone Penetration tests near the airside pavement conducted by TAIP in 2016, the observed subgrade strength was quite variable, ranging within 0-6 blows per 50mm penetration. The analysis of the data suggested a subgrade strength at the airport in order of CBR=6%.

3) Climate

The historical records of temperature and rainfall at VAV in the past 30 years is shown in Figure 5-2-19.



Source: Tonga Meteorological Services

Figure 5-2-19 Historical Weather Records (1981-2010) at VAV

(1) Temperature

The aerodrome reference temperature of VAV is 30°C.

(2) Rainfall

The mean average rainfall during the wet season at VAV is 170-270mm/month.

(3) Wind Strength and Directions

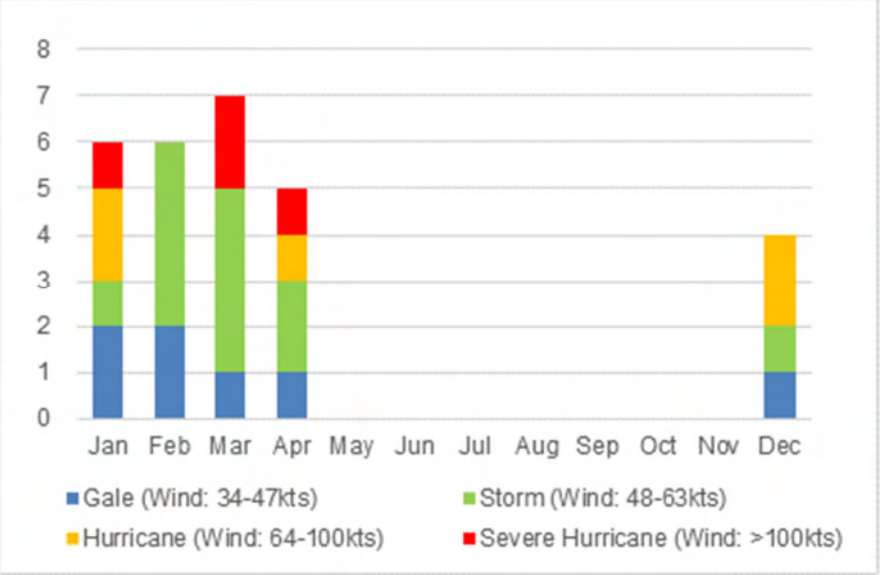
According to the hourly wind observation records from 2009-2018 at VAV, the total observation of wind strength shows that 20% is less than 3 knots and 66% is less than 10 knots. The results of wind coverages analysis with 20 knots cross winds and 5 knots tail winds show that the coverages of RWY08 and 26 are 96.13% and 57.66% respectively.

(4) Visibility

The Survey Team analyzed hourly visibility observation records in the last five years at VAV and found that more than 99% of times the visibility satisfies the longest visibility minima of all GNSS approach procedures at the airport, i.e., 2,500 m.

4) Natural Disaster

The number, strength and produced month of tropical cyclone affected at Vava'u and Ha'apai from 1960 to 2006 are summarized. The data show that the tropical cyclones were produced only during the wet season and the frequent months were from January to March in this area.



Source: JICA Survey Team based on Data from Tonga Meteorological Services

Figure 5-2-20 Number, Strength and Produced Month of Tropical Cyclone Affected at Vava'u and Ha'apai Area

5-2-6 Land Use

The airport is located less than 1km west or west-northwest of Holonga village and is surrounded by coconut plantations, grazing and crops field. According to "Environmental Management Plan (2013)" prepared by TAIP:

i. Vegetation along the perimeter fence was managed using roundup.
ii. Scouring and channelization of the soil had been visible on the southern slopes to the perimeter fence approximately halfway along the runway.
iii. There were land constraints at the airport due to the topography and neighboring land ownership.

5-3 Review of Airport Improvement Plan

5-3-1 Airport Improvement Policy

The project proposal for VAV by the Government of Tonga includes (i) extension of Runway 08/26 by 1,200m x 45m and (ii) a new airport terminal. Study on an airport facility improvement plan is to be conducted by placing priority on these two facilities.

The following points are the basic policies for the planning improvement of VAV.

- The airport facilities should be improved to cater to the traffic demand expected in 2030 in accordance with international standards and good practices.
- Terminal development plan that meets the required development scale should be planned within the area where land acquisition is unnecessary or easy.
- Propriety of runway extension should be judged considering influence of obstacles on aircraft operations.
- Expansion and improvement of the existing passenger terminal building should be planned with phased developments to continue airport operations during construction period.
- The terminal facility improvement should be planned considering barrier-free, eco-friendliness and required functions in the event of a disaster.

5-3-2 Review of Runway Improvement Plan

The Project Proposal for VAV includes i) runway extension of 1,200m, ii) runway widening to 45m and iii) strengthening of pavement. According to DCA, a 1,200m extension of the runway was proposed by referring to the 2,335m long runway of Niue, a neighboring country of Tonga, based on the expectation of direct flights of B737 and A320/321 to AKL.

1) Runway Length

As stated in Chapter 3, it is considered premature to expect operation of direct flights to/from AKL by 2030. For a reference, the JICA Survey Team calculated the required runway length for direct flights from VAV to AKL by ANZ's A320-200 in conditions appearing in the Table below and calculated the length as 2,253m (about 550m extension).

Table 5-3-1 Assumptions for Required Runway Length for ANZ's A320-200

Item	Assumed Value	Source
Aerodrome Reference Elevation	233FT	AIP
Aerodrome Reference Temperature	30℃	AIP
Wind	0 kt	
Surface Condition	WET	
Flight Range (to Auckland)	1654 NM	VAV-AKL-CHC(Alternate)
Weight per Passenger	110 kg/psn	FAA standard

Source: Survey Team

On the other hand, the JICA Survey Team found in FJI's reply to the questionnaire for this survey that take-off weight restrictions were being imposed on current operations of ATR72-600 due to obstacles such as palm trees and terrain around the airport. Although TAL has removed some obstacles penetrating from the approach surface in 2019, all of the obstacles restricting take-off weight should be removed as far as practicable so that air traffic growth will not be interfered by such restrictions in the future. The following images show the area where terrain is penetrating from 1.7% gradient surface of take-off funnel for ATR72-600 stipulated in ATR's performance guide.

RWY08 Departure
(TORA=1,500m/TODA= 1,700m)

RWY26 Departure
(TORA=1,500m/TODA= 1,700m)

Source: Survey Team

Figure 5-3-1 Penetrating Area from 1.7% Take-Off Funnel of ATR72-600

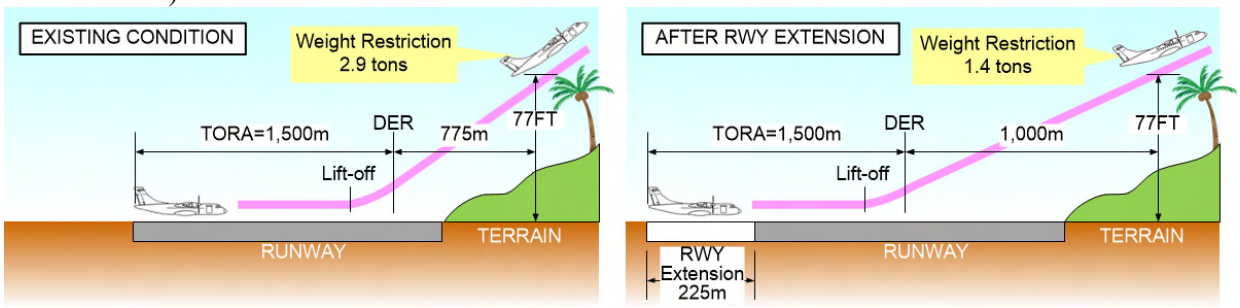
In the meantime, the JICA Survey Team plan to extend the existing runway by 225m toward the west for development in 2030 to relax take-off weight restrictions, as an alternative solution, based on the following considerations:

i. According to FJI, restricted take-off weight on ATR72-600 due to the obstacles is currently 20.4 tons (2.9 tons reduction from MTOW) at 28℃ in VAV even though 1.500m of TORA is sufficient for the departures with MTOW. By subtracting 2.5 tons of fuel load plus 13.5 tons of operational empty weight (OEW) from the restricted take-off weight, payload under that

restriction is estimated as 4.4 tons which is equivalent to 44 passengers without cargos (about 65% of load factor).

ii. According to ATR's Flight Operation Manual (FOM), 2.9 tons of take-off weight restriction can be interpreted as the situation that an obstacle of 77ft above the elevation of departure end of the runway (DER) is located within the take-off funnel at a distance of 775m from the DER, as illustrated in the existing condition of the Figure 5-2-2.

iii. Since TAL has already leased land to the west of runway and begun coordination with the relevant authority for the provision of the Runway End Safety Area including diversion of the existing public road crossing the leased land, the runway will be able to extend by 225m toward the west by utilizing that leased land without an additional land acquisition process. This runway extension (starter extension) will increase the distance between the 77ft high obstacle and DER from 775m to 1,000m (as illustrated in "after runway extension" of the Figure 5-3-2), and take-off weight restriction will be reduced from 2.9 to 1.4 tons. This will increase the passengers to 5.8 tons, which is equivalent to 59 passengers (about 87% of load factor).

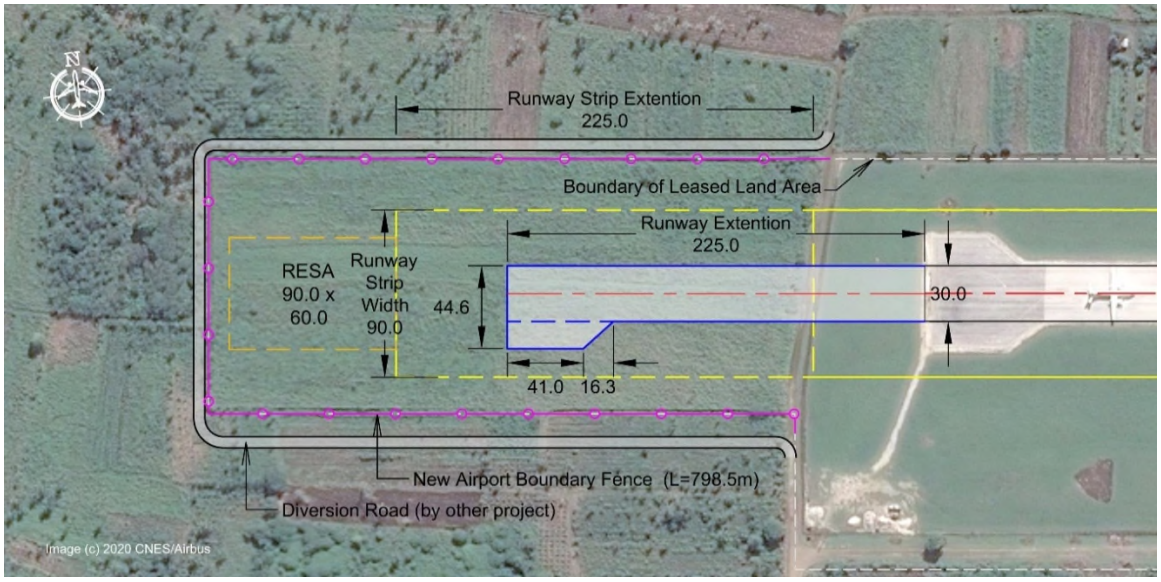


Source: Survey Team

Figure 5-3-2 Weight Restriction on Departing ATR72-600 before/after Runway Extension

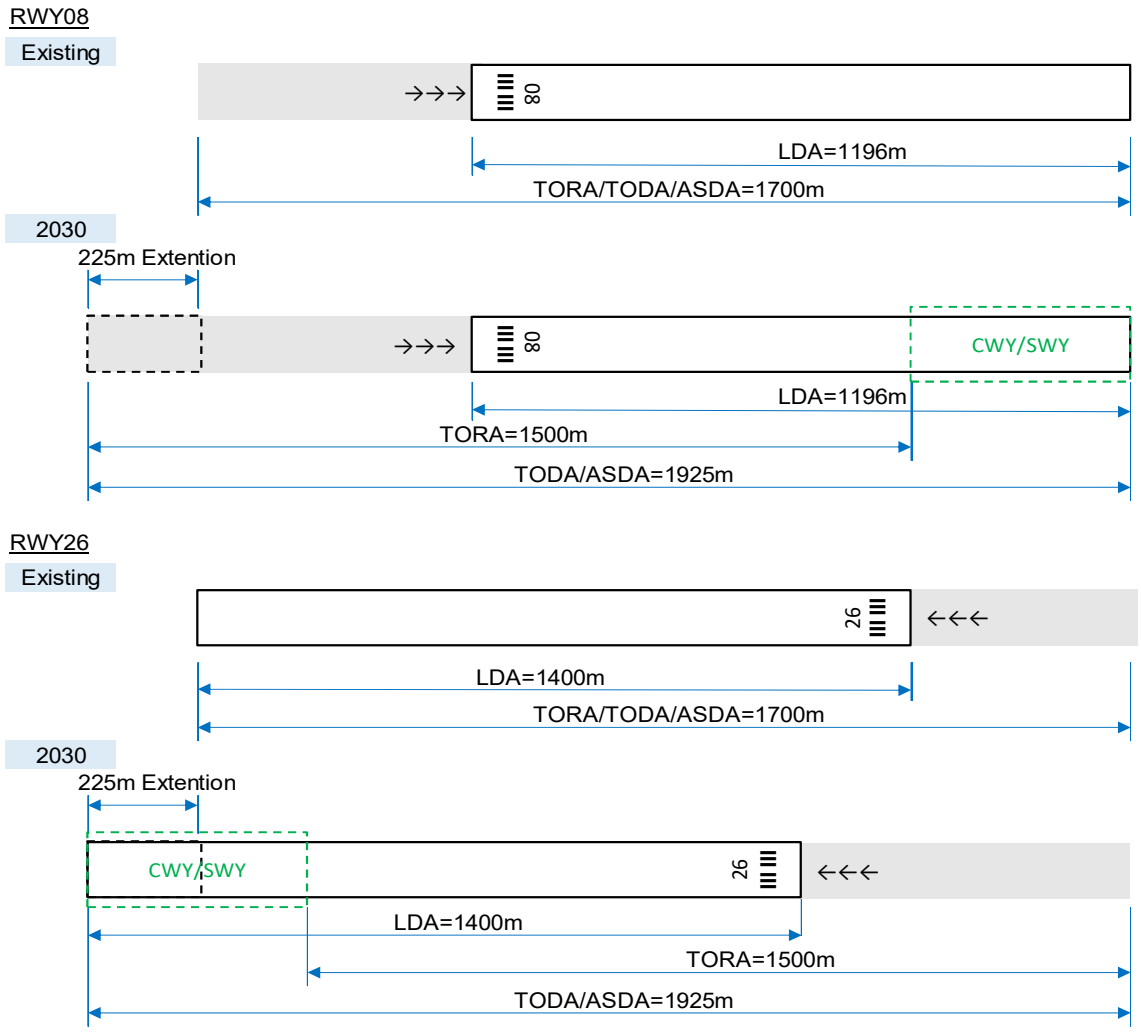
iv. The same solution might be applied to ease take-off weight restrictions of RWY26 departures by runway extension of about 200 – 300m toward the east. However, it is considered that the benefit is insufficient to recover the time and cost of land acquisition required for such a runway extension, because the dominant (96%) usage of the runway is RWY08.

The layout plan of the runway extension and proposed declared distances appear in Figure 5-3-3.



Source: Survey Team

Figure 5-3-3 Layout Plan of Runway Extension toward West at VAV

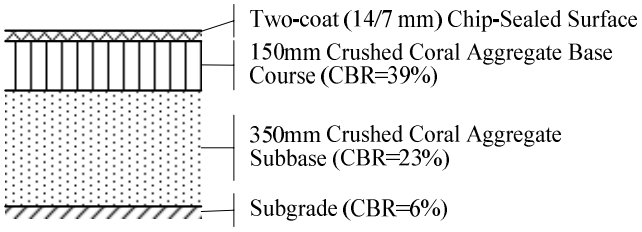


Source: Survey Team

Figure 5-3-4 Proposed Declared Distances in 2030

2) Pavement

The width and strength of existing runway is sufficient for operation of ATR72-600, the largest aircraft at VAV in 2030, and no improvement measures will be required. Since the JICA Survey Team confirmed that the existing pavement structure will be able to support anticipated aircraft traffic volume of 20 years design period after 2020, the pavement structure at the part of the runway extension is planned to be the same as the existing runway pavement as shown below:



Source: Survey Team

Figure 5-3-5 Pavement Structure for Runway Extension

3) Airfield Lights

In relation to the abovementioned runway extension, airfield lights listed in Table 5-3-2 should be developed.

Table 5-3-2 Development of Airfield Lights

Facility	Q'ty	Description
Runway Edge Lights	8 nos.	Extended part of runway.
Runway End Lights	6 nos.	Extended RWY26 end.
Runway Turn Pad Lights	7 nos.	Alongside runway turn pad at the end of RWY26.
Runway Threshold Wing Bar Lights	10 nos.	RWY26 Threshold Wing Bar Light are relocated to the new threshold.
PAPI	4 nos.	RWY26 PAPI is relocated to the new threshold.

Source: Survey Team

5-3-3 New Airport Terminal

1) Passenger Terminal Improvement

Figures 5-3-6 and 5-3-7 show Options 1 and 2 proposed in the project proposal. Option 1 proposes extension of the waiting area of 6m x 38.7m on the land side. Option 2 shows a two-story Passenger Terminal Building (PTB) with four passenger boarding bridges. On the basis of the air traffic demand forecast described in Chapter 3, Option 1 is considered as a realistic proposal for the target year of 2030, and Option 2 is considered as a long-term plan beyond 2040. "Strategic Development Plan" created in 2010 the planned expansion to 1,900 m^2 based on peak hour one-way traffic of 80 passengers. Since the one-way peak hour traffic is estimated to be 61 passengers in Chapter 3, the required floor area is estimated to be 1,900 ÷ 80 x 61 = 1,449 m^2 based on the above plan.

Figure 5-3-6 Option 1 – New Extension for Terminal Building

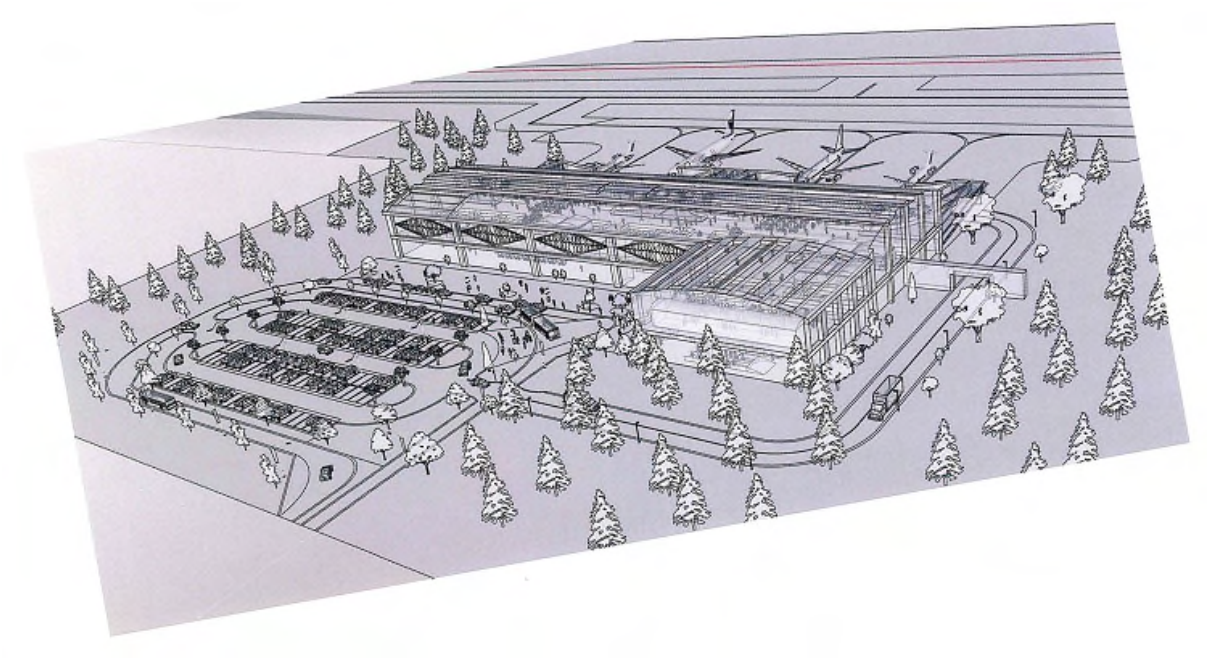


Figure 5-3-7 Perspective of Option 2

The required scale of various facilities in the PTB is estimated as shown in Table 5-3-3 based on 61 busy hour passengers, planning parameters[1], such as check-in processing time per passenger, and rules of thumb in the Airport Development Reference Manual, IATA. The total area including 10% design margin is estimated to be 1,300m^2, about 10% less than the abovementioned target.

Table 5-3-3 Facility Requirements of Passenger Terminal Building

Facility	Area (m^2)	No.	Remarks
Departure Concourse	69	-	1.5 friends/pax
Check-in	44	3	90 sec/pax, MQT: 15 min
Baggage Make Up	137	-	
Security	12	1	12 sec/pax, MQT: 3 min
Emigration	19	1	15 sec/pax, MQT: 5 min
Gate Lounge	87	-	80% seated
Health Check	5	1	10 sec/pax
Immigration	53	3	80 sec/pax, MQT: 10 min
Baggage Claim	100	1	20 min/flight
Baggage Break Down	(66)	-	
Customs	15	1	25% checked, 2 min/pax
Arrival Hall	153	-	Pax: 5min, Friend: 30 min, 2 friends/pax
Concessions	76	-	Proportionated area of Strategic Plan
Offices	57	-	Proportionated area of Strategic Plan
Toilet, Storage, Circulation, etc.	260		20% of total floor area
Design Margin	(128)		10% of total floor area
Total	1,084 (1,278)		

Source: Survey Team

A conceptual floor plan of PTB is produced as shown in Figure 5-3-8 by adding an office space and immigration queuing space to Option 1, and Table 5-3-4 compares facility requirements and facilities planned in the conceptual plan.

[1] It was not possible to conduct passenger survey, because there was little traffic due to COVID-19. Therefore, the parameters are taken from the Desk Top Review.

Figure 5-3-8 Conceptual Floor Plan of Passenger Terminal Building

Table 5-3-4 Comparison of Required and Planned Facilities

Facility		Requirements		Planned		Remarks
		Area (m^2)	No.	Area (m^2)	No.	
Departure Concourse	Waiting Area	69	-	289	-	
Arrival Hall		153	-			
Check-in		44	3	54	3	
Baggage Make Up		**137**	-	**71**	-	Include baggage screen & storage.
Emigration		**19**	1	**9**	1	
Security		12	1	26	1	
Gate Lounge		87	-	151	-	
Health Check		**5**	**1**	**-**	**-**	No arrival health check
Immigration		53	3	49	3	
Baggage Claim		**100**	1	**58**	-	
Baggage Break Down		**(66)**	-	-		Exterior
Customs		15	1	17	1	
Concessions		**76**	-	**56**	-	Duty free, snack bar, canteens
Offices		**57**	-	**39**	-	Customs, quarantine, security
Toilet		260	-	59	-	
Storage				8	-	
Plant				9	-	Switch board
Circulation				124	-	
Design Margin		(128)	-	-	-	
Total		1,084 (1,278)	-	1,019	-	Ground floor only

Source: Survey Team

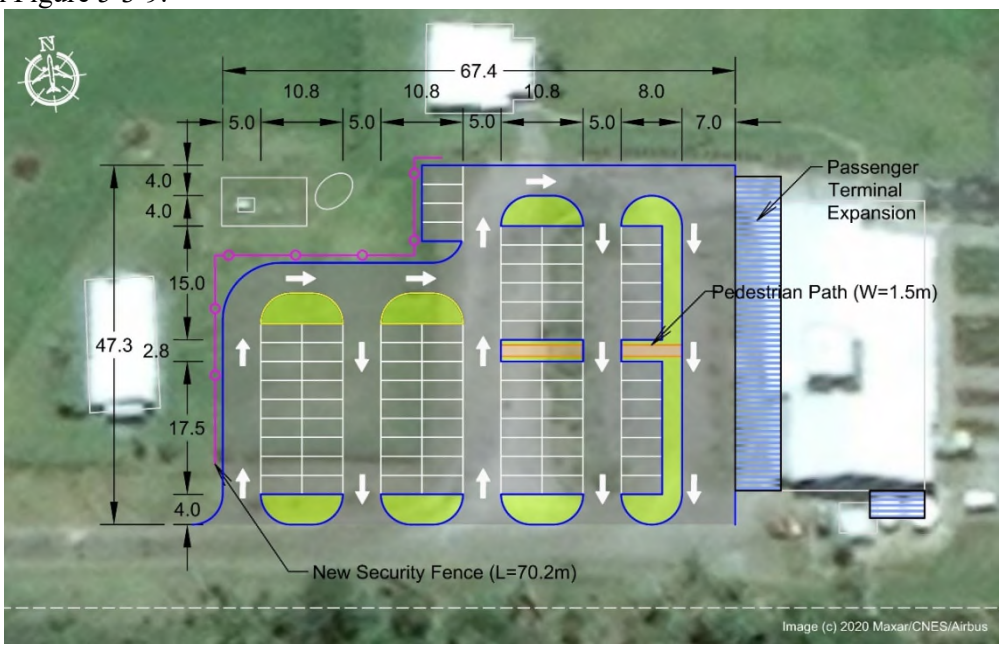
The following points are comments on the facilities that have less space than required.

- Baggage Makeup and Baggage Claim areas are smaller than the requirements because the required area includes spaces for baggage conveyors, which are not used at VAV. Therefore, it is not an issue
- Queue of passengers at Immigration will extend to the circulation area, but it is not a major issue.
- Baggage Breakdown is not covered, but it is not an issue to be addressed since unloading from the aircraft is done under the sky.

- Arrival Health Check may be only a thermographic camera and a chair near the arrival entrance.
- Office spaces are available in other area than ground floor of the PTB.
- Less concession is not an issue to be addressed immediately.

2) Roads and Car Park

Corresponding to the existing terminal expansion toward the existing car park area, the existing car park area is required to expand toward the west to accommodate the current parking demand (about 80 lots) in the terminal area. The geometries of car parking lots and circulation road are planned based on those in the drawings of Project Proposal. Layout plan of car park area and circulation road is shown in Figure 5-3-9.



Source: Survey Team

Figure 5-3-9 Layout Plan of Car Park Area and Circulation Road at VAV

3) Ancillaries

In relation to the abovementioned development, ancillary facilities listed in Table 5-3-5 should be developed.

Table 5-3-5 Development of Ancillary Facilities

Facility	Q'ty	Description
Water Tank	2 nos.	The existing 10kL tanks on the south of terminal building will be relocated.
Electrical Conduit	Approx. 60m	The existing conduit (63mm dia.) between PTB and Met Station will be relocated for car parking expansion.

Source: Survey Team

4) Proposed Terminal Area Layout Plan

Figure 5-3-10 shows the proposed terminal area layout plan.

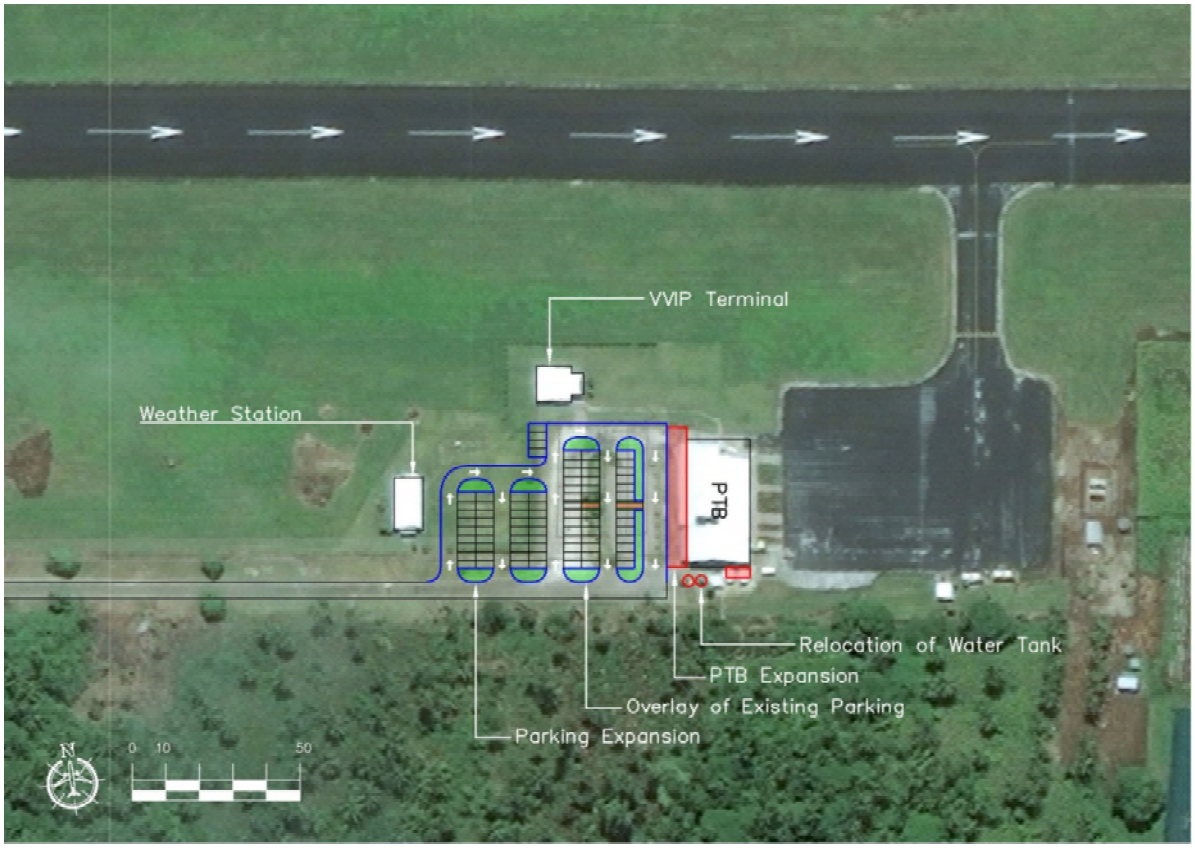


Figure 5-3-10 Proposed Terminal Area Layout Plan

5-3-4 Needs of Improvement of Other Facilities

Needs of improvement of other major facilities are evaluated based on the air traffic demand forecast described in Chapter 3.

1) Runway Strip

The width of the existing runway strip, 90m, is not in compliance with the standard of CAANZ for a non-precision instrument runway where the code number is 3. It shall be widened to 150m wide, separately from this project.

2) Runway End Safety Area

The existing runway does not have runway end safety areas. A minimum 90m x 60m runway end safety area shall be provided on each end of the runway in compliance with the standards of CAANZ, separately from this project.

3) Airfield Lighting System

It is recommendable to consider installation of SALS in accordance with the standard of CAANZ for non-precision instrument approach runway, separately from this project.

4) Obstacle Limitation Surface

It is recommendable to consider the removal of existing obstacles above the approach surface and transitional surface in accordance with the recommendation of CAANZ, separately from this project.

5-4 Candidate Project for Japanese Assistance

5-4-1 Outline of the Project

1) Objectives of the Project

The objectives of the Project are to improve the existing runway and expand the existing passenger terminal at Vava'u International Airport in order to handle air traffic demand expected in 2030 at an appropriate level of service standards, thereby contributing socio economic development of Vava'u sub-division.

2) Scope of the Project

As a result of "5-3 Review of Airport Improvement Plan" the following improvements are identified as main components of the Project for improvement of Vava'u International Airport.

- Starter extension of the runway by 225m on the west
- Expansion of the existing passenger terminal building
- Expansion of the existing car park area

The following points are associated to the above-mentioned components of the Project. Among them, airfield lights are considered to be closely related to the starter extension, and better to be done by a single contractor. However, the remaining three, i.e., water tanks, fence between car park and airside, and electrical conduit, may be done separately prior to the works of the main components, as site preparation by the recipient country.

- Addition and relocation of airfield lights
- Relocation of water tanks
- New security fence between car park and airside
- Relocation of electrical conduit

Improvements of other facilities described in Section 5-3-4 are not intended to be parts of the Project. Diversion of the existing road on the west of the runway crossing the leased land is expected to be done as a part of an on-going project for provision of the RESA prior to the Project.

5-4-2 Design Concept

1) Eco-friendliness

Environmental consideration technologies applicable to the Project may be limited to the use of LED lights. Application of other environmental consideration technologies should be further studied in the succeeding design stage.

2) Barrier-free

Provision of parking lots for people with disabilities near the PTB is taken into account for the review of the existing plan. The location and access path to/from the PTB should be reviewed and designed in the succeeding design stage. Application of other design elements to achieve a barrier free airport, such as braille blocks and audible signage, should be further studied in the succeeding design stage.

3) Disaster Relief

VAV, as one of the two international airports of Tonga, will function as a disaster relief base for transporting peoples and goods, if TBU, the main gateway of the international air transport, is not functioning. To prepare for such a possibility, it is worth considering for the Government of Tonga keeping mobile storage units (MSU) in several locations on Vava'u Island.

5-4-3 Expected Implementation Schedule

The expected construction schedule is shown in Table 5-4-1. The total duration of the construction is estimated as 8.5 months.

Table 5-4-1 Expected Construction Schedule

ID	Task Name	Dura-tion	Month 1	2	3	4	5	6	7	8	9	10
1	Preparation Works	1.0										
1 1	Temporary Office	0.5										
1 2	Relocation of Existing Utilities	0.5										
2	Passenger Terminal Building Expansion	5.0										
2 1	Demolition and Clearing of Expansion Area	0.2										
2 2	Expansion of PTB	5.0										
2 3	Renovation of PTB	1.0										
3	Runway Extension	7.0										
3 1	Demolition, Clearing and Grabbing	2.0										
3 2	Earthworks	2.5										
3 3	Pavement Works	2.5										
3 4	Fencing, Pavement Markings, Seeding	2.0										
3 5	Airfield Lighting System	2.0										
4	Carpark	2.5										
4 1	Demolition and Clearing	0.3										
4 2	Earthworks	0.2										
4 3	Pavement Works	1.4										
4 4	Drainage, Pavement Markings, Sodding	0.1										

Source: Survey Team

5-4-4 Approximation of Project Cost

The approximate cost of the Project, including price escalation, physical contingency, and consulting services, is estimated to be JPY 564 million as shown in Table 5-4-2 with the following conditions:

- Time of Estimation: December 2020
- Exchange Rate: TOP 1 = JPY 49.9120 (Tonga Development Bank, 2020/12/02 TTB)
- Price Escalation: 2.0%/(3.6% to local currency for 1.5 year up to June 2022, assuming the local currency portion of 58% in the construction cost and 50% in the consulting service cost)
- Physical Contingency: 10%

The unit prices of each construction items are mainly the estimated based on estimated unit price of the new ferry terminal construction project in Tongatapu, adjusted with unit prices of manpower, construction equipment, materials and transportation collected from local contractors. Besides, the indirect construction cost is estimated based on JICA's project cost estimation practice. The estimated approximate construction cost is shown in Appendix 4.

Approximate cost by components is shown in Table 5-4-3.

Table 5-4-2 Approximate Project Cost

ITEM			JPY (million)
I.	Construction Cost (A+B+C+D+E)		535
	A. Direct Construction Cost		280
		i. Passenger Terminal Building	37
		ii. Car Park	27
		iii. Runway	216
	B. Indirect Construction Cost		158
	C. Management and Overhead		38
	D. Price Escalation (A+B+C) x 2%		10
	E. Contingency (A+B+C+D) x 10%		49
II.	Consulting Service Fee (F+G+H)		29
	F. Consulting Fee A x 9%		25
	G. Price Escalation F x 2%		1
	H. Contingency (F+G) x 10%		3
III.	Total Project Cost		564

Source: Survey Team

Table 5-4-3 Approximate Project Cost by Components

Component	JPY (million)
Passenger Terminal Building & Car Park	129
Runway	435
Total	564

Source: Survey Team

5-5 Environmental and Social Considerations

5-5-1 Land Acquisition Status

The land area of VAV shown by red lines in Figure 5-5-1 is sub-leased from MOI to TAL since 2014 with 50 years contract.

Source: Produced by Survey Team based on data provided by TAL

Figure 5-5-1 Boundary of Sub-leased Area at VAV

5-5-2 Environmental Categorization

1) Regulations and Relevant Guidelines

Please refer to Section 4-5-2.

2) Environmental and Social Conditions

The project site is the existing terminal area of VAV and the land already leased for provision of RESA. VAV is situated in a sparsely populated area on the island of Vava'u. The airport is surrounded primarily by plantations with coconut trees and some grazing and small farms growing crops. About 2km to the south is Leimatu'a village with a population of about 1,000 and about 3km to the east is Holonga village with a population of about 500. There are about ten churches at or near the villages and a primary school in each village.

There are no official biological protected areas, or any sites or structures of known cultural significance anywhere near the project site. Wastewater is directed to a septic system and there is a government approved waste disposal site on the island.

3) Screening and Categorization of the Project

Diversion of the existing road to the west of the runway crossing the leased land is a prerequisite of the runway extension. Even if this diversion road is regarded as a part of the project, required land acquisition will be small, and no resettlements as well as demolition of existing buildings will be required. Therefore, the project is unlikely to cause major negative environmental or social impacts. Possible negative impacts related to the project are expected to be confined to the construction phase. Freshwater will be required for workers and some construction activities (e.g., dust suppression, concrete and bitumen production, etc.). Noise and vibration disturbances are particularly likely during construction related to the transportation of construction materials from the quarry and operation of equipment. Potential adverse impacts from quarrying or mining are high, if uncontrolled.

Normal mitigation measures of irreversible impacts, if any, will be designed readily. Thus, the project can be clarified as a Category B project under JICA's environment classification. JICA's environmental screening form is in Appendix 5.

5-5-3 Further Considerations and Procedure

Please refer to Section 4-5-3.

CHAPTER 6
PRELIMINARY EVALUATION OF CANDIDATE PROJECT

CHAPTER 6 PRELIMINARY EVALUATION OF CANDIDATE PROJECT

6-1 Relevance to the Government Policies

"Ministry of Infrastructure Corporate Plan 2019/20-2021/22" states, as its organizational outputs of the Civil Aviation Division, "achieving a safer and more affordable domestic and international air transportation supporting growth of economic activity in the aviation sector". Both projects for Fua'amotu and Vava'u are in line with this statement. Therefore, the two projects are relevant to the ministry's policy. However, the project for Fua'amotu may be considered more relevant because the Corporate Plan identifies "New Fua'amotu International Terminal (extension and refurbish of existing terminal)" as one of the new initiatives.

"Country Assistance Policy for Kingdom of Tonga" (April 2012) states "Japan promotes development of infrastructures, maintenance, and human resource development in order to create a sound environment to promote industries, including agriculture and fisheries as well as tourism, which are the core industries of the Kingdom of Tonga." The two projects are relevant to this policy.

6-2 Effectiveness of the Project

1) Beneficiary of the Project

As can be seen in Table 6-2-1, the number of direct and indirect beneficiaries of the project for Fua'amotu are 5.8 and 5.4 times of that for Vava'u respectively. Since Fua'amotu is the international gateway and domestic hub of the Kingdom, the total population of the Kingdom, i.e., 100,651 people, may be regarded as indirect beneficiaries. In that case, the indirect beneficiaries of the project for Fua'amotu are 7.3 times of that for Vava'u. Therefore, the project for Fua'amotu is considered to be more effective.

Table 6-2-1 Comparison of Number of Beneficiaries

Item	Fua'amotu	Vava'u
Main Direct Beneficiary (Baseline Annual Passengers)	275,587	47,266
Main Indirect Beneficiary (Population of the Island)	74,611	13,738

Source: Survey Team

2) Cost of the Project

The approximate cost of the project for Fua'amotu (JPY 2.57 billion) is within the range of amounts of Japan's Grant Aid to Tonga since the year 2000 in Table 6-2-2, and that for Vava'u (JPY 0.56 billion) is a little less than the minimum.

Table 6-2-2 Japan's Grant Aid to Tonga Since Year 2000

Project Title	Grant Agreement	Amount (JPY million)
The Project for Introduction of Nationwide Early Warning System and Strengthening	2018/06	2,837
The Project for Installation of Wind Power Generation System	2017/05	2,100
The Project for Upgrading of Wharf for Domestic Transport	2016/06	3,320
The Project for Introduction of a Micro-Grid System with Renewable Energy for the Tonga Energy Road Map	2013/03	1,573
The Project for Upgrading and Refurbishment of Vaiola Hospital (Phase 2)	2010/05	1,922
The Project for Introduction of Clean Energy by Solar Home System	2010/03	590
The Project for Construction of the Inter-Islands Vessel	2008/06	1,676
The Project for Upgrading and Refurbishment of Vaiola Hospital	2004/08	1,030
The Project for Improvement of the Nuku'alofa Water Supply	2000/07	1,177

Source: JICA

Although the approximate cost of the project for Fua'amotu is 4.6 times of that for Vava'u, the project cost per direct and indirect beneficiary of the project for Fua'amotu is about 0.8 times of that for Vava'u. If the total population of the Kingdom is used as indirect beneficiary, the project cost per indirect beneficiary of the project for Fua'amotu is about 0.6 times of that for Vava'u. Therefore, the project for Fua'amotu is considered to be more cost effective.

Table 6-2-3 Comparison of Project Cost

Item		Fua'amotu	Vava'u
Approximate Project Cost		JPY 2.6 billion	JPY 0.6 billion
Project Cost per Beneficiary	Direct Beneficiary	JPY10,000/head	JPY12,000/head
	Indirect Beneficiary	JPY35,000/head	JPY42,000/head

Source: Survey Team

6-3 Operation and Effect Indicators

The number of air passengers and aircraft movements can be used as the operation and effect indicators. Table 6-3-1 shows baseline and target values of the project for improvement of Fua'amotu and Vava'u International Airports.

Table 6-3-1 Operation and Effect Indicators

Operation and Effect Indicators	Fua'amotu		Vava'u	
	Baseline (Year 2019)	Target (Year 2025)	Baseline (Year 2019)	Target (Year 2025)
Number of Annual Passengers	275,587	316,947	47,266	53,685
Number of Annual Aircraft Movements	4,006	4,375	1,048	1,110

Source: Survey Team

6-4 Priority of Candidate Projects

As stated in the previous sections, the two projects are relevant to the policies of Tongan and Japanese Governments, but the project for Fua'amotu may be considered more relevant. In terms of effectiveness, the project for Fua'amotu is considered to be more effective. Therefore, the Survey Team put higher priority on the Project for Improvement of Fua'amotu International Airport.

APPENDICES

Appendix-1: Major Discussions on Passenger Terminal Floor Plan

2020/10/23 Tongan Side

What we did consider though is that there will be a need to redesign the partitioning of the extended terminal. We think it best to keep the whole of the domestic foot traffic at the eastern end of the extended terminal.....this includes the check-in, baggage make-up as well as arrival hall and baggage claim. This will also avoid the issues that can arise when the domestic and international movements have differing security arrangements.....especially for domestic traffic joining international flights etc. We note too that there is a crossing of pathways of international and domestic foot traffic on air-side from the departure lounges as currently located. We take it that final design will allow for a redrafting of internal partitions.

2020/10/30 Tongan Side

From TAL's side, I personally do not have a problem with the proposed plan. The likely problem from our side would be ensuring that domestic passengers that are not screened by aviation security and international passengers do not mix which is something we can easily manage.

2020/11/05 Tongan Side

They are in agreement that the domestic check in and baggage claim be all on the eastern end of the PTB.....this is also useful for domestic passengers arriving to connect onto international flights and does not then have passenger lines crossing each other.

2020/11/05 Survey Team

If domestic arrival is located at the east end of the extended area as you proposed, walk distance of transfer from domestic to international will be shorter, but it will be longer for transfer from international to domestic. So, I don't see much difference between the two layout plans in terms of convenience of transfer.

2020/11/10 Survey Team

The Survey Team produced an alternative floor layout of the Passenger Terminal Building (PTB) based on the comment received on 23 October as shown in Figure-2. Table-1 shows comparison of originally proposed plan and the alternative plan.

Table-1

Item	Originally Proposed Plan	Alternative Plan
1. Security concern on mixing domestic and international passengers on air side	Manageable	Almost none
2. Distance between domestic aircraft parking stand and domestic arrival/departure gate	Approx. 100m longer	Approx. 100m shorter
3. Walking distance for transfer between domestic and international	Approx. 50m longer *1	Approx. 50m shorter
4. Arrangement of services on land side for arrival passengers, such as public transportation, information counter, etc.	One location in front of arrival area	Two locations or long walk
5. Common use of security screening facilities for departing passengers	Possible	Not possible
6. Flexible use of departure gate lounge for domestic and international operations *2	Possible	Not possible
7. Flexible use of baggage claim for domestic and international operations *2	Possible	Not possible

*1 It is possible to make the walking distance almost equal by locating domestic gate lounge on the east of international gate lounge, if no security screening facilities for domestic passengers.

*2 Flexible use will be a good option to ease congestions of international passengers during excessive peak, such as overlapping of ANZ's B777 (or B787) with VOZ's B737, while there is no domestic operation.

2020/11/12 Remote Meeting

It was not possible to come to an agreement. Major comments of Tongan side [and counter comments of the Survey Team] are as follows:

- Security screening facility/space is required for domestic departure in case of the alternative plan. [It will require additional cost.]
- It is an additional benefit of the alternative plan that transfer from domestic to international is not required to pass through congested public area. [Transfer from international to domestic is required to pass through the public area.]
- A part of international gate lounge needs to be partitioned for transit passengers. [Domestic gate lounge may be used for transit lounge.]
- Domestic and international passenger flow will cross on the air side in case of the original plan. [Crossing can be avoided by managing timing of opening of departure gate. Crossing of flow will not be a problem, if ramp buses are used. It is also possible to park domestic aircraft on the existing international aircraft parking position to avoid crossing of the passenger flow.]
- Ramp buses are used only in case of bad weather. [Use of the ramp buses may be increase because distance between PTB and the furthest aircraft parking spot is 100m or more.]

2020/11/17 Survey Team

More comprehensive comparison of the Original and Alternative Plans has been made as described in Table-2. Items 1-3 are advantages of Alternative Plan, and items 4-7 are advantages of the Original Plan. As a result of comparison, the Survey Team consider as follows:

- Advantages of Alternative Plan on items 1 and 2 and Advantages of Original Plan on items 4 and 7 are considered to cancel each other.
- Item 3 is an advantage of Alternative Plan, and beneficiaries will be about 62,000 / 2 x 0.3 = 9,300 pax/year. Item 6 is an advantage of Original Plan, and beneficiaries will be more than 351 x 30 = 10,530 pax/year. Therefore, these two items are considered to cancel each other.
- Item 5 is an advantage of Original Plan to improve security without cost. Additional X-ray scanner and walkthrough metal detector of Alternative Plan will require additional investment of about JPY 10 million and cost for maintenance and repair in the future.
- In summary, the Original Plan has an advantage in terms of cost effectiveness.
- In addition, the Survey Team believe flexibility is an important element in planning so as to deal with various unexpected situations in the future.
- Therefore, the Survey Team recommend the Originally Plan for further development.

Table-2

Item	Originally Plan	Alternative Plan
1. Security concern on mixing dom. and int'l pax on airside	Mixing can be avoided by managing timing of opening departure gate, use of ramp buses, etc.	There will be no possibility of mixing.
2. Distance between dom. aircraft parking stand and dom. arrival/ departure gates	Distance is about 100m longer than the alternative plan. However, one int'l parking stand is vacant in most of the time, and can be used for dom.	Distance is about 100m shorter than the original plan. This is a benefit for both pax and transport of baggage.
3. Smooth transfer between domestic and international	Walking distance for transfer pax (estimated to be about 30% of arrivals) from dom. to int'l is about 50m longer through public area. (It will be possible to make the walking distance almost equal to the alternative plan by locating dom. gate lounge on the east of int'l gate lounge.) Public area will not be so congested except int'l peak.	Walking distance for transfer from dom. to int'l is about 50m shorter. It will be smooth without passing through congested public area.
4. Provision of services on landside for arrival pax, such as public transportation, information counter,	Such services can be located at one place near the int'l and dom. arrival area.	Provision of such services at two locations, near the int'l and dom. arrival areas, is desirable. Otherwise, some pax should walk about 100m longer to find

etc.		the services.
5. Security screening for departing passengers	Common use of X-ray scanners and walk through metal detectors for both dom. and int'l is planned.	Currently manual search is used for dom. Additional X-ray scanner and walkthrough metal detector may be provided for dom. operation at TBU in the future, However, it will be not easy at airports of outer islands.
6. Flexible use of departure gate lounge for domestic and international operations	Flexible use is possible. It can ease congestions of int'l pax during excessive peak hours. More than 351 pax/hour are expected to occur about 30 times/year in the night, when there is no dom. departure.	Flexible use is not planned. Some congestions during excessive peak hours are allowed in the internationally accepted planning practice.
7. Flexible use of baggage claim for domestic and international operations	Flexible use is possible. It is an option to deliver baggage faster during peak hours.	Flexible use is not planned.

2020/11/24 Tongan Side (1)

The proposed plan is not acceptable to AVEC as it would require all domestic airports to have passenger screening when there is a crossing over the two types of passengers; especially of both arriving and departing domestic passengers moving through what is really an international thorough fare for passengers. The Manager of AVSEC deemed such crossing over to be "highly risky" and, as such, not acceptable.

The domestic airline similarly does not wish to have international and domestic passengers using the same apron thoroughfare citing the likelihood of delays occurring when one or the other needs to wait for the completion of either embarking or disembarking. It was noted that the embarking and disembarking time for wide body jets (777, 787, A330, A350) can be of as much as 20 minutes. Domestic turn times are of 30 minutes only to ensure the full schedule of flights are completed largely during daylight hours and up to 15 flights can be operated by a range of aircraft.

International turn times range from 45 minutes for B738, 60 minutes for A321 and 75 minutes for wide-bodies. International airlines do not wish there to be delays due to waiting for the embarkation or disembarkation of domestic passengers, so their objection is the same as that of the domestic carrier.

The ground handler, ATS, says the proposed terminal design makes for the inefficient use of ramp crews. The normal ramp crew of six can handle all domestic traffic if both arrival and departures are from adjacent areas. When these are split as in the proposed terminal the ramp crew will at times be doubled to ensure turn times are met. The proposed terminal design also makes for excessive foot traffic by ground crews as they pass through streams of passengers and/or other ground crew when the arrival baggage hallway is separated so greatly from the departure make up area. Generally there is a dedicated ground crew for the domestic services (6) and another for ground crew for international services (can be as many as 12). Frequently there are as many as 15 domestic services and up to four international services in a day, though approximately half of the international flights are night turn rounds.

Arriving domestic passengers who are connecting to international flights need only turn the corner to reach the international check-in in the alternative design. Under the proposed design they are channelled through what is a public area which TAL may develop as a food hall, mixed shopping centre or a café or restaurant depending on whether the area remains enclosed as now or whether it is opened. Having a stream of domestic arrivals passing through this area is considered disrupting to those of the public who are meeting or fare welling international passengers. That arriving international passengers need to proceed along the walkway to reach the domestic check remains the same in both designs.

2020/11/24 Survey Team (1)

Please be reminded the followings:

- There are three parking spots for small jets on the existing international apron.
- Spot 2 and 3 will be occupied as Spot 4 by medium jet, such as B777 and B787, only a few times in a week.
- Overlap of two small jets were only 10 times in the last two peak months, December 2019 and January 2020.
- Therefore, Spot 1 that is adjacent to the new domestic apron will be vacant, and can be used for domestic during most of the time.

2020/11/24 Tongan Side (2)

The stakeholders do not see an advantage for item 4.....this is because the arrival area is usually taken up with the public meeting and greeting and farewelling people for the international flights, the mixing can simply cause congestion. Also most domestic arrivals will leave by car, or taxi and not by buses.....and these can be spread the length of the terminal area as they now are as the general public do not park alongside the terminal. The nature of the traffic differs quite markedly so why mix them?

For item 5. There is no screening of domestic services; so there is no advantage in the proposed design. When the domestic service requires screening all domestic ports will have to have security screening, also we note the crush through the screening area when there are 300 plus departing will cause delays in the domestic services.....or vice versa. It simply does not work.

For item 6. The domestic departure lounge will be in use for domestic traffic for most of the day at 30 minute intervals.....in this way there is really only any value to flexible use for night flights.....the main departure hall currently takes up to 300 people and this number is seldom exceeded.

For item 7. The new arrival hall is adequate for wide body (300+) or for 2 narrow body aircraft at the one time (A321 and B738 - total 350 people). A domestic baggage claim area (a carousel is not necessary) can simply be bench style as it is now in both TBU and VAV and can take up to 50 people quite comfortably. That size will only rarely, if ever, be of use if added to the international baggage claim area.....they have to be separated in any event due to Customs and Quarantine demands in the international area. And given that a domestic flight comes in nearly every 30 minutes it is again seen as creating a risk when security measures differ.

2020/11/24 Survey Team (2)

Item 4: International peak hours are mostly during the night, and there will be less meeters/greeters when domestic passengers arrive. We think that the transfer passenger must arrive well in advance of connecting flight (before international arrival). We think taxis will be used by both domestic and international arriving passengers. So, it is inconvenient for taxi drivers to separate domestic and international arrivals. Also, foreigners arrived by domestic flights may wish to go to Information Counter. If the counter is near the international arrival, they need to walk about 100m.

Item 5: We know there is no screening equipment for domestic operation at present, but think it's better to screen in the future. We know it will be not easy to provide screening equipment at other domestic airports, but why don't you use the equipment available at TBU that has sufficient capacity to process both international and domestic passengers. Please be reminded that no domestic operation is expected during the peak hour of international operation as explained in Air Traffic Demand Forecast.

Item 6: We expect the international peak will be in the night, when there is no domestic operations. Please be reminded that there will be excessive peaks, i.e. more than 351 busy hour passenger for planning, and assume it may be 30 times per year.

Item 7: Size of the existing baggage claim belt is good for small jet. So, small belt for domestic can be used additionally for medium jet, i.e. B777 or B787, we think it is a good option. You may also use small belt for priority passengers. Such option can be used only when there is no domestic operation (mainly international peak hours in the night), and all passengers will be forced to go through customs by closing an exit door from domestic baggage claim to the public area.

We are of the opinion that crossing of international and domestic passenger can be avoided by ATS's operation. I understand it may be a headache for ATS, but you have a sufficient time to consider solutions until design stage in preparatory survey.

2020/11/25 Tongan Side (1)

1) AVSEC staff is assigned at the entrance to the existing departure lounge of the existing domestic terminal.

2) On Item (4) I do not have a problem with this and using any taxi is convenient for the passenger and the airport as well. The 100m walk is a blessing for Tongans and it's really nothing compared to NZ and many other countries.

3) On Item (5) We know that there is no screening equipment for domestic operations at present, but we think it will be better to start screening at some stage going forward. Fua'amotu and Vava'u are equipped so we're only be looking at 'Eua, Ha'apai, Niuatoputapu and Niuafo'ou. These non-equipped, non-screened airports can easily be equipped with a hand-held wand for departing passengers at minimal costs and also consistent with the regular risks assessment exercises undertaken from time to time.

2020/11/25 Tongan Side (2)

The advantage you suggest for the original plan as provided by Viliami-san for point 3 is far outweighed by all the other disadvantages further of which I am working on getting to you.....especially on having all domestic and international passengers going through the one security screening point.

2020/11/25 Survey Team [Comments on issues raised on 2020/11/24 Tongan Side (1)]

[Such crossing will be rare case, i.e. simultaneous departure of domestic and international or simultaneous domestic arrival and international departure. If ever predicted, the crossing can be avoided by management of the passenger flows. In addition, TAL think it will be better to start screening at some stage going forward. So, it is recommendable to start at the new terminal of TBU.]

[Potential crossing will be with international departures as explained before, and it will be rare. If ever predicted, it seems better to hold the international departures for a while domestic passengers are walking.]

[There will be little possibility to wait departures for a while domestic passengers are walking. The maximum number of passengers of a domestic flight is only 8 to 32, and it will probably take only a few minutes for embarkation or disembarkation.]

[Distance between domestic Baggage Breakdown and Baggage Make-up of the Original Plan is about 60m. As it will take about one minute only by walk, it should not be a big issue.]

[Public area will not be so congested, because it is not the busy hour of international operations. As the transfer from international to domestic will walk through the same public area even in case of the Alternative Plan, it should not be a big issue.]

****

Appendix 2 Breakdown of Construction Cost - Fua'amotu

Currency	TOP	USD
Exchange Rate	49.912	105.26

	Quantity		Rate		Amount		Total
	Unit	Quantity	TOP	JPY	TOP	JPY	JPY
I. Construction Cost (A+B+C)	-		-	-			2,140,705,131
A. Direct Construction Cost	-		-	-	-		1,660,645,250
1. Building Works							1,067,092,060
(1) New Terminal Building	sq.m	2,220	-	248,767	-	552,262,740	552,262,740
(2) Terminal Renovation	sq.m	2,920	-	146,921	-	429,009,320	429,009,320
(3) VVIP Building	sq.m	173	-	248,767	-	43,036,691	43,036,691
(4) Visitors' Shed	sq.m	500	-	47,366	-	23,683,000	23,683,000
(5) Guard House	sq.m	16	9,575.36	247,257	153,205.76	3,956,112	11,602,918
(6) Tool Booth	No.	1	739.96	1,438,514	739.96	1,438,514	1,475,447
(7) Septic Tank 60cu.m	No.	1	-	1,864,616	-	1,864,616	1,864,616
(8) Water Tank	No.	5	-	270,040	-	1,350,200	1,350,200
(9) Relocation of Water Tank	No.	3	765.14	181,350	2,295.42	544,050	658,619
(10) Upgrade of Elec. Supply System	LS	1	11,665.26	1,566,273	11,665.26	1,566,273	2,148,509
2. Special Equipment							98,502,364
(1) Solar PV Grid System	kW	80	938.76	426,881	75,100.80	34,150,480	37,898,911
(2) Baggage Handling System	m	76	-	344,836	-	26,207,536	26,207,536
(3) Security Screening System	LS	1					34,395,917
a. Inline hold baggage screening	unit	1	-	12,916,981	-	12,916,981	12,916,981
b. Cabin baggege screening	unit	2		9,191,093		18,382,186	18,382,186
c. Walk through metal detector	unit	2		1,548,375	-	3,096,750	3,096,750
3. Furniture	sq.m	2,220	-	7,208	-	16,001,760	16,001,760
4. Civil Works							392,344,993
(1) Demolition works	LS	1					36,205,473
a. Taxiway pavement	sq.m	2,590	158.92	-	411,602.80	-	20,543,919
b. VVIP building	sq.m	447	231.18	-	103,337.46	-	5,157,779
c. Airside Road at VVIP	sq.m	590	158.92	-	93,762.80	-	4,679,889
d. Landside Fence	m	42	8.42	-	353.64	-	17,651
e. Landside Pavement	sq.m	732	158.92	-	116,329.44	-	5,806,235
(2) Earthworks	LS	1					57,674,558
a. Top soil stripping PTB	sq.m	1,194	5.72	-	6,829.68	-	340,883
b. Top soil stripping Airside	sq.m	16,720	5.72	-	95,638.40	-	4,773,504
c. Top soil stripping VIP area	sq.m	1,931	5.72	-	11,045.32	-	551,294
d. Top soil stripping Landside	sq.m	9,370	5.72	-	53,596.40	-	2,675,104
e. Embankment PTB	cu.m	669	64.12	-	42,896.28	-	2,141,039
f. Embankment Airside	cu.m	6,374	64.12	-	408,700.88	-	20,399,078
g. Embankment VIP area	cu.m	869	64.12	-	55,720.28	-	2,781,111
h. Embankment Landside	cu.m	4,217	64.12	-	270,394.04	-	13,495,907
i. Excavation PTB	cu.m	3,347	14.23	-	47,627.81	-	2,377,199
j. Excavation Airside	cu.m	6,374	14.23	-	90,702.02	-	4,527,119
k. Excavation VIP area	cu.m	869	14.23	-	12,365.87	-	617,205
l. Excavation Landside	cu.m	4,217	14.23	-	60,007.91	-	2,995,115
(3) Pavement Works	LS	1					296,478,441
a. Taxiway and apron (t=74cm)	sq.m	13,007	302.74	378	3,937,739.18	4,916,646	201,457,084
b. GSE road (t=45cm)	sq.m	1,913	176.81	378	338,237.53	723,114	17,605,226
c. VIP access road (t=45cm)	sq.m	670	176.81	378	118,494.53	253,328	6,167,627
d. Landside road (t=45cm)	sq.m	7,032	176.81	378	1,243,327.92	2,658,096	64,715,079
e. Pedestrian path (t=19cm)	sq.m	117	-	6,295	-	739,600	739,600
f. Curbstone	m	1,005	-	5,765	-	5,793,825	5,793,825
(4) Storm water Drainage Works	LS	1					1,986,521
a. Landside infiltration pit	No.	12	1,930.97	27,779	23,171.64	333,348	1,489,891
b. Airside infiltration pit	No.	2	1,930.97	27,779	3,861.94	55,558	248,315
c. VIP area infiltration pit	No.	2	1,930.97	27,779	3,861.94	55,558	248,315
5. Lighting System							73,818,909
(1) Parking Lights	unit	17	1,463.50	113,007	24,879.50	1,921,119	3,162,905
(2) Taxiway Edge Lights	unit	28	6,103.00	213,419	170,884.00	5,975,732	14,504,894
(3) Taxiway Guidance Signs	unit	6	2,649.44	599,300	15,896.64	3,595,800	4,389,233
(4) Apron Flood Lights	unit	4	34,509.78	11,218,017	138,039.12	44,872,068	51,761,877

6. Miscellaneous Works								12,885,164
	(1) Pavement Markings	LS	1					4,543,500
		a. Landside	sq.m	358	-	3,900	-	1,396,200	1,396,200
		b. VIP area	sq.m	27	-	3,900	-	105,300	105,300
		c. Airside	sq.m	780	-	3,900	-	3,042,000	3,042,000
	(2) Road Sign	LS	1					2,223,424
		a. Landside guidance sign	No.	3	-	537,439	-	1,612,317	1,612,317
		b. Landside restriction sign	No.	2	-	18,417	-	36,834	36,834
		c. VIP area guidance sign	No.	1	-	537,439	-	537,439	537,439
		d. VIP area restriction sign	No.	2	-	18,417	-	36,834	36,834
	(3) Landscape	LS	1					5,833,536
		a. Landside	sq.m	744	-	736	-	547,584	547,584
		b. Airside	sq.m	7,182	-	736	-	5,285,952	5,285,952
	(4) Fence and Gate	LS	1					284,704
		a. Security fence	m	7	21.35	13,713	149.45	95,991	103,450
		b. Gate	No.	1	3,061.69	28,439	3,061.69	28,439	181,254
B. Indirect Construction Cost								308,917,261
	1. Temporary Works and Site Expenses	LS	1		-	-	-	308,917,261
C. Management and Overhead		-		-	-	-		171,142,620

Appendix 3 Environmental Screening Form - Fua'amotu

Name of Proposed Project:
The Project for International Terminal Building Improvement in Fua'amotu Airport
Project Executing Organization, Project Proponent or Investment Company:
Ministry of Infrastructure
Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: Mr. Ringo K. Fa'oliu
Address: 'Alaivaha'amama'o Bypass Road, Fanga 'o Pilolevu, Tonga
Organization: Ministry of Infrastructure
Tel: +676 23100
Fax: +676 25440
E-Mail: rfaoliu@infrastructure.gov.to
Date:
Signature:

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site
Fua'amotu International Airport
Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

1. Expansion of International Terminal Building: Approx. 2,200 sq.m
2. Expansion of Aircraft Parking Apron with GSE service road: Approx. 10,200 sq.m
3. Construction of a New Taxiway: 15m width and 132m length
4. Expansion of Car Park: Approx. 5,600 sq.m
5. Construction of Terminal Circulation Road: 6m width and 224m length

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

■YES: Please describe the higher program/policy.
（Tonga Strategic Development Framework 2015-2025 ）
□NO

2-3. Did the proponent consider alternatives before this request?

■YES: Please describe outline of the alternatives

(Runway extension and International Terminal Building Expansion under World Bank project)

□NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

□Implemented □Not implemented

If implemented, please mark the following stakeholders.

□Administrative body

□Local residents

□NGO

□Others（ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

■New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other （ ）

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE), required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (□Implemented □Ongoing/planning)

(Reason why EIA is required:)

☐Not necessary

☐Other (please explain)

~~Question 5:~~

~~In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.~~

~~☐Approved without a supplementary condition~~	~~☐Approved with a supplementary condition~~	~~☐Under appraisal~~

~~(Date of approval: Competent authority:)~~

~~☐Under implementation~~

~~☐Appraisal process not yet started~~

~~☐Other ( )~~

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

☐Not required

☐Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ■No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

☐Yes ■No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

☐Land reclamation, land development, and/or land-clearing (scale: hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☐ Air pollution
☐ Water pollution
☐ Soil pollution
☐ Waste
■ Noise and vibrations
☐ Ground subsidence
☐ Offensive odors
☐ Geographical features
☐ Bottom sediment
☐ Biota and ecosystems
■ Water usage
☐ Accidents
☐ Global warming

☐ Involuntary resettlement
☐ Local economies, such as employment, livelihood, etc.
■ Land use and utilization of local resources
☐ Social institutions such as social infrastructure and local decision-making institutions
☐ Existing social infrastructures and services
☐ Poor, indigenous, or ethnic people
☐ Misdistribution of benefits and damages
☐ Local conflicts of interest
☐ Gender
☐ Children's rights
☐ Cultural heritage
☐ Infectious diseases such as HIV/AIDS
☐ Other ( )

Outline of related impact:

New land acquisition is not required and the project is unlikely to cause any major negative environmental or social impacts. Possible negative impacts related to the project are expected to be confined to the construction phase. Freshwater will be required for workers and some construction activities (e.g. dust suppression, and concrete and bitumen production). Noise and vibration disturbances are particularly likely during construction related to the transportation of construction materials from the quarry and operation of equipment. Potential adverse impacts from quarrying or mining are high, if uncontrolled.

~~Question 10:~~

~~In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?~~

~~☐ Yes ☐ No~~

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

■ Yes ☐ No

Appendix 4 Breakdown of Construction Cost - Vava'u

Currency	TOP	USD
Exchange Rate	49.912	105.26

	Quantity		Rate		Amount		Total
	Unit	Quantity	TOP	JPY	TOP	JPY	JPY
I. Construction Cost (A+B+C)	-		-	-			476,874,714
A. Direct Construction Cost	-		-	-	-		280,723,676
1. Building Works							34,324,589
(1) Immigration & Office Expansion	sq.m	69	-	256,728	-	17,714,232	17,714,232
(2) Public Area Expansion	sq.m	206	-	48,882	-	10,069,692	10,069,692
(3) Building Renovation	sq.m	52	-	117,068	-	6,087,536	6,087,536
(4) Relocation of Water Tank	No.	2	789.62	187,153	1,579.24	374,306	453,129
2. Furniture	sq.m	327	-	7,439	-	2,432,553	2,432,553
3. Civil Works							190,957,010
(1) Demolition works	LS	1					13,562,538
a. Existing Road Pavement	sq.m	1,264	158.92	-	200,874.88	-	10,026,067
b. Landside Median	sq.m	232	231.18	-	53,633.76	-	2,676,968
c. Perimeter Fence	m	176	8.63	-	1,518.88	-	75,810
d. Landside Fence	m	70	8.63	-	604.10	-	30,152
e. Landside Pavement	sq.m	95	158.92	-	15,097.40	-	753,541
(2) Earthworks	LS	1					104,532,393
a. Clearing	sq.m	2,238	2.58	-	5,774.04	-	288,194
b. Top soil stripping at building	sq.m	312	5.86	-	1,828.32	-	91,255
c. Top soil stripping at Airside	sq.m	44,752	5.86	-	262,246.72	-	13,089,258
d. Top soil stripping at Landside	sq.m	1,101	5.86	-	6,451.86	-	322,025
e. Embankment PTB	cu.m	51	65.70	-	3,350.70	-	167,240
f. Embankment Airside	cu.m	22,376	65.70	-	1,470,103.20	-	73,375,791
g. Embankment Landside	cu.m	110	65.70	-	7,227.00	-	360,714
h. Excavation PTB	cu.m	514	14.58	-	7,494.12	-	374,047
i. Excavation Airside	cu.m	22,376	14.58	-	326,242.08	-	16,283,395
j. Excavation Landside	cu.m	248	14.58	-	3,615.84	-	180,474
(3) Pavement Works	LS	1					71,844,388
a. Runway (t=72cm)	sq.m	7,467	134.22	394	1,002,220.74	2,941,998	52,964,840
b. Landside road (t=41cm)	sq.m	2,425	131.86	394	319,760.50	955,450	16,915,336
c. Pedestrian path (t=19cm)	sq.m	28	-	6,450	-	180,600	180,600
d. Curbstone	m	302	-	5,906	-	1,783,612	1,783,612
(4) Storm water Drainage Works	LS	1					1,017,691
a. Landside infiltration pit	No.	8	1,978.45	28,463	15,827.60	227,704	1,017,691
4. Lighting System							14,937,733
(1) Runway Edge Lights	LS	1	98,366.05	7,450,202	98,366.05	7,450,202	12,359,848
(2) Relocation of Wing Bar and PAPI	LS	1	38,298.46	666,332	38,298.46	666,332	2,577,885
5. Miscellaneous Works							38,071,791
(1) Pavement Markings	LS	1					3,372,624
a. Runway	sq.m	747	-	3,996	-	2,985,012	2,985,012
b. Landside	sq.m	97	-	3,996	-	387,612	387,612
(2) Road Sign	LS	1					588,392
a. Landside guidance sign	No.	1	-	550,654	-	550,654	550,654
b. Landside restriction sign	No.	2	-	18,869	-	37,738	37,738
(3) Landscape	LS	1					20,952,312
a. Airside Sodding	sq.m	9,782	-	754	-	7,375,628	7,375,628
b. Airside Seeding	sq.m	25,362	-	503	-	12,757,086	12,757,086
c. Landside Sodding	sq.m	1,087	-	754	-	819,598	819,598
(4) Fence and Gate	LS	1					13,158,463
a. Perimeter fence	m	799	21.88	14,050	17,482.12	11,225,950	12,098,518
b. Security fence	m	70	21.88	14,050	1,531.60	983,500	1,059,945
B. Indirect Construction Cost							157,885,770
1. Temporary Works and Site Expenses	LS	1		-	-	-	157,885,770
C. Management and Overhead	-		-	-	-		38,265,268

Appendix 5 Environmental Screening Form - Vava'u

Name of Proposed Project:
The Project for Runway Extension and Terminal Building Improvement in Vava'u Airport
Project Executing Organization, Project Proponent or Investment Company:
Ministry of Infrastructure
Name, Address, Organization, and Contact Point of a Responsible Officer:

Name: Mr. Ringo K. Fa'oliu
Address: 'Alaivaha'amama'o Bypass Road, Fanga 'o Pilolevu, Tonga
Organization: Ministry of Infrastructure
Tel: +676 23100
Fax: +676 25440
E-Mail: rfaoliu@infrastructure.gov.to
Date:
Signature:

Check Items

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site
Vava'u International Airport
Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

1. Expansion of Runway: 225 m
2. Expansion of Terminal Building: Approx. 230 sq.m
3. Expansion of Car Park: Approx. 2,800 sq.m

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

■YES: Please describe the higher program/policy.
(Tonga Strategic Development Framework 2015-2025)
□NO

2-3. Did the proponent consider alternatives before this request?

■YES: Please describe outline of the alternatives
(Runway extension of 1,200m and New Terminal Building Construction)
□NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

□Implemented □Not implemented

If implemented, please mark the following stakeholders.

□Administrative body

□Local residents

□NGO

□Others（ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

■New ☐Ongoing (with complaints) ☐Ongoing (without complaints)

☐Other （ ）

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE), required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

☐Necessity (□Implemented □Ongoing/planning)

(Reason why EIA is required:)

☐Not necessary

☐Other (please explain)

~~Question 5:~~

~~In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.~~

~~☐Approved without a supplementary condition~~	~~☐Approved with a supplementary condition~~	~~☐Under appraisal~~

~~(Date of approval: Competent authority:)~~

~~☐Under implementation~~

~~☐Appraisal process not yet started~~

~~☐Other ( )~~

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please

indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

☐Not required

☐Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ■No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands, reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

■Yes ☐No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

■Land reclamation, land development, and/or land-clearing (scale: 0.5 hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related adverse environmental and social impacts, and describe their outlines.

☐ Air pollution
☐ Water pollution
☐ Soil pollution
☐ Waste
■ Noise and vibrations
☐ Ground subsidence
☐ Offensive odors
☐ Geographical features
☐ Bottom sediment
☐ Biota and ecosystems
■ Water usage
☐ Accidents
☐ Global warming

☐ Involuntary resettlement
☐ Local economies, such as employment, livelihood, etc.
■ Land use and utilization of local resources
☐ Social institutions such as social infrastructure and local decision-making institutions
☐ Existing social infrastructures and services
☐ Poor, indigenous, or ethnic people
☐ Misdistribution of benefits and damages
☐ Local conflicts of interest
☐ Gender
☐ Children's rights
☐ Cultural heritage
☐ Infectious diseases such as HIV/AIDS
☐ Other ( )

Outline of related impact:

Diversion of the existing road on the west of the runway crossing the leased land is a prerequisite of the runway extension. Even if this diversion road is regarded as a part of the project, required land acquisition will be small, and no resettlements as well as demolition of existing building will be required. Therefore, the project is unlikely to cause major negative environmental or social impacts. Possible negative impacts related to the project are expected to be confined to the construction phase. Freshwater will be required for workers and some construction activities (e.g. dust suppression, and concrete and bitumen production). Noise and vibration disturbances are particularly likely during construction related to the transportation of construction materials from the quarry and operation of equipment. Potential adverse impacts from quarrying or mining are high, if uncontrolled.

~~Question 10:~~

~~In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?~~

~~☐ Yes ☐ No~~

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

■ Yes ☐ No