The Republic of Fiji
Ministry of Public Enterprises
Fiji Broadcasting Company

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
THE REHABILITATION OF THE MEDIUM WAVE RADIO TRANSMISSION
IN
THE REPUBLIC OF FIJI

APRIL 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

YACHIYO ENGINEERING CO., LTD.

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Summary

1. Overview of the Republic of Fiji

The Republic of Fiji has a total population of approximately 880,000 (2013, World Bank). It is an island nation composed of more than 330 islands covering a combined area of 18,270 square kilometers (2011, Pacific Islands Centre). Fiji is situated in the South Pacific Ocean between Australia and New Zealand and it has a marine tropical climate that stays mild throughout the year. Seasons in the Republic of Fiji comprise the rainy season (October~April) and the dry season during the other months of the year. In the areas with low rainfall, annual precipitation is around 2,000 millimeters, but this increases to 3,000 millimeters in coastal parts and 6,000 millimeters in the mountains. Within the rainy season, the period between October and March is the cyclone season.

The Republic of Fiji has GDP of USD 4.04 billion and a real GDP growth rate of 3%, and its per capita GNI is USD 4,430 (2013, World Bank). Primary industry accounts for 13.2% of GDP, secondary industry for 18.9%, and tertiary industry for 67.9% (2012, World Bank), and tourism, sugar, and the apparel industries are major sources of foreign currency. Agriculture accounts for approximately 10% of GDP. The traditional sugar industry has gradually lost international competitiveness due to price competition from other countries and the impact of flooding in 2009, and the value of exports fell to FJD 77 million in 2010, however, it has been recovering in recent years and stood at FJD 114 million in 2013, accounting for 1.9% of GDP (Fiji Bureau of Statistics). Revenue from the tourism industry based on marine resorts that make use of the country's abundant marine resources is FJD 1.32 billion, accounted for 22% of GDP in fiscal 2013, indicating that this is now a major industry for the Republic of Fiji (Fiji Bureau of Statistics).

2. Background and Outline of the Project

Since the citizens of the Republic of Fiji inhabit an expansive area in the South Pacific making it difficult to communicate and move around, it is difficult to convey disaster information or deliver assistance in emergencies. Having very limited land area and low altitude, these islands are extremely prone to natural disasters, and the threat of natural disasters arising from rising ocean levels caused by climate change, landslides caused by increased rainfall triggered by increasingly larger cyclones, and damage to houses and infrastructure caused by river flooding is growing more acute every year. In these circumstances, initiatives on protection from disasters are conducted within numerous international frameworks such as the Pacific Islands Forum (hereinafter referred to as PIF), the Council of Regional Organizations of the Pacific (hereinafter referred to as CROP) the Pacific Disaster Risk Partnership Network and so on. The Government of Japan also provides support via the Disaster Prevention Program, which is geared to mitigating the risk of natural disasters. In the Roadmap for Democracy and Sustainable Socio-Economic Development 2010-2014, from the viewpoint of provincial development, the Government of the

Republic of Fiji recognizes the importance of providing information to citizens and the need to urgently establish a 24-hour disaster monitoring setup and warning system. In order to ensure prompt responses to natural disasters, the communication of information to citizens is essential, and radio broadcasting is seen as an effective means of conveying evacuation advisories to citizens and providing large quantities of uniform information on disaster recovery.

The transmitter and antenna in the aforementioned medium wave radio broadcasting system of the Fiji Broadcasting Company (hereinafter referred to as FBC) were installed in 2000 and 1953 respectively. Because broken down parts are repaired on a stopgap basis, the transmitting output is reduced, sound quality becomes distorted, and broadcasting quality is unstable. It is thus urgently desired to replace the transmitter and antenna, however, although FBC can secure funds for maintenance, it does not have the financial strength to conduct rehabilitation of the medium wave radio broadcasting system, which would require a large investment. Moreover, since it needs to keep broadcasting information on approaching cyclones and so on to residents on remote islands even during the rehabilitation works, it will be necessary to conduct technical review on the method and schedule of antenna construction. FBC has experience of small-scale works, however, it does not have personnel who are able to plan and construct a medium wave radio broadcasting system comprising a large antenna and transmitter in a radial earth arrangement.

Under these circumstances, the Republic of Fiji in 2013 made a request to the Government of Japan for a grant aid project – the Project for the Rehabilitation of the Medium Wave Radio Broadcasting in the Republic of Fiji – aimed at rehabilitating the medium wave radio broadcasting system comprising Naulu transmitting station and antenna.

Since rehabilitation of the medium wave radio broadcasting system will make it possible to provide stable medium wave radio broadcasts and information on disasters and lifestyle to the entire area of the Republic of Fiji (excluding Rotuma Island), the Government of Japan consigned implementation of the preparatory survey.

3. Outline of the Study Findings and Contents of the Project

JICA dispatched a team to the Republic of Fiji from September 30 to October 28, 2014 to confirm the contents of the Project request and conduct field survey of the proposed site for equipment installation. Then it was carried out a topographic survey and soil investigation by the team from January 25th to February 16th. On returning home, the team analyzed its findings, implemented the rough design, and conducted cost estimation. Based on the results, it conducted explanations of the outline design of the Project from March 8 to 14, 2015.

Through rehabilitating the medium wave radio transmitter and antenna, this grant aid project aims to benefit citizens through providing stable medium wave radio broadcasts and information on disaster prevention, public health, education, agriculture, culture, etc. to the entire area of the Republic of Fiji (excluding Rotuma Island).

Table-1 Project Equipment

No.	Item	Quantity
1	MW Antenna System (60 m, Umbrella Type, dual frequency antenna)	1 lot
2	Transmitter-1 (558kHz)	1 lot
3	Transmitter-2 (990kHz)	1 lot
4	Output Change-over Switch, Dummy Load	1 lot
5	Power Supply Equipment and Air Conditioning System	1 lot
6	ISDN Codec	1 lot
7	Maintenance Equipment and Tools	1 lot
8	Spare Parts	1 lot
9	Consumable Parts	1 lot

The Project responsible agency on the Republic of Fiji side is the Ministry of Public Enterprises and the implementing agency is FBC. Medium wave radio broadcasts are the only means of conveying information to remote islands in the Republic of Fiji, however, as has been described, because sufficient output cannot be secured due to equipment breakdowns, broadcasts are unstable and extremely limited in coverage. The Project intends to rebuild the radio transmitter house and procure and install medium wave radio broadcasting equipment in order to provide radio broadcasts over the entire area of the Republic of Fiji (excluding Rotuma Island) with transmission output of 10 kW over the frequencies of 558 kHz and 990 kHz that have been registered with the International Telecommunication Union (ITU). As a result of Project implementation, the medium wave radio broadcasting system will be rehabilitated, making it possible to provide stable medium wave radio broadcasts to the entire area of the Republic of Fiji (excluding Rotuma Island); moreover, through constructing a dual structure radio system and establishing a means of program transmission between FBC headquarters and Naulu transmitter station, the reliability of broadcasts will also be improved.

4. Project Schedule and Cost estimation

The Project implementation schedule including implementation design, tender, and installation works will be 23 months based on the Government of Japan's Grant Aid guidelines. The total Project cost on the Fijian side will be approximately 4.3 million yen including comprising the fencing installation cost, electricity charges, and telecommunications fees.

5. Evaluation of the Project

(1) Quantitative Effects

It is anticipated that introduction of medium wave radio transmitter equipment in the Project will allow more citizens to have access to radio broadcasts and information on disaster prevention and everyday lifestyle affairs. The following paragraphs 1) through 3) indicate the effects that can be anticipated by introducing the proposed equipment.

1) Estimated population of covered areas

In the case where output is increased to 10 kW as a result of the Project, it will be possible to provide radio broadcasts over the entire area of the Republic of Fiji (excluding Rotuma Island). As was indicated in Table-2, it will become possible for approximately 100,000 residents living mainly in remote islands to newly listen to medium wave radio broadcasts.

Table-2 Number of Listeners Now and After Implementation

Current (2 kW) number of listeners	Number of listeners after implementation (10 kW)	Additional benefitting population
780,000	880,000	100,000

Incidentally, citizens on the island of Rotuma, which cannot pick up medium wave radio broadcasts, receive broadcasts from neighboring countries such as Tonga, Australia, and so on. Moreover, FBC had installed FM transmitter (100 W) in Rotuma islands in November 2014 and been started FM radio broadcasting there.

2) Reduction of broadcast interruptions:

Currently FBC implements 24 hour broadcasts from the medium wave transmitter installed at Naulu transmitting station close to Nausori Airport. In the current system, programs produced in the FBC studios are transmitted to Nakobalevu transmitting station on the outskirts of Suva by microwave signals, and they are then converted to FM waves and sent to Naulu transmitting station, which converts the FM signals to medium wave radio broadcasting signals. Thus, various items of equipment are involved between the production of programs in FBC studios and their transmission as medium wave broadcasts, however, such broadcasts are interrupted when the said equipment is damaged by cyclones and so on. In the network that is proposed in the project, since programs from FBC studios will be directly conveyed to the transmitter via ISDN line without passing through the various microwave and FM equipment, it will be possible to minimize the impacts of weather fluctuations, cyclones, etc. and thus sustain stable broadcasts. Table-3 shows a comparison of broadcast interruption times at present and following project implementation.

Table-3 Comparison of Broadcast Interruption Times between Now and After Implementation

Now	After implementation	Reduction
100 hours/year	8 hours/year	92 hours/year

Broadcasts are frequently interrupted due to problems with the existing broadcasting equipment, however, when the new transmitter equipment is introduced, interruptions will be limited to the minimum necessary stoppages for maintenance work.

3) Reduction of power consumption

The transmitter and antenna are connected by a cable known as a coaxial feeder, however, because the electrical characteristic known as impedance is not consistent between these two instruments at present, energy is not efficiently converted into radio waves. As a result, much energy is dissipated as heat, leading to a lot of power consumption and loss. Through installing a new transmitter in the Project, since performance will be improved, making it possible to secure consistency with the antenna, it will be possible to save on power. Through adopting an energy saving transmitter that utilizes semiconductors, it will be possible to achieve electricity saving of approximately 70% compared to the existing transmitter. Table-4 shows a comparison of power consumption between the present and after Project implementation.

Table-4 Comparison of Power Consumption between Now and After Implementation

Now (assuming 10 kW)	After implementation (10 kW)	Saving ratio
Approximately 55 kWh	Approximately 38 kWh	Approximately 30%

(2) Qualitative Effects

1) Improvement in broadcasting quality

As a result of stopgap repairs to the existing analog transmitter, output is decreased and a lot of noise is generated due to mismatch of transmitter and antenna, etc.; moreover, the sound quality of broadcasts is poor because audio signals become distorted and unstable. Furthermore, there is no equipment for monitoring transmitter characteristics, and it is difficult to make transmitter adjustments. Through introducing a modern transmitter, implementing inspections, and monitoring characteristics through utilizing measuring devices, it will become possible to much of transmitter and antenna and conduct high quality broadcasts.

2) Continuation of medium wave radio broadcasts:

Due to deterioration over time, the existing antenna and transmitter house have worn and damaged foundations and are unfit for long-term use. Through rehabilitating the antenna and transmitter, it will be possible to sustain medium wave radio broadcasts and provide stable transmissions of disaster prevention and general lifestyle information to the 880,000 citizens of the Republic of Fiji including those on remote islands.

PREPARATORY SURVEY REPORT

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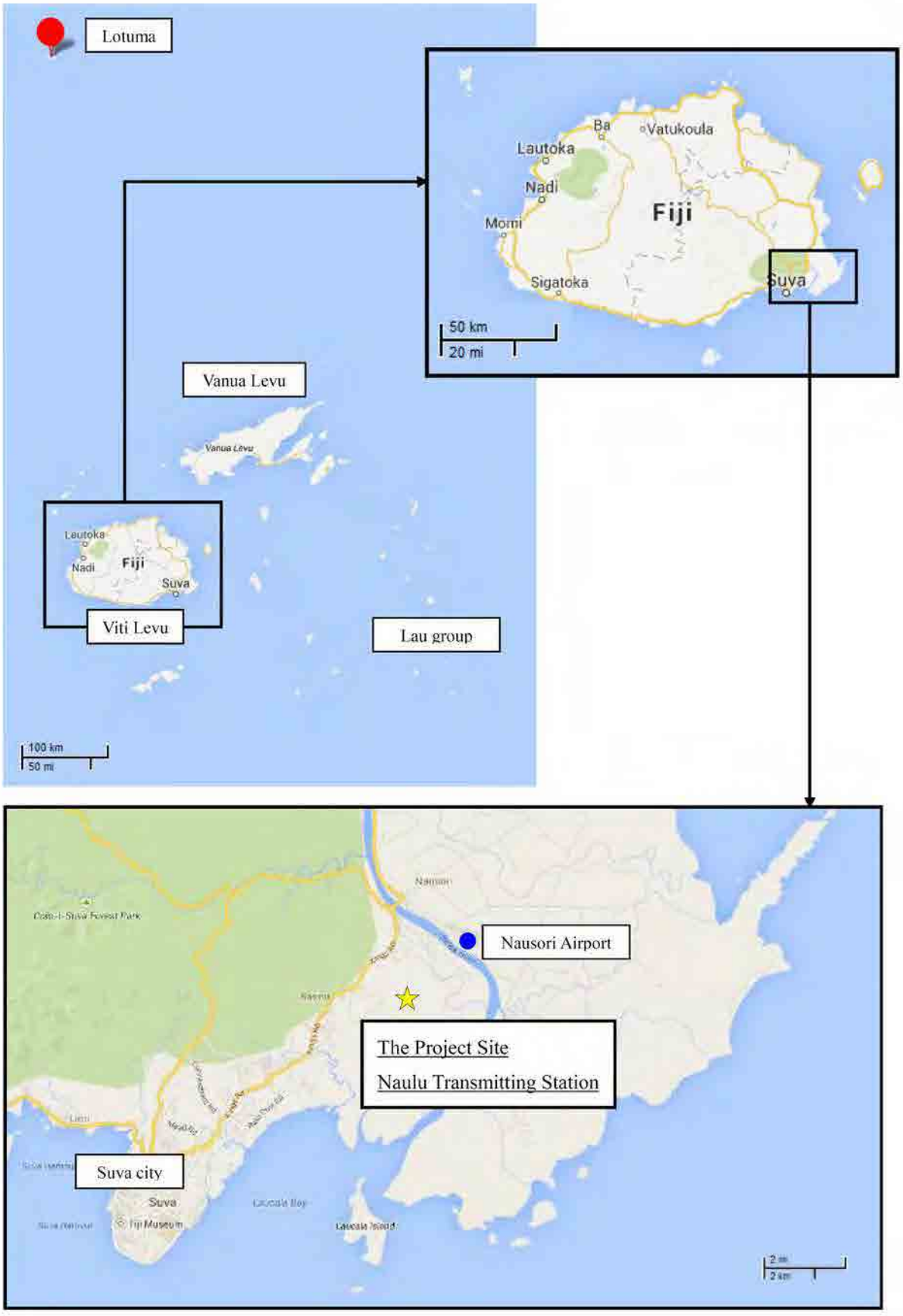
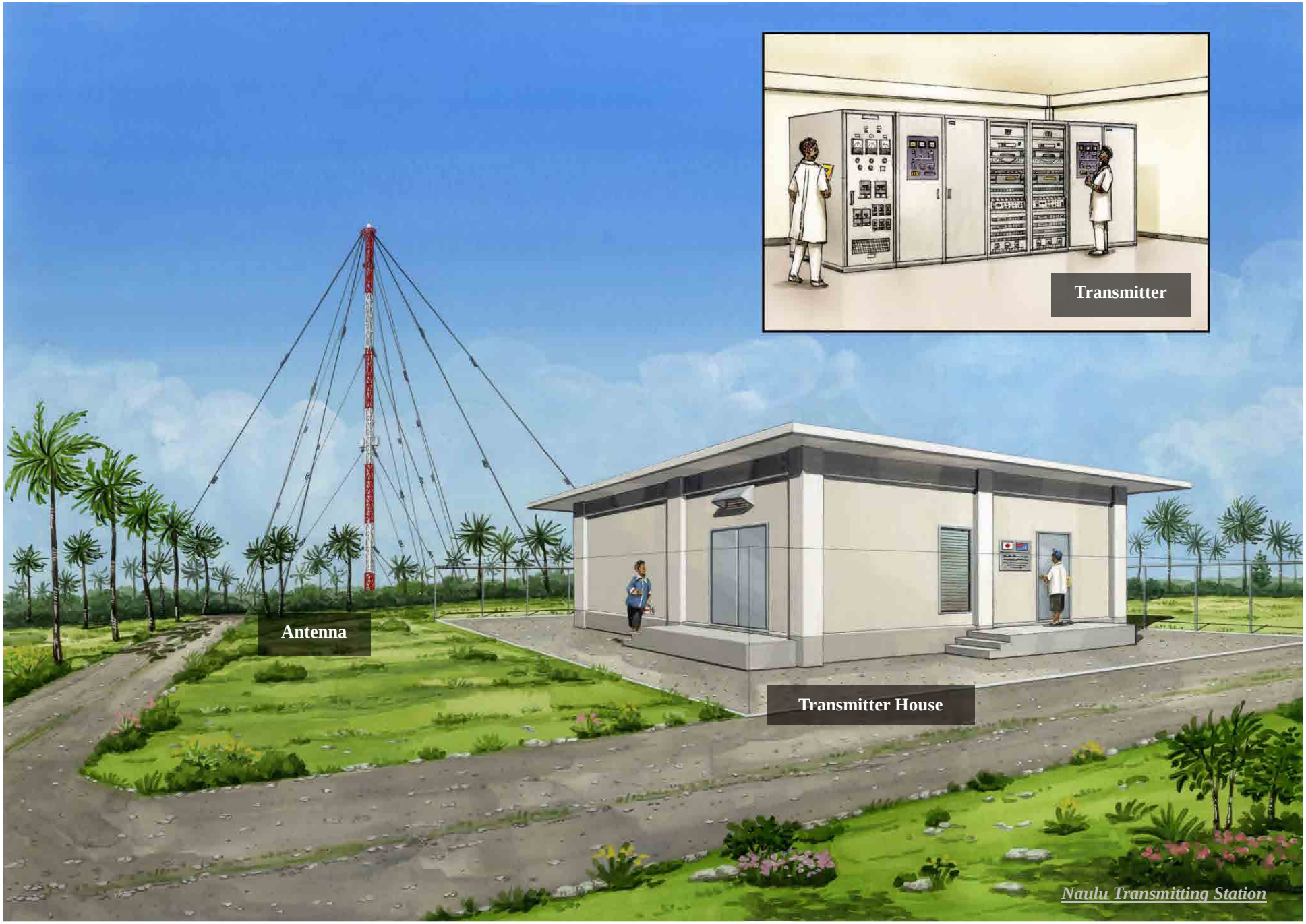
[Appendices]



Location Map



The Project for the Rehabilitation of the Medium Wave Radio Transmission / Perspective

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List of Abbreviations

AC	Alternate Current
AM	Amplitude Modulation
ATU	Antenna Tuning Unit
AVR	Automatic Voltage Regulator
CAAF	Civil Aviation Authority of FIJI
CROP	Council of Regional Organization in the Pacific
DL	Dummy Load
DOE	Department of Environment
DV	Domestic Violence
FBC	Fiji Broadcasting Corporation
FEA	Fiji Electricity Authority
FET	Field Effect Transistor
FM	Frequency Modulation
FMS	Fiji Meteorological Service
IP	Internet Protocol
IPP	Independent Power Producer
ISDN	Integrated Service Digital Network
ITU	International Telecommunication Union
MOA	Ministry of Agriculture
MW	Medium Wave
NDMO	National Disaster Management Office
NFB	No Fuse Breaker
OJT	On the Job Training
PDB	Primary Distribution Board
PIE	Program Input Equipment
PIF	Pacific Islands Forum

CHAPTER 1 BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

The Pacific island nations are extremely prone to natural disasters and urgently need to implement strategic countermeasures. In these circumstances, initiatives are conducted within numerous frameworks such as the Pacific Islands Forum, the Council of Regional Organizations of the Pacific, and the Pacific Disaster Risk Partnership Network and so on. The Government of Japan provides support via the Disaster Prevention Program, which is geared to mitigating the risk of natural disasters arising from climate change in this region. Radio broadcasting is seen as an effective means of giving evacuation advisories at times of emergency and transmitting large quantities of uniform information to citizens when recovering from disasters.

The transmitter and antenna in the aforementioned medium wave radio broadcasting system of the FBC were installed in 2000 and 1953 respectively. Because broken down parts are repaired on a stopgap basis, the transmitting output is reduced, sound quality becomes distorted, and broadcasting quality is unstable. It is thus urgently desired to replace the transmitter and antenna, however, although the FBC can secure funds for maintenance, it does not have the financial strength to conduct renewal of the medium wave radio broadcasting system, which would require a large investment. Moreover, since it needs to keep broadcasting information on approaching cyclones and so on to residents on remote islands even during the renewal works, it will be necessary to conduct technical review on the method and schedule of antenna construction. The FBC has experience of works for small-scale FM and TV transmitters, however, it is totally unaccustomed to constructing a medium wave radio broadcasting system comprising a large antenna and transmitter in a radial earth arrangement.

Under these circumstances, in 2013, the Republic of Fiji made a request to the Government of Japan for a grant aid project – the Project for the Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji – aimed at rehabilitating the medium wave radio broadcasting system comprising Naulu transmitting station and antenna.

Since rehabilitation of the medium wave radio broadcasting system will make it possible to provide stable medium wave radio broadcasts and information on disasters and lifestyle to the entire area of the Republic of Fiji (excluding Rotuma Island), the Government of Japan consigned implementation of the preparatory survey.

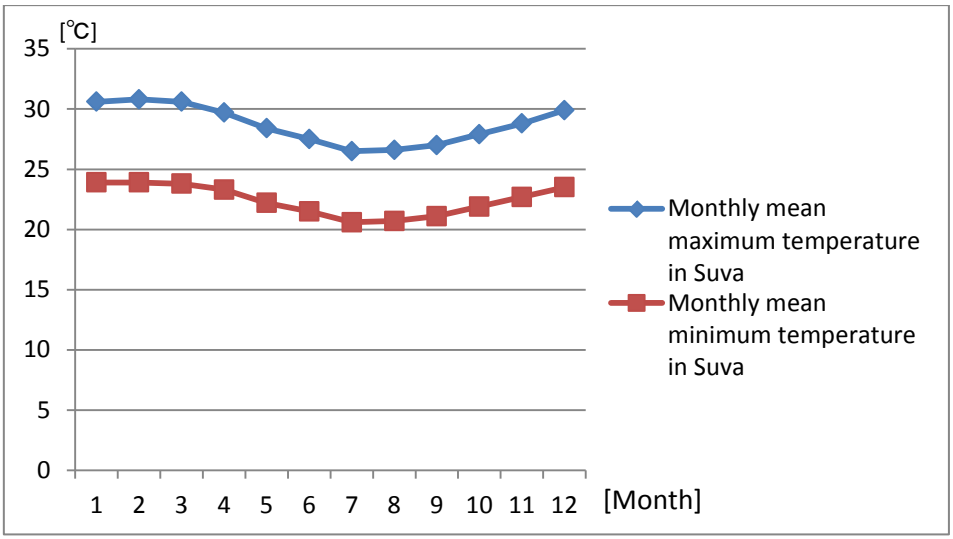
1-1 Natural Conditions

(1) Geography

The Republic of Fiji, located in the south central Pacific Ocean west of Australia, is an island nation covering a wide area, mostly ocean, stretching from latitude 12 to 21 degrees south and longitude 177 to 175 degrees east. The combined area of land is 18,270 square kilometers (2011, Pacific Islands Centre), which is approximately the same area as Shikoku in Japan. The main island of Viti Levu, where the capital Suva is situated, has an area of 10,390 square kilometers, and the second largest island is Vanua Levu with an area of 5,538 square kilometers. Viti Levu has mountains that reach altitudes over 1,300 meters and influence the weather conditions.

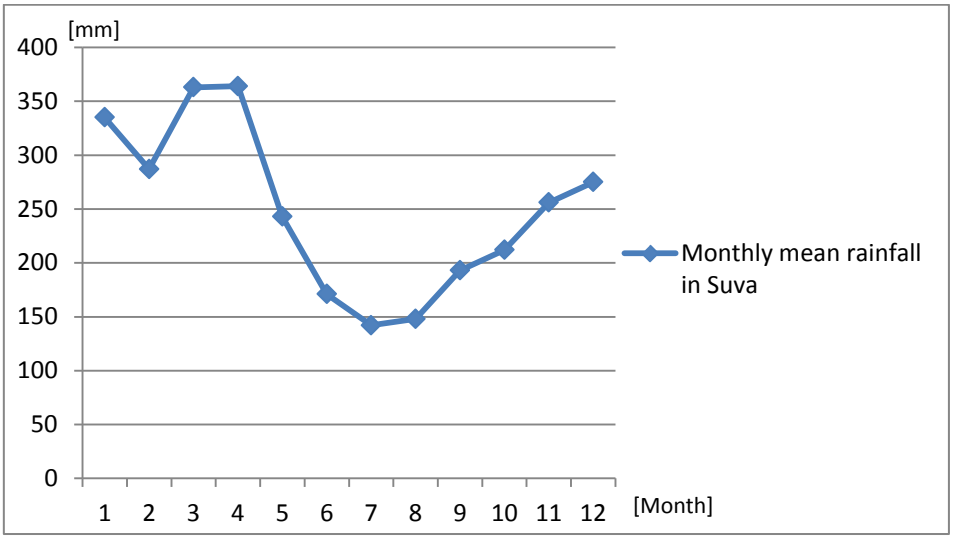
(2) Climate

The Republic of Fiji has a marine tropical climate. Southeasterly trade winds constantly blow on Vitu Levu where the Project site is located, but winds are not very strong except during the cyclone season from October to March. Temperatures remain almost constant. During the day, temperature is approximately 2 degrees higher on the downstream side of the island (northwest) compared to the upwind side (southeast), but humidity is lower. Due to the ocean influence, daily changes and seasonal fluctuations in temperature are small in coastal areas. The average temperature disparity between the coolest season (July and August) and hottest season (January and February) is only around 2 to 4 degrees. According to Fiji Meteorological Service (FMS), the extreme lowest temperature in the Republic of Fiji is 8 degrees and the highest is 39.4 degrees. Precipitation fluctuates greatly due to the influence of trade winds and terrain. Seasons in the Republic of Fiji comprise the rainy season (October~ April) and the dry season during the other months of the year, and localized torrential rain sometimes falls in the rainy season. In particular, a lot of rain falls on Viti Levu during the rainy season, but conversely water shortages sometimes arise on the northwest side in the dry season. In the areas with low rainfall, annual precipitation is around 2,000 millimeters, but this increases to 3,000 millimeters in coastal parts and 6,000 millimeters in the mountains. Since the Republic of Fiji is situated on the cyclone path, it is frequently experiences cyclones between November and March. On average, damage occurs once or twice a year, and serious damage occurs once every two years. Figure 1-1-1 shows the mean monthly maximum temperatures, and Figure 1-1-2 shows mean monthly rainfall.



Source: FMS data (mean for 1942-2011)

Figure 1-1-1 Monthly Mean Maximum and Minimum Temperatures



Source: FMS data (mean for 1942-2011)

Figure 1-1-2 Monthly Mean Rainfall

(3) Survey of Natural Condition Resources

1) Topographic survey and Soil investigation

Simple boring and Simple penetration test were conducted at the site of new Transmitter house. Boring and Standard penetration test were conducted at the site of new antenna. Bearing capacity obtained at the bottom of foundation of new transmitter house (about 1.0 m depth from ground level) is approximately 10.0 t / m2, and based on the result, it is possible to design by using strip footing.

On the other hand, since the ground surface of the antenna site is soft, it is necessary to design

by using pile foundation. Necessary N value for design of pile foundation was confirmed by this survey, as Table 1-1-1 shows result of standard penetration test at the antenna site.

Table 1-1-1 Result of standard penetration test at the antenna site

Survey position	Depth (m)	N value
Foundation of antenna pole	10.5 - 15.95	39 - 57
Foundation of guy wire (east)	4.9 - 11.45	30 - 50
Foundation of guy wire (west)	5.0 - 11.45	34 - 46
Foundation of guy wire (north)	10.4 - 15.95	43 - 53

2) Site survey

As a result of site survey, the difference of elevation between new antenna site and new Transmitter house site is approximately 15 m. Therefore, it is confirmed necessity to set access road for construction vehicle on sloping land between both site to conduct pile work, concrete work and installation work at antenna site.

3) Road

Width of public road to access the Project site is about 6 m. The elevation between public road and new Transmitter house site is a slight different and it should not be a problem for a construction road.

1-2 Environmental and Social Consideration

The Project intends to renew existing equipment, with the removal of existing equipment and installation of new equipment taking place on the grounds of FBC Naulu Transmitting Station. As a result of quantity surveying, since it is deemed to be not necessary to cut trees (mainly coconut trees) inside the site grounds and it is possible to secure the same distance as present from neighboring residents (two houses), there should be no problems, although it will be necessary to conduct following administrative procedures with related agencies in a timely manner, since the procedures exert crucial influence on the progress of the Project. Following procedures should be finished by the end of April 2015, as a condition for the implementation of the Project.

(1) Environmental and social consideration assessment:

As the removal work of existing facilities and installation of new ones are planned on the FBC site, it is unlikely that implementation of the Project will cause negative impact on the environment or resettlement of residents. However, in line with a regulation for the construction work in the Republic of Fiji, it is required to undergo an Environmental and social consideration assessment by the Department of Environment (hereinafter referred to as "DOE"). DOE had already conducted the preliminary survey (DOE Ref 5/1/1/A (VI) 21/02/2014) for Environmental Impact Assessment (EIA) in the construction and

environmental management plan. Besides, based on the request from FBC with detailed plan of the Project including design drawings of the new antenna and transmitter house, DOE is planning to conduct a field investigation in the upcoming weeks. As a result of the survey, written approval from a standpoint of environmental impact should be given to FBC by DOE.

(2) Assessment by the Civil Aviation Authority of Fiji (CAAF):

The existing antenna is not situated on any aircraft take-off or landing paths and does not infringe any legislation or regulations. The Civil Aviation Authority of Fiji (hereinafter referred to as "CAAF") mentioned that no restriction would be imposed on the new antenna found at 300 meter away from the existing antenna in the FBC site and with same height (60 meters) as the existing antenna. However, in light of the Aviation Law of the Republic of Fiji, it is required to undergo an Aviation Impact Assessment by CAAF, and as a result, written approval for the construction of the new antenna should be given to FBC by CAAF.

(3) Application for building authorization:

With regard to building legislation, it is required to apply for building authorization to Nausori Town Council in terms of the construction of new antenna and transmitter house, and as a result, written approval as a building permits should be given to FBC by the Council.

CHAPTER 2 CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) Overall Goal and Project Objectives

In the state development strategy of the Republic of Fiji, the information and communications sector is targeted as a mean for planning of priority activities. Within this, the Government of the Republic of Fiji views media as a st rategic partner and aims to convey government information all over the Republic of Fiji via the major media channels. Moreover, since land of the Republic of Fiji is prone to natural disasters including cyclones and flooding, the government gives priority to mitigating disaster risks and conducting disaster management. In this respect, it aims to enhance the disaster risk management through utilizing the roles of disaster response agencies and radio. Accordingly, the Government of the Republic of Fiji is hoping to establish medium wave radio broadcasting across the entire nation as a means of rectifying information disparities and delivering information to remote islands.

In light of this background, the Overall goal of this Grant Aid Project shall be as follows: “To provide, via public broadcasting, information related to disaster prevention, public health, education, agriculture, culture, etc. and thereby improve citizen’s wellbeing.” The Project goal towards this end shall be to “provide stable medium wave radio broadcasting services in the Republic of Fiji (excluding Rotuma Island) through constructing a medium wave radio broadcasting system.”

(2) Outline of the Project

After technical discussions held with FBC, the contents of the project will be as requested by the Republic of Fiji; however, from the viewpoint of equipment composition, the Project will be advanced upon rearranging these in the manner shown in Table 2-1-1. The table also shows a comparison with the contents requested by the Fijian Side at the time of the M/D of outline design survey indicated in Annex 3 Items.

Table 2-1-1 Contents of the Assistance Project

Description	Q'ty	Requirement mentioned in the MD
1. MW Antenna System (60 m, Umbrella Type, dual frequency antenna)	1 lot	・ Transmitting Antenna (Two-wave common use) ・ Diplexer/Combiner ・ ATU (Two-wave common use) ・ Feeder Cable
2. Transmitter-1 (558kHz)	1 lot	・ Transmitter-1 (558 kHz) ・ Program Input Equipment (PIE) Rack System
3. Transmitter-2 (990kHz)	1 lot	・ Transmitter-2 (990 kHz) ・ Program Input Equipment (PIE) Rack System
4. Output Change-over Switch, Dummy Load	1 lot	・ Coaxial Patch Panel (U Link) ・ Dummy Load
5. Power Supply Equipment and Air Conditioning System	1 lot	Power Supply ・ Isolation and Lightning Protection Transformer ・ Automatic Voltage Regulator (AVR) ・ Primary Distribution Board (PDB) ・ Engine Generator ・ Air Conditioner
6. ISDN Codec	4 sets (8 units)	・ ISDN Codec
7. Maintenance Equipment and Tools	1 lot	・ Spare Parts (Maintenance Equipment and Tool)
8. Spare Parts	1 lot	
9. Consumable Parts	1 lot	・ Consumable Parts
10. Transmitter House	1 lot	・ Transmitter House

Source: Study Team

Concerning construction of the transmitter house, it will be included in the Installation Work of Transmitter.

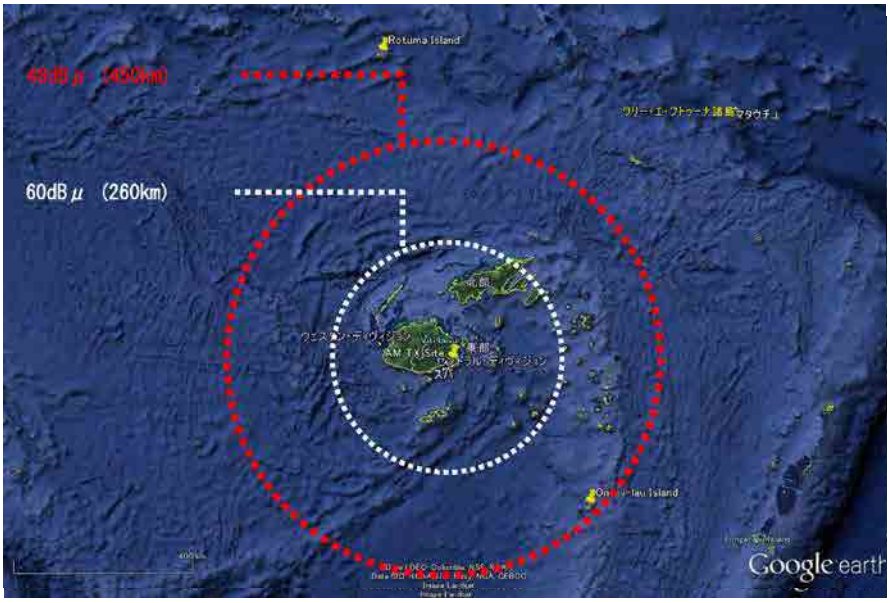
2-2 Outline Design of the Japanese Assistance

2-2-1 Design policy

(1) Basic Policy

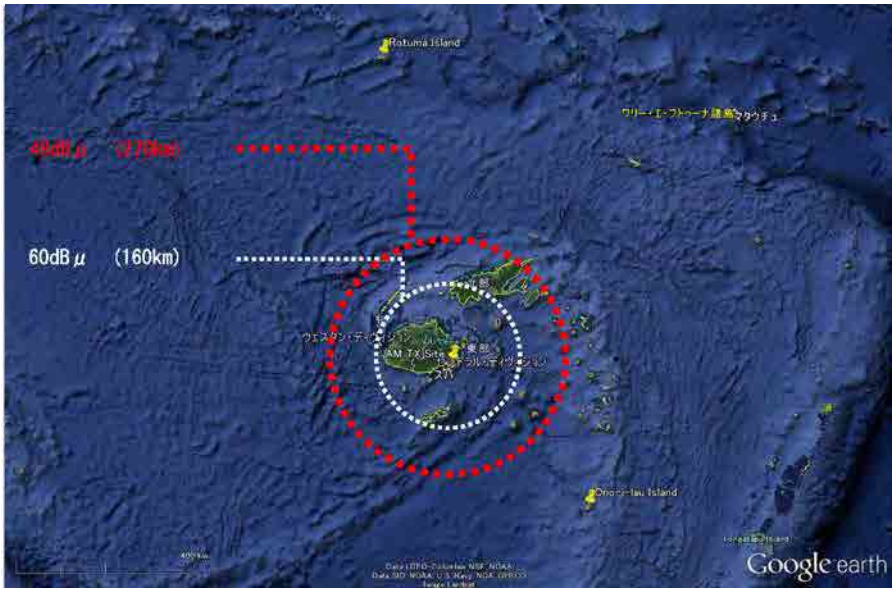
For remote islands in the Republic of Fiji, medium wave radio broadcasting is the sole means of conveying information; however, as mentioned earlier, because sufficient output cannot be secured due to equipment failures, broadcasts are unstable and confined to an extremely limited area. The Project aims to provide radio broadcasts across the whole area of the Republic of Fiji excluding Rotuma Island in the frequencies that have been registered with the International Telecommunication Union (ITU), i.e. 558 k Hz and 990 k Hz, and with transmission output of 10 kW, and it entails rebuilding a r adio Transmitter House and procuring and installing medium wave radio broadcasting equipment. Through the Project, the medium wave radio broadcasting system will be rehabilitated and stable medium wave radio

broadcasting will be provided to all over the Republic of Fiji (excluding Rotuma Island). Moreover, through providing the medium wave broadcasts on two different frequencies and preparing a method for transmitting between FBC headquarters and Naulu transmitting station, broadcasting reliability will be improved. The area to be covered by the medium wave radio service after the Project implementation is shown in Figure 2-2-1 and Figure 2-2-2.



1) Frequency	:558kHz
2) TX Output Power	:10kW
3) Antenna Height	:60m
4) Antenna Efficiency	:50%(-3dB)
5) Grand Conductivity	:30mS/m
(dBμ shows field strength)	

Figure 2-2-1 Coverage in the Case of Transmitter-1 (558 kHz)



1) Frequency	:990kHz
2) TX Output Power	:10kW
3) Antenna Height	:60m
4) Antenna Efficiency	:50%(-3dB)
5) Grand Conductivity	:30mS/m
(dBμ shows field strength)	

Figure 2-2-2 Coverage in the Case of Transmitter-2 (990 kHz)

(2) Policy regarding Radio Broadcast Programming

As was mentioned above, FBC is contracted by the government to provide programs on lifestyle information services produced by government ministries and agencies to citizens throughout the country. In the Project, it will be possible to broadcast programs using two different frequencies, and Table 2-2-1 shows the respective coverage and number of listeners of these two 558 kHz and 990 kHz broadcasts.

Table 2-2-1 Contents of Medium Wave Radio Broadcasting Stations in the Project

Frequency	Station Name	Primary Language	Coverage (48dBμ for Japanese standard)	The Number of Listeners
558 kHz	RF1	Fijian	More than 450 km	881,000 Fijian excluding Rotuma
990 kHz	Gold	English	More than 270 km	Approximately 870,000 Fijian

Source: Study Team

RF1 Station broadcasts disaster prevention, health education, agricultural and other lifestyle-linked information in the Republic of Fiji, and it is an essential source of information for people living on islands scattered over a wide area. On the other hand, Gold Station broadcasts domestic and international news contents and weather forecasts produced by FBC in English every hour, and it attracts many listeners. It also broadcasts live from the spot (jingles) and gives updates every 15 minutes when cyclones are approaching, and thereby makes a major contribution to disaster prevention. In the Project, since broadcasts will be made by combining two frequencies via a single antenna, it will be possible to transmit two programs simultaneously. Accordingly, even if one of the transmitters interrupts (for inspections or repairs), the broadcast may continue with the other transmitter, thereby achieving greater reliability.

(3) Policy regarding Natural Conditions

1) Temperature and Humidity

According to weather data obtained from FMS, the maximum temperature in the target area is 34.6 °C and the minimum temperature is 12.3 °C. Since the main items of medium wave radio broadcasting equipment to be procured in the Project will be used indoors in an air conditioned environment, it will not be necessary to take any special measures regarding outside temperature and humidity. However, regarding design of the indoor temperature, consideration will be given to secure the equipment performance and functions assuming the design outside temperature to be 35 °C and the maximum permissible temperature for all equipment to be 40 °C.

2) Salt Damage

The scheduled site for construction of the transmitter house and medium wave antenna in the Project is located approximately 5 kilometers from the coast; however, because they receive sea winds, salt-resistant specifications will be considered for the external walls, openings, antenna pole, air conditioner (outside parts), and other items exposed to outside air.

3) Seismic Conditions

There has been no record of large earthquakes in the Republic of Fiji: however, when designing the Transmitter House and antenna foundations and equipment to be constructed and installed in the Project, the National Building Code of Fiji and Japanese structural standards will be taken into account.

(4) Policy regarding Social Conditions

The ethnic composition of the Republic of Fiji is (is) 56.8% Melanesian, 37.5% Indian and 5.7% others, and the official languages are Fijian, Hindi and English. The islands of the Republic of Fiji are spread over a wide area of the South Pacific, and the majority of the citizens on the islands including the Lau Group, remote from the Viti Levu are of Melanesian descent. To ensure that programs can be effectively delivered to the citizens spread out over the wide area, consideration will be given to the distribution of citizens based on t heir language.

(5) Policy regarding Construction Conditions

In the Republic of Fiji, public and commercial facilities are medium-size buildings (10 stories or so), while most other buildings tend to be two-story of wood or block structures. Local construction companies have the capacity to build such medium-scale reinforced concrete structures, and are thus capable of undertaking construction of the Transmitter House and antenna foundations in the Project. There are no problems regarding procurement of construction materials, laborers, and heavy construction machinery; and concrete made from locally produced aggregate and river sand has sufficient quality. Quality standards for construction materials are based on Australian and New Zealand standards. Concerning safety management during the works, since the Project site is located on the outskirts of suburban residential areas of Suva, the works will not have a large effect on the local areas; however, ample care will need to be taken regarding fences and countermeasures to protect nearby residents and preserve the safety of workers.

(6) Policy regarding Procurement Conditions Including Third Countries

The Fijian side strongly hopes to introduce Japanese equipment that offers high quality and reliability and allows maintenance parts to be purchased locally via agents. Broadcasting equipment in the Republic of Fiji has until now been purchased with local funding, with many

of the major items composed of Japanese equipment, and the local engineers are used to operating and maintaining Japanese equipment. Therefore, basically Japanese products shall be adopted for the broadcasting equipment in the Project, while a third party products with a proven track record of use in broadcasting stations shall be used for items not handled by Japanese manufacturers. Table 2-2-2 shows the main items to be procured from third countries.

Table 2-2-2 Main Products to be Procured from Third Countries

Equipment	Procurement Country
・Audio Processor Amplifier ・Dummy Load ・ISDN Codec ・Impedance Bridge	DAC country

Radio broadcasting equipment such as transmitters and antenna does not function independently, but it only works functions following general adjustment of power sources, transmitters, antennas, etc. Therefore, based on the basic composition compiled by the Study Team, all the equipment items selected in the implementation stage will be coordinated by the Japanese equipment supplier to function as a single system, and the system performance will be assessed and confirmed before shipping and after installation in order to secure the overall system performance and quality.

(7) Policy regarding Equipment Grades

Broadcasting equipment is broadly divided into three based on their use: equipment for civilian use, equipment for professional use and equipment for broadcasting station use. Equipment for broadcasting station use is designed with a view to ensuring continuous operation, reducing failures and realizing a high degree of reliability and redundancy in circuitry. Concerning the Medium Wave (MW) antenna system, transmitters, etc. that are key to broadcasting station operation, the Project will select equipment for the broadcasting station use.

(8) Policy regarding Procurement Method and Works Period

Equipment procured in Japan or third countries will primarily be transported to the Republic of Fiji by sea shipping. It takes around 30 minutes by car from Suva Port to the Project site of FBC Naulu Transmitting Station, and there are no particular problems regarding this overland transportation. Transportation from Japan to the Project site will require about 50 days. Moreover, before the Japanese side starts work on construction of the Transmitter House and the antenna foundations, it will be necessary for the Fijian side to secure the Transmitter House and the antenna sites for, complete the necessary administrative procedures, and provide a temporary storage area, work area, and waste dump site. Also, the Fijian side will

need to finish removing the existing antenna after the installation of the new antenna and before antenna adjustment and test the broadcasting. To ensure that the Fijian side implements these works without delay, care will be taken by preparing an efficient staffing plan that enables the consultant supervisor to give appropriate advice and guidance to the counterparts.

(9) Policy regarding Telecommunications Situation

Concerning the program transmission line for transmitting between FBC headquarters and the existing Transmitter House of Naulu Transmitting Station, conventionally programs have been transmitted along a micro line to the Nakobalevu TV/FM transmitting station, and FM broadcasts from the transmitting station are received and used as the signal source for the medium wave transmitter. Micro line is used on part of the program transmission route; however, since the effects of strong winds on the parabola antenna used in the micro line sometimes leads to interruptions of the broadcasts, this system is prone to cyclones or other disasters. In the Project, it is planned to provide a reliable program transmission system resistant to weather conditions through using an ISDN line in an underground telecommunication cable as the means of transmitting programs. Though the ISDN line is maintained by TELECOM Fiji, IP line will be allocated instead of ISDN line as a reliable mean of transmitting programs in case ISDN line has not enough capacity.

(10) Policy regarding Antenna

1) ITU Registration Contents

Naulu Transmitting Station, which is the target of the Project, has undergone the ITU registration procedure to conduct transmission at frequencies of 558 kHz and 990 kHz and output of 10 kW with an antenna height of 60 meters. Based on the registered contents with ITU, the new antenna will have the same height (60 meters) as the existing one.

2) Height of Antenna

CAAF says that it will impose no restrictions on the new Project antenna, provided that it will be the same location and have the same height (60 meters) as the existing antenna. Before the Project is implemented, the Study Team will submit the necessary antenna drawings, etc. to FBC for assessment. The CAAF will give its consent for the new antenna after confirming that the application contents are the same as the existing antenna.

3) Policy regarding Shape of Antenna

It has been confirmed based on the ITU standard field intensity chart that the planned medium wave radio broadcasting in the Project will be conducted at frequencies of 558 kHz and 990 kHz and output of 10 kW with an antenna height of 60 meters and will cover all of the Republic of Fiji apart from Rotuma Island, and it is envisaged that broadcasts will even be receivable in the Riau Islands, which are about 400 kilometers from Naulu Transmitting

Station. Since the transmitting station is only around 4 kilometers from Nausori International Airport and the antenna height registered with ITU is 60 meters, out of three possible antenna shapes (T-shaped antenna, umbrella-type base-insulated antenna, supported by guy wires with top loading), the umbrella-type base insulated antenna, which has a proven track record in Oceania, shall be adopted in consideration of past performance, electrical efficiency, maintenance, etc.

4) Antenna Site

The antenna site which is required a radial earth line of 120 meters diameter is located on flat land down the hill on the north side of the existing Transmitter House. This site has been selected to ensure that broadcasting from the existing antenna can continue during the works. Because this site is a marshy zone, the earth has good conductivity and high efficiency can be expected from the antenna; however, it will be necessary to take measures to ensure that work can be implemented on the marshy land when executing the foundation works. Moreover, because the new antenna site is situated roughly 15 meters below the existing Transmitter House, it will be necessary to construct a temporary access road for work vehicles. The new antenna will be roughly 300 meters away from the existing one; however, ample earth working will need to be taken to ensure that operators and work vehicles are not at risk of electrical shock caused by electromagnetic induction during the antenna building works. Through implementing such countermeasures during the prolonged antenna foundation and building works period, it will be possible to continue broadcasting medium wave radio programs from the existing antenna. However, when implementing the general adjustments and testing transmission from the antenna, since the existing antenna will be an obstruction, it will first be necessary to remove it.

Since it won't be possible to conduct medium wave radio broadcasting during the period between removal of the existing antenna and start of broadcasting by the new antenna, FBC has been advised to give an advance notice and advertising campaign of the Project to listeners and to encourage the use of FM broadcasts and mobile phone texts for obtaining information in the event of disasters.

5) Adjustment and Test broadcasts

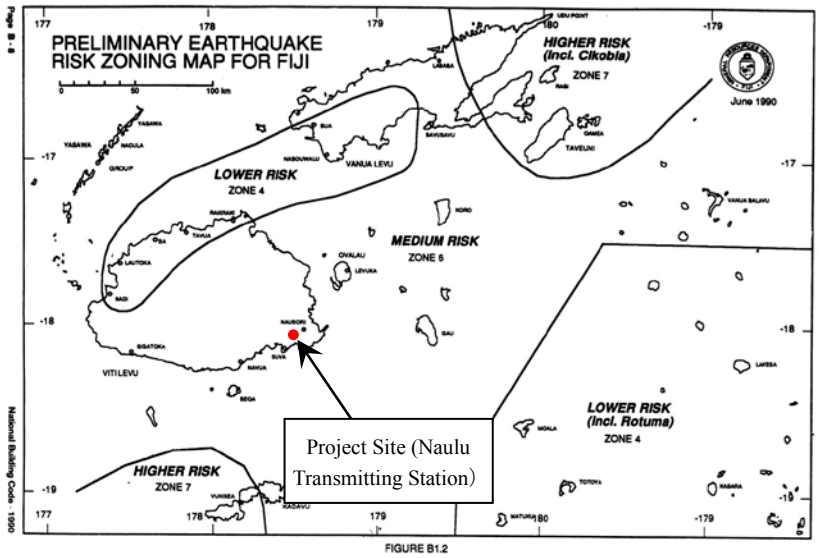
Since the frequency of existing antenna and new one is same, to avoid interference to measurement data by existing antenna when adjustment and test broadcasts will be conducted, it is necessary to demolish existing antenna. Thus it will need to interrupt MW radio broadcasting for two months between after demolishing existing antenna and before start broadcasting by new antenna, and existing antenna shall be demolished to avoid interruption the broadcast in cyclone season (October to March) Ministry of Public Enterprises and FBC will be needed to make a public announcement for advertisement of new MW radio broadcasting and notice of an interruption of MW radio broadcasting during a transition

period from the old MW radio system to new one in advance.

(11) Policy regarding the Transmitter House

1) Policy regarding Structure of Transmitter House

The existing Transmitter House at Naulu Transmitting Station is too deteriorated to be used for operating the new transmitter to be installed under the Project. However, since the existing building is used for purposes other than medium wave radio broadcasting, it needs to be retained. Moreover, it will be necessary to keep appropriate length of the existing high frequency power cable for connecting the planned antenna to the transmitter installed in the new Transmitter House to be built next to the existing one. The new Transmitter House will be a single story building composed of transmitter room, generator room, and maintenance room; considering that cyclones hit the area every year, the structure will be reinforced concrete with partial concrete block masonry. The seismic coefficient and wind force used in the structural design will be according to the National Building Code Fiji, meaning a seismic coefficient of Zone 6, which is 0.6 (see Figure 2-2-3) and a wind velocity of 57 m/s, and the structural will be designed according to the Japanese structural standard.



Source: National Building Code Fiji

Figure 2-2-3 Building Standard Zones

(12) Policy regarding Power Supply Equipment

Since the Project Transmitter House will contain two 10 k W transmitters with improved transmitter efficiency, capacity of the emergency generator installed in the new Transmitter House will be downsized from 145 k VA to 65 k VA. Commercial power supply to the new Transmitter House will be supplied from the low voltage power source (AC415 V) of the existing step-down transformer.

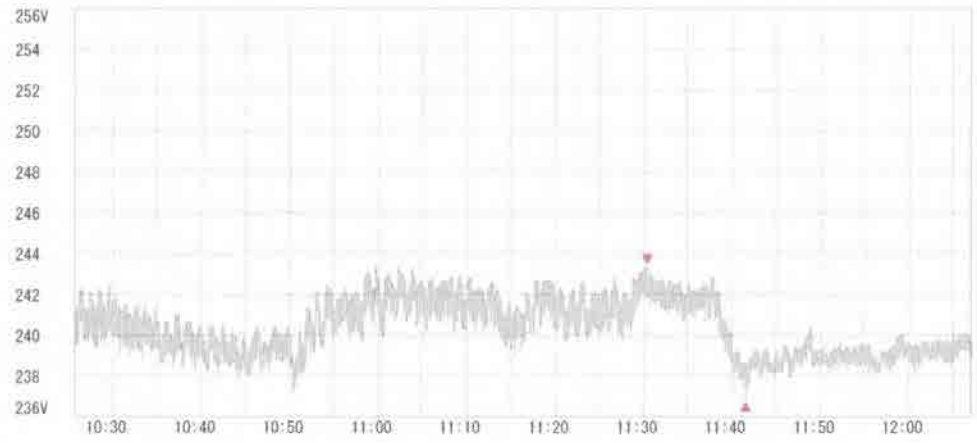
The Study Team measured voltage in the existing Transmitter House of the commercial power supply system that is currently conventionally used.

Measurement site: Transmitter room of the existing Transmitter House

Measurement period: October 2, 2014, from 10:15 to 12:05

Results: See Figure 2-2-4

Observations: Nominal voltage in the Republic of Fiji is 240 V (single phase), and the measured voltage varies from 236.8 V to 243.4 V. Although there were no power interruptions of note, the Team saw how the voltage can vary over the short term. Such voltage fluctuations have an adverse impact on the electronic circuitry of broadcasting equipment and can lead to abnormal heating, malfunction, failure and so on. Accordingly, installing an AVR (automatic voltage regulator) possessing enough capacity to satisfy the power consumption of the equipment will be planned on the power source side of the equipment installed in the new Transmitter House.



Max.: 243.4V (October 2, 2014,11:30)

Min.: 236.8V (October 2, 2014.11:42)

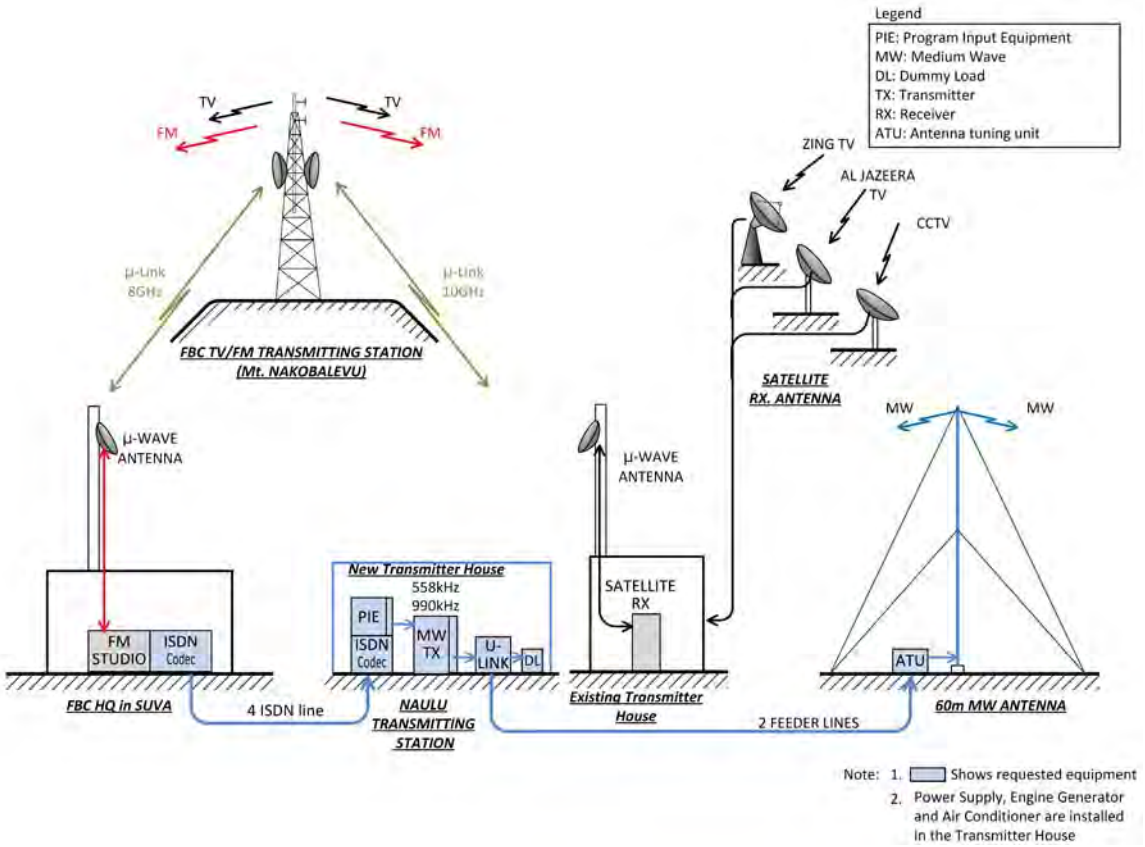
Measuring place: Transmitter House

Source: Study Team

Figure 2-2-4 Voltage Measurement results in the Existing FBC Transmitter House

(13) Outline of the Target Project

Figure 2-2-5 shows the outline of the Project.



Source: Study Team

Figure 2-2-5 Project Outline

2-2-2 Basic Plan (Construction Plan/Equipment Plan)

(1) Design Conditions

1) Weather and Site Conditions

(weather data shows mean values between 1942–2011 obtained from FMS)

(a) Site altitude (altitude above sea level)

- Transmitter house: 21 m
- MW antenna zone: 6 m

(b) Site power supply: AC 415 V (3 phase), 240 V (single phase), 50 Hz

(c) Temperature (annual mean)

- Low temperature: 22.4 °C
- High temperature: 28.7 °C

(d) Humidity (annual mean): 80.8%

(e) Mean wind velocity (annual mean): 5 m/s

(f) Climate

- Rainy season: October to March
- Dry season: April to September

(g) Mean rainfall (annual mean): 249 mm

2) Applicable Standards

	Name of Standard	Application
(a)	International Electrotechnical Commission (IEC)	Main functions of electrical goods in general
(b)	International Standardization Organization (ISO)	Performance of industrial products in general
(c)	Japanese Industrial Standards (JIS)	Industrial products in general
(d)	Japanese Electrotechnical Commission (JEC)	Electrical goods in general
(e)	The Standard of Japan Electrical Manufacturer's Association (JEM)	Same as above
(f)	Japan Electric Association Code (JEAC)	Same as above
(g)	Japan Cable Makers' Association Standard (JCS)	Electrical wires and cable
(h)	Electrical Industrial Association of Japan (EIAJ)	Electrical goods in general
(i)	International Telecommunication Union (ITU)	Electrical goods in general
(j)	Society of Motion Picture and Television Engineers (SMPTE)	Broadcasting equipment in general
(k)	Other related Japanese and International standards such as AES/EBU (Audio Engineering Society/ European Broadcast Union)	Industrial products in general
(l)	International Civil Aviation Organization (ICAO)	Antenna Mast
(m)	Electronic Industries Alliance of the U.S.A (EIA)	Same as above
(n)	Japanese Building Code and Standards	Building design
(0)	National Building Code Fiji	Building design, Tower design
(P)	Standards Document Aerodromes Civil Aviation Authority of Fiji	Tower design

(2) Building (Transmitter House) Plan

1) Plan Outline

Room sizes inside the Project transmitter house have been determined on condition that the minimum required area for the equipment to be installed is secured. The plan outline is indicated below.

Outline of Plan			
Transmitter house	(1) Area:	Transmitter Room:	28.0 m^2
		Engine Generator Room:	17.5 m^2
		Maintenance Room:	10.5 m^2
		Total:	56.0 m^2
	(2) Eaves height:	GL＋4.6 m	
	(3) Structure:	RC single story structure with concrete block walls	
	(4) Building Facility:	Electrical Facility: AC Power Inlet and Distribution Panel, Lighting, Ventilation	

2) Structural Plan

The structural form of the transmitter house will comprise reinforced concrete pure frames single story structure with continuous footing.

3) Finishing Plan

In order to control the room temperature due to the heat radiation from the transmitter, the transmitter room will be equipped with an air conditioner. Moreover, concrete roof and external concrete block walls (t = 200) will be adopted to enhance heat insulation and air tightness of the room. Because the Republic of Fiji is an island country surrounded by ocean, stainless steel doors and aluminum windows will be adopted for exterior fittings in consideration of rusting. The specifications and finishing contents of each room are as indicated below.

Finishing Schedule		
Transmitter house	Common for Transmitter Room, Generator Room and Maintenance Room	
	Floor:	Mortar steel Trowel, protection against dust coating
	Base Board:	Mortar steel Trowel, protection against dust coating
	Wall:	Mortar steel Trowel, painting
	Ceiling:	Concrete finishing (with repair)

(3) Equipment Plan

1) MW Antenna System

Based on the contents of the application to ITU, the antenna pole will be 60 meters high. Concerning the type of antenna, as mentioned earlier, the umbrella-type base-insulated antenna will be adopted in consideration of cost, performance and electrical efficiency. Underground radial earth will be installed in order to sustain the propagation efficiency of the broadcasting waves. Also, OB Lighting System will be installed on the antenna pole to ensure the safety of the aircraft operation.

2) 10 kW MW Transmitter

Basically, the two 10 kW output transmitter, 558 kHz transmitter and 990 kHz transmitter, are registered with the ITU are planned. It is intended to cover all area of the Republic of Fiji (excluding Rotuma Island) using the output of the 558 k Hz transmitter. The 990 k Hz transmitter will have a slightly smaller service area; however, because it will be able to broadcast to the surrounding islands such as Viti Levu and Vanua Levu, it will be useful for conducting broadcasts in two languages. Since the Fijian side plans to utilize medium wave radio broadcasting for disaster prevention, the Project plans to install highly reliable medium wave transmitters used in Japan for broadcasting facilities.

3) Transmitter Power Source and Air Conditioning Equipment

Since the city power supply to the Transmitter House is prone to short-term voltage fluctuations, an AVR (automatic voltage regulator) will be installed in order to prevent negative impacts on the broadcasting equipment. Also, to ensure that radio broadcasts are not interrupted by power interruptions, an emergency generator capable of allowing around 10 hours of continuous operation will be installed.

Also, in order to cool the heat generated by transmitters, a separate air conditioning system will be installed in the Transmitter House.

4) Measurement Devices and Tools for Maintenance

The minimum necessary measurement devices and special tools necessary for performing routine maintenance of the Project transmitters and antenna system, etc. will be procured.

5) Spare Parts and Consumable Parts

The Project will procure spare parts and consumable parts necessary for a year or until the first equipment failure. The spare parts will comprise units and Power FET, etc.

2-2-3 Outline Design Drawings

Table 2-2-3 shows the composition of the Project broadcasting equipment, and Table 2-2-4 shows the outline design drawings.

(1) Equipment Composition

Table 2-2-3 Equipment Composition

No.	Description	Q'ty
1	**MW Antenna System (60m, Umbrella Type, dual frequency antenna)**	
1.1	Antenna System	1 set
1.2	OB Lighting System	1 set
1.3	Radial Earth	1 set
1.4	Diplexer with Antenna Tuning Unit (ATU)	1 set
1.5	ATU Compartment	1 set
1.6	Auxiliary Material for ATU Compartment	1 set
1.7	Coaxial Feeder	2 sets
1.8	Dehydrator	1 set
2	**Transmitter-1 (558kHz)**	
2.1	10kW Medium Wave Transmitter (558kHz)	1 set
2.2	Program Input Equipment (PIE) Rack	
(1)	Audio Processor Amplifier	2 sets
(2)	Control Panel (Input Select Switch, Meter Panel and Monitor Switcher)	1 set
(3)	Monitor Amplifier	1 set
(4)	Monitor Speaker	1 set

No.	Description	Q'ty
(5)	ON AIR Monitor Receiver with Receiving Antenna	1 set
(6)	Audio Input Panel	1 set
(7)	NFB Panel	1 set
(8)	Rack	1 set
3	**Transmitter-2 (990kHz)**	
3.1	10kW Medium Wave Transmitter (990kHz)	1 set
3.2	Program Input Equipment (PIE) Rack	
(1)	Audio Processor Amplifier	2 sets
(2)	Control Panel (Input Select Switch, Meter Panel and Monitor Switcher)	1 set
(3)	Monitor Amplifier	1 set
(4)	Monitor Speaker	1 set
(5)	ON AIR Monitor Receiver with Receiving Antenna	1 set
(6)	Audio Input Panel	1 set
(7)	NFB Panel	1 set
(8)	Rack	1 set
4	**Output Change-over Switch, Dummy Load**	
4.1	Output Change-over Switch (5 Port U-link)	1 set
4.2	Dummy Load	1 set
5	**Power Supply Equipment and Air Conditioning System**	
5.1	65kVA Engine Generator with Fuel Tank	1 set
5.2	Control panel with Automatic Change-over Switch	1 set
5.3	65kVA Automatic Voltage Regulator & Primary Distribution Board (PDB)	1 set
5.4	65kVA Isolation and Lightning Protection Transformer	1 set
5.5	Air Conditioning	2 sets
6	**ISDN Codec**	
6.1	ISDN Codec	4sets (8units)
7	**Maintenance Equipment and Tools**	
7.1	Distortion Meter/Oscillator	1 set
7.2	Audio Attenuator	1 set
7.3	Oscilloscope	1 set
7.4	Frequency Counter	1 set
7.5	Circuit Tester	1 set
7.6	Impedance Bridge, Receiver / Generator	1 set
7.7	Field Strength Meter	1 set
7.8	Tool Kit	1 set
8	**Spare Parts**	
8.1	PA Module for Transmitter (1pc each type)	2 set
8.2	Power FET for PA Module	2 set
8.3	RF Driver Unit for Transmitter	2 set
8.4	Power Supply Module for Transmitter (1pc each type)	2 set
8.5	Control Board for Transmitter	2 set
8.6	Monitor Board for Transmitter	2 set

No.	Description	Q'ty
8.7	Printed Board for AVR	1 set
8.8	Maintenance Kit for Antenna System	1 set
9	**Consumable Parts**	
9.1	Fan unit for Transmitter	10 sets
9.2	Air Filter for Transmitter	10 sets
9.3	Fuse for Transmitter	10 sets
9.4	Surge Absorber for Isolation Transformer	5 sets
9.5	Limp for OB Lighting System	5 sets
9.6	Fuse for PIE	10 sets
9.7	Fuse for AVR	5 sets

(2) Outline Design Drawings

The outline design drawings for the equipment targeted in the Project are indicated below (refer to Appendix-5. Outline Design Drawings).

Table 2-2-4 Outline Design Drawings

Dwg No.	Dwg Title
G-01	Site Location /Site Plan
S-01	Block Diagram of MW Transmitting System
MA-01	MW Antenna Layout
MA-02	MW Antenna Elevation
A-01	New Transmitter House Site Plan
A-02	New Transmitter House Floor Plan
A-03	New Transmitter House Elevation /Section

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project will be implemented based on the Government of Japan's Grant Aid scheme. Therefore, it will be implemented after approval is granted by the Government of Japan and the Exchange of Notes (E/N) and the Grant Agreement (G/A) are signed by the Government of Japan and the Government of the Republic of Fiji. The following paragraphs describe the basic items and points that require particular consideration when implementing the project.

(1) Project Implementing Agency

The Project implementing agency on the Fijian side is FBC, while the Ministry of Public Enterprises, which has jurisdiction over FBC and other public enterprises, is the Project responsible agency. The implementing department in FBC is the Engineering Department, which will execute the Project and also be in charge of equipment operation and maintenance. Therefore, in order to smoothly advance the Project, it will be necessary for FBC Engineering Department to conduct close liaison and discussions with the Japanese consultant and

contractor and appoint personnel in charge of the Project.

(2) Consultant

In order to implement the procurement and installation of equipment in the Project, the Japanese consultant will conclude a design supervision contract with FBC and implement the implementation design and execution supervision. Also, the consultant will prepare tender documents and conduct the tender on behalf of FBC (the Project implementing agency).

(3) Contractor

In accordance with the framework of the Government of Japan's Grant Aid scheme, the Japanese contractor that has been selected by the Fijian side in competitive tender will implement the facilities construction, equipment procurement and installation works, and technical guidance (OJT) of the Project. Since it will be necessary to continue supplying spare parts and conducting post-installation service to resolve breakdowns and so on after the completion of the Project, it will be necessary to establish a liaison setup with FBC after the handover of the equipment.

(4) Necessity for Dispatch of Engineers

The equipment to be procured in the Project comprises precision instruments for using in broadcasting stations, and it will be inspected in Japan before shipping it to the Republic of Fiji. Therefore, because high-level technology will be needed to install the Project equipment and conduct post-installation testing, adjustment, etc., it will be necessary to dispatch engineers from Japan to carry out control, technical guidance and schedule control activities.

2-2-4-2 Implementation Conditions

It is possible to secure laborers for construction works in the Republic of Fiji; however, there are few skilled workers or engineers specialized in schedule, quality, safety, etc. control technologies. Therefore, it will be necessary for the Japanese contractor to dispatch skilled workers and engineers from Japan to the Republic of Fiji as the need arises. As for the construction equipment, machines required for the inland transportation and installation of equipment, aggregate, etc. required for the concrete works and so on, can be procured in the Republic of Fiji.

Moreover, because FBC will need to keep broadcasting cyclone warnings, etc. while the works are in progress, FBC wants to use the existing antenna for as long as possible. If the existing antenna is retained and the new antenna is constructed on an adjoining site, the workers will be a risk electrical shock of current arising from electromagnetic waves in the existing antenna flowing to the new antenna. Therefore, the impact of electromagnetic waves will be mitigated through building the new antenna as far from the existing one as possible, and the following safety measures will be taken regarding metal equipment, tools, etc. to protect workers from electrical shock:

(1) Electrical charging of metal objects will be prevented through connecting the base of the new antenna to ground.

(2) Heavy machinery such as crane, pile driver, winch, etc. will always be grounded. Also, grounding will be definitely conducted around temporary structures, such as scaffolding.

(3) The use of heavy machinery that utilizes computers, if any, use will be limited in order to prevent malfunctions and functional stoppages.

(4) Workers will limit skin exposure to a minimum, and they will always wear rubber or leather gloves when they need to touch metal.

(5) When connecting steel to steel, generation of sparks caused by electrical discharge will be prevented by making electrical contacts by using booster cable, etc.

(6) Use of metal measuring tape, etc. will be prohibited. When carrying steel and members that cause induced voltage, care will be taken to carry them horizontally and so on.

Even after taking the above measures, since it will be necessary to eliminate effects from the new antenna when making adjustments, it will be necessary to remove the existing antenna upon temporarily interrupting the broadcasts.

2-2-4-3 Scope of Works

The Japanese side will be responsible for construction of the Transmitter House and procurement and installation of broadcasting equipment, while the Fijian side will be responsible for removing existing equipment and securing power and ISDN lines and so on. Table 2-2-5 shows the scope of works on the Japanese and the Fijian sides.

Concerning the securing of power and ISDN lines and the implementation of test broadcasts, which are the responsibilities of the Fijian side, since these include contents that are linked to handling of the Project equipment, the equipment supplier will offer appropriate advice to the Fijian side.

Table 2-2-5 Scope of Works

No.	Items	Responsible		Remarks
		Japan	Fiji	
1	To confirm land registration and its property, and permission for the implementation of the Project and to clear the site		●	
2	To bear the following commissions paid to the Japanese bank for banking services based upon the Banking Arrangement (B/A)		●	
	1) Advising commission of Authorization to pay (A/P)		●	
	2) Payment commission		●	
3	To ensure prompt unloading and customs clearance at the port(s) of disembarkation, and internal transportation in the recipient country			
	1) Marine or Air transportation of the procured equipment and components from Japan and/or third countries to the recipient country	●		
	2) Tax exemption and customs clearance of the equipment and components at the port(s) of disembarkation in the recipient country		●	
	3) Internal transportation of the equipment and components from the port(s) of disembarkation to the project site in the recipient country	●		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted/be borne by the Authority without using the Grant		●	
5	To accord Japanese physical persons and / or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●	
6	To maintain and use properly and effectively the facilities constructed and the equipment provided under the Grant Aid		●	
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●	
8	To give due environmental and social consideration in the implementation of the Project (Obtain document for permit of EIA, ITU, Civil Aviation and Construction etc. for proposal building site.)		●	
9	To provide the power supply from the existing substation to the new Transmitting House		●	
10	To secure sites for the installation of the equipment, material storing yard, temporary construction yard and waste disposal site		●	
11	To provide four (4) ISDN lines (including two (2) spare lines) for radio program between existing studio and new Transmitting House		●	
12	Procurement of the Equipment			
	1) Materials for Transmitting House	●		

No.	Items	Responsible		Remarks
		Japan	Fiji	
	2) Materials for Antenna foundation, building and radial earth	●		
	3) Antenna system including Antenna Tuning Unit (ATU) components, engine generator and air conditioning	●		
	4) Transmitter system and ATU	●		
13	To remove designated equipment and obstacles from the Project site		●	
14	To demolish the existing Antenna, feeder, foundation and leveling the site		●	
15	To construct the following facilities and install the equipment			
	1) The Transmitting House and Antenna (including the safety gate and fence around the Antenna pole, leveling the Antenna site)	●		
	2) The security gates and fences around the Transmitting House and allocation of security guard(s) in the site (excluding the safety gate and fence around the Antenna pole)		●	
	3) The temporary road within the site for construction of the Transmitting House and Antenna	●		
	4) The road outside the site if necessary		●	
	5) The parking lot if necessary		●	
16	To secure enough budget and personnel necessary for the operation and maintenance and test broadcasting of the facilities constructed and the equipment provided under the Grant Aid, including the periodical maintenance work after the completion of the Project		●	
17	To make a public announcement for advertisement of New MW radio broadcasting and notice of an interruption of MW radio broadcasting during a transition period from the old to the new MW radio system by TV, radio and newspaper.		●	

Note: ● denotes the side responsible for the work.

2-2-4-4 Consultant Supervision

(1) Basic Policy of Consultant Supervision

The consultant has the obligation to organize a project team in charge of the Project affairs and to smoothly execute the implementation design and the supervision work in accordance with the contents of the Government of Japan's Grant Aid cost estimation manual and the basic design. The consultant will dispatch specialist engineers according to the progress of the equipment installation works, onsite test and adjustment works, etc., and it will guide and supervise the contractor and strive to control the schedule, quality, progress and safety based on the plan. Also, they have the obligation to implement pre-shipping inspections of the equipment and prevent any troubles from arising after the equipment has been transported.

The major points to bear in mind regarding consultant supervision of execution of the Project and procurement are described below.

1) Schedule Control

The consultant will compare the progress of the work with the implementation schedule decided by the contractor in the contract every month or every week in order to adhere to the delivery deadline given in the contract. In cases where delays are predicted, the procurement agent will warn the contractor and demand the submission and implementation of a plan of countermeasures. Comparison of the planned schedule and actual progress will mainly be based on the following items:

(a) Confirmation of works performance (plant manufacture and shipping performance)
(b) Confirmation of equipment delivery
(c) Confirmation of schedule according to the implementation schedule.

2) Quality Control

Quality will be carried out based on the following items to determine whether the procured equipment satisfies the required quality stated in the contract documents:

(a) Checking of equipment specifications
(b) Checking of shop drawings and specifications of equipment
(c) Attendance of plant inspections of equipment and checking of plant inspection results
(d) Checking of installation guidelines
(e) Checking of trial operation, adjustment, test and inspection guidelines of equipment
(f) Supervision of equipment installation works and witnessing of trial operation, adjustment and testing by the Japanese Supplier.

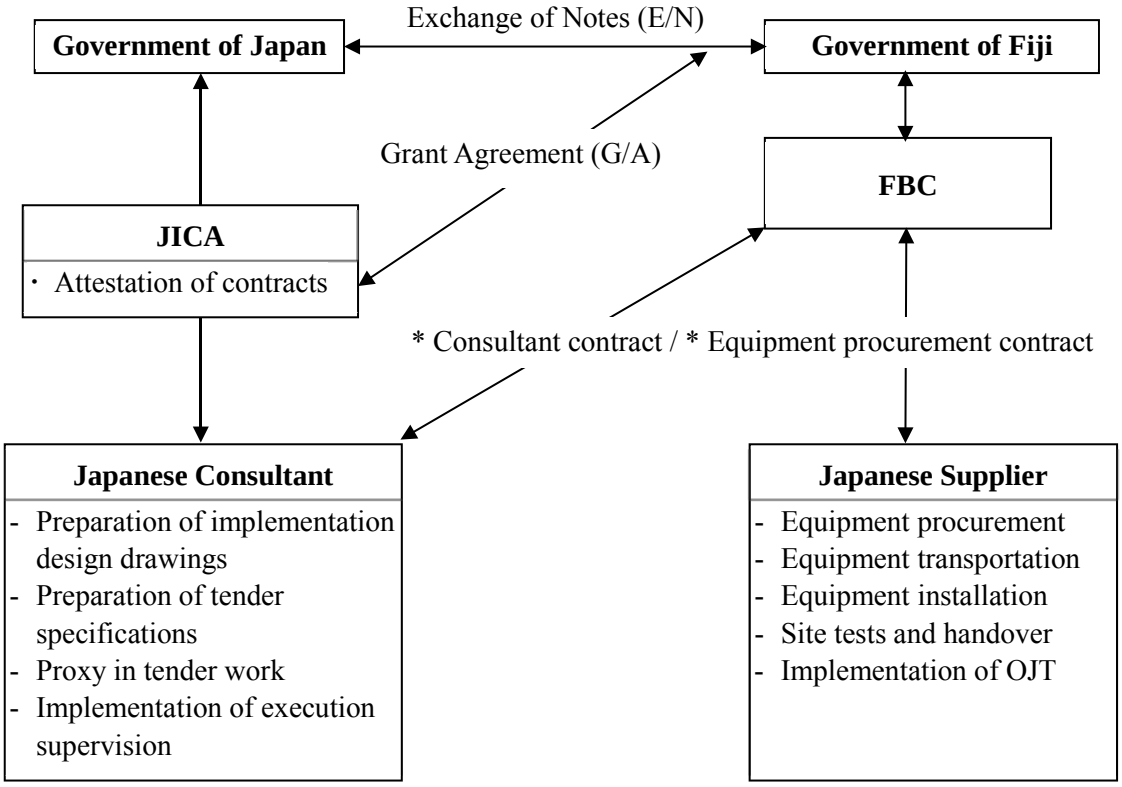
In cases where doubts arise over quality as a result of conducting confirmation and checks, the consultant will immediately demand the contractor to make amendments, revisions or corrections.

3) Labor Supervision

Discussions will be held and cooperation will be sought with responsible officers of the contractor, and safety control will be exercised during the construction period in order to prevent the occurrence of industrial accidents on the Project site, injuries to third parties or any other accidents. Important points to consider in safety control on the ground are as follows:

(a) Establishment of safety control regulations and appointment of manager
(b) Planning of the work vehicles and construction machinery operating routes and thorough enforcement of safe driving
(c) Encouragement of laborers to utilize welfare measures and vacations
(d) Security measures during the stay

Figure 2-2-6 shows the relationships between the parties involved in the Project.



*Note: The Consultant Contract and equipment procurement contract require verification by JICA

Figure 2-2-6 Project Implementation Relationships

(2) Works Supervisor

The contractor will procure and deliver equipment and implement the installation works. Since the contractor will need to thoroughly ensure that the subcontractor complies with the works schedule, quality, progress and safety measures prescribed in the contract, it will dispatch engineers who have experience of similar projects in overseas countries to provide guidance and education on the ground.

2-2-4-5 Quality Control Plan

Pre-shipping inspections will be encouraged to make sure that the procured equipment complies with the technical specifications indicated in the tender documents. Moreover, during installation, quality control works will be carried out according to the execution control criteria indicated in the execution guidelines.

2-2-4-6 Procurement Plan

The equipment to be procured for the Project is not manufactured in the Republic of Fiji and will thus be procured from Japan or third countries in the case of some limited items. Table 2-2-6 shows the procurement sources.

Table 2-2-6 Equipment Procurement Sources

No.	Equipment	Procurement Country		
		Japan	Fiji	Third Country
1.	MW antenna system	●	-	-
2.	10kW Transmitter	●	-	● (Audio Processor Amplifier and Dummy Load)*
3.	Power Supply Equipment and Air Conditioning System	●	-	-
4.	ISDN Codec	-	-	●
5.	Maintenance Equipment and Tools	●	-	● (Impedance Bridge)*
6.	Spare Parts	●	-	-
7.	Consumable Parts	●	-	-

*One of the Equipment of item No. 2 and 5 shall be procured by third country

In case where the Project is implemented, the equipment manufacturers will provide free warranty for one year. Moreover, for appropriate operation and maintenance of the equipment, it will be necessary for Fiji side to allocate budget for purchasing the necessary expendable parts following completion of the Project.

2-2-4-7 Operational Guidance Plan

Since the Fijian side has operated and maintained transmitters and studio equipment for more than 50 years, there is basically no problem in the handling of the equipment. FBC engineering department currently has 21 engineers and carries out maintenance of FM transmitters, TV transmitters, and medium wave transmitters. The transmitters to be procured in the Project are scheduled to be digital AM modulation type medium wave transmitters that have never been used in the Republic of Fiji. Functionally, these are the same as the analog medium wave transmitters that have been used so far; however, because inspection and handling methods differ for each product, the equipment suppliers will conduct trainings (OJT) using actual equipment for FBC employees who will be in charge of the actual operation and maintenance at the time of installation and adjustment.

The Training (OJT) items will be as follows.

	Item	Guidance Items
Initial Operation Training	Equipment operating methods	Explanation of operating procedures for starting and stopping, explanation of instruments and status displays, etc.
Operation and Maintenance Training (OJT)	Inspections	Explanations of equipment operation methods, adjudication criteria, recording, measurement device connection methods, etc. in respect to daily and annual inspection items
	Response to failures	Explanation of status displays (alarms) at times of failure, judgment of failed sections, recovery from failure, cautions when replacing parts, etc.
	Measurement device operating method	Explanations about handling, routine maintenance, storage methods, etc. of measurement devices used in inspections, etc.

Concerning listeners, National Disaster Management Office (NDMO) has until now educated citizens in local communities on how to collect information from medium wave radios in disaster evacuation training. The questionnaire survey conducted by the Study Team shows that most of the use the radio to gather information in emergencies, thereby confirming that the said education activities have been effective. Accordingly, giving technical guidance based on a soft component is deemed not necessary.

2-2-4-8 Implementation Schedule

The Project implementation schedule has been compiled as shown in Table 2-2-7 based on t he Government of Japan's Grant Aid guidelines. Following the implementation design, the Transmitter House works and equipment installation works will be implemented simultaneously, and the Project will take approximately 23 months.

As the sole nationwide radio broadcaster in the Republic of Fiji, FBC is commissioned by the government to provide lifestyle-related information services. In particular, FBC needs to widely convey disaster prevention information to all citizens including those on remote islands during the cyclone season from October to March. Accordingly, FBC has requested that the installation works be implemented without interrupting current broadcasts during the said period.

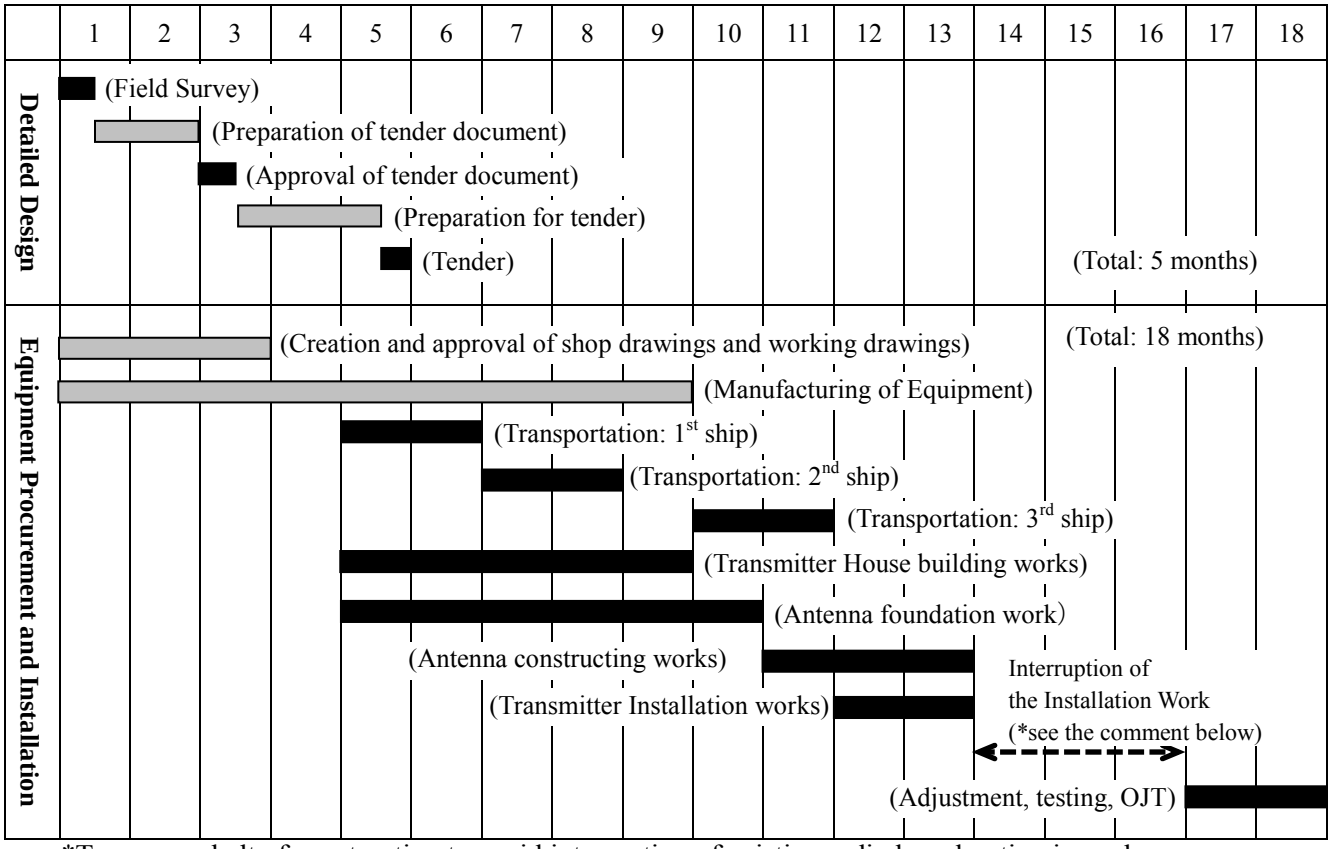
The equipment and materials will be shipped from Japan by the following 3 shipments:

- 1st ship; Antenna foundation material and Radial Earth
- 2nd ship; Antenna System
- 3rd ship; Transmitter, ATU, Power Supply Equipment, Air Conditioning System, etc.

It will take approximately 11 months to install the new antenna and transmitter from the beginning of Transmitter House Building Works. Within this, it is expected that around two months will be needed for making adjustments and conducting test broadcasts necessary for switching between the old and new antennas, and it will be necessary to interrupt broadcasts at this time. The period of the interruption of the Installation work will be approximately three months in order to continue regular

radio broadcasting using the existing transmitter in the cyclone period. Table 2-2-7 shows the Project implementation schedule.

Table 2-2-7 Project Implementation Schedule



*Temporary halt of construction to avoid interruption of existing radio broadcasting in cyclone season

2-3 Obligations of Recipient Country

The Japanese side will be responsible for the procurement and installation of equipment and construction of the transmitter house for the Project, while the Fijian side will be responsible for removing existing equipment and other items necessary for conducting the works of the Project.

(1) Tax Exemption Measures

FBC should take all necessary procedure for the exemption of customs duties, internal taxes and other fiscal levies, in collaboration with Ministry of Public Enterprises. In case the exemption would not be processed in a timely manner, anyhow, such tentative payment(s) should be owed by the Fijian side. The procedures required for the exemption are as follows.

<For the equipment and materials imported from Japan and /or third country>

1) The Japanese contractor will send shipping documents including a list of equipment to FBC before loading the procured equipment and materials onto the ship in Japan and /or third country.
2) Based on concession letter which Ministry of Finance is planning to issue to FBC by the end of March 2015, FBC will conduct prompt unloading and customs clearance of all equipment and materials at the port disembarkation in the Republic of Fiji.

<For the equipment and materials procured in the Republic of Fiji>

1) The Japanese contractor will send a list of equipment to FBC before purchasing the necessary equipment and materials in the Republic of Fiji.
2) FBC will temporarily bear internal taxes and other fiscal levies on equipment and materials.
3) After completion of the procurement, FBC will request and receive a refund of internal taxes and other levies from Fiji Revenuer and Customs Authority on the basis of assessment result by the Authority.

(2) Temporary Storage Area

The Fijian side will provide a location close to the Project site where the equipment and materials procured in the Project (antenna, transmitter, measuring devices, etc.) can be temporarily stored with protection against theft until the end of the installation works.

(3) Removal of Obstructions

The Fijian side will remove obstructions from the new antenna site before construction of the temporary works access road and start of the antenna foundation works by the Japanese side.

(4) Removal of Existing Antenna

The Fijian side will remove the existing antenna (antenna, branch line, and foundations) before the start of new antenna adjustment and testing.

(5) Securing of a Waste Dump

The Fijian side will secure a site to dispose of the materials generated when obstructions and the existing antenna are removed from the new antenna site before construction of the temporary works access road and start of the antenna foundation works by the Japanese side.

(6) Securing of Commercial Power Supply

The Fijian side will install a power cable and watt hour meter between the existing step-down transformer and distribution panel in the new transmitter building and secure the commercial power supply before the start of new antenna adjustments and testing.

(7) Securing of Transmission Path (ISDN) from FBC Headquarters to the Transmitter House

The Fijian side will secure the program transmission path by installing ISDN lines (4 lines) between FBC headquarters and new transmitter house by the start of the equipment installation works by the Japanese side.

(8) Implementation of Test Broadcasts

The Fijian side will implement test broadcasts following completion of the equipment installation works by the Japanese side.

(9) Installation of Fences and Gates

The Fijian side will install fences and gates around the grounds of the new transmitter house.

(10) Public Announcement

The Fijian side will make a public announcement for advertisement of New MW broadcasting and notice of an interruption of MW radio broadcasting during a transition period from the old to the new system by TV, radio and newspaper.

2-4 Project Operation Plan

(1) Operation and Maintenance Setup

In order for FBC to fulfill its role as a public broadcaster, it is necessary to procure and upgrade equipment based on the budget and plans of FBC. Therefore, periodic upgrading will be taken into consideration when planning maintenance of the Project equipment. Table 2-4-1 shows the maintenance plan.

Since medium wave transmitters constantly use air filters, aircraft obstacle (warning) light bulbs etc., parts will need to be changed once every one to five years. Moreover, fuses, fan units, etc. will be appropriately changed when they wear out or break. The medium wave

transmitter unit and program inputting equipment, etc. will undergo overall renewal eight years after starting service considering the depreciation period and technological innovation. Table 2-4-1 shows the equipment maintenance plan.

Table 2-4-1 Equipment Maintenance Plan

Replacement Interval	Objection Parts
1~5 years	Air Filter, Lamp for OB Lighting System, Each kind of board
When damaged	Each kind of fuse, Fan unit, Surge Absorber for Isolation Transformer
After 8 years	Medium Wave Transmitter, Program Input Equipment (PIE)

(2) Routine Inspections

Due to the technological innovations of recent years, electronic instruments have acquired greater reliability and durability; moreover, equipment troubles have become less frequent because fewer components are used. In view of this trend, maintenance inspection cycles for equipment are becoming longer in Japan. However, in order to effectively utilize equipment over a long period, it is important to implement routine and periodic inspections without fail; and such inspections are especially important for agencies like FBC which cannot conduct frequent equipment upgrades due to budget constraints. Therefore, it will be necessary to prepare the minimum necessary maintenance standards for routine and periodic inspections and prepare a s etup for preventing equipment failures in advance. Table 2-4-2 shows the routine and periodic inspection items and necessary inspection instruments for the equipment to be procured by the Project.

Table 2-4-2 Equipment Inspection Items and Necessary Instruments

Inspection Contents	Inspection Item	Necessary Measuring Instrument
Routine inspection and pre-work inspection	Visual inspection of meters and failure displays, etc.	Audio Monitoring
	Visual inspection of connections	Tool Kit
Half year inspection (characteristic inspection)	Audio characteristic measuring (Frequency Response・S/N), Harmonic Distortion, Level Diagram	Distortion Meter/Oscillator, Oscilloscope
	Voltage measurement of power source, etc.	Oscilloscope, Circuit Tester
1 year inspection (characteristic inspection)	Transmitting Frequency Antenna characteristic Electric field strength	Frequency Counter, Impedance Bridge, Field strength Meter

(3) Spare Parts

Table 2-4-3 shows the Spare Parts that FBC will need to procure in the three years following the Project implementation. In the Project, enough Spare Parts for a year or until the first equipment failure will be procured. Concerning the handling of transmitter PA modules, RF driver units, power supply modules and other Spare Parts, it is scheduled for Japanese engineers to conduct technology transfer to FBC employees and engineers of related departments in OJT during the Installation Work, and FBC will need to secure the funds to

purchase replacement parts every year to make sure the continuation of appropriate maintenance.

Table 2-4-3 shows the main Spare Parts.

Table 2-4-3 Spare Parts

Item	Each 3 years
	Quantity
PA Module	6
RF Driver Unit	6
Power Supply Module	6
Each kind of control printed board	6
Power FET	6

(4) Consumable Parts

Table 2-4-4 shows the Consumable Parts that will be needed to conduct maintenance on the medium wave transmitter and antenna. Concerning the handling of transmitter air filters and other consumable parts, it is scheduled for Japanese engineers to conduct technology transfer to FBC employees and engineers of related departments in OJT during the Installation Work, and FBC will need to secure the funds to purchase Consumable Parts every year to make sure the continuation of appropriate maintenance. Table 2-4-4 shows the main Consumable Parts.

Table 2-4-4 Consumable Parts

Item	Each years
	Quantity
Fan unit for Transmitter	2
Air Filter for Transmitter	4
Each kind of fuse	10
Lamp for OB Lightning System	3
Surge Absorber for Isolation Transmitter	2

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Cost Estimation Borne by the Government of Japan

This section is closed due to confidentiality.

(2) Cost Estimation Borne by the Government of the Republic of Fiji (GOF)

Item	Cost Estimation (FJD)	Note
Removal of obstacles from the Project site of new antenna	6,600	Removal work: FJD 50 x 6 0 person-day = FJD 3,000 Equipment: FJD 3,600
Removal of existing antenna, feeder, foundation and leveling the Project site	10,000	Removal work: FJD 50 x 100 person-day = FJD 5,000 Equipment: FJD 5,000
Securing of commercial power supply from the existing substation to the new Transmitter House	30,000	Cable approx.75 mm^2: FJD 150/m x 80 m = FJD 12,000 kWh meter: FJD 1,000 Installation: FJD 17,000
Installation of four (4) ISDN lines (including two (2) spare lines) for radio program between FBC headquarters and new Transmitter House	350	Installation: FJD 350
Installation of fences and gates around the new transmitter house (excluding the safety gate and fence around the Antenna pole)	14,000	FJD 200/m x 70 m = FJD 14,000
Administrative approval from DOE, CAAF and Nausori Town Council for implementation of the Project	300	Application: FJD 300
Bank commissions (Advising commission of Authorization to Pay (A/P) and payment commission	15,350	Assumed as 0.1% of the total project cost.
Total	76,600	

Notes:

1) Conditions of cost estimation

- Estimated timing: October 2014
- Exchange rates: USD 1.00 = JPY 104.83
  FJD 1.00 = JPY 55.741

2) Others

The project is implemented in accordance with the system of Japan's Grant Aid. The above cost estimation does not assure the ceiling cost on the E/N and shall be reviewed by the Government of Japan before the conclusion of E/N between the two governments.

2-5-2 Operation and Maintenance Cost

For sound/effective operation of FBC broadcasting station the long-term, it w ill be necessary to appropriately upgrade the equipment that is procured by the Project in the future. Therefore, in addition to the maintenance of new and existing equipment, a maintenance plan that also includes the periodic upgrading costs should be prepared as described in the next section.

(1) Setting Criteria

Concerning future financial performance, the estimated figures adopted in the strategic plan prepared by FBC are used for up to 2017. In consideration of the recent GDP growth rate of Fiji, it is assumed that revenue (business revenues and non-business revenues) from 2017 to 2024 will increase by 3%, and costs (except depreciation costs and interest costs) will also grow at an annual rate of 3%.

(2) Expenditure

The equipment to be procured by the Project will start operation in 2017, and the annual operation and maintenance costs are estimated as follows.

1) Increase in Electric Energy Consumption

Table 2-5-1 shows the electric power cost. The annual electric power cost will be increased due to a replacement of transmitter. Increased cost is calculated as below

a) Annual power tariff for the new 10 kW transmitter: FJD133,500
b) Annual power tariff for the current 2 kW transmitter: FJD19,500
b) – a) Annual increase in power tariff: FJD114,000

2) Maintenance Cost

Table 2-5-1 shows the maintenance costs related to the Project transmitter house (that will contain the transmitter and other Project equipment), the ISDN usage, the electrical and air conditioning equipment (inside the transmitter house), and the antenna pole. In particular, air conditioning system inspections are important for operating the transmitter, which radiates a lot of heat, while painting of the antenna pole will be essential to prevent rusting.

3) Replacement Parts

Table 2-5-1 shows the replacement parts that FBC will need to procure after the Project implementation. Fans, filters, fuses, light bulbs, etc. have high frequency of use and need to be replaced or renewed almost every year. The tri-annual replacement parts costs have been adjusted to yearly costs. This Project will procure spare parts necessary for a year or until the first equipment failure. Concerning the handling of replacement parts for the transmitter air filter and so on, it is scheduled for Japanese engineers to conduct technology transfer to FBC employees and engineers of related departments in OJT during the site works, and FBC will

need to secure the funds to purchase replacement parts every year to make sure that appropriate maintenance is continued. Table 2-5-1 shows the main maintenance costs.

Table 2-5-1 Increased Power Cost, Maintenance Cost, and Replacement Parts Cost

Item	Unit price (FJD)	Quantity	Total price (FJD)
1. Electric Power Cost including New Transmitter *	133,500	1set	133,500
2. ISDN Fee	2,100	1 set	2,100
3. Maintenance Cost			
(1) Service Maintenance for Air Conditioning	2,700	1 set	2,700
(2) Maintenance for Electric Equipment	3,700	1 set	3,700
(3) Painting for Antenna Pole	20,000	1 set	20,000
4. Consumable Parts and Spare Parts			
(1) Fan unit for Transmitter	1,250	2 sets	2,500
(2) Air Filter for Transmitter	1,250	4 sets	5,000
(3) Lamp for OB Lightning System	1,667	3 sets	5,000
(4) Each kind of fuse	500	10 sets	5,000
(5) Surge Absorber for Isolation Transformer	2,500	2 sets	5,000
(6) PA Module (average cost per year)	2,500	2 sets	5,000
(7) RF Driver Unit (average cost per year)	2,500	2 sets	5,000
(8) Power Supply Module (average cost per year)	2,500	2 sets	5,000
(9) Each kind of control printed board (average cost per year)	5,000	2 sets	10,000
(10) Power FET (average cost per year)	2,500	2 sets	5,000
(11) Fuel cost for Engine Generator	4,000	1 set	4,000
Total			218,500

*The total maintenance cost after the Project is FJD218,500 and the Electrical Power Cost before the Project is FJD19,500. Therefore, the maintenance cost increased by the Project will be FJD199,000.

(3) Saving for Equipment Renewal Cost

The equipment to be procured in the Project will start operation in 2017, and it will be necessary to save part of the renewal cost (FJD415,000 out of FJD3,320,000) annually as a reserve fund for eight years after starting operation, until 2025. Judging from the current FBC finances, the reserve fund will likely be financed by subsidies from renewal of the public broadcasting utility contract between the Government of the Republic of Fiji and FBC. Table 2-5-2 shows the breakdown of equipment renewal costs saved over eight years following Project implementation.

Table 2-5-2 Equipment Renewal Costs

Item	Unit price (FJD)	Quantity	Total price (FJD)
Transmitter (1 set)	1,260,000	2	2,520,000
Guy Wire・Insulator (1 set)	500,000	1	500,000
Air Conditioning	150,000	1	150,000
Engine Generator	150,000	1	150,000
Total			3,320,000

(4) Revenue

The business revenue of FBC is mainly from advertisement (from the private sector), revenue pay programs, sports programs, selling non-broadcasting contents and so on. Through implementing the Project, broadcasts will reach remote areas and islands that were not covered before; however, since broadcasts will mainly consist of public broadcasts based on medium wave, no increase in revenue is expected.

(5) Revenue from Government Subsidies

An annual government subsidy of FJD2,910,000 to FBC is fixed until 2016 based on contract. In interviews with the Ministry of Public Enterprises and Ministry of Finance, the financial support for FBC as an important public broadcasting agency has been confirmed; so, it is assumed that a similar subsidy amount will be provided for the coming 10 years.

(6) Estimation Results

Table 2-5-3 shows the revenue and expenditure forecast for FBC up to the renewal of equipment (until 2024) based on the above preconditions. The profit-and-loss account of FBC for 2013 showed a loss of approximately FJD5.6 million; however, an amount of loss is expected to decrease steadily from now on in line with decreasing depreciation cost of the FM broadcasting equipment that was renewed in 2009 and the TV broadcasting equipment that started service in 2011. Based on the balance of the revenue and expenditure forecast below, a loss of FJD1million is estimated when the Project equipment starts operating in 2017 and a small amount of loss is still estimated in 2024 when the renewal of Project equipment is necessary. Therefore, it seems difficult that FBC will improve its financial performance by revenues from private sector alone by 2024, and save enough money to cover the maintenance and renewal costs of the Project equipment. Accordingly, it will be necessary for the Government of the Republic of Fiji to continue subsidizing FBC to stabilize its finances and secure the necessary budget to maintain the company mission as a public broadcasting agency. As Ministry of Finance and Ministry of Public Enterprises showed a will to maintain the current subsidy level in the future and ensure necessary funds for capital investment in the Project, it is expected that FBC will ensure the budget for renewing and maintenance of the Project equipment by the continuing financial support by the government.

Table 2-5-3 FBC Financial Plan (up to 2024)

Financial Plan for Fiji Broadcasting Corporation								Completion of the Project							
	Actual(audited)				*Projection by FBS*				*Forecast*						
PROFIT AND LOSS STATEMENT	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*
Revenue from Operation	3,030,835	3,663,514	6,428,631	8,042,530	9,762,661	11,007,060	12,107,766	13,318,543	13,718,099	14,129,642	14,553,532	14,990,137	15,439,842	15,903,037	16,380,128
Advertising		671,141	2,344,595	3,055,980	3,552,955	4,085,898	4,494,488	4,943,937	5,092,255	5,245,023	5,402,373	5,564,445	5,731,378	5,903,319	6,080,419
Paid programs		1,464,295	2,207,961	2,634,117	3,083,503	3,546,028	3,900,631	4,290,694	4,419,415	4,551,997	4,688,557	4,829,214	4,974,090	5,123,313	5,277,012
Special events		398,909	698,873	826,379	997,357	1,146,961	1,261,657	1,387,822	1,429,457	1,472,340	1,516,511	1,562,006	1,608,866	1,657,132	1,706,846
Commercial outside broadcast		297,659	322,347	631,846	678,341	1,020,092	1,122,101	1,234,312	1,271,341	1,309,482	1,348,766	1,389,229	1,430,906	1,473,833	1,518,048
Sports		358,078	546,452	384,933	440,810	506,932	557,625	613,387	631,789	650,742	670,265	690,372	711,084	732,416	754,389
Other operating income		473,432	308,403	509,275	1,009,695	701,149	771,264	848,391	873,843	900,058	927,060	954,872	983,518	1,013,023	1,043,414
Non operating income	330,724	153,494	258,711	408,238	410,222	471,755	518,931	570,824	587,949	605,587	623,755	642,467	661,741	681,594	702,042
Total Revenue	3,361,559	3,817,008	6,687,342	8,450,768	10,172,883	11,478,815	12,626,697	13,889,367	14,306,048	14,735,229	15,177,286	15,632,605	16,101,583	16,584,631	17,082,169
Income from gifted assets with the project								*1,800,000*	*1,800,000*	*1,800,000*	*1,800,000*	*1,800,000*			
Total Revenue with the project								*15,689,367*	*16,106,048*	*16,535,229*	*16,977,286*	*17,432,605*	*16,101,583*	*16,584,631*	*17,082,169*
Expense															
Administration and operating expense	3,873,703	4,850,183	11,667,174	12,621,772	11,543,413	12,915,952	13,187,991	13,895,187	14,198,043	14,509,984	14,831,283	15,162,222	15,503,089	15,854,181	16,215,807
Operating, administration expense and others	1,442,353	1,926,315	3,198,470	3,682,615	3,791,417	3,915,952	4,031,991	4,220,067	4,346,669	4,477,069	4,611,381	4,749,723	4,892,214	5,038,981	5,190,150
Depreciation and Amortization	312,461	187,732	3,945,617	3,988,424	2,880,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000	3,800,000
Wages and salaries	1,759,626	1,972,578	2,353,894	2,461,587	2,747,213	2,900,000	2,987,000	3,435,050	3,538,102	3,644,245	3,753,572	3,866,179	3,982,164	4,101,629	4,224,678
Power and transmission	351,131	467,754	792,798	859,871	924,783	1,000,000	1,030,000	1,060,900	1,092,727	1,125,509	1,159,274	1,194,052	1,229,874	1,266,770	1,304,773
Program expense	8,132	295,804	1,376,395	1,629,275	1,200,000	1,300,000	1,339,000	1,379,170	1,420,545	1,463,161	1,507,056	1,552,268	1,598,836	1,646,801	1,696,205
Finance cost	121,998	30,690	2,012,950	1,431,770	1,390,751	1,390,751	1,119,132	1,119,132	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Total Expense	3,995,701	4,880,873	13,680,124	14,053,542	12,934,164	14,306,703	14,307,123	15,014,319	15,198,043	15,509,984	15,831,283	16,162,222	16,503,089	16,854,181	17,215,807
Operating profit/loss before income tax	(634,142)	(1,063,865)	(6,992,782)	(5,602,774)	(2,761,281)	(2,827,888)	(1,680,426)	(1,124,952)	(891,995)	(774,754)	(653,997)	(529,617)	(401,505)	(269,551)	(133,637)
Depreciation of the project equipment								*1,800,000*	*1,800,000*	*1,800,000*	*1,800,000*	*1,800,000*			
***Total Expense with the project*								*16,814,319*	*16,998,043*	*17,309,984*	*17,631,283*	*17,962,222*	*16,503,089*	*16,854,181*	*17,215,807*
***Operating profit/loss before income tax with the project*								*(1,124,952)*	*(891,995)*	*(774,754)*	*(653,997)*	*(529,617)*	*(401,505)*	*(269,551)*	*(133,637)*

	Actual(audited)				Projection by FBS				Forecast						
BALANCE SHEET	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*
Current Assets															
Cash and cash equivalents(restricted cash)	1,401,006	1,328,350	161,181	276,075	687,778	1,570,306	650,407	467,890	481,927	496,385	511,276	526,614	542,413	558,685	575,446
Trade and other receivables	1,158,728	1,162,232	1,377,429	1,919,421	919,421	917,421	1,032,209	1,158,476	1,193,230	1,229,027	1,265,898	1,303,875	1,342,991	1,383,281	1,424,779
Inventories	12,943	52,652	24,397	32,025	48,139	48,139	49,583	48,139	49,583	51,071	52,603	54,181	55,806	57,480	59,205
Financial and other assets	934,565	1,152,656	1,217,831	1,920,732	927,187	927,187	2,744,899	727,187	749,003	771,473	794,617	818,455	843,009	868,299	894,348
Total current assets	3,507,242	3,695,890	2,780,838	4,148,253	2,582,525	3,463,053	4,477,098	2,401,692	2,473,743	2,547,955	2,624,394	2,703,126	2,784,219	2,867,746	2,953,778
Non-Current Assets															
Property, plant and equipment	16,889,155	23,942,724	21,517,376	18,226,196	18,755,604	16,021,339	13,593,139	14,862,295	15,308,164	15,767,409	16,240,431	16,727,644	17,229,473	17,746,357	18,278,748
FITB & others	190,627	110,269		0	56,121	56,121	56,121	56,121	56,121	56,121	56,121	56,121	56,121	56,121	56,121
Total non-current assets	17,079,782	24,052,993	21,517,376	18,226,196	18,811,725	16,077,460	13,649,260	14,918,416	15,364,285	15,823,530	16,296,552	16,783,765	17,285,594	17,802,478	18,334,869
Total Assets	20,587,024	27,748,883	24,298,214	22,374,449	21,394,250	19,540,513	18,126,358	17,320,108	17,838,028	18,371,485	18,920,946	19,486,890	20,069,814	20,670,224	21,288,647
***Fixed assets increased by the project*								*7,200,000*	*5,400,000*	*3,600,000*	*1,800,000*				
***Total Assets with the project*								*24,520,108*	*23,238,028*	*21,971,485*	*20,720,946*	*19,486,890*	*20,069,814*	*20,670,224*	*21,288,647*
Current Liabilities															
Creditors and other payables	1,047,542	1,200,086	979,437	1,569,998	4,178,809	4,509,950	3,382,463	3,365,463	3,466,427	3,570,420	3,677,532	3,787,858	3,901,494	4,018,539	4,139,095
Interest bearing borrowings			1,310,372	1,485,584	0	0	0	0	0	0	0	0	0	0	0
Provisions	66,893	88,498	94,363	82,239	84,239	86,239	88,826	90,826	93,551	96,357	99,248	102,225	105,292	108,451	111,705
Deferred income	18,850	4,000	31,022	51,333	0	0	0	0	0	0	0	0	0	0	0
Total current liabilities	1,133,285	1,292,584	2,415,194	3,189,154	4,263,048	4,596,189	3,471,289	3,456,289	3,559,978	3,666,777	3,776,780	3,890,084	4,006,786	4,126,990	4,250,800
Non-Current Liabilities															
Interest bearing borrowings	14,252,810	19,897,803	19,315,901	19,382,594	17,259,023	14,990,031	13,458,407	10,882,109	11,208,572	11,544,829	11,891,174	12,247,910	12,615,347	12,993,807	13,383,621
Deferred income	14,306	25,276	217,232	145,588	27,255	27,255	29,276	29,276	29,276	29,276	29,276	29,276	29,276	29,276	29,276
Deferred tax liability	36,004	0	0	0	39,093	39,093	49,868	49,868	0	0	0	0	0	0	0
Total non-current liabilities	14,303,120	19,923,079	19,533,133	19,528,182	17,325,371	15,056,379	13,537,551	10,961,253	11,237,848	11,574,105	11,920,450	12,277,186	12,644,623	13,023,083	13,412,897
Total Liabilities	15,436,405	21,215,663	21,948,327	22,717,336	21,588,419	19,652,568	17,008,840	14,417,542	14,797,826	15,240,882	15,697,231	16,167,269	16,651,409	17,150,073	17,663,697
***Deferred income liability from the project*								*7,200,000*	*5,400,000*	*3,600,000*	*1,800,000*				
***Total Liabilities with the project*								*21,617,542*	*20,197,826*	*18,840,882*	*17,497,231*	*16,167,269*	*16,651,409*	*17,150,073*	*17,663,697*
Accumulated fund									1,880,370	3,925,215	6,088,105	8,372,582	10,782,293	13,320,995	15,992,559
Net Assets with project reserve fund	5,150,619	6,533,220	2,349,887	(342,887)	(194,169)	(112,055)	1,117,518	2,902,566	4,920,571	7,055,817	9,311,820	11,692,203	14,200,697	16,841,147	19,617,510
SHAREHOLDERS EQUITY															
Capital Contribution by Fiji Government	2,586,667	2,530,434	2,566,810	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000	2,910,000
Accumulated Capital contribution	2,786,669	5,317,103	7,883,913	10,793,913	13,703,913	16,613,913	19,523,913	22,433,913	25,343,913	28,253,913	31,163,913	34,073,913	36,983,913	39,893,913	42,803,913
Share premium reserve	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355	3,913,355
Accumulated profit/losses	(1,549,405)	(2,697,238)	(9,447,381)	(15,050,155)	(17,811,436)	(20,639,324)	(22,319,750)	(23,444,702)	(24,336,697)	(25,111,451)	(25,765,448)	(26,295,065)	(26,696,571)	(26,966,121)	(27,099,758)
Total Shareholders Equity	5,150,619	6,533,220	2,349,887	(342,887)	(194,168)	(112,056)	1,117,518	2,902,566	4,920,571	7,055,817	9,311,820	11,692,203	14,200,697	16,841,147	19,617,510
***Cost borne by the Fiji Government at the start of the Project*								*76,600*							
***Annual cost for operation & maintenance of the Project*								*199,000*	*199,000*	*199,000*	*199,000*	*199,000*	*199,000*	*199,000*	*199,000*
***Accumulated Annual cost of the project*								*275,600*	*474,600*	*673,600*	*872,600*	*1,071,600*	*1,270,600*	*1,469,600*	*1,668,600*
***Total Shareholders Equity with the project*								*2,626,966*	*4,445,971*	*6,382,217*	*8,439,220*	*10,620,603*	*12,930,097*	*15,371,547*	*17,948,910*
***Reserved funds for renewal of the equipment*								*415,000*	*415,000*	*415,000*	*415,000*	*415,000*	*415,000*	*415,000*	*415,000*
***Accumulated reserved fund for the project*								*415,000*	*830,000*	*1,245,000*	*1,660,000*	*2,075,000*	*2,490,000*	*2,905,000*	*3,320,000*

Source: Study Team

CHAPTER 3 PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

- The Scope of Works on the Fijian side shown in Table 2-2-5 are implemented smoothly.

3-2 Necessary Inputs by Recipient Country

- The Government of the Republic of Fiji continues to fund the FBC from now on.
- The human resources and budget required for conducting routine inspections and maintenance work are secured.
- The budget needed for purchasing repair parts, etc. is secured.

3-3 Important Assumptions

- Policies concerning the broadcasting sector in the Republic of Fiji are not changed.
- There are no major natural disasters such as earthquake, etc.
- There are no sudden incidents such as acts of terrorism or coup d'état.

3-4 Project Evaluation

3-4-1 Relevance

(1) Contribution to Development Plans

The Republic of Fiji takes is committed to tackling natural disasters. According to the Natural Disaster Management Act 1998 Part-4 Emergency Operation, 18 Public Declaration, it is recommended that radio and TV broadcasts should be used to convey information to citizens when taking measures in the event of disaster.

In the Roadmap for Democracy and Sustainable Socio-Economic Development 2010-2014, expansion of information and telecommunications are raised as important measures. According to this, more than 90% of citizens have access to radio broadcasts, and radio is an important tool for obtaining information. The Roadmap also mentioned improvement of lifestyle information services for citizens as a means of promoting regional industry, and the Government of the Republic of Fiji and Fiji Broadcasting Corporation have signed an agreement to conduct radio broadcasts for disaster prevention, national policies, education, agriculture, public health, and domestic and international news. Accordingly, the Project will make a contribution to national development plans.

(2) Natural Disaster Broadcasts

Currently the FBC broadcasts public service contents such as news and education programs, and it is also commissioned by the government to implement emergency broadcasts in the event of natural disasters such as cyclones, tsunami, flooding, etc. In the urban parts of the Republic of Fiji, IT infrastructure such as mobile phone and internet networks is established,

however, there have been cases where lines and networks have become overloaded at times of earthquake and other disasters. Moreover, because a lot of telephone relay stations are located in mountain areas, in the event where power supply becomes damaged, it takes a long time to recover and ensure usefulness of these facilities at times of disaster. In contrast, FBC medium wave radio broadcasts entail no such problems of overloading, and because emergency generators are installed, broadcasts can be reliably continued even if power is interrupted due to accident or disaster. Moreover, because radio receivers can be carried around and operated on dry cell batteries, they enable access to information even in evacuation centers and places that don't have power supply. Therefore, radios have different characteristics than mobile phones and they play an important role as a means of conveying uniform disaster information to residents rapidly and over a wide area. The Meteorological Service thus uses radio broadcasting to issue evacuation advisories when cyclones are approaching, while the NDMO also uses radio to issue warnings at times of natural disaster. Accordingly, since radio broadcasting is highly effective, immediate and wide reaching, it plays an important role in directly conveying emergency information at times of disasters.

(3) Role as a Public Broadcaster

Since medium wave radio broadcasts can be received by residents on remote islands far away from Vanua Levu and Viti Levu, as well as by communities that haven't yet been electrified, they are used as a means of conveying lifestyle information to citizens. As a result of visiting the Ministry of Public Works, the Finance Ministry, the Information Ministry, the Ministry of Education NDMO, FMS, the Ministry of Agriculture, the power company, the Civil Aviation Authority of Fiji (CAAF), the Planning Department and other related departments, it was found that radio broadcasts are used to convey not only information on natural disasters, but also programs about farm product prices for rural communities (Ministry of Agriculture), education programs by specialized departments in the Ministry of Education (over the past 30 years), and so on. Such programs are broadcast every day and play a vital role in providing education to remote islands. Also, the Ministry of Health uses radio to broadcast information on preventing infectious diseases. Thus, it was confirmed in each ministry and agency that the FBC plays an important role as the sole public broadcaster and provider of wide area emergency broadcasts at times of disaster in the Republic of Fiji.

(4) Beneficial Effect for Impoverished People

The combined population of provincial areas and remote islands in the Republic of Fiji is approximately 410,000; moreover, such areas have a poverty rate of 43%, compared to 19% in the urban areas (2007, according to the Fiji Bureau of Statistics). Moreover, power supply by the power company is limited to the densely populated areas such as Viti Levu and Vanua Levu, while citizens on the sparsely populated remote islands have insufficient power supply and cannot freely use refrigerators, TVs and other electrical appliances. Accordingly, battery-operated radios are important tools for collecting information in non-electrified areas

such as these. Moreover, radios are inexpensive and affordable for islanders who cannot afford to buy TVs, internet devices and so on. The restoration of medium wave radio broadcasts for conveying essential information on news, weather, disasters, etc. over a wide scope will impart a major beneficial impact on impoverished people.

(5) Necessity and Advantage of Using Japanese Technology

Since Japanese broadcasting equipment, which is technologically superior, will be supplied, this will benefit both Japan and the Republic of Fiji. Therefore, implementation of the Project is deemed to be highly valid.

3-4-2 Effectiveness

(1) Quantitative Effects

(a) Estimated population of covered areas: Figure 3-4-1 shows the areas of coverage under the current 2 kW output and under the Project 10 kW output.

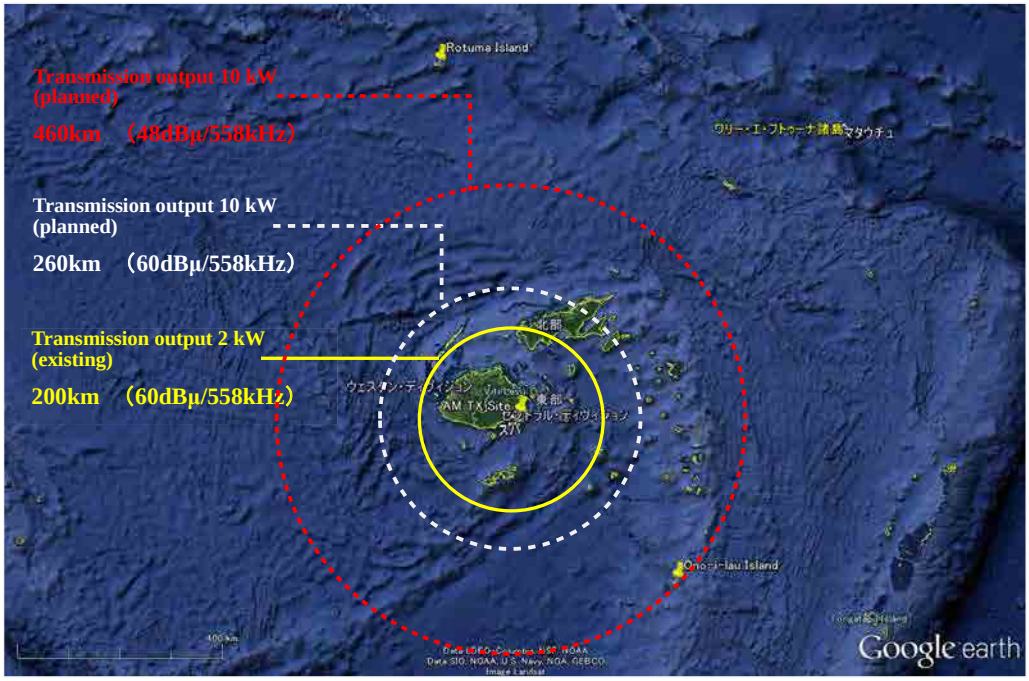


Figure 3-4-1 Coverage under the Current 2 kW Output and the Project 10 kW Output

In the case where output is boosted to 10 kW as a result of the Project, it will be possible to provide radio broadcasts over the entire area of the Republic of Fiji (excluding Rotuma Island), and it will become possible for approximately 100,000 residents living mainly in remote islands to newly listen to medium wave radio broadcasts.

Table 3-4-1 Number of Listeners Now and After Implementation

Current (2 kW) number of listeners	Number of listeners after implementation (10 kW)	Additional benefitting population
780,000	880,000	100,000

Incidentally, citizens on the island of Rotuma, which cannot pick up medium wave radio broadcasts, receive broadcasts from neighboring countries such as Tonga, Australia and so on, and they can also receive private satellite TV broadcasts of programs made in the Republic of Fiji. According to the FBC, it is currently installing an FM transmitter (100W) in Rotuma Island and plans to establish a satellite phone line for transmitting programs in the future.

(b) Reduction of broadcast interruptions: Currently the FBC implements 24 hour broadcasts from the medium wave transmitter installed at Naulu transmitting station close to Nausori Airport. In the current system, programs produced in the FBC studios are transmitted to Nakobalevu transmitting station on the outskirts of Suva by microwave signals, and they are then converted to FM waves and sent to Naulu transmitting station, which converts the FM signals to medium wave radio broadcasting signals. (Figure 3-4-2 shows the equipment configuration between the studio and transmitting station).

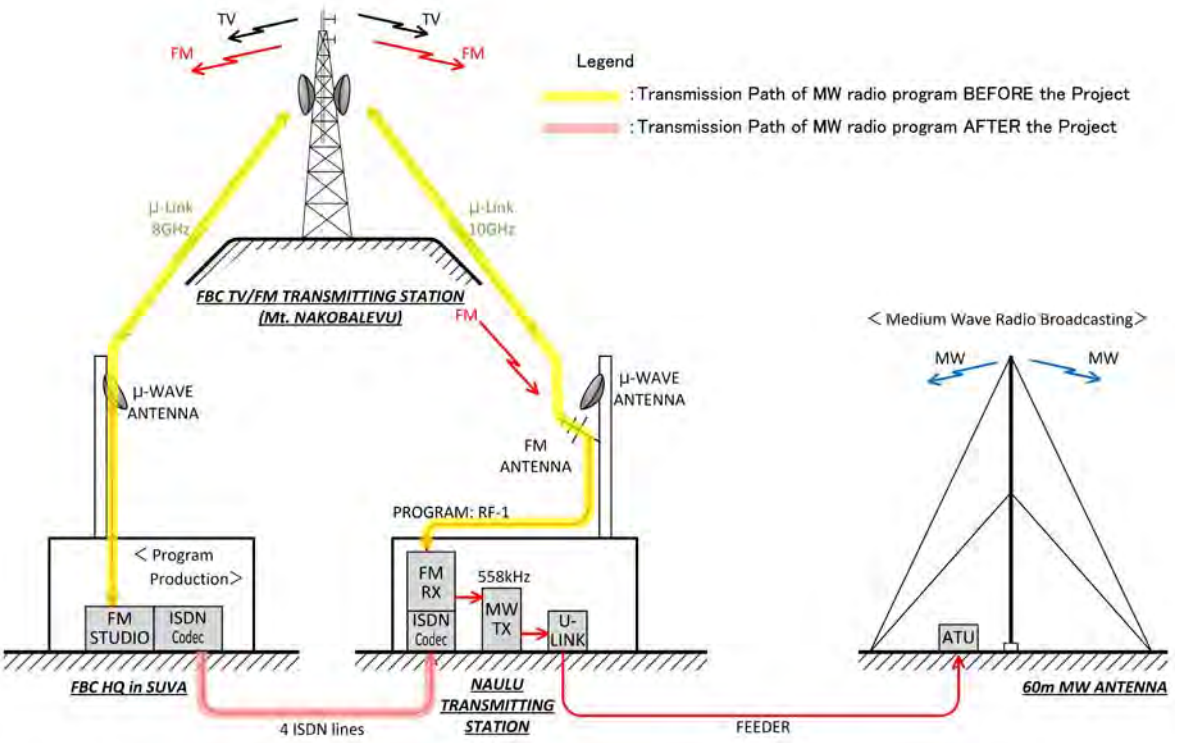


Figure 3-4-2 FBC Program Transmission Path

Thus, various items of equipment are involved between the production of programs in the FBC studios and their transmission as medium wave broadcasts, however, such

broadcasts are interrupted when the said equipment is damaged by cyclones and so on. In the network that is proposed in the project, since programs from the FBC studios will be directly conveyed to the transmitter via ISDN line without passing through the various microwave and FM equipment, it will be possible to minimize the impacts of weather fluctuations, cyclones, etc. and thus sustain stable broadcasts. Table 3-4-2 shows a comparison of broadcast interruption times at present and following project implementation.

Table 3-4-2 Comparison of Broadcast Interruption Times between Now and After Implementation

Now (interruption time)	After implementation (interruption time)	Reduction
100 hours/year	8 hours/year	92 hours/year

Broadcasts are frequently interrupted due to overheating of power sources in the existing equipment, however, when the new transmitter equipment is introduced, interruptions will be limited to the minimum necessary stoppages for maintenance work.

(c) Reduction of power consumption: The transmitter and antenna are connected by a cable known as a co axial feeder, however, because the electrical characteristic known as impedance is not consistent between these two instruments at present, energy is not efficiently converted into radio waves. As a result, much energy is dissipated as heat, leading to a lot of power consumption and loss. Through installing a new transmitter in the Project, since performance will be improved, making it possible to secure consistency with the antenna, it will be possible to save on power.

As a result of conducting trial calculation in the survey, through adopting an energy saving transmitter that utilizes semiconductors, it will be possible to achieve electricity saving of approximately 70% compared to the existing transmitter. Table 3-4-3 shows a comparison of power consumption between the present and after Project implementation.

Table 3-4-3 Comparison of Power Consumption between Now and After Implementation

Now (assuming 10 kW)	After implementation (10 kW)	Saving ratio
Approximately 55 kWh	Approximately 38 kWh	Approximately 30%

Incidentally, since the FBC hasn't kept receipts from the time when two 10 k W transmitters were used to conduct broadcasting in the past, power consumption at that time was estimated based on the current power consumption, and the estimated power consumption was compared with that of the new transmitter.

(2) Qualitative Effects

(a) Improvement in broadcasting quality: As a result of stopgap repairs to the existing analog transmitter, output is increased and a lot of noise is generated due to generation of higher harmonics, etc.; moreover, the sound quality of broadcasts is poor because audio signals become distorted and modulation efficiency is poor. Furthermore, there is no equipment for monitoring transmitter characteristics, and it is difficult to make transmitter adjustments. Through introducing a modern transmitter, implementing inspections, and monitoring characteristics through utilizing measuring devices, it will become possible to improve the modulation efficiency of audio signals and conduct high quality broadcasts.

(b) Continuation of medium wave radio broadcasts: Due to deterioration over time, the existing antenna and transmitter house have worn and damaged foundations and are unfit for long-term use. Through rehabilitating the antenna and transmitter, it will be possible to sustain medium wave radio broadcasts and provide stable transmissions of disaster prevention and general lifestyle information to the 880,000 citizens of the Republic of Fiji including those on remote islands.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

1. Member List of the Study Team

The members of the Team are as follows;

Outline Design Survey

Name	Work Assignment	Position
Mr. Hiroyuki IDE	Leader	Senior Advisor JICA
Mr. Hiroshi TAKEUCHI	Sub-Leader	Director Transportation and ICT Group Infrastructure and Peacebuilding Department JICA
Mr. Kaoru OKADA	Cooperation Planning	Deputy Director Transportation and ICT Group Infrastructure and Peacebuilding Department JICA
Mr. Kiyofusa TANAKA	Chief Consultant / Broadcasting Planning	Yachiyo Engineering Co., Ltd.
Mr. Katsumi NAGATOMO	Transmitting System Planning /Cost Estimation	Yachiyo Engineering Co., Ltd
Mr. Mitsuhiro NASU	Transmitting House Renovation Planning 1 /Cost Estimation	Yachiyo Engineering Co., Ltd.
Ms. Yoshiyuki CHOSO	Social Condition Research	Yachiyo Engineering Co., Ltd.
Mr. Takayasu KASE	Transmitting House Renovation Planning 2 / Survey of Natural Condition Resources	Yachiyo Engineering Co., Ltd.

Outline Design Survey (Additional Survey of Natural Condition Resources)

Name	Work Assignment	Position
Mr. Hironori KOMATSU	Transmitting House Renovation Planning 2 / Survey of Natural Condition Resources	Yachiyo Engineering Co., Ltd.

Explanation of Draft Outline Design

Name	Work Assignment	Position
Mr. Kaoru OKADA	Leader /Cooperation Planning	Deputy Director Transportation and ICT Group Infrastructure and Peacebuilding Department JICA
Mr. Kiyofusa TANAKA	Chief Consultant / Broadcasting Planning	Yachiyo Engineering Co., Ltd.
Mr. Katsumi NAGATOMO	Transmitting System Planning /Cost Estimation	Yachiyo Engineering Co., Ltd

APPENDIX 2

STUDY SCHEDULE

2. Study Schedule

Outline Design Survey

No.	Date		JICA			Consultant Team					Place of Stay
			Leader	Cooperation Planning	Sub-leader	Chief Consultant/ Broadcasting Planning	Transmitting System Planning /Cost Estimation	Transmitting House Renovation Planning 1/Cost Estimation	Social Condition Research	Transmitting House Renovation Planning 2 / Survey of Natural Condition Resources	
			Hiroyuki Ide	Kaoru Okada	Hiroshi Takeuchi	Kiyofusa Tanaka	Katsumi Nagatomo	Mitsuhiro Nasu	Yoshiyuki Choso	Takayasu Kase	
1	29 Sep	Mon				Trip [Narita→ Sydney]					On board
2	30 Sep	Tue				Trip [Sydney→ Nadi] Trip [Nadi → Suva]					Suva
3	1 Oct	Wed				・Meeting at JICA Fiji Office ・Visit to Ministry of Public Enterprises & Tourism ・Discussion with FBC, (Inception Report, Schedule of Survey, etc.) ・Survey of existing FBC facilities (broadcasting networks, studio equipment, organization, human logistics) ・Discussion with FBC (Details of Survey, Comprehensive schedule of Survey)					Suva
4	2 Oct	Thu				・Survey of existing facilities(Radio Transmitting Station) ・Discussion with FBC (Financing subjects by C/P, Demarcation, etc.) ・Discussion with local consultant (social /environmental condition, etc.) ・Visit to NDMO and other related Ministries, FBC financial statement analysis					Suva
5	3 Oct	Fri				・NDMO	・Field Survey		・NDMO		Suva
6	4 Oct	Sat				・Social condition search, industrial port research, etc. ・Discussion with local consultant on the household Survey of radio usage					Suva
7	5 Oct	Sun		Trip [Narita→Nadi]		・Consultant team discussion, Analyzing documents					Suva
8	6 Oct	Mon		Trip [Nadi→Suva] ・Courtesy call to Embassy of Japan ・Visit to JICA Fiji Office ・Visit to Ministry for Public Enterprises & Tourism		・Survey of existing facilities(Radio Transmitting Station) ・Discussion with FBC (Technical part, Financial part)					Suva
9	7 Oct	Tue		・Discussion with FBC on M/D ・Survey of existing facilities ・Collection of Answers to Questionnaires from FBC ・Discussion with FBC on Preparatory question list ・Visit to project site					・Collection of Answers to Questionnaires from FBC ・Analyzing Financial documents		Suva
10	8 Oct	Wed		・Discussion with FBC on M/D ・Visit to Australian Government Dept. of Foreign Affairs and Trade ・Ministry of Information			・Survey of existing facilities (transmitter)	・Discussion with local consultant (existing facilities on the current environment)	・Discussion with FBC on M/D ・Visit to AusAID, ・Ministry of Information		Suva
11	9 Oct	Thu		・Discussion with FBC	Trip [Suva→Nadi]	・Survey of equipment procurement procedure, Confirmation of the progress of topographic Survey and soil investigation, transportation of material)					Suva
12	10 Oct	Fri			Trip [Nadi→Narita]	・Study of design conditions and Preparation of Drawings, etc. ・Preparation of the field report		・Study of design conditions and Preparation of Drawings, etc.	・Social Condition Study ・Interviewing to the local radio listeners		Suva
13	11 Oct	Sat	Trip [Jakarta→ Sydney]			・Preparation of the field report				Trip [Narita→ Sydney]	Suva
14	12 Oct	Sun	Trip [Sydney→ Nadi]			・Consultant team discussion, Analyzing documents ・Meeting with Telecom Fiji Ltd.				Trip [Sydney→ Nadi] Trip [Nadi→Suva]	Suva
15	13 Oct	Mon	Trip [Nadi→Suva] ・Internal Meeting ・Ministry of Agriculture	・Preparation of M/D		・Preparation of the field report ・Ministry of Strategic Plan ・Meeting with FBC ・Ministry of Agriculture	・Preparation of the field report ・Meeting with Telecom Fiji Ltd.	・Survey of Natural Condition Resource	・Ministry of Strategic Plan ・Meeting with FBC ・Ministry of Agriculture	・Survey of Natural Condition Resource	Suva

No.	Date		JICA			Consultant Team					Place of Stay
			Leader	Cooperation Planning	Sub-leader	Chief Consultant/ Broadcasting Planning	Transmitting System Planning /Cost Estimation	Transmitting House Renovation Planning 1/Cost Estimation	Social Condition Research	Transmitting House Renovation Planning 2 / Survey of Natural Condition Resources	
			Hiroyuki Ide	Kaoru Okada	Hiroshi Takeuchi	Kiyofusa Tanaka	Katsumi Nagatomo	Mitsuhiro Nasu	Yoshiyuki Choso	Takayasu Kase	
16	14 Oct	Tue	・Meeting with SPC			・Preparation of the field report ・Ministry of Education	・Preparation of the field report	・Study of design conditions and Preparation of Drawings, etc.	・Preparation of the field report ・Ministry of Education	・Survey of Natural Condition Resource	Suva
17	15 Oct	Wed	・Discussion with FBC on M/D			・Preparation of the field report ・NDMO ・Ministry of communication	・Preparation of the field report	・Ditto	・NDMO ・Ministry of Communication	・Ditto	Suva
18	16 Oct	Thu	・Discussion with FBC on M/D ・Reporting to JICA Fiji Office about progress of Survey			・Preparation of the field report ・Fiji Electricity Authority	・Preparation of the field report		・Preparation of the field report ・Fiji Electricity Authority	・Preparation of the field report	Suva
			・Survey of ICT information	Trip [Suba→Nadi]		Trip [Suba→Nadi]	・Discussion with FBC on field report				Suva
19	17 Oct	Fri	・Conclude M/D Trip [Suva→Nadi]	Trip [Nadi→Narita]		Trip [Nadi→Narita]	・Conclude M/D	Trip [Suva－Nadi] ・Civil Aviation Authority of FIJI ・Fiji Meteorological Service (FMS) Trip [Nadi－Suva]		・Conclude M/D	Suva
20	18 Oct	Sat	Trip [Nadi→ Sydney]				・Market Survey				Suva
21	19 Oct	Sun	Trip [Sydney→ Jakarta]				・Consultant team discussion, Analyzing documents				Suva
22	20 Oct	Mon					・Market Survey, Preparation of survey report	・Visiting local constructor ・Obtaining estimated construction cost	・Interviewing to the local radio listeners	・Confirming on-site study of Natural Condition Resources	Suva
23	21 Oct	Tue				Trip [Narita→Nadi]	・Market Survey ・Preparation of survey report		・Ditto		Suva
24	22 Oct	Wed				Trip [Nadi→Suva] ・Preparation of survey report ・Discussion with FBC on field report	・Preparation of survey report ・Discussion with FBC on field report	・Discussion with FBC on field report		・Obtaining the report from Surveyor (Natural Condition Resources), reviewing the report	Suva
25	23 Oct	Thu				・Preparation of survey report					Suva
26	24 Oct	Fri				・Obtaining an approval on the field report from FBC			・Ministry of Finance	・Obtaining an approval on the field report from FBC	Suva
27	25 Oct	Sat				・Preparation of survey report					Suva
28	26 Oct	Sun				・Preparation of survey report					Suva
29	27 Oct	Mon				・Reporting to Embassy of Japan about the progress of Survey ・Reporting to JICA Fiji Office about progress of Survey Trip [Suva → Nadi]					Nadi
30	28 Oct	Tue				Trip [Nadi→ Sydney]					Sydney
31	29 Oct	Wed				Trip [Sydney→ Narita]					

Outline Design Survey (Additional Survey of Natural Condition Resources)

No.	Date		JICA	Consultant Team Transmitting House Renovation Planning 2 / Survey of Natural Condition Resources Hironori KOMATSU	Place of Stay
1	25 Jan	Sun		Trip [Narita→ Incheon] Trip [Incheon→ Nadi]	On board
2	26 Jan	Mon		Trip [Sydney→ Nadi] Trip [Nadi→Suva]	Suva
3	27 Jan	Tue		・ Confirming the progress of Soil Investigation by Surveyor	Suva
〃	〃	〃		・ Confirming the progress of Soil Investigation by Surveyor ・ Reviewing daily site report by Surveyor	Suva
20	13 Feb	Fri		・ Reviewing daily site report by Surveyor	Suva
21	14 Feb	Sat		・ Preparation of survey report	Suva
22	15 Feb	Sun		Trip [Suva→ Nadi]	Nadi
23	16 Feb	Mon		Trip [Nadi→ Incheon] Trip [Incheon→ Narita]	

Explanation of Draft Outline Design

No.	Date		JICA	Consultant Team			Place of Stay
				Project Manager/ Broadcasting Planning	Equipment Planning/Cost Estimation	Cost Estimation	
			Kaoru Okada	Kiyofusa Tanaka	Katsumi Nagatomo	Yosuke Ikeda	
1	7 Mar	Sat	Trip [Haneda→ Hong Kong] Trip [Hong Kong→ Nadi]	Trip [Narita→ Sydney]			On board
2	8 Mar	Sun	Trip [Nadi→ Suva]	Trip [Sydney→ Nadi] Trip [Nadi→ Suva]			Suva
3	9 Mar	Mon	・ Explanation and Discussion about Draft Final Report and Draft Specifications with FBC ・ Visiting to JICA Fiji Office and Embassy of Japan				Suva
4	10 Mar	Tue	・ Discussion about Draft Final Report and Draft Specifications with Ministry of Public Enterprises and FBC ・ Overall on site survey (Naulu Transmitter Station)				Suva
5	11 Mar	Wed	・ Discussion about M/D with Ministry of Public Enterprises and FBC				Suva
6	12 Mar	Thu	・ Obtaining an approval on Draft Final Report and Draft Specifications, and Sign to M/D with Ministry of Public Enterprises, FBC and Ministry of Finance				Suva
7	13 Mar	Fri	・ Reporting to Embassy of Japan in Fiji about the overall of survey ・ Reporting to JICA Fiji Office about overall of survey ・ Additional Study, Reviewing the report				Nadi
			Trip [Suva→ Nadi]				Nadi
8	14 Mar	Sat	Trip [Nadi→ Hong Kong] Trip [Hong Kong→ Haneda]	Trip [Nadi→ Sydney]			Sydney
9	15 Mar	Sun		Trip [Sydney→ Narita]			

APPENDIX 3
LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

3. List of Parties Concerned in the Recipient Country

Name of Organization	Position
Ministry of Public Enterprises	
Shaheen Ali	Acting Permanent Secretary
Maciu N. Lumelume	Deputy Secretary
Sovaia Marawa	Deputy Secretary for Trade
Sujeet Chand	Principal Economic Planning Officer
Laisa Bolalevu	Acting Principal Financial Analyst
Sawaran Lata	Economic Planning Officer
Rachna Kumari	Economic Planning Officer
Fiji Broadcasting Corporation (FBC)	
Riyaz Sayed-Khaiyum	Chief Executive Officer
Vimlesh Sagar	Chief Financial Officer
Nitendra Prasad	Chief Officer of Technology and Logistics
Shammi Lochan	Manager Radio Programs
Ministry of Finance, Strategic Planning, National Development & Statistics	
Kamal Gounder	Principal Economic Planning Officer
Nanise Vosayaco	Chief Economic Planning Officer
Mereseini Waibuta	Chief Economic Planning Office
Mere Cakaunitabua	Senior Economic Planning Officer
Mosese Ravasavula	Senior Economic Planning Officer
Tevita Tuicakau	Principal Accounts Officer
Ministry of Information, National Archives & Library Services	
Sharon Smith Jones	Permanent Secretary
Sunia Ratulevu	Principal Officer National Disaster Management
Ministry of Education	
Pita Kaulotu Cavakilagi	Director
Lusiana Bainivalu Fotofili	Director
Aporosa Duwai	Officer
Ministry of Communication	
Elvin Prasad	Senior Engineer

Ministry of Agriculture (MOA)

Ilimeleki Kaiyanuyanu	Chief Economist
Reama Naco	Principal Agriculture Officer
Mere Nakota	Principal Information Officer
Diana Ralulu	Secretary
Varea Pasapasa	Officer

National Disaster Management Office (NDMO)

Manasa Tagicakibau	Director
Sunia Ratulevu	Principal Officer National Disaster Management

Fiji Meteorological Service (FMS)

Alipate Waqaicelua	Director of Meteorology (Suva Met. Office)
Jale Uluilakeba	Officer in Charge (Suva Met. Office)
Terry Atalifo	Officer in Charge (Nadi Met. Office)

Civil Aviation Authority of Fiji

Netava Waqa	Chief Executive
Ajai Kumar	Manager
Ilairia Abakaucoro	Air Traffic Management Inspector
Isei Tuganilau Tudreu	Controller Ground Safety

Fiji Electric Authority (FEA)

Krishneel Prasad	Acting GM System Planning & Control
Vuate Karawalevu	Unit Leader for Telecommunications & SCADA

Australian Embassy

John Morley	First Secretary
Marcus Khan	Governance Specialist
Tukatara Tangi	Program Manager – Regional (Growth and Resilience)

Embassy of Japan in Fiji

Kinzo Nakagun	Counsellor and Deputy Chief of Mission
Shinobu Nakai	First Secretary
Yukitsune Kokuba	Second Secretary

JICA Fiji Office

Shumon Yoshihara	Resident Representative (Outline Design Survey)
Hiroyuki Sawada	Resident Representative (Explanation of Draft Outline Design)
Ichiro Mimura	Deputy Director
Katsuhiko Ohara	Assistant Resident Representative
Shigeki Ishigaki	Assistant Resident Representative
Sawada Hideki	Assistant Resident Representative
Ohashi Yuichi	Assistant Resident Representative
Nila Prasad	Program Officer

APPENDIX 4

MINUTES OF DISCUSSIONS (M/D)

MINUTES OF DISCUSSIONS
ON THE PREPARATORY SURVEY ON
THE PROJECT FOR THE REHABILITATION OF THE MEDIUM WAVE RADIO TRANSMISSION
IN THE REPUBLIC OF FIJI

In response to a request from the Government of the Republic of Fiji, Japan International Cooperation Agency (hereinafter referred to as "JICA") in consultation with the Government of Japan had decided to conduct a Preparatory Survey for Outline Design on the Project for the Rehabilitation of the Medium Wave Radio Transmission (hereinafter referred to as "the Project"), and sent a Preparatory Survey Team (hereinafter referred to as "the Team") to the Republic of Fiji.

The Team is headed by Mr. Hiroyuki IDE, Senior Advisor, JICA, and is scheduled to stay in the Republic of Fiji from 30 September to 28 October 2014.

The Team held a series of discussions with officials concerned of the Government of the Republic of Fiji and conducted field surveys in the Project area. In the course of discussions and field surveys, both sides have confirmed the main items described in the attached sheets. The team will proceed to further studies and prepare a Preparatory Survey Report.

Suva, 17 October 2014

Hiroyuki IDE
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Shaheen Ali
Acting Permanent Secretary
Ministry of Public Enterprises
Republic of Fiji

Riyaz Sayed-Khaiyum
Chief Executive Officer
Fiji Broadcasting Corporation
Republic of Fiji

ATTACHMENTS

1. Title of the Project

Both sides confirmed that the title of the Project shall be "The Project for the Rehabilitation of the Medium Wave Radio Transmission".

2. Objective of the Project

Both sides confirmed that the objective of the Project is to provide stable national medium wave radio broadcasting service in the Republic of Fiji, excluding Rotuma Island, through the rehabilitation of the medium wave radio transmission.

3. Project Site

The Project site is located in Naulu Rewa, about 10 kilometer north-east from central Suva, Republic of Fiji, which is shown in Annex 1.

4. Objective of the Preparatory Survey

Both sides confirmed the objective of the Survey as follows:

4-1. To understand the background and objective of the Project and examine its impacts and appropriateness;

4-2. To identify the components, and conduct outline design and cost estimation of the Project, based on the data and information collected from and the results of discussions with the Fijian side; and

4-3. To study the issues of environmental and social considerations through the Survey.

5. Responsible and Implementing Organization

The Responsible and Implementing Organization of the Project is Ministry of Public Enterprises, affiliated with Fiji Broadcasting Corporation (hereinafter referred to as "FBC"). The organization charts are shown in Annex 2.

6. Items requested by the Government of the Republic of Fiji

6-1. By reconfirming application submitted by the Republic of Fiji in December 2013, the items described in Annex 3 were finally requested by the Fijian side with the priority.

6-2. Both sides confirmed that the appropriateness of the request would be examined in accordance with the further studies and analysis in Japan and the final components of the Project would be decided by the Japanese side from the viewpoint of necessity, technical and financial viability, sustainability and cost-effectiveness.

6-3. Both sides confirmed that there were no duplication for the Project to be conducted by other development partners or private enterprises.

7. Japan's Grant Aid Scheme

7-1. The Fijian side understands the Japan Grant Aid scheme explained by the Team, as described in Annex 4 and Annex 5.

7-2. The Fijian side will take the necessary measures, as described in Annex 6, to facilitate the smooth implementation of the Project, as a condition for the Japan Grant Aid to be implemented.

8. Environmental and Social Considerations

The Team explained that environmental and social considerations for the Project is categorized as "Category C" according to the JICA Environmental and Social Consideration Guideline, since the components of the Project are limited to reconstruction of existing Antenna system and Transmitting House in the FBC site, and installation of equipment.

9. Schedule of the Survey

Both sides confirmed the schedule of the Survey as follows. The schedule may be subject to change during the preparation and the course of the Survey.

9-1. The Team will continue further studies in the Republic of Fiji until 28 October 2014.

9-2. JICA will prepare the Draft Final Report and send a mission team to explain the details of the Project including the final components and cost estimation to the Fijian side around March 2015.

9-3. JICA will finalize the Final Report and send it to the Fijian side around April 2015.

10. Other Relevant Issues

10-1. Provision of Conveniences to the Team by the Fijian Side

The Fijian side shall, at its own expenses, provide the Team with the following items in cooperation with FBC and other organizations concerned.

(1) Security-related information as well as measures to ensure the safety of the Team members;
(2) Information as well as support in obtaining medical service;
(3) Data and information related to the Preparatory Survey;
(4) Counterpart personnel;
(5) Suitable office space with necessary equipment and services;
(6) Credentials or identification cards;
(7) Entry permits necessary for the survey team members to conduct field surveys; and
(8) Support in obtaining other privileges and benefits if necessary.

10-2. Provision of Conveniences to the Project by the Fijian Side

The Fijian side confirmed that undertakings described in Annex 7 should be taken

by the Fijian side at its own expense if implementation of the Project is approved by the Government of Japan.

10-3. Privatization

As for the possible ideas of privatization of radio broadcasting services which currently Ministry of Public Enterprises and FBC deals, Ministry of Public Enterprises and FBC confirmed that all of the equipment and facilities to be procured by Japan Grant Aid would not be deemed within the scope of possible privatization. Even if the possibility of privatization issues arises in the future, Ministry of Public Enterprises and FBC shall consult with JICA with sufficient information in accordance with the major undertakings described in Annex 6 and 7 prior to any important decision-makings. Ministry of Public Enterprises and FBC agreed to obtain the prior concurrence of JICA by providing sufficient information and explanations as well.

10-4. Interruption of Broadcasting Service on Medium Wave

The Team explained that 11-month interruption is required when the construction of new antenna will be done at the same location as the existing antenna because the construction should be started from the foundation work after the removal of the existing antenna. The Team also explained that, even in the case that the construction of new antenna will be done at the location adjacent to the existing antenna, 6-month interruption is required due to the following reasons.

1) Electromagnetic waves from the existing antenna will affects workers engaged in the construction work of new antenna mast; and
2) Existing antenna may fall down and it makes workers in dangerous situation as they work in high place and it's difficult for them to evacuate immediately.

Therefore, the existing antenna should be removed by the time of the completion of foundation work and before starting the antenna mast construction.

There is a possibility that the interruption period becomes less than 6 months if the suitable location for new antenna is found at about 300 meter away from the existing antenna in the FBC site, where the effect of electromagnetic wave from the existing antenna is considered relatively small. Even in this case, an interruption of the existing antenna is unavoidable but probably limited in the period of adjustment and test of broadcasting from new antenna.

Both sides recognized that the interruption period mentioned above should be shorten as much as possible so that necessary information should be provided to the Fijian people by using the existing antenna or by other means whenever a natural disaster is foreseen, even in the construction period of new antenna.

The Team continue to consider the suitable location of new antenna in the FBC site

for keeping the existing antenna functional as long as possible. The location of new antenna will be decided based on the result of detailed survey and analysis from technical viewpoints on the effect of electromagnetic wave, soil condition and natural condition.

10-5. Countermeasure against a Cyclone

The Fijian side strongly requested to avoid the interruption of the broadcasting service on medium wave during the cyclone season from October to March in the Republic of Fiji as the broadcasting is a vital source for getting related information.

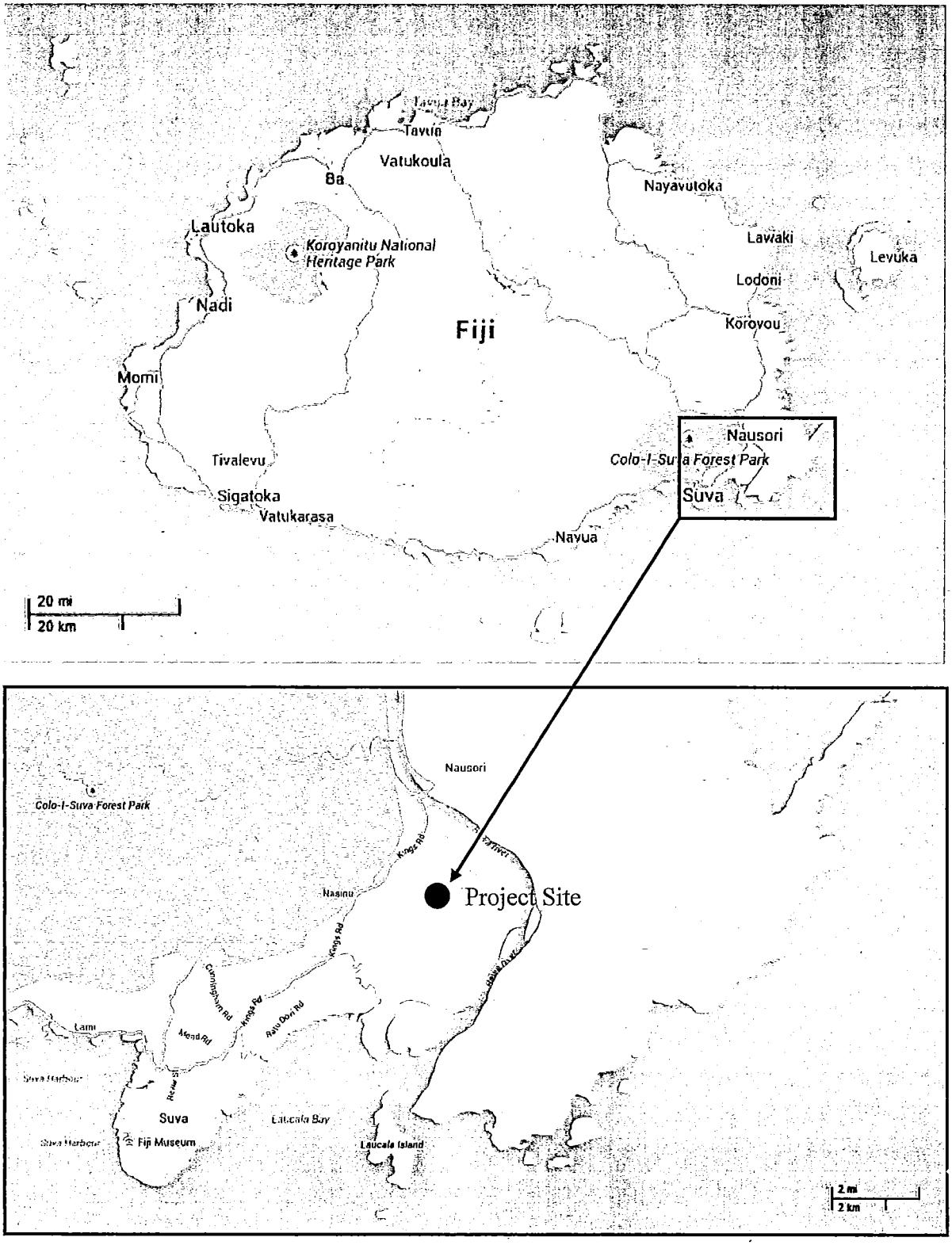
The Team will consider steps to construct the new antenna in non-cyclone season from April to September and both sides agreed to consider other methods so as to provide necessary information to the Fijian people. If keeping the existing antenna is technically possible during setting up the new antenna, following countermeasures will be considered.

1) Broadcasting by using the existing antenna at night while construction work does not taken
2) Pause of the construction work and restarting of broadcasting on medium wave by using the existing antenna in case of foreseeing natural disaster

Besides, the Fijian side will consider alternative methods for providing public service for announcing news and related information by SMS, internet and other methods in the period of interruption of broadcasting service on medium wave.

Annex 1: Project Site
Annex 2: Organization Charts of Ministry of Public Enterprises and Fiji Broadcasting Corporation
Annex 3: Items Requested by the Fijian Side
Annex 4: Japan's Grant Aid
Annex 5: Flow Chart of Japan's Grant Aid Procedures
Annex 6: Major Undertakings to be taken by Each Government as a condition for the Japan Grant Aid to be implemented
Annex 7: Major Undertakings to be taken by Each Government after an approval of Project implementation

Project Site

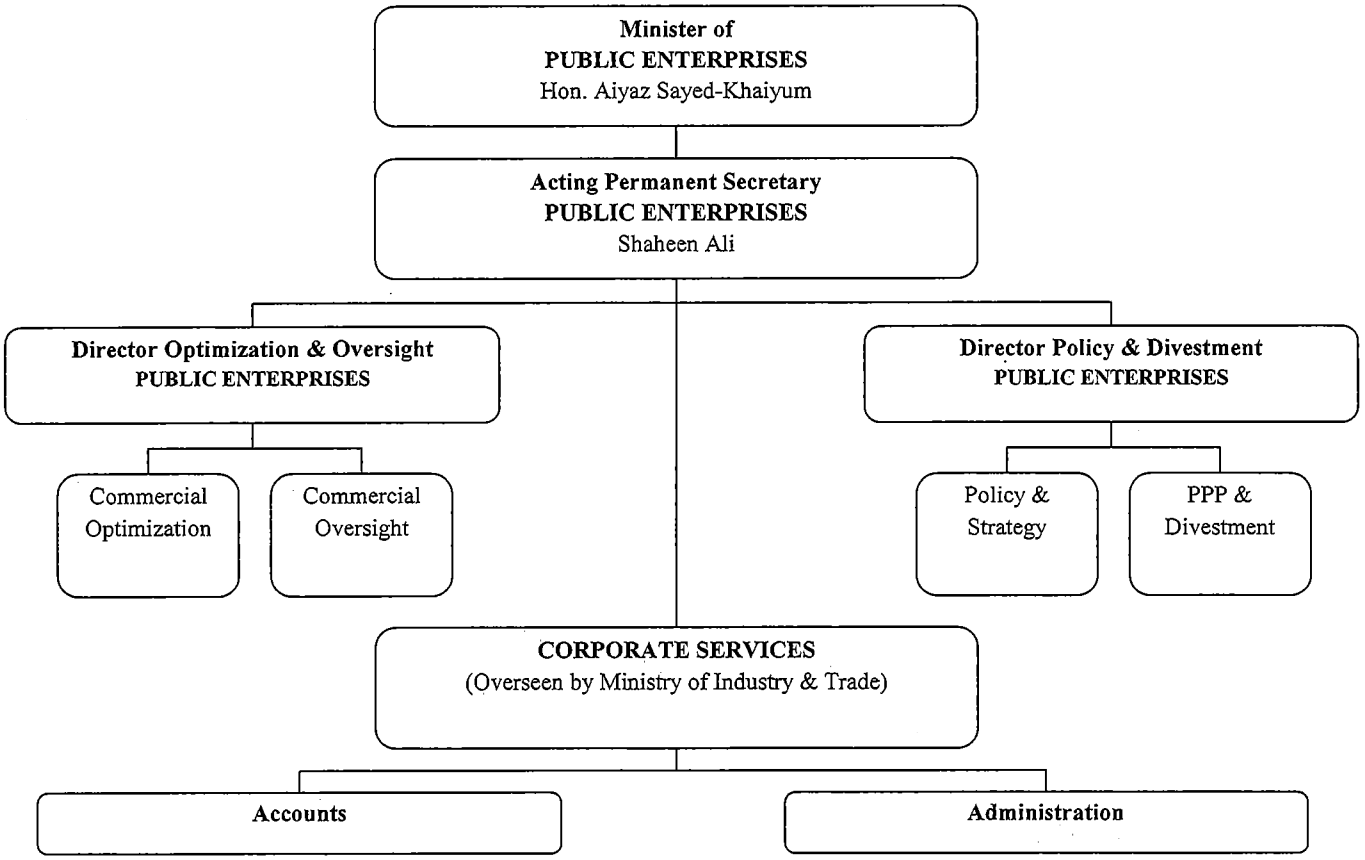


Project Site: Naulu Rewa, about 10 km north-east from central Suva, Fiji

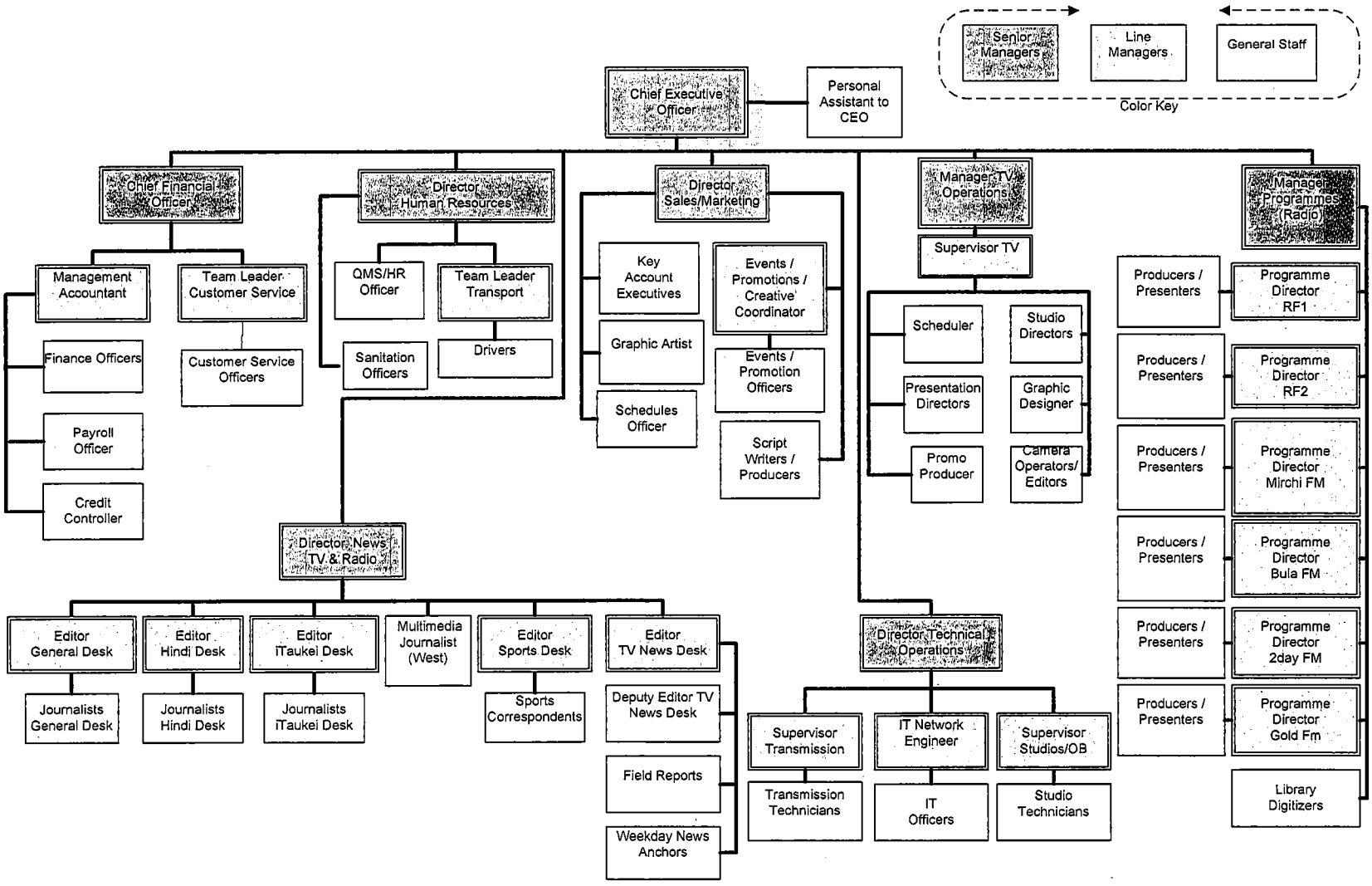
Annex 2

Organization Charts

1. Ministry of Public Enterprises



2. Fiji Broadcasting Corporation



Annex 3

Items Requested by the Fijian Side

No.	Item	Q'ty	Note
1	Transmitting Antenna (Two wave common use)	1 set	Height: 60 m Type: Umbrella Radial Earth Obstacle Warning Light Austin Transformer
	Diplexer/Combiner	1 set	558 kHz/990 kHz
	ATU (Two wave common use)	1 set	
	Feeder Cable	1 set	
	Transmitter 1	1 set	558 kHz 10 kW
	Transmitter 2	1 set	990 kHz 10 kW
	Coaxial Patch Panel (U Link)	1 set	
	Dummy Load	1 set	
	Power Supply		
	- Isolation and Lightning Protection Transformer	1 set	
	- Automatic Voltage Regulator (AVR)	1 set	
	- Primary Distribution Board (PDB)	1 set	
	Program Input Equipment (PIE) Rack System	1 lot	2 sets of PIE
2	Transmitting House	1 set	
3	Spare Parts	1 set	*including Maintenance Equipment and Tools
	Consumable parts	1 set	
4	Engine Generator	1 set	
	Air Condition	1 set	
5	ISDN Codec	4 pairs	

Japan's Grant Aid

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures:

a) Preparatory Survey
   - The Survey conducted by JICA

b) Appraisal and Approval
   - Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet

c) Authority for Determining Implementation
   - The Notes exchanged between the GOJ and a recipient country

d) Grant Agreement (hereinafter referred to as "the G/A")
   - Agreement concluded between JICA and a recipient country

e) Implementation
   - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.
- Preparation of an outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes (hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex 6.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

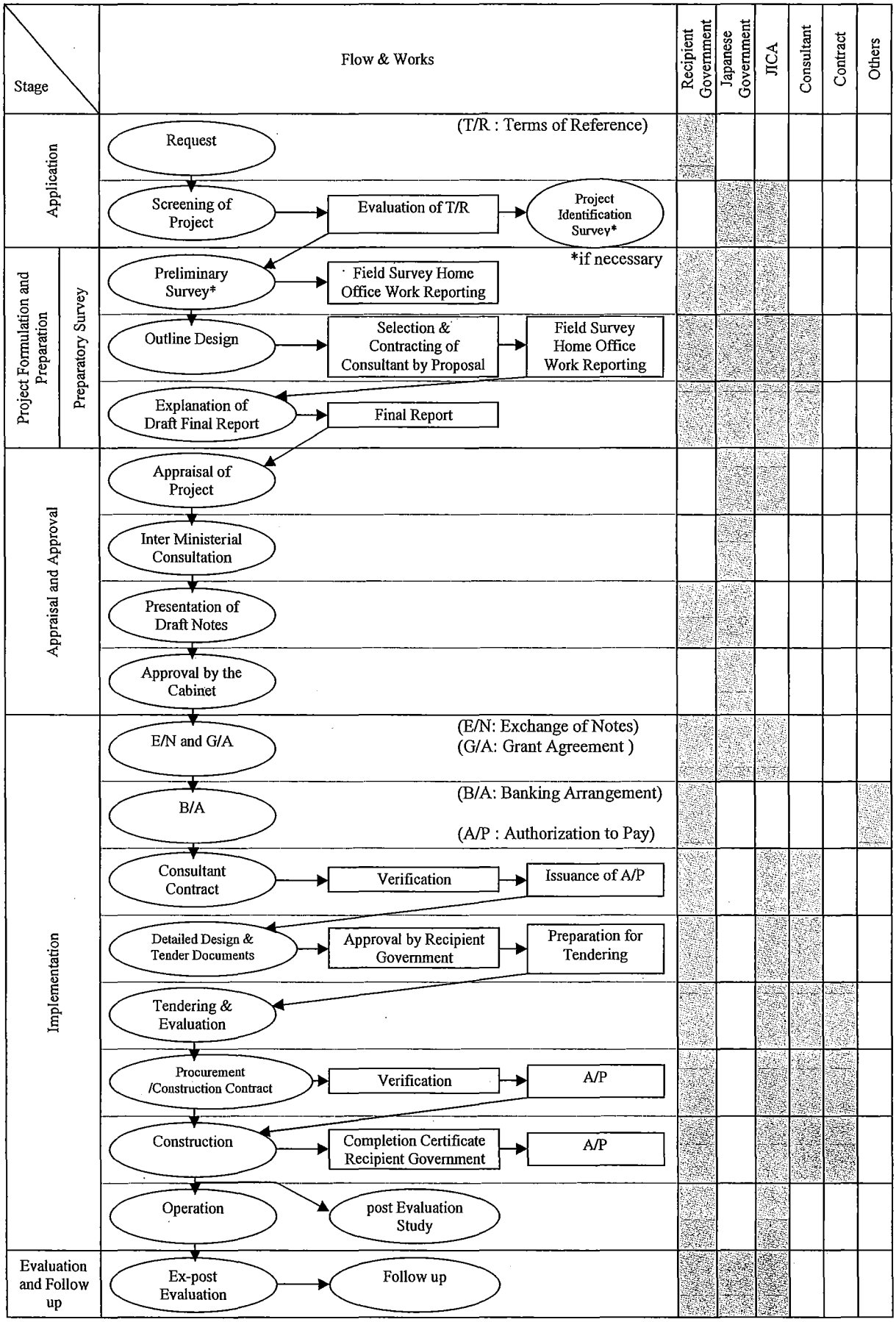
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the

Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

Flow Chart of Japan's Grant Aid Procedures



Major Undertakings to be taken by Each Government as a condition for the Japan Grant Aid to be implemented

No.	Items	To be covered by		Remarks
		Grant Aid	Recipient Side	
1	To confirm land registration and its property, and permission for the implementation of the Project and to clear the site		●	
2	To bear the following commissions paid to the Japanese bank for banking services based upon the Banking Arrangement (B/A)		●	
	1) Advising commission of Authorization to pay (A/P)		●	
	2) Payment commission		●	
3	To ensure prompt unloading and customs clearance at the port(s) of disembarkation, and internal transportation in the recipient country			
	1) Marine or Air transportation of the procured equipment and components from Japan and/or third countries to the recipient country	●		
	2) Tax exemption and customs clearance of the equipment and components at the port(s) of disembarkation in the recipient country		●	
	3) Internal transportation of the equipment and components from the port(s) of disembarkation to the project site in the recipient country	●		
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted/be borne by the Authority without using the Grant		●	
5	To accord Japanese physical persons and / or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●	
6	To maintain and use properly and effectively the facilities constructed and the equipment provided under the Grant Aid		●	
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●	
8	To give due environmental and social consideration in the implementation of the Project		●	

●: denote the side responsible for the work

Major Undertakings to be taken by Each Government after an approval of Project implementation

No.	Items	To be covered by		Remarks
		Grant Aid	Recipient Side	
1	To provide the power supply from the existing substation to the new Transmitting House		●	
2	To secure sites for the installation of the equipment, material storing yard, temporary construction yard and waste disposal		●	
3	To provide four (4) ISDN lines (including two (2) spare lines) for radio program between existing studio and new Transmitting House		●	
4	Procurement of the Equipment			Listed in Annex 3
	1) Materials for Transmitting House	●		
	2) Materials for Antenna foundation, building and radial earth	●		
	3) Antenna system including Antenna Tuning Unit (ATU) component, engine generator and air conditioning	●		
	4) Transmitter system and ATU	●		
5	To remove designated equipment and obstacles from the Project site		●	
6	To demolish the existing Antenna, feeder, foundation and Transmitting House, and leveling the site		●	
7	To construct the following facilities and install the equipment			
	1) The Transmitting House and Antenna (including the safety gate and fence around the Antenna pole)	●		
	2) The security gates and fences around the Transmitting House and allocation of security guard(s) in the site (excluding the safety gate and fence around the Antenna pole)		●	
	3) The temporary road within the site for construction of the Transmitting House and Antenna	●		
	4) The road outside the site if necessary		●	
	5) The parking lot if necessary		●	
8	To secure enough budget and personnel necessary for the operation and maintenance of the facilities constructed and the equipment provided under the Grant Aid, including the periodical maintenance work after the completion of the Project		●	

●: denote the side responsible for the work

MINUTES OF DISCUSSIONS
ON THE PREPARATORY SURVEY
FOR THE PROJECT FOR THE REHABILITATION OF THE MEDIUM WAVE RADIO TRANSMISSION
IN THE REPUBLIC OF FIJI
(Explanation of the Draft Outline Design)

On the basis of the previous preparatory survey in the Republic of Fiji from September to October 2014, and the following technical examination in Japan, Japan International Cooperation Agency (hereinafter referred to as "JICA") prepared a Draft Preparatory Survey Report (hereinafter referred to as "the Report") describing the outline design on the Project for the Rehabilitation of the Medium Wave Radio Transmission (hereinafter referred to as "the Project").

The Preparatory Survey Team visiting the Republic of Fiji from 8 March 2015 to 14 March 2015 (hereinafter referred to as "the Team"), headed by Mr. Kaoru Okada, Deputy Director, Transportation and ICT Group, Infrastructure and Peacebuilding Department, JICA, explained to and consulted with the Ministry of Public Enterprises, Fiji Broadcasting Corporation (hereinafter referred to as "FBC") and concerned officials of the Government of the Republic of Fiji (hereinafter referred to as "GOF") on the contents of the Report.

As a result of discussions, both sides confirmed the main items described in the attachment.

Suva, 13 March 2015

Kaoru Okada
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Shaheen Ali
Acting Permanent Secretary
Ministry of Public Enterprises
Republic of Fiji

Riyaz Sayed-Khaiyum
Chief Executive Officer
Fiji Broadcasting Corporation
Republic of Fiji

ATTACHMENT

1. Components of the Draft Outline Design Report

GOF, Ministry of Public Enterprises and FBC (herein after referred to as "the Fijian side") agreed and accepted the contents of the Report explained by the Team. In particular, the components of the Project described below as (1) to (3), which were presented by the Team during its stay in this time, as a result of succeeding surveys and thorough technical examination, were discussed and agreed by both sides to be conducted.

(1) Procurement of equipment listed in Annex-1
(2) Construction of a new antenna including the safety gate and fence around the antenna pole, and installation of the related equipment
(3) Construction of a new transmitter house and installation of the related equipment

2. Cost Estimation for the Project

2.1. The Team explained to the Fijian side the Project Cost Estimation in Annex-2; while the final Project Cost to be described in the Exchange of Notes (hereinafter referred to as "E/N") would be appraised by the Government of Japan.

2.2. Both sides further confirmed that details of the planned procurement and construction works in the Report should never be duplicated and/or disclosed to any third parties until all the contracts for the Project would be concluded.

3. Validity of the Previous Minutes of Discussions

Both sides confirmed that all the agreements in the Minutes of Discussions concluded in the preceding Preparatory Survey signed on 17 October 2014 shall be valid unless information was updated by the Report.

4. Japan's Grant Aid Scheme

The Fijian side reconfirmed and fully understood the scheme of the Japan's Grant Aid and the necessary measures to be undertaken by the Fijian side, which was explained by the Team and agreed as the Minutes of Discussions signed on 17 October 2014.

5. Undertakings by the Fijian Side

5.1. The Fijian side promised to execute the Major Undertakings to be Taken by the Fijian side for the Project listed in Annex-3 in time, at full responsibility and its own expenses based on the contents of the Report.

5.2. The Fijian side fully understood the possibilities of the suspension/termination of the Project if any violations on the undertakings occurred.

5.3 Both sides confirmed that while an annual budget of FJD 2,910,000 to FBC was fixed until 2016 based on the contract between GOF and FBC, GOF should continue budgeting FBC in and after 2017 so as to stabilize its finances and secure the necessary budget to maintain its setup as a public broadcasting agency. If the budget cannot be approved in time and/or appropriately, there is a possibility that the Project might be suspended or terminated.

5.4. After the commencement of broadcasting operation with equipment procured by the Project, FBC promised to request budgeting for appropriate operation and maintenance of the facilities procured and constructed by the Project in a timely manner, to make their best efforts to obtain the budget approval from the office of the Prime Minister on behalf of the GOF in time and to report its approval progress to JICA Fiji office.

5.5. The Fijian side confirmed that the customs duties, internal taxes and other fiscal levies imposed in the Republic of Fiji with respect to the purchase of the products and the services should be exempted in accordance with the regulations of E/N between the both governments.

5.6. Both sides confirmed that FBC should take all necessary procedures for the exemption of customs duties, internal taxes and other fiscal levies, in collaboration with Ministry of Public Enterprises. In case the exemption would not be processed in a timely manner, anyhow, both sides confirmed such tentative payment(s) should be owed by the Fijian side. The procedures required for the exemption are as follows.

5.6.1. For the equipment and materials imported from Japan and /or third country

(1) The Japanese contractor will send shipping documents including a list of equipment to FBC before loading the procured equipment and materials onto the ship in Japan and/or third country.

(2) Based on the concession letter which Ministry of Finance is planning to issue to FBC by the end of March 2015, FBC will conduct prompt

unloading and customs clearance of all equipment and materials at the port of disembarkation in the Republic of Fiji. The copy of the concession letter in 2014 issued by the Ministry of Finance is attached as Annex-5.

5.6.2. For the equipment and materials procured in the Republic of Fiji

(1) The Japanese contractor will send a list of equipment to FBC before purchasing the necessary equipment and materials in the Republic of Fiji.

(2) FBC will temporarily bear internal taxes and other fiscal levies on equipment and materials.

(3) After completion of the procurement, FBC will request and receive a refund of internal taxes and other fiscal levies from Fiji Revenue and Customs Authority on the basis of the assessment result by the Authority.

5.7. Both sides confirmed that FBC should conduct following administrative procedures with related agencies in a timely manner, since the procedures exert crucial influence on the progress of the Project. Both sides further confirmed that all the following procedures should be finished by the end of April 2015, as a condition for the implementation of the Project.

5.7.1. Environmental and social consideration assessment

As the removal work of existing facilities and installation of new ones are planned on the FBC site, it is unlikely that implementation of the Project will cause negative impact on the environment or resettlement of residents. However, in line with a regulation for the construction work in the Republic of Fiji, it is required to undergo an Environmental and social consideration assessment by the Department of Environment (hereinafter referred to as "DOE").

DOE had already conducted the preliminary survey (DOE Ref 5/1/1/A (VI) 21/02/2014) for Environmental Impact Assessment (EIA) in the construction and environmental management plan. Besides, based on the request from FBC with detailed plan of the Project including design drawings of the new antenna and transmitter house, DOE is planning to conduct a field investigation in the upcoming weeks. As a result of the survey, written approval from a standpoint of environmental impact should be given to FBC by DOE.

5.7.2. Aviation Impact Assessment

The existing antenna is not situated on any aircraft take-off or landing paths and does not infringe any legislation or regulations. The Civil Aviation Authority of FIJI (hereinafter referred to as "CAAF") mentioned that no restriction would be imposed on the new antenna found at 300 meter away from the existing antenna

in the FBC site and with same height (60 meters) as the existing antenna. However, in light of the Aviation Law of the Republic of Fiji, it is required to undergo an Aviation Impact Assessment by CAAF, and as a result, written approval for the construction of the new antenna should be given to FBC by CAAF.

5.7.3. Building permits

With regard to building legislation, it is required to apply for building authorization to Nausori Town Council in terms of the construction of new antenna and transmitter house, and as a result, written approval as a building permits should be given to FBC by the Council.

5.8. Both sides confirmed that FBC shall report to JICA Fiji office the progress of Major Undertakings by the Fijian side until all the works to be done. Reports to JICA Fiji office shall be submitted monthly with actual progress bar chart in Annex-3. Besides, other than the monthly report, Ministry of Public Enterprises and FBC shall reply if requested by JICA.

6. Operation and Maintenance of the Facilities

The Fijian side agreed to secure enough staff and budgets, and to take every necessary action for appropriate operation and maintenance of the facilities procured and constructed by the Project. The annual operation and maintenance costs are estimated as shown in Annex-4.

7. Schedule of the Study

JICA will complete the Final Report of the Preparatory Survey both in Japanese and English, in accordance with the confirmed items, and send the English version to the Fijian side around April 2015. The schedule is tentative and subject to change.

8. Disclosure of Information

Both sides confirmed that the study results excluding the Project cost estimation and details of the construction works shall be disclosed to the public after completion of the Preparatory Survey. All the study results including the Project cost and details of the construction works will be disclosed to the public after all the contracts for the Project are concluded.

9. Collaboration among Relevant Organizations

Ministry of Public Enterprises and FBC promised to work closely with relevant organizations, such as the Ministry of Finance, Department of Environment and Civil Aviation Authority of Fiji.

10. Misconduct

Both sides confirmed that if there were any suspicion of corruption or fraudulent practices in the implementation process of the Project, Ministry of Public Enterprises and FBC shall provide JICA with related information reasonably requested by JICA, including information of any concerned official of the government and/or public organizations of the Republic of Fiji. Ministry of Public Enterprises and FBC shall not treat unfairly or unfavorably the physical persons and juridical persons that provide the information.

11. Safety Measures

11.1. To avoid accidents on the site during the implementation of the Project, the Fijian side agreed to take and cause the consultant and the contractor to take safety measures such as setting safety assurance to the site, providing information for security control to public and deploying adequate security personnel, based on "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects". The Guidance has been published on JICA's website below.

http://www.jica.go.jp/activities/schemes/oda_safety/ku57pq00001nz4eu-att/guidance_en.pdf

11.2. The Team recommended Ministry of Public Enterprises and FBC to explain the citizens about the necessity and significance of the Project, interruption period of broadcasting service on medium wave, impact and so forth, so as to enhance their understanding and support for the smooth implementation of the Project.

Annex-1: List of Equipment Procured (CONFIDENTIAL)
Annex-2: Project Cost Estimation (CONFIDENTIAL)
Annex-3: Major Undertakings to be Taken by the Fijian Side
Annex-4: Annual Operation and Maintenance Costs (CONFIDENTIAL)
Annex-5: The Copy of the Concession Letter in 2014 issued by the Ministry of Finance

Annex-1

List of Equipment Procured

No.	Description	Quantity
1	MW Antenna System (60 m, Umbrella Type, dual frequency antenna)	
1.1	Antenna System	1 set
1.2	OB Lighting System	1 set
1.3	Radial Earthing	1 set
1.4	Diplexer with Antenna Tuning Unit (ATU)	1 set
1.5	ATU Compartment	1 set
1.6	Auxiliary Material for ATU Compartment	1 set
1.7	Coaxial Feeder	2 sets
1.8	Dehydrator	1 set
2	Transmitter-1 (558 kHz)	
2.1	10 kW Medium Wave Transmitter (558 kHz)	1 set
2.2	Program Input Equipment (PIE) Rack	1 set
(1)	Audio Processor Amplifier	2 sets
(2)	Control Panel (Input Select Switch, Meter Panel and Monitor Switcher)	1 set
(3)	Monitor Amplifier	1 set
(4)	Monitor Speaker	1 set
(5)	ON AIR Monitor Receiver with Receiving Antenna	1 set
(6)	Audio Input Panel	1 set
(7)	NFB Panel	1 set
(8)	Rack	1 set
3	Transmitter-2 (990 kHz)	
3.1	10 kW Medium Wave Transmitter (990 kHz)	1 set
3.2	Program Input Equipment (PIE) Rack	1 set
(1)	Audio Processor Amplifier	2 sets
(2)	Control Panel (Input Select Switch, Meter Panel and Monitor Switcher)	1 set
(3)	Monitor Amplifier	1 set
(4)	Monitor Speaker	1 set
(5)	ON AIR Monitor Receiver with Receiving Antenna	1 set
(6)	Audio Input Panel	1 set
(7)	NFB Panel	1 set
(8)	Rack	1 set
4	Output Change-over Switch, Dummy Load	
4.1	Output Change-over Switch (5 Port U-link)	1 set
4.2	Dummy Load	1 set

No.	Description	Quantity
5	Power Supply Equipment and Air Conditioning System	
5.1	65 kVA Engine Generator with Fuel Tank	1 set
5.2	Control panel with Automatic Change-over Switch	1 set
5.3	65 kVA Automatic Voltage Regulator & Primary Distribution Board (PDB)	1 set
5.4	65 kVA Isolation and Lightning Protection Transformer	1 set
5.5	Air Conditioning	2 sets
6	ISDN Codec	
6.1	ISDN Codec	8 sets
7	Maintenance Equipment and Tools	
7.1	Distortion Meter/Oscillator	1 set
7.2	Audio Attenuator	1 set
7.3	Oscilloscope	1 set
7.4	Frequency Counter	1 set
7.5	Circuit Tester	1 set
7.6	Impedance Bridge, Receiver / Generator	1 set
7.7	Field Strength Meter	1 set
7.8	Tool Kit	1 set
8	Spare Parts	
8.1	PA Module for Transmitter (1pc each type)	2 sets
8.2	Power FET for PA Module	2 sets
8.3	RF Driver Unit for Transmitter	2 sets
8.4	Power Supply Module for Transmitter (1pc each type)	2 sets
8.5	Control Board for Transmitter	2 sets
8.6	Monitor Board for Transmitter	2 sets
8.7	Printed Board for AVR	1 set
8.8	Maintenance Kit for Antenna System	1 set
9	Consumable Parts	
9.1	Fan unit for Transmitter	10 sets
9.2	Air Filter for Transmitter	10 sets
9.3	Fuse for Transmitter	10 sets
9.4	Surge Absorber for Isolation Transformer	5 sets
9.5	Limp for OB Lighting System	5 sets
9.6	Fuse for PIE	10 sets
9.7	Fuse for AVR	5 sets

Annex-2

Project Cost Estimation

1. Cost Estimation Borne by the Government of Japan

This section is closed due to confidentiality.

2. Cost Estimation Borne by the Government of the Republic of Fiji

Item	Cost Estimation (FJD)	Note
Removal of obstacles from the site of new antenna	6,600	Removal work: FJD 50 x 60 person-day = FJD 3,000 Equipment: FJD 3,600
Removal of existing antenna, feeder, foundation and leveling the site	10,000	Removal work: FJD 50 x 100 person-day = FJD 5,000 Equipment: FJD 5,000
Securing of commercial power supply from the existing substation to the new Transmitter House	30,000	Cable approx. 75 mm^2: FJD 150/m x 80 m = FJD 12,000 kWh meter: FJD 1,000 Installation: FJD 17,000

Item	Cost Estimation (FJD)	Note
Installation of four (4) ISDN lines (including two (2) spare lines) for radio program between FBC headquarters and new Transmitter House	350	Installation: FJD 350
Installation of fences and gates around the new transmitter house (excluding the safety gate and fence around the Antenna pole)	14,000	FJD 200/m x 70 m = FJD 14,000
Administrative approval from DOE, CAAF and Nausori Town Council for implementation of the Project	300	Application: FJD 300
Bank commissions (Advising commission of Authorization to Pay (A/P) and payment commission	15,350	Rough approx. 0.1% of the total Project cost
Total	76,600	

Notes:

1) Conditions of cost estimation

- Estimated timing: October 2014
  USD 1.00 = JPY 104.83
- Exchange rates: FJD 1.00 = JPY 55.741

2) Others

The project is implemented in accordance with the scheme of Japan's Grant Aid. The above cost estimation does not assure the ceiling cost on the E/N and shall be reviewed by the Government of Japan before the conclusion of E/N between the both governments.

Annex-3

Major Undertakings to be Taken by the Fijian Side

1. Undertakings as a condition for the Japan Grant Aid to be implemented

No.	Items	Remarks
1	To confirm land registration and its property, and permission for the implementation of the Project and to clear the site	
2	To bear the following commissions paid to the Japanese bank for banking services based upon the Banking Arrangement (B/A)	
	1) Advising commission of Authorization to pay (A/P)	
	2) Payment commission	
3	To ensure prompt unloading and customs clearance at the port(s) of disembarkation, and internal transportation in the Republic of Fiji	
4	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Fiji with respect to the purchase of the products and the services be exempted/be borne by the Authority without using the Grant	
5	To accord Japanese physical persons and / or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the Republic of Fiji and stay therein for the performance of their work	
6	To maintain and use properly and effectively the facilities constructed and the equipment provided under the Grant Aid	
7	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	
8	To give due environmental and social consideration in the implementation of the Project	

2. Undertakings of which progress required to be shared with and to be reported to JICA in a timely manner

The Fijian side is required to implement following items described below and report to JICA Fiji office monthly and the times when the items marked "▼" is done. Furthermore, FBC is also required to report to JICA on an ad-hoc basis in response to JICA's inquiries.

Undertaking			Month	2015										2016												2017				
				Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Project Implementation	Conclusion of E/N and G/A (P)			■	▲																							
	Detailed Design						■	■																				
	Tender Notice								▲																			
	Tender									▲																		
	Shop drawings and working drawings											■	■	■														
	Equipment manufacture											■	■	■	■	■	■	■	■									
	Transportation: 1st ship														■	■												
	Transmitter house building works														■	■	■	■	■									
	Antenna foundation work														■	■	■	■	■	■								
	Transportation: 2nd ship																■	■										
	Transportation: 3rd ship																			■	■							
	Antenna constructing works																			■	■	■						
	Transmitter Installation works																					■	■					
	Adjustment, testing, OJT																										■	■
Securing budget	Budget for 2015 and 2016	Plan		Annual budget of FJD 2,910,000 to FBC was fixed until 2016																								
		Actual																										
	Request of budget for 2017 - 2020	Plan																▼										
		Actual																										
	Approval of budget for 2017 - 2020	Plan																					▼					
		Actual																										
Bank arrangement	Opening of bank account and arrange Authorization to Pay	Plan					▼																					
		Actual																										
	Payment of bank commission	Plan					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
		Actual																										
Tax exemption	Submission of application for tax exemption	Plan														▼		▼			▼							
		Actual																										

Temporary halt of construction to avoid interruption of existing radio broadcasting in cyclone season

Undertaking		Month	2015										2016												2017				
			Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Environmental & social consideration assessment by DOE	Request of DOE's assessment	Plan	FBC already done																									
		Actual																											
	Assessment by DOE	Plan	▼																									
		Actual																											
	Issuance of the letter of approval by DOE	Plan	▼																									
		Actual																											
Aviation assessment by CAAF	Request of CAAF's assessment	Plan	FBC already done																									
		Actual																											
	Assessment by CAAF	Plan	▼																									
		Actual																											
	Issuance of the letter of approval by CAAF	Plan	▼																									
		Actual																											
Building authorization by Nausori Town Council	Request of Nausori Town Council's assessment	Plan	FBC already done																									
		Actual																											
	Authorization by Nausori Town Council	Plan	▼																									
		Actual																											
	Issuance of the letter of approval by Nausori Town Council	Plan	▼																									
		Actual																											
Preparation for storing the equipment	Provision of temporary storage area close to the Project site	Plan															■	■	■	■	■	■	■	■	■	■	■	■	■
		Actual																											
Preparation before starting the antenna foundation works	Keep the construction site clear	Plan	■	■	■	■	■	■	■	■	■		■	■	▼														
		Actual																											
	Provision of a waste disposal site	Plan														■	■	■	■	■	■	■	■	■	■	■	■	■	■
		Actual																											
Preparation before new antenna adjustment and testing	Securing of commercial power supply	Plan															■	■	▼										
		Actual																											
	Removal of existing antenna, feeder, foundation and leveling the site	Plan																										▼	
		Actual																											
Telecom cables	Installation of 4 ISDN lines between FBC HQ and transmitter house	Plan																	■	■	■	▼							
		Actual																											

Undertaking		Month	2015									2016											2017				
			Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Provision of safety measures	Installation of fences and gates around the new transmitter house	Plan																								▼		
		Actual																										
Trial operation	Implementation of test broadcasts	Plan																										
		Actual																										
Public Announcement by TV, Radio and Newspaper	Information of Interruption	Plan																										
		Actual																										
	Advertisement of New MW broadcasting	Plan																										
		Actual																										

Annual Operation and Maintenance Costs

1. Expenditure

The equipment to be procured by the Project will be operational in 2017, and the annual operation and maintenance costs are estimated as shown in the following table.

Item	Unit price (FJD)	Quantity	Total (FJD)
Electric Power Cost including New Transmitter	133,500	1 set	133,500
ISDN Fee	2,100	1 set	2,100
Maintenance Cost			
Maintenance for Electric Equipment	3,700	1 set	3,700
Service Maintenance for Air Conditioning	2,700	1 set	2,700
Painting for Antenna Pole	20,000	1 set	20,000
Consumable Parts and Spare Parts			
Fan unit for Transmitter	1,250	2 sets	2,500
Air Filter for Transmitter	1,250	4 sets	5,000
Lamp for OB Lightning System	1,667	3 sets	5,000
Each kind of fuse	500	10 sets	5,000
Surge Absorber for Isolation Transformer	2,500	2 sets	5,000
PA Module (average cost per year)	2,500	2 sets	5,000
RF Driver Unit (average cost per year)	2,500	2 sets	5,000
Power Supply Module (average cost per year)	2,500	2 sets	5,000
Each kind of control printed board (average cost per year)	5,000	2 sets	10,000
Power FET (average cost per year)	2,500	2 sets	5,000
Fuel cost for Engine Generator	4,000	1 set	4,000
Total (FJD)			218,500

(1) Electric Power Cost

The annual electric power cost will be increased due to a replacement of transmitter. Increased cost is calculated as below.

(a) Annual electric power cost for the new 10 kW transmitter: FJD 133,500
(b) Annual electric power cost for the current 2 kW transmitter: FJD 19,500
(c) Increased annual cost (= (a) – (b)): FJD 114,000

(2) Maintenance Cost

The breakdown of the maintenance cost includes the fee of new transmitter and other related equipment, ISDN lines, air conditioning, and new antenna pole procured by the Project. In particular, maintenance of air conditioning facility is important for operating the installed equipment, and painting of the antenna pole is essential to prevent rusting.

(3) Consumable Parts and Spare Parts

Measuring cables, fans, filters, fuses, light bulbs, etc. have high frequency of use and need to be replaced or renewed almost every year. The tri-annual replacement parts costs are adjusted into annualized costs. The Fijian side is required to secure the budget to purchase consumable parts every year to make sure that appropriate maintenance is continued, while the parts necessary for a year or first replacements are procured by the Project.

2. Saving for Equipment Renewal Cost

The Fijian side is required to save part of the renewal cost (FJD 415,000 out of FJD 3,320,000) annually as a reserve fund for eight years until 2025 after starting operation with new equipment in 2017. The following table shows the breakdown of equipment renewal costs saved over eight years.

Item	Unit price (FJD)	Quantity	Total (FJD)
Transmitter (1 set)	1,260,000	2 sets	2,520,000
Guy Wire, Insulator (1 set)	500,000	1 set	500,000
Air Conditioning	150,000	1 set	150,000
Engine Generator	150,000	1 set	150,000
Total (FJD)			3,320,000

MINISTRY OF FINANCE

P.O. Box 2212, Government Buildings, Suva, Fiji; Tele: (679) 330 7011, Fax: (679) 330 0834
Website: www.finance.gov.fj, Email: info@finance.gov.fj
Ro Lalabalavu House, 370 Victoria Parade, Suva

10th January, 2014 Fin File: 20/4/3

Riyaz Saiyad Khaiyum
The Chief Executive Officer
Fiji Broadcasting Corporation
P.O. Box 334
Suva.

Dear Sir,

Re: Extension for Duty Concession on the Importation of Technical Equipment for Radio and Free to Air Television Project.

Reference is made to your letter dated 27th November, 2013, with regards to the above mentioned subject.

Please be informed that the Minister for Finance has granted approval for the extension of duty concession to Fiji Broadcasting Corporation under ad hoc Section 10 of the Customs Tariff Act for the upgrading of radio station and free to air television at a concessionary rate of Free Fiscal, Free Import Excise and 15% VAT payable.

This approval will be valid until 31/12/2014.

Any disposal or usage of goods under concession for any purpose other than what the concession is granted for shall invoke Section 17 of the Customs Tariff Act and the goods shall be liable for duty.

We trust that the above clarifies Ministry of Finance's position on this matter.

Yours faithfully,

Manuqalo Banivalu
for **Permanent Secretary – Ministry of Finance.**

cc: The Chief Executive Officer – Fiji Revenue & Customs Authority

APPENDIX 5

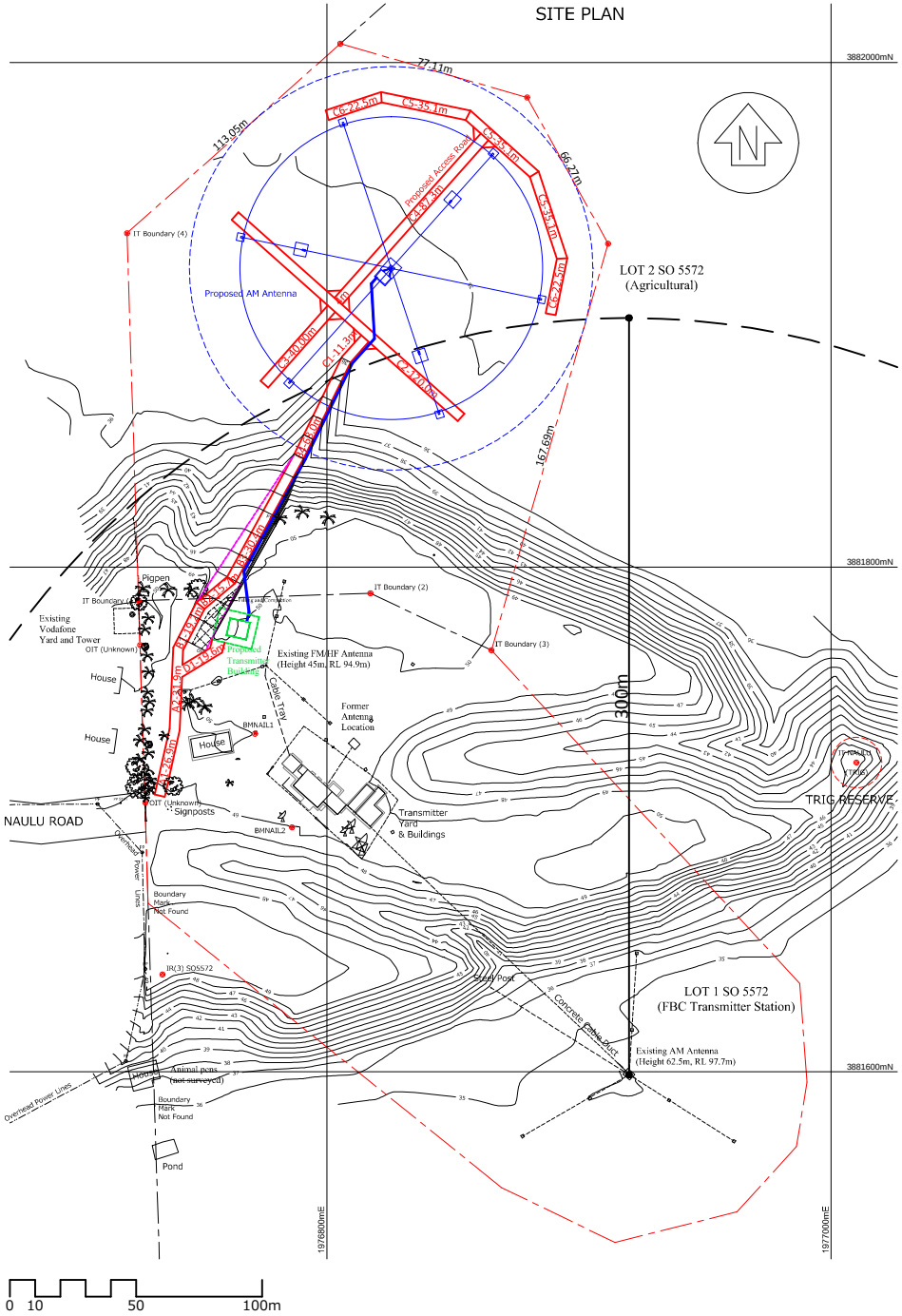
OUTLINE DESIGN DRAWINGS

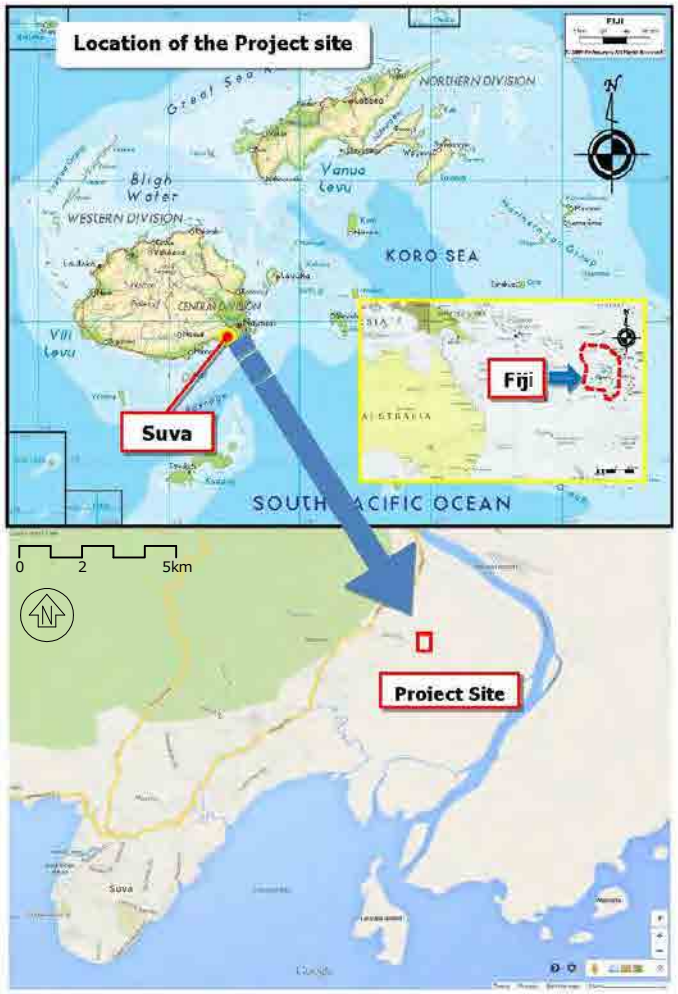
5. Outline Design Drawings

Dwg No.	Dwg Title
G-01	Site Location /Site Plan
S-01	Block Diagram of MW Transmitting System
MA-01	MW Antenna Layout
MA-02	MW Antenna Elevation
A-01	New Transmitter House Site Plan
A-02	New Transmitter House Floor Plan
A-03	New Transmitter House Elevation /Section

A-5-2

SITE PLAN





LEGEND

- Boundary
- Major Contour (1m spacing)
- Building
- Fence
- Gate
- Stay Anchor Block (Concrete)
- Satellite Dish
- Coconut Palm
- Other Tree
- Power Pole
- Survey Mark

SURVEY MARK SCHEDULE

Name	Easting (m)	Northing (m)	RL (m)
IT NAULU (TRIG)	1977010.03	3881722.55	47.92
IR(3) SO5572	1976734.84	3881638.53	49.59
IT Boundary (1)	1976725.32	3881786.69	50.21
IT Boundary (2)	1976817.28	3881789.66	50.33
IT Boundary (3)	1976865.26	3881767.05	50.08
IT Boundary (4)	1976720.75	3881932.40	35.52
IT Boundary (5)	1976844.42	3882042.20	34.81
BMNAIL1	1976771.52	3881733.96	50.00
BMNAIL2	1976786.17	3881696.86	49.04
OIT (Unknown)	1976725.95	3881769.12	50.24
OIT (Unknown)	1976728.01	3881706.67	49.33

The Project for the Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji

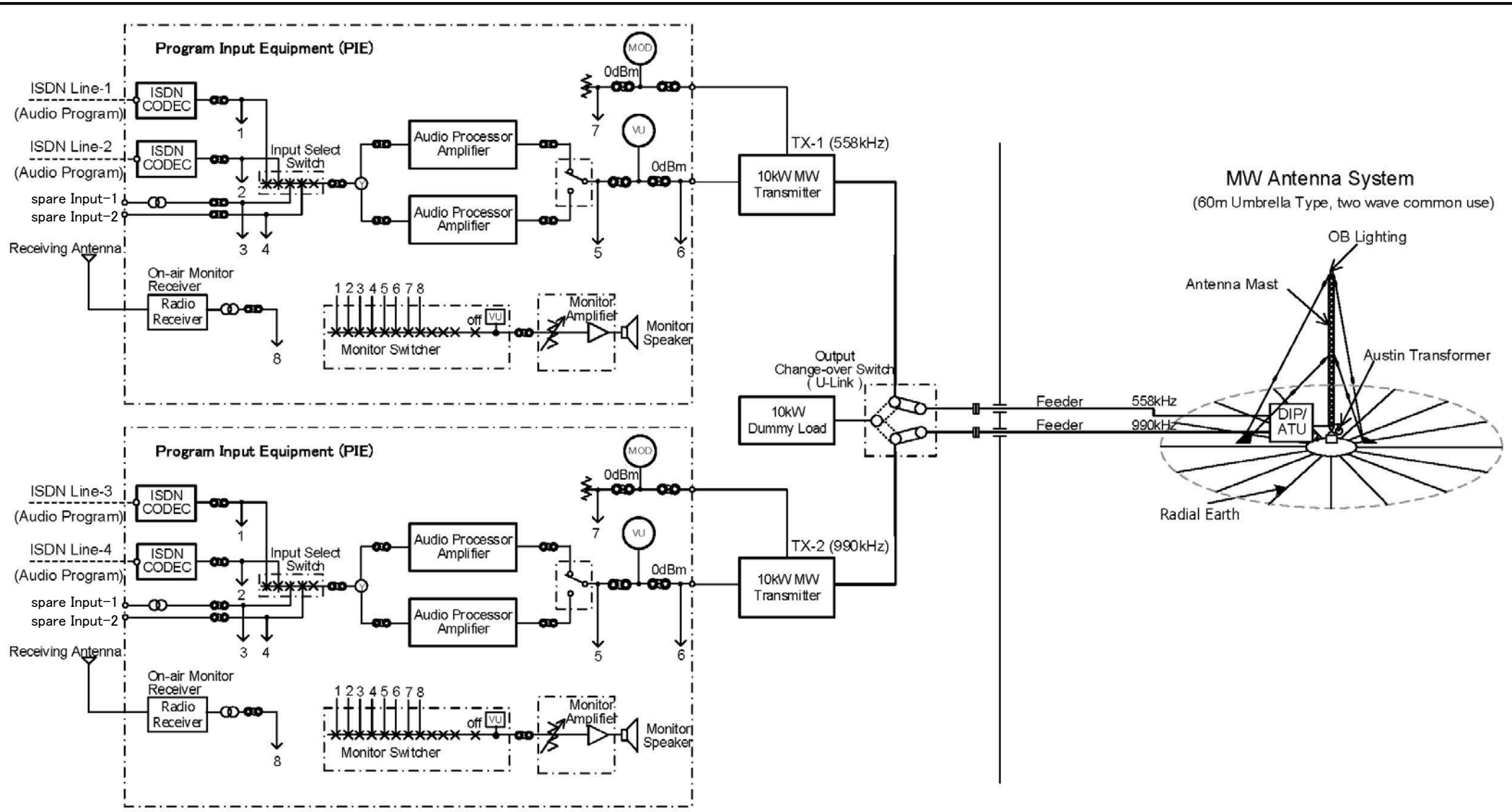
SCALE: None

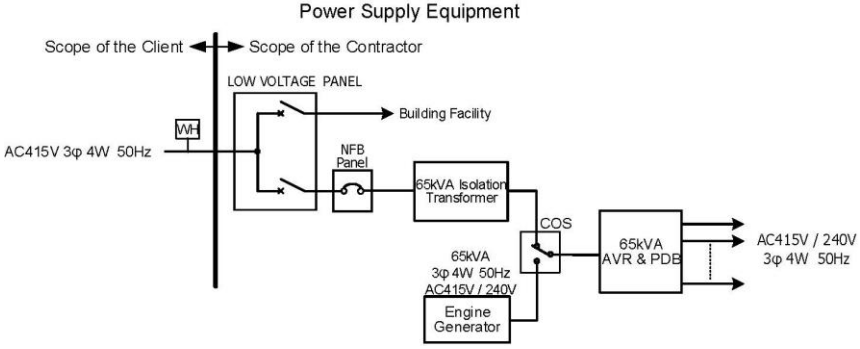
Title: Site Location / Site Plan

DWG. No.: G-01

DATE	DESIGNED	CHECKED	APPROVED	REVISION
28 Nov. 2014	H. Komatsu	T. Kobayashi	K. Tanaka	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN





Abbreviation

ATU	:	Antenna Tuning Unit
AVR	:	Automatic Voltage Regulator
COS	:	Change-over Switch
DIP	:	Diplexer / Combiner
MW	:	Medium Wave
NFB	:	Non Fuse Breaker
PDB	:	Primary Distribution Board
OB	:	Obstruction (Lighting)

Symbol

- : Molded Case Circuit Breaker
- VU : VU (Audio Level) Meter
- MOD : Modulation Percent Meter
- : Audio Jack

The Project for the Rehabilitation of the Medium Wave Radio in the Republic of Fiji

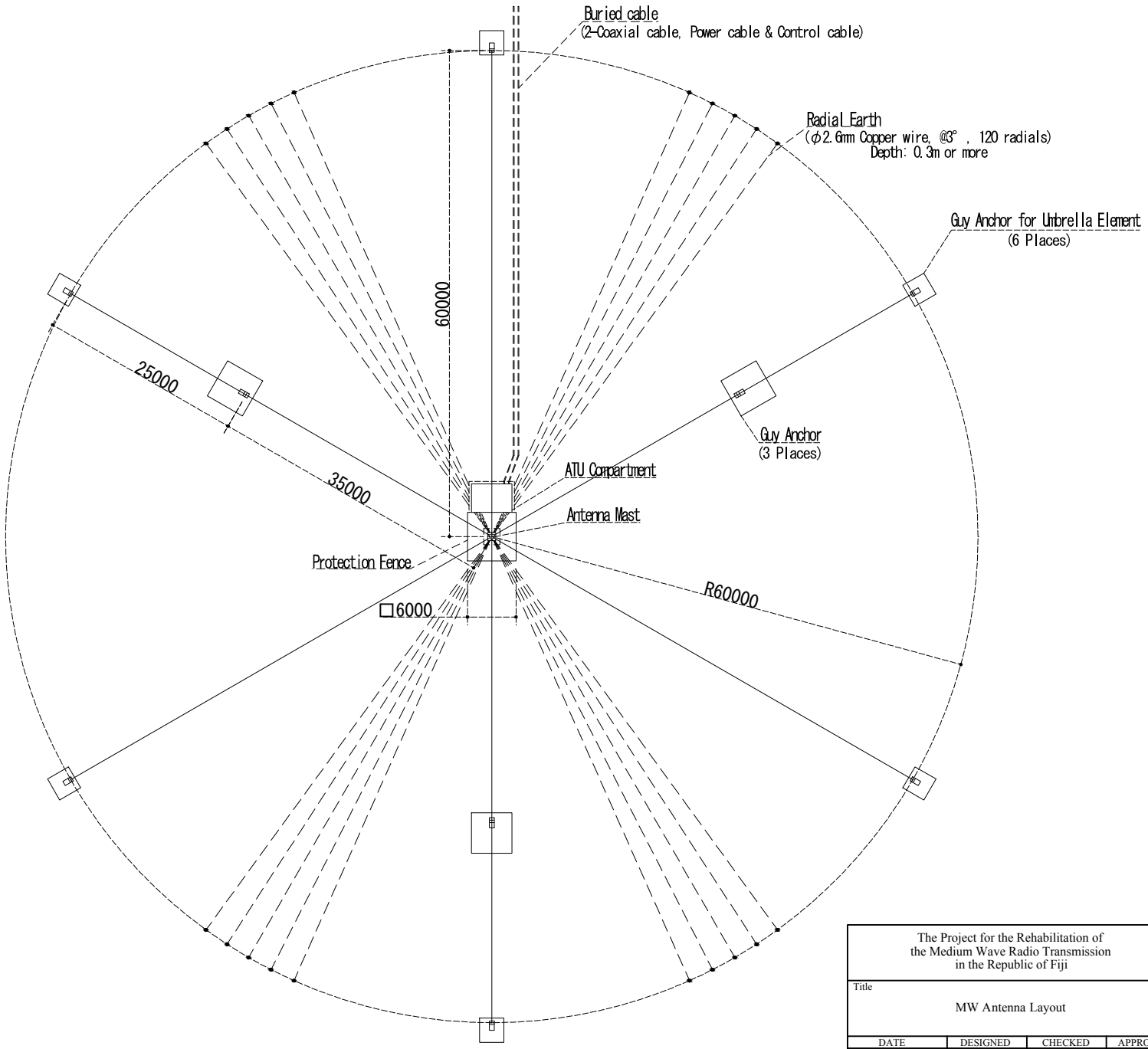
Title: Block Diagram of MW Transmitting System

DWG. No.: S-01

DATE	DESIGNED	CHECKED	APPROVED	REVISION
18 Sep 2014	K. Nagatomo	T. Kobayashi	K. Tanaka	

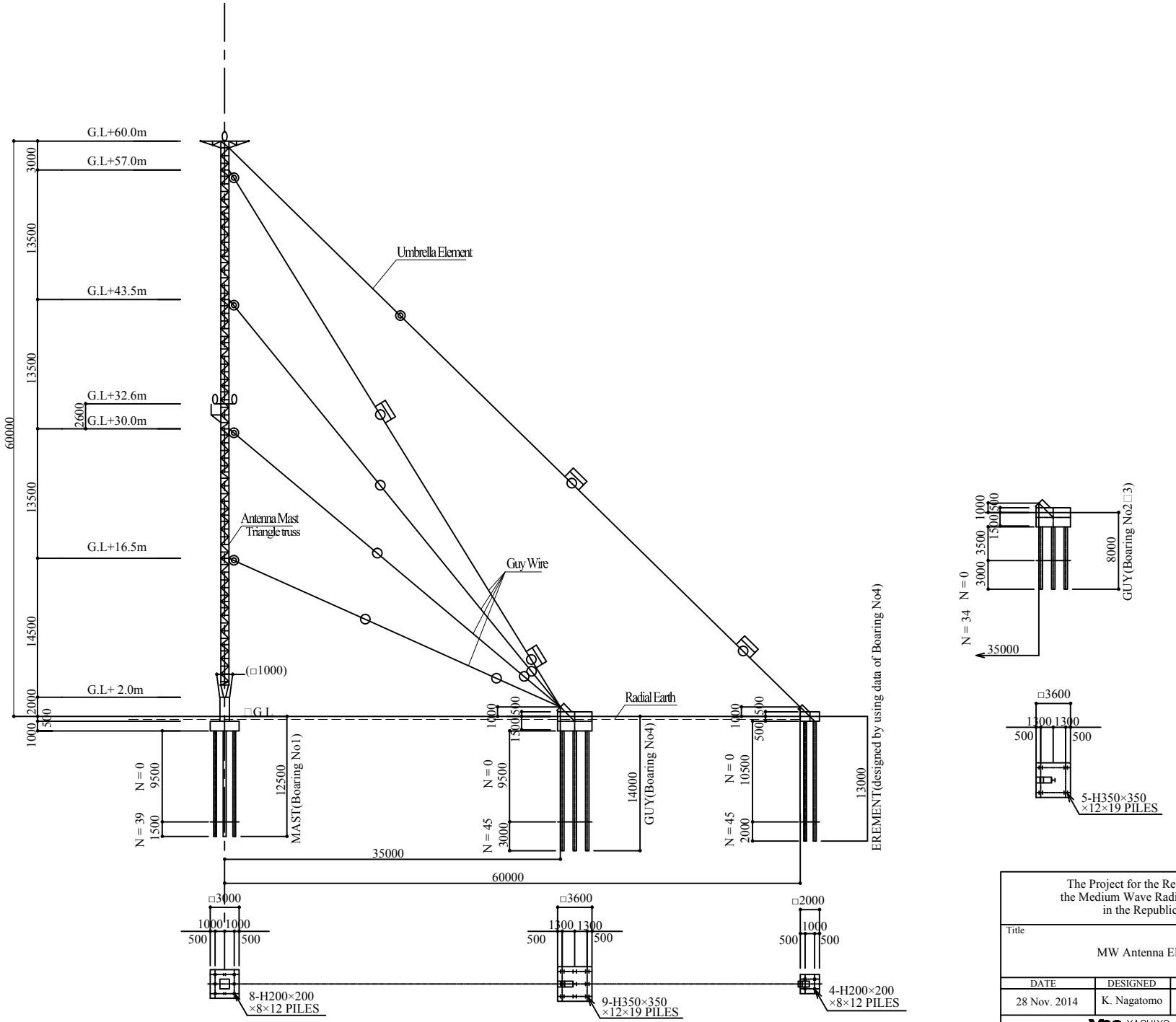
YACHIYO ENGINEERING CO., LTD.
TOKYO JAPAN

A-5-3



The Project for the Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji				SCALE: S=1/500 (for A3 paper)
Title: MW Antenna Layout				DWG. No.: MA-01
DATE	DESIGNED	CHECKED	APPROVED	REVISION
28 Nov. 2014	K. Nagatomo	T. Kobayashi	K. Tanaka	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN



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Title: MW Antenna Elevation				DWG. No.: MA-02
DATE	DESIGNED	CHECKED	APPROVED	REVISION
28 Nov. 2014	K. Nagatomo	T. Kobayashi	K. Tanaka	
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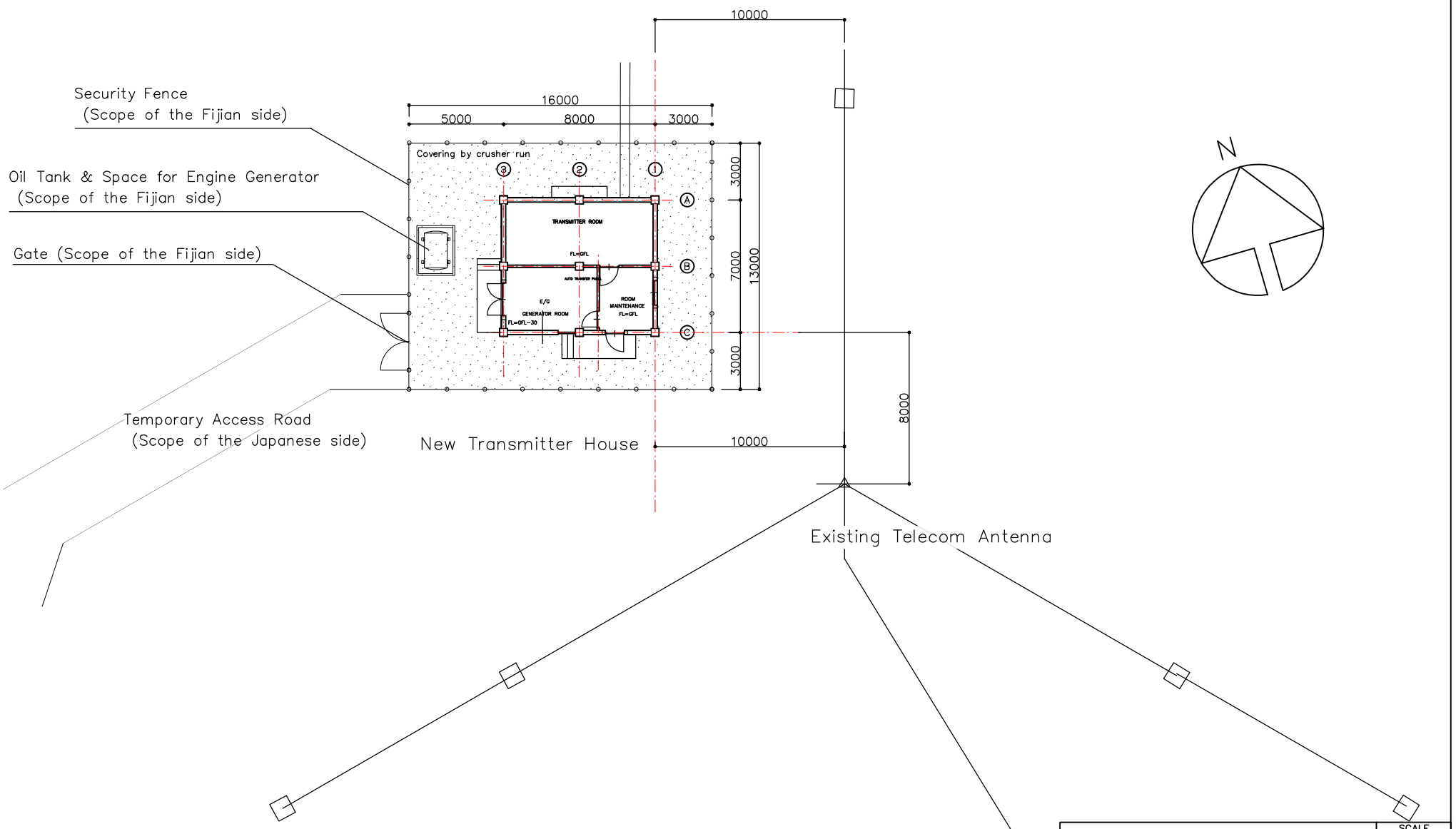

A-5-6

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Title: New Transmitter House Site Plan				DWG. No.: A-01
DATE	DESIGNED	CHECKED	APPROVED	REVISION
28 Nov. 2014	M. Nasu	H. Komatsu	K. Tanaka	
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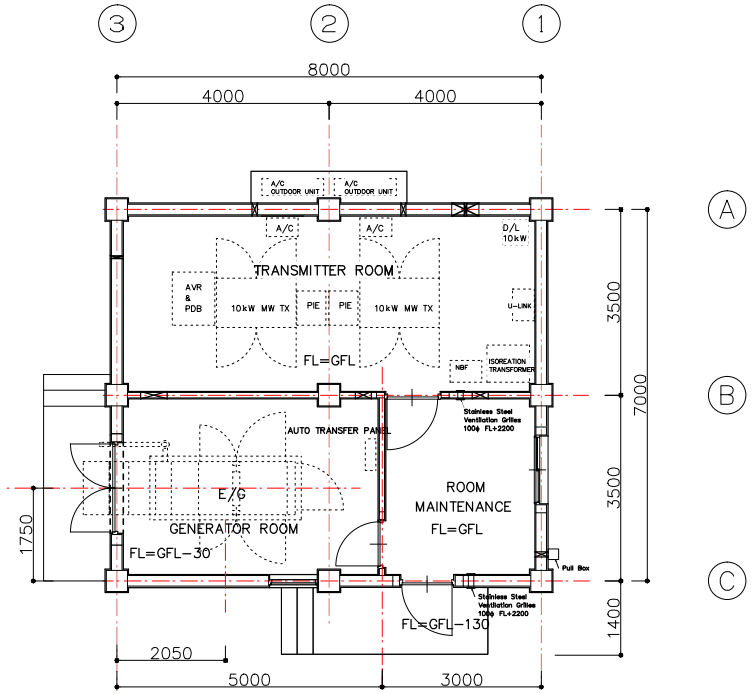

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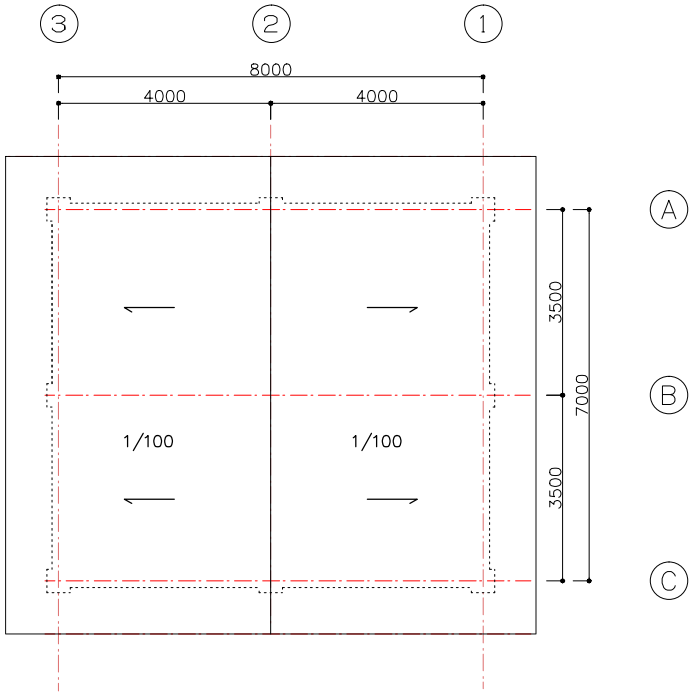

ROOF PLAN S=1/100

The Project for the Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji				SCALE: S=1/100 for A3 paper
Title: New Transmitter House Floor Plan				DWG. No.: A-02
DATE	DESIGNED	CHECKED	APPROVED	REVISION
28 Nov. 2014	M. Nasu	H. Komatsu	K. Tanaka	
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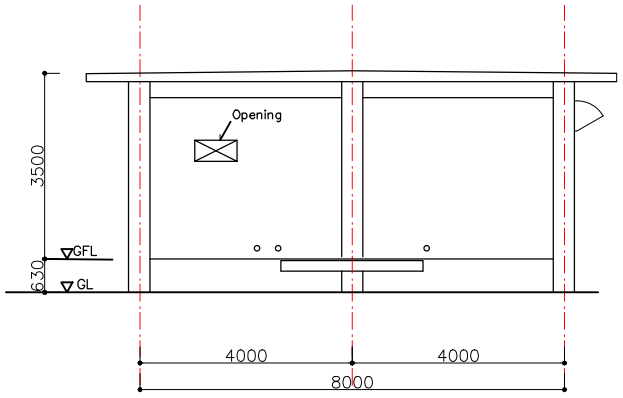

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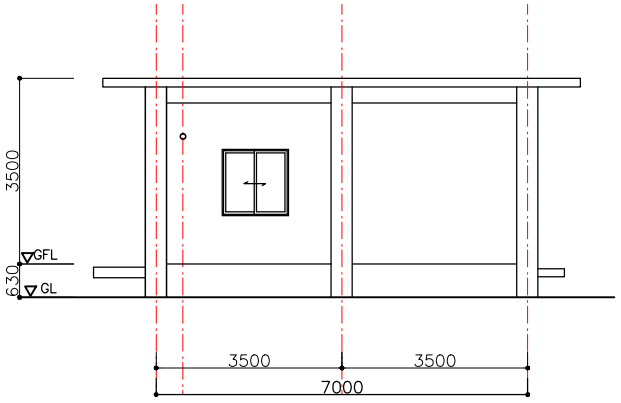

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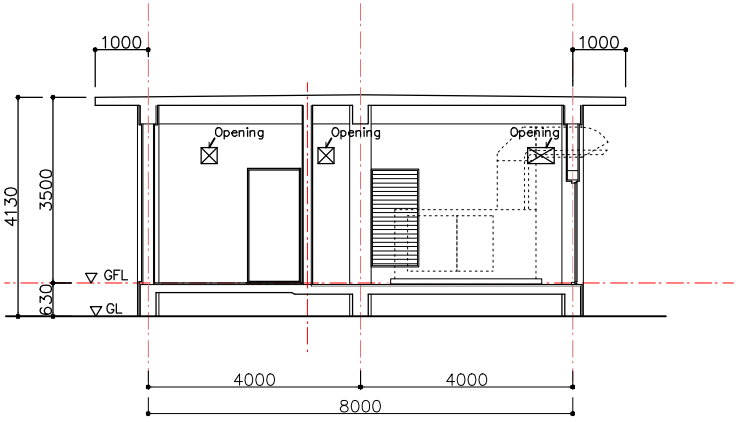

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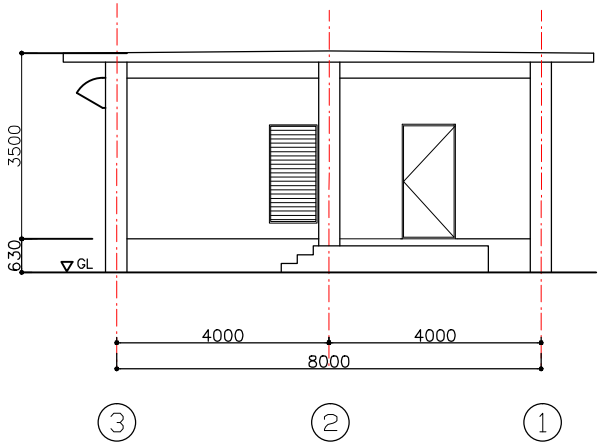

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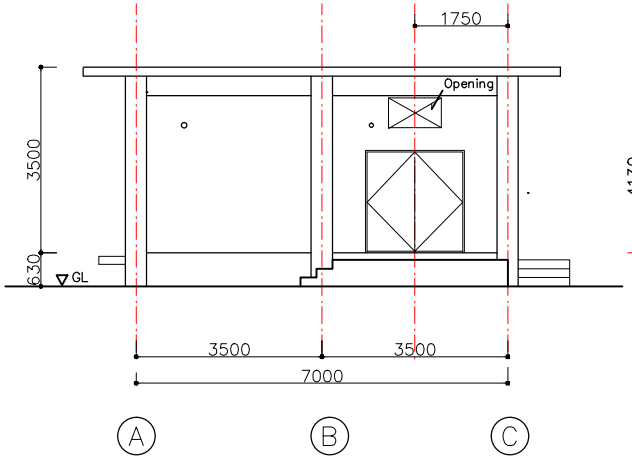

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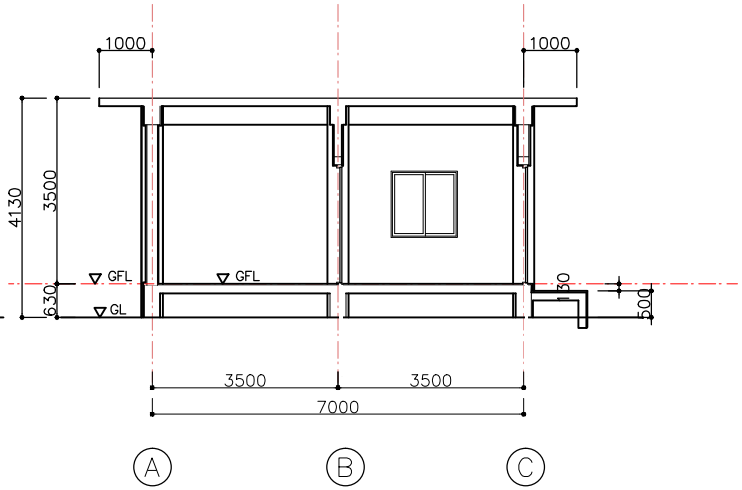

①– LINE SECTION

A-5-8

The Project for the Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji				SCALE: S=1/100 for A3 paper
Title: New Transmitter House Elevation / Section				DWG. No.: A-03
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28 Nov. 2014	M. Nasu	H. Komatsu	K. Tanaka	

YACHIYO ENGINEERING CO., LTD.
TOKYO, JAPAN

APPENDIX 6
REPORT OF TOPOGRAPHIC SURVEY AND SOIL INVESTIGATION

6. Report of Topographic Survey and Soil Investigation

(1) Report of Simple boring and Simple penetration test at the site of new Transmitter house

REPORT

Yachiyo Engineering Co. Ltd

The Rehabilitation of The Medium Wave Radio Transmission in The Republic of Fiji
Topographical Survey and Soil Explorations

Tonkin & Taylor

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Table of contents

1 Introduction

1.1 General

Tonkin and Taylor International (T&TI) was engaged by Yachiyo Engineering Co., Ltd. (YEC) to undertake soil investigations and a topographic survey for a proposed new medium wave radio antenna and transmission house (defined herein as 'the site') in Suva, Fiji.

The investigations and survey have been carried out in accordance with the "Contract of Topographical Survey and Soil Explorations" provided to T&TI by YEC. The soil investigations comprised 5 hand augered boreholes and 6 Scala penetrometer tests, at locations directed by the representative of YEC. Laboratory testing of recovered soil samples from the site was also undertaken. This work scope was agreed with YEC.

The topographic survey of the site was undertaken by New Zealand based topographical surveyors, under the supervision of T&TI.

The geotechnical assessment was undertaken in accordance with our proposal dated 6 October 2014[1].

The scope of the geotechnical investigations has included:

- A review of relevant existing information held in T&TI archives.
- A site walkover by an engineering geologist from T&TI.
- T&TI supervision of the Topographical Survey conducted by a NZ based surveyor.
- 5 handaugered boreholes to maximum of 6m depth.
- 6 Scala penetrometer tests to maximum of 9m depth.
- Assessment of suitable foundation solutions for structures on the site.
- Geotechnical assessment of the planned access road.
- Preparation of this report outlining the geology, site subsurface conditions and presenting preliminary geotechnical information and recommendations to support the development of the site.

This report summarises the results of the soils investigations carried out at the site.

1.2 Project Description

The republic of Fiji comprises an archipelago of more than 332 islands, of which 110 are permanently inhabited, and more than 500 islets, amounting to a total land area of about 18,300 square kilometres (7,100 sq mi). The two major islands, Viti Levu and Vanua Levu, account for 87% of the population of almost 860,000. The capital and largest city, Suva, is on Viti Levu.

The proposed works are part of the 'The Rehabilitation of The Medium Wave Radio Transmission in The Republic of Fiji', located east of Suva, approximately 4km west of Nausori airport.

The project involves construction of a new medium wave antenna mast and transmission house as well as temporary roads needed for access across the site. Excavation of the slope between the transmission house and the antenna mast will be required to establish a suitable grade for the access road.

[1] Tonkin and Taylor International Ltd. (6 October 2014) , Basic Design Study project for the Rehabilitation of the Medium Wave Radio Transmission for a site in Fiji- Topographical Survey and Soil Investigation: Alternative Methodology

2 Site Description

The site is located at the end of Naulu Road, Naulu, Fiji. The Site lies to the east of Suva city on the city fringes. The site is approximately 12km from Suva CBD and 4km from Nausori Aiport.

The site is located on a river terrace on the eastern outskirts of Suva. To the north, east and south of the site are the floodplains of the Rewa River. The Rewa River is located to the east of the site and the area surrounding the site consists of swamps and floodplain deposits with dense vegetative cover. The land to the west is largely residential with many small dwellings located along the western boundary of the site. The central section of the site comprises the existing buildings on gently sloping land (<5°) to the southwest. The banks of the terrace slope at approximately 20°.

The site, in its current layout includes an existing transmission house serving a telecommunications antenna. The telecommunications antenna is located slightly north of the current transmission house along a terraced portion of the site. The existing medium wave antenna is located to the south of the current transmission house.

The site of the proposed medium wave antenna is largely covered in vegetation, from small scrub and grass in the central section to dense bush located within the floodplains. Coconut palms lie along the western boundary of the site.

3 Summary of the Topographic Survey

A topographical survey of the site was undertaken by surveyors in October 2014 under the supervision of T&TI. The topographical survey details and results are summarised in the following section.

Topographical survey of the site was undertaken on 16th to 18th October 2014.

Equipment used included:	Sokkia RTK GPS XR1 Base and Rover
	Sokkia SET4130R3-36T Reflectorless Total Station
Local Benchmark used:	BMNALI1 RL 50.00m
Coordinate system used:	Fiji Geodetic Datum 1986
Height Datum:	Assumed (refer note below)

Note: Topographical plans of Fiji list the height of Naulu Trig as 56 feet (approximately 17m). Our survey has included this benchmark- 'It NAULU (TRIG) on our plans, with assumed RL 47.92m.

The Topographical Survey plans and report have been presented in Appendix B.

4 Summary of the Soils Investigation

4.1 General

The soil investigations were carried out in October 2014 and the scope of the work was completed in accordance with the 'Contract of Topographical Survey and Soil Explorations', appended for convenience in Appendix A. All field tests were terminated in hard ground or at the target depth.

The following tasks were completed for the soils investigation:

- Proposed Transmission House
    - 2 No. Hand auger boreholes (BH1 and BH2) to 5.0m below existing ground level.
    - 2 No. Scala penetromter tests (SC1 and SC2) to 5.0m below ground level.
- Proposed temporary road
    - 1 No. Hand auger (BH3) to 3.6m below existing ground level.
    - 1 No. Scala penetrometer (SC3) to 3.1m below existing ground level.
- Proposed antenna support location.
    - 1 No. Hand auger borehole (BH4) to 5.0m below existing ground level.
    - 1 No Scala penetrometer (SC4) to 4.2m below existing ground level.
- Proposed antenna mast location
    - 1 No. Hand auger borehole (BH5) to 6.0m below existing ground level.
    - 3 No. Scala penetrometer (SC5, SC6) to maximum of 9.0m below ground level.

The subsections below present a summary of the investigation work and laboratory testing results. Site investigation logs are presented in Appendix C and laboratory testing results are presented in Appendix D.

4.2 Hand auger and Scala penetrometer Investigations

The soil investigation testing, including hand augered boreholes and Scala penetrometer tests, was undertaken over a period of 4 days (16 October – 19 October 2014) at the site. In-situ shear strength testing was carried out in the hand auger boreholes in cohesive materials using a calibrated pilcon shear vane and samples were taken for geotechnical laboratory testing. The subsurface soils were described in accordance with NZ Geotechnical Society guidelines and shear strengths are recorded on the borehole logs presented in Appendix C. The Scala penetrometer provides continuous soil strength data until hard ground/refusal is achieved (10 - 20 blows per 50mm penetration). The results of the Scala penetrometer tests are included in Appendix C.

Correlations between Scala penetrometer test results and SPT 'N' values have been developed over a long period of time. The developed correlations are particularly relevant in granular soils.

4.2.1 Site 1- Proposed transmission house

Two hand auger boreholes and two Scala penetrometer tests were undertaken in the area of the proposed transmission house, immediately northwest of the existing transmission house on 16 October 2014. The hand auger boreholes extended to a depth of up to 5.0m below existing ground level. Groundwater was observed at 3.3-3.4m below existing ground level. The Scala penetrometer tests were terminated at 5.0m below ground level.

4.2.2 Site 2- Proposed temporary road

One hand auger borehole and one Scala penetrometer test were undertaken in the area of the proposed temporary road, to be constructed to provide access to the new antenna location. This location was approximately 100m northwest of the existing transmission house. The hand auger borehole extended to 3.6m where very dense sands were encountered. No groundwater was encountered. The Scala penetrometer test was terminated at 3.1m below ground level (due to refusal).

4.2.3 Site 3- Proposed antenna support location

One hand auger borehole and one Scala penetrometer test were undertaken in the area of the proposed antenna support location. This location was approximately 200m northwest of the existing transmission house. The hand auger borehole extended to 5.0m where hard silts were encountered. Groundwater was measured as being 0.3m below ground level. The Scala penetrometer test was terminated at 4.2m below ground level (due to refusal).

4.2.4 Site 4- Proposed antenna mast location

One hand auger borehole and three Scala penetrometer tests were undertaken in the area of the proposed antenna mast location. This location was approximately 200m north of the existing transmission house. The hand auger borehole extended to 6.0m below ground level. Groundwater was measured as being 0.3m below ground level. The Scala penetrometer test was terminated at 9.0m below ground level (the maximum depth attainable).

4.3 Geotechnical Laboratory Schedule

The recovered samples were brought back to Auckland and geotechnical laboratory testing was carried out by Geotechnics Ltd. The laboratory tests have been completed in full accordance with the relevant New Zealand standards, identified in the subsections below, and the laboratory is fully accredited with international Accreditation New Zealand (IANZ) registration.

The soil testing consisted of the following:

- -Moisture content (8 No.)
- -Solid density (8 No.)
- -Particle size distribution (8 No.)
- - Chloride content (8 No.)

5 Subsurface Conditions

5.1 Geological Setting

Published Geological information[2] suggests the central section of the site is underlain by Suva Marl of Miocene age. To the north, east and south the site is underlain by recent alluvium.

Observations on site confirmed the presence of alluvial deposits on the floodplain surrounding the site. Suva Marl was observed in road cuttings leading to the site, however no outcrops of Suva Marl were observed on site.

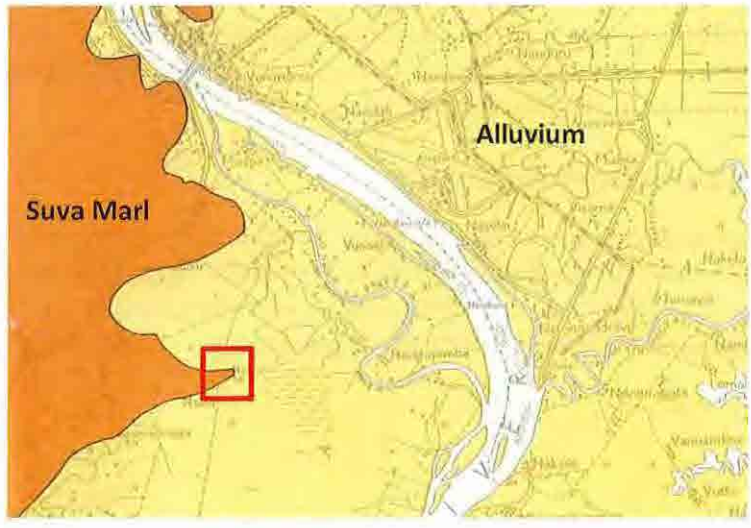


Figure 1- Published Geology of the Suva area- Ibbotson (1960). Site shown in red.

5.2 Ground and Groundwater Conditions

5.2.1 Site 1- Proposed Transmission House

The two hand auger boreholes located at the proposed transmission house encountered very similar ground conditions and these are summarised in Table 1 below. The investigations extended to 5.0m below ground level.

Table 1-Summary of ground conditions (Site 1-Proposed Transmission House)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength (Cu)
0-0.3m	Topsoil	Sandy TOPSOIL with minor organics and trace silt, loose, dry , low plasticity	N/A
0.3-1.3m	Alluvial Sediments	Silty fine SAND, light yellowish brown, loose, dry	N/A
1.3-1.7m	Alluvial Sediments	Silty fine SAND, minor medium sand, trace fine gravel, light brown streaked red, loose, dry	N/A

[2] Ibbotson,P, 1960, *Geology of the Suva Area, Viti Levu*, Geological Survey Department, Suva, Fiji,

1.7-2.6m	Alluvial Sediments	Fine SAND with minor silt and medium sand, light greyish brown, loose, dry	N/A
2.6-3.7m	Alluvial Sediments	Sandy SILT, trace clay, light brown streaked red, very stiff, moist, low plasticity	110-145kPa
3.7-4.3m	Alluvial Sediments	Sandy SILT, trace fine gravels, light greyish brown, stiff, saturated, low plasticity	90-116kPa
4.3-5.0m	Alluvial Sediments	Silty fine SAND, dark grey, loose, saturated	N/A

Groundwater encountered between 3.3 m and 3.4 m below ground level.

The two Scala penetrometer tests SC1 and SC2 were terminated between 4.9 and 5.0m. SC2 reaching refusal at 4.90m. From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strengths are summarised in Table 2 below:

Table 2- Summary of Scala penetrometer results (Site 1-Proposed Transmission House)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Consistency	Equivalent SPT "N" values
0-0.4m	0.5	Topsoil (Non-Cohesive)	Very Loose	2
0.4-0.9m	0.5-1	Sands (Non-Cohesive)	Loose	3
0.9-3.0m	2-3	Sands (Non-Cohesive)	Medium Dense	8-12
3.0-4.7m	3	Silts (Cohesive)	Stiff	12 (Cu 90 to 145kPa)
4.7-5.0m	5-11	Sands (Non-Cohesive)	Dense	20-40

5.2.2 Site 2- Proposed Temporary Road

The hand auger borehole located at the location of the proposed temporary road is summarised in Table 3 below. The investigations extended to 3.6m below ground level.

Table 3-Summary of ground conditions (Site 2-Proposed Temporary Road)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength
0.0-0.1m	Topsoil	Silty TOPSOIL, dark brown, firm, dry	N/A
0.1-3.2m	Alluvial Sediments	SILT, minor organics and trace clay, stiff to very stiff, dry	70-200kPa
3.2-3.6m	Alluvial Sediments	Silty fine SAND, dark greenish grey, dense, moist	N/A

Groundwater was not encountered in this borehole during the geotechnical investigations at this site. It is anticipated that the ground water level is likely at approximately 6.0m depth at this site.

The Scala penetrometer test SC3 was terminated at 3.1m (Due to refusal). From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strengths are summarised in Table 4 below:

Table 4- Summary of Scala penetrometer results (Site 2-Proposed Temporary Road)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0-0.1m	0.5	Topsoil (Non-Cohesive)	Very Loose	2
0.1-2.9m	2	Silts (Cohesive)	Stiff to very stiff	8
2.9-3.1m	7	Sands (Non-Cohesive)	Medium Dense	28

5.2.3 Site 3- Proposed Antenna Support

The hand auger borehole located at the location of the proposed antenna support is summarised in Table 5 below. The investigations extended to 5.0m below ground level.

Table 5-Summary of ground conditions (Site 3-Proposed Antenna Support)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength
0.0-1.8m	Organic deposits	Organic SILT with rootlets, dark brown, soft, wet, low plasticity	15-25kPa
1.8-3.0m	Organic deposits	SILT with minor organics and fine sands, dark brown, soft, saturated, low plasticity	38-59kPa
3.0-3.7m	Alluvial Sediments	Sandy SILT, trace fine gravels, grey, firm, saturated	52-100kPa
3.7-4.2m	Alluvial Sediments	Silty SAND, trace medium gravels, dark grey, med dense, saturated	N/A
4.2-5.0m	Alluvial Sediments	Sandy SILT, greenish grey, hard, wet, low Plasticity, weakly cemented	UTP*

*UTP= unable to penetrate soil with shear vane

Groundwater was encountered at 0.3m below ground level in this borehole during the geotechnical investigations at this site.

The Scala penetrometer test SC3 was terminated at 4.9m (Due to refusal). From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strengths are summarised in Table 6 below:

Table 6- Summary of Scala penetrometer results (Site 3-Proposed Antenna Support)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0-3.0m	0	Organic Silts (Cohesive)	Very Soft	0
3.0-3.8m	1.5	Silts (Cohesive)	Soft	5
3.8-4.2m	7-10	Silt (Cohesive)	Hard	28-40

5.2.4 Site 4- Proposed Antenna Mast location

The hand auger borehole located at the location of the proposed antenna mast location is summarised in Table 7 below. The investigations extended to 6.0m below ground level.

Table 7-Summary of ground conditions (Site 4-Proposed Antenna Mast location)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength
0.0-3.0m	Organic deposits	Organic SILT with rootlets, dark brown, soft, wet, low plasticity	15-29kPa
3.0-3.4m	Alluvial Sediments	Sandy SILT, dark grey, soft, saturated	20kPa
3.4-5.5m	Alluvial Sediments	Silty fine SAND, dark grey, loose, saturated	N/A
5.5-6.0m	Alluvial Sediments	Silty medium to fine SAND, minor organics and trace coarse sand, dark grey, loose, saturated	N/A

Groundwater was encountered at 0.3m below ground level in this borehole during the geotechnical investigations at this site.

The Scala penetrometer test SC3 was terminated at 9.0m (The maximum depth attainable). From this in-situ testing, we can assess the soil strengths at specific depths below the site. The Scala results and inferred soil strengths are summarised in Table 8 below:

Table 8- Summary of Scala penetrometer results (Site 4-Proposed Antenna Mast location)

Depth (Below ground level)	Average Scala Blows per 50mm	Soil Type	Inferred Strength	Equivalent SPT "N" values
0-3.0m	0	Organic Silts (Cohesive)	Very Soft	0
3.0-5.0m	2	Silts (Cohesive)	Very Soft	8
5.0-6.5m	3	Sands (Non-Cohesive)	Medium Dense	12

6.5-9.0m	4	Unknown	Dense	16

5.2.5 Summary of Scala Penetrometer results and equivalent SPT "N" value

Tables 9-13 below provide Scala Penetrometer results and equivalent SPT "N" values for SC1, 2, 4, 5 and 6 at 0.5m intervals.

Table 9- Summary of Scala Penetrometer results and equivalent SPT "N" value-SC1

Depth (Below ground level)	Average Scala Blows per 50mm	Inferred Strength	Equivalent SPT "N" values
0.5	1	Loose	4
1.0	2	Loose	8
1.5	2.5	Medium Dense	10
2.0	2	Loose	8
2.5	2	Loose	8
3.0	1	Loose	4
3.5	2	Loose	8
4.0	2	Loose	8
4.5	2	Loose	8
5.0	4	Medium Dense	16

Table 10- Summary of Scala Penetrometer results and equivalent SPT "N" value-SC2

Depth (Below ground level)	Average Scala Blows per 50mm	Inferred Strength	Equivalent SPT "N" values
0.5	0.5	Very Loose	2
1.0	2	Loose	8
1.5	2.5	Medium Dense	10
2.0	2	Loose	8
2.5	3	Medium Dense	12
3.0	3	Medium Dense	12
3.5	4	Medium Dense	16
4.0	4	Medium Dense	16
4.5	4	Medium Dense	16
5.0	10	Dense	40

Table 11- Summary of Scala Penetrometer results and equivalent SPT "N" value-SC4

Depth (Below ground level)	Average Scala Blows per 50mm	Inferred Strength	Equivalent SPT "N" values
0.5	0	Very Loose	0
1.0	0	Very Loose	0
1.5	0	Very Loose	0
2.0	0	Very Loose	0
2.5	0	Very Loose	0
3.0	1	Loose	4
3.5	2	Loose	8
4.0	8	Dense	32

Table 12- Summary of Scala Penetrometer results and equivalent SPT "N" value-SC5

Depth (Below ground level)	SC5-Average Scala Blows per 50mm	SC5- Inferred Strength	SC5-Equivalent SPT "N" values
0.5	0	Very loose	0
1.0	0	Very loose	0
1.5	0	Very loose	0
2.0	0	Very loose	0
2.5	0	Very loose	0
3.0	0	Very loose	0
3.5	1	Loose	4
4.0	1.5	Loose	6
4.5	2	Loose	8
5.0	5	Medium Dense	20
5.5	3	Medium Dense	12
6.0	3	Medium Dense	12
6.5	3	Medium Dense	12
7.0	4	Medium Dense	16
7.5	4	Medium Dense	16
8.0	5	Medium Dense	20
8.5	6	Medium Dense	25
9.0	7	Medium Dense	28

Table 13- Summary of Scala Penetrometer results and equivalent SPT "N" value-SC6

Depth (Below ground level)	Average Scala Blows per 50mm	Inferred Strength	Equivalent SPT "N" values
0.5	0	Very Loose	0
1.0	0	Very Loose	0
1.5	0	Very Loose	0
2.0	0	Very Loose	0
2.5	0	Very Loose	0
3.0	0	Very Loose	0
3.5	1	Loose	4
4.0	2	Loose	8
4.5	2	Loose	8
5.0	3	Medium Dense	12
5.5	3	Medium Dense	12
6.0	3	Medium Dense	12
6.5	3	Medium Dense	12
7.0	4	Medium Dense	16
7.5	4	Medium Dense	16
8.0	4.5	Medium Dense	18
8.5	5	Medium Dense	20
9.0	4.5	Medium Dense	18

6 Geotechnical Laboratory Testing Results

A summary of the geotechnical laboratory testing results is presented in Table 14 and 15 below. A full set of the geotechnical testing data sheets is presented in Appendix D.

Table 14 – Summary of the geotechnical laboratory testing

Site Location	Hand Auger No.	Sample Depth (m)	Solid Density	Grain Size Analysis	Moisture Content
Transmitter House	BH1	1.0-1.5	2.68 t/m3	Silty SAND with minor clay, light yellow grey brown with light red	30.7%
Transmitter House	BH1	3.0-3.5	2.69 t/m3	Sandy SILT with minor to some clay, light yellow grey brown with light red	49.2%
Transmitter House	BH2	2.0	2.65 t/m3	Silty SAND with minor clay, light yellow grey brown with light red	41.8%
Transmitter House	BH2	3.5	2.66 t/m3	Sandy SILT with minor to some clay, light yellow brown with light red	53.7%
Access Road	BH3	0.5-1.5	2.78 t/m3	Sandy SILT with minor to some clay, light yellow brown mottled light red	51.0%
Access Road	BH3	2.0-3.0	2.80 t/m3	Sandy SILT with minor to some clay, light yellow grey brown mottled light red	48.9%
Antenna Support	BH4	3.5	2.67 t/m3	Sandy SILT with some clay, soft to firm, light greenish grey, mottled black	72.9%
Antenna location	BH5	6.0	2.82 t/m3	Silty SAND with trace of clay and a trace of organics, light green dark grey mottled black	56.7%

Table 15: Summary of chloride content testing results

Chloride content test location and depth (bgl)	Site Location	Chloride content (mg/kg dry wt)
BH1-2.0m	Transmission House	<50
BH2-0.5m	Transmission House	<50
BH2-1.0m	Transmission House	<50
BH2-1.5m	Transmission House	<50
BH4-4.0m	Antenna Support	<50
BH4-5.0m	Antenna Support	53
BH5-3.0m	Antenna Mast	<50
BH5-4.5m	Antenna Mast	57

7 Discussion and Engineering properties

Recommendations and opinions in this report are based upon data from 5 No. hand augered boreholes and 6 No. Scala penetrometer tests from the following sites.

- Proposed new transmission house
- Proposed temporary road to the new antenna
- Proposed antenna support position
- Proposed antenna mast location

The nature and continuity of the subsoil away from the test locations is inferred, but it must be appreciated that actual conditions could vary from the assumed model.

From the results of the soils investigation, geotechnical laboratory testing and also using published empirical relationships, we have assessed the engineering properties for the underlying soils at the four sites for the designer's consideration in the following subsections.

Actual ground conditions should be confirmed by a geotechnical engineer competent to judge whether the soils exposed in the foundation excavations are compatible with those described within this report.

8 Site Seismic Classification

8.1.1 General

It is appropriate to design the foundations and structure in accordance with the New Zealand Standard NZS 1170.5:2004[3] which is adopted in Fiji. From the geotechnical investigations undertaken we consider that the site should be classified as a Class D- (Deep or soft soil sites). If rock is encountered in future geotechnical investigations at a depth of less than 20m below ground level the site classification could change to Class C (Shallow Soils).

8.1.2 Importance Level

In accordance with NZS 1170.0:2002[4] which is adopted in Fiji we have completed this assessment on the basis that the proposed development will be an Importance Level 2 structure. If this is changed during detailed design then updates will be required to this report.

8.1.3 Peak Ground Acceleration

The probabilistic earthquake hazard assessment for Fiji prepared by Jones[5] provides recommendations with respect to estimated ground accelerations. Peak ground accelerations (PGAs) expected from the design earthquakes under serviceability limit state (SLS) and ultimate limit state (ULS) conditions are presented in Table 16 below.

[3] NZS 1170.5: 2004 *Structural design actions – Earthquake Actions (New Zealand).* SANZ.
[4] NZS 1170:0: 2002 *Structural design actions – Part 0: General Principles*
[5] Jones, T, 1997, *Probabilistic Earthquake Hazard Assessment for Fiji*, AGSO, Canberra, Australia,

Table 16: Design Peak Ground Accelerations

Design Life (years)*	Serviceability Limit State (SLS)		Ultimate Limit State (ULS)	
	Return Period	Peak Ground Accelerations	Return Period	Peak Ground Accelerations
50	1 in 25 years	0.08g	1 in 500 years	0.30g

** Design Life to be confirmed by the structural engineer/architect as appropriate. If different from that assumed, or if this changes during the project life then these values and the opinions in this report may require reviewing and amending as and where necessary.*

8.2 Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle Range

Table 17 and 18 below summarises the approximate solid densities, undrained shear strengths, cohesion and effective internal friction angles for the different sites. These have been assessed using results of the site investigations and laboratory testing.

Table 17- Summary of Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle- Proposed Transmission House

Depth (Below existing ground level)	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength (kPa)	Cohesion (kPa)	Effective Internal Friction Angle (deg)
0.5-1.0m	Silty fine SAND, loose, dry	18	N/A	0	28
1.5-2.5m	Fine SAND with minor silt and medium sand, loose, moist	18	N/A	0	30
2.5-4.2m	Sandy SILT, trace clay, very stiff, wet, minor gravels from 3.7m	18	143kPa	4	30
4.2-5.0m	Silty fine SAND, loose, saturated	18	N/A	0	30

Table 18- Summary of Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle- Proposed Antenna Mast Location

Depth	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength (kPa)	Cohesion (kPa)	Effective Internal Friction Angle (deg)
0.0-3.0m	Organic SILT, soft, wet	18	16-29	2	25

3.0-3.4m	Sandy SILT, dark grey, Soft, saturated	18	20	2	25
3.4-5.0m	Silty fine SAND, loose, saturated	18	N/A	0	28
5.0-6.0m	Silty medium to fine SAND, minor organics, loose, saturated	18	N/A	0	30
7.0-9.0m	Unknown	Unknown	Unknown	Unknown	30

8.3 Foundation Design

8.3.1 General

Following discussions with YEC, it is understood that shallow foundations will be constructed for the proposed transmission house, providing the ground conditions are suitable.

The site investigation data has indicated that shallow foundations may be utilised for the proposed Transmission house depending on the actual loadings. We have provided bearing capacities for the upper 1m of the subsoil.

The proposed antenna mast site is located on very poor ground conditions, as such it is expected the antenna will require deep piled foundations, as will the antenna supports.

We recommend using a strength reduction factor of 0.5 (Φ_G=0.5) to give an ultimate limit state (ULS) bearing capacity, in accordance with New Zealand Design Standards (ref: NZS 1170). For serviceability limit state design we recommend a strength reduction factor of 0.33 (Φ_G=0.3) to give an allowable bearing capacity.

8.3.2 Transmission House

Shallow foundations would be suitable for the proposed transmission house, founded at a depth of at least 600mm below the finished surface level. This is typical foundation depth for buildings.

Both SC1 and SC2 indicated similar bearing capacities for the founding material based on the in situ testing undertaken. This is shown in the Table 19 below.

If some of the proposed equipment to be located within the Transmission House require specific foundations, we have also provided a bearing capacities at 1m, 2m 3m, 4m and 5m.

Table 19- Summary of bearing capacities for the proposed Transmission House

Site	Depth (Below existing ground level)	Geotechnical Bearing Capacities			Foundation Type
		Allowable - (kPa or kN/m2)	ULS* - (kPa or kN/m2)	Ultimate(kPa or kN/m2)	
Transmission House (SC1/SC2 and BH1/BH2)	600mm	75	110	225	Shall strip footings up to 1m wide
	1m	100	150	300	
	2m	180	270	540	Deep Foundation (i.e. Bored piles) '3 x B' Embedment into the founding layer
	3m	180	270	540	
	4m	270	405	810	
	5m	360	540	1080	

**ULS =Ultimate Limit State (ref. NZS1170)*

8.3.3 Temporary Road

We have provided a California Bearing Ratio (CBR) for the possible cut depths for the temporary road. CBR values are used to design roads/pavements for construction. These are shown in Table 20 below.

Table 20- Summary of CBR Value for the proposed temporary road

Site	Depth (Below existing ground level)	CBR Value for pavement design
Temporary Road (BH3/SC3)	0.3m	3%
	0.6m	4%
	0.9m	5%
	1.2m	8%
	1.5m	9%
	1.8m	9%
	2.1m	8%
	2.4m	6%
	2.7m	6%
	3.0m	7%

(1)ULS =Ultimate Limit State (ref. NZS1170)

8.3.4 Antenna Mast

Due to the poor ground conditions observed during the site investigations at this location, shallow foundations are unlikely to suitable. We understand that deep machine drilled boreholes are to be undertaken to investigate ground conditions at depth. Structural verification will be needed to ensure both bearing capacity and settlement of the underlying soil are within design tolerances. This should consider both dead and live (e.g. wind) loadings for the Antenna Mast design.

Based on the site investigations at the Antenna location the bearing capacities are as follows. Typically these would not be suitable for design and the practicalities of constructing deep pad foundation in very poor and wet ground would be very difficult. We would not recommend this option. Bearing capacities for the Antenna Mast location are provided in Table 21.

Table 21- Summary of bearing capacities for the proposed Antenna Mast

Site	Depth (Below existing ground level)	Geotechnical Bearing Capacities									Foundation Type
		Allowable - (kPa or kN/m2)			ULS* - (kPa or kN/m2)			Ultimate - (kPa or kN/m2)			
		SC4/BH4	SC5/BH5	SC6	SC4/BH4	SC5/BH5	SC6	SC4/BH4	SC5/BH5	SC6	
Antenna Mast	0.50m	40	25	25	60	35	35	120	75	75	Shall strip footings up to 1m wide
	1.0m	25	40	30	35	60	45	75	120	90	
	1.5m	40	40	40	60	60	60	120	120	120	
	2.0m	105	75	60	155	110	90	315	225	180	Deep Foundation (i.e. Bored piles) '3 x B' Embedment into the founding layer
	2.5m	165	45	45	240	65	65	495	135	135	
	3.0m	270	45	45	405	65	65	810	135	135	
	4.0m	330	120	120	495	180	180	990	360	360	
	5.0m	#	165	165	#	245	245	#	495	495	
	6.0m	#	165	165	#	245	245	#	495	495	
	7.0m	#	165	165	#	245	245	#	495	495	
	8.0m	#	165	165	#	245	245	#	495	495	
	9.0m	#	#	255	#	#	380	#	#	765	

**ULS =Ultimate Limit State (ref. NZS1170); # - did not drill to these depths*

We also consider that the placement of large shallow pad foundations for the Antenna mast and supports could lead to large ground settlements.

We have provided below some Coefficient's of Volume Compressibility (M_v) for the soils types observed in the investigations. Typical Mv values are provided in Table 22.

Table 22- Typical M_v values for the soil types at the Antenna Mast site

Site	Depth Range (Below existing ground level)	Soil Type	Mv Values (m2/MN)
Antenna Mast (BH5/SC5)	0.0m – 3.0m	Soft organic SILT	1.5
	3.0m – 3.4m	Soft Sandy SILT	1.0
	>3.4m	Loose silty SAND	N/A

9 Applicability

This report has been prepared for the benefit of YEC with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Tonkin & Taylor International Ltd

Environmental and Engineering Consultants

Report prepared by:

P.P Jamie Yule

Engineering Geologist

Reviewed for Tonkin & Taylor International Ltd by:

Andy Pomfret

Project Manager

Authorised for Tonkin & Taylor International Ltd by:

Chris Freer

Project Director

JWY

p:\751078\workingmaterial\751078-report-jwyrev2.docx

Appendix B: **Topographical Survey and Geotechnical Investigation Location Plans**

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF EQUIPMENT FOR DISASTER RISK MANAGEMENT IN THE REPUBLIC OF FIJI

CONTRACT OF TOPOGRAPHICAL SURVEY AND SOIL EXPLORATIONS

LOCATION GUIDES
(not to scale)

SOIL TEST LOCATION SCHEDULE

Name	Easting (m)	Northing (m)	RL (m)
BH1/SC1	1976769.80	3881776.36	50.02
BH2/SC2	1976767.18	3881771.37	49.91
BH3/SC3	1976741.38	3881833.75	42.31
BH4/SC4	1976741.42	3881896.06	35.50
BH5/SC5/SC5A	1976804.49	3881917.35	35.16
SC6	1976793.78	3881915.72	35.20

SURVEY MARK SCHEDULE

Name	Easting (m)	Northing (m)	RL (m)
IT NAULU (TRIG)	1977010.03	3881722.55	47.92
IR(3) SO5572	1976734.84	3881638.53	49.59
IT Boundary (1)	1976725.32	3881786.69	50.21
IT Boundary (2)	1976817.28	3881789.66	50.33
IT Boundary (3)	1976865.26	3881767.05	50.05
IT Boundary (4)	1976726.75	3881932.40	35.52
IT Boundary (5)	1976844.42	3882042.20	34.81
BMNAIL1	1976771.52	3881733.96	50.00
BMNAIL2	1976786.17	3881690.86	49.04
OIT (Unknown)	1976725.95	3881769.12	50.24
OIT (Unknown)	1976728.01	3881706.67	49.33

Note:

BMNAIL1 is flush within concrete step block between house and transmitter buildings.

BMNAIL2 is in concrete kerb alongside southern access to transmitter buildings yard.

Centre and outermost stay locations of proposed new AM antenna were marked with wooden pegs (protruding ~1.2m)

Not all trees shown (generally only those along western site boundary, and those at the top of the slope north of existing buildings)

Survey Conducted 16 - 18 October 2014, using:

Sokkia GPS RTK (GNSS Receiver)
Model: GRX1/U
Serial Numbers: 633-00426
633-00141

Sokkia Total Station (Reflectorless)
Model: SET4130R3
Serial Number: 145240

SURVEY DATUM: FIJI GEODETIC DATUM 1986
(Coordinate and Bearing Origins from SO 5572)
HEIGHT DATUM: ASSUMED
(BMNAIL1 = 50.00m)

SITE PLAN

LEGEND

- Boundary
- Major Contour (1m spacing)
- Minor Contour (0.25m spacing)
- Building
- Fence
- Gate
- Concrete Kerb (Driveway Edge)
- Gravel Road Edge
- Stay Anchor Block (Concrete)
- Satellite Dish
- Coconut Palm
- Other Tree
- Power Pole
- Soil Test Site
- Survey Mark

A-6-25

Revision	Description	Approved	Date
D	Section Locations A - A and B - B Shown		05-11-14
C	Equipment Description Amended		30-10-14
B	Test Location Labels Amended		20-10-14
A	For Information		29-10-14

Client

Tonkin & Taylor

Drawn	ES
Designed	
Surveyed	ES
Project:	Fiji

Scale: 1:1000 (A1)
1:2000 (A3)

Title: Topographical Survey
Fiji Broadcasting Corp. site,
Naulu Road, Nasinu
Viti Levu, FIJI

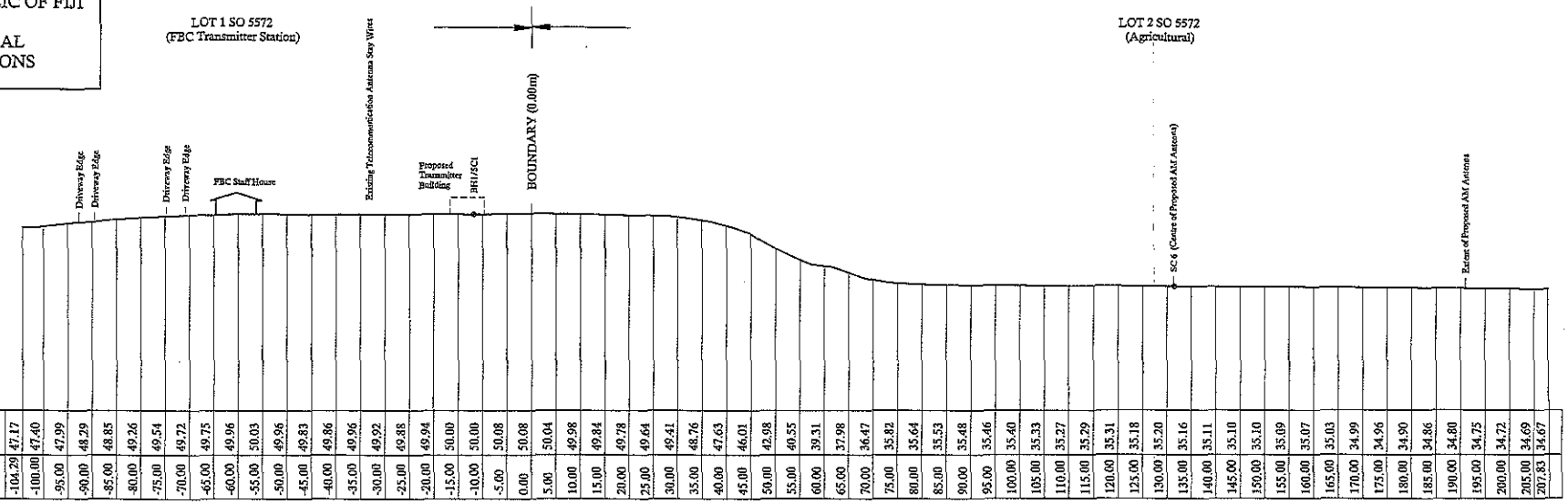
Dwg. No.	T01
Job No.	14018
Revision	D

PREPARATORY SURVEY ON THE PROJECT FOR IMPROVEMENT OF EQUIPMENT FOR DISASTER RISK MANAGEMENT IN THE REPUBLIC OF FIJI

CONTRACT OF TOPOGRAPHICAL SURVEY AND SOIL EXPLORATIONS

HEIGHT DATUM: ASSUMED
(BMNAIL1 = 50.00m)

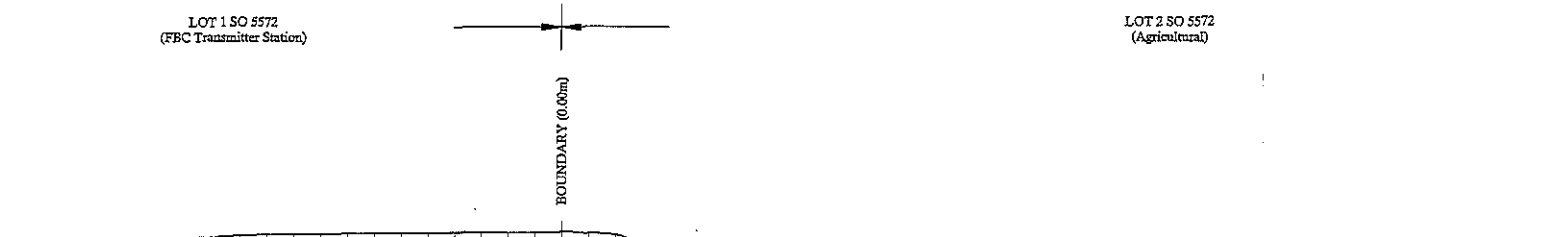
For Section Locations refer Dwg. No. T01



Datum (m) 10

Existing Ground Levels	47.17	47.40	47.99	48.29	48.85	49.26	49.54	49.72	49.75	49.96	50.03	49.96	49.83	49.86	49.96	49.92	49.88	49.94	50.00	50.00	50.08	50.08	50.04	49.98	49.84	49.78	49.64	49.41	48.76	47.63	46.01	42.98	40.55	39.31	37.98	36.47	35.82	35.64	35.53	35.48	35.46	35.40	35.33	35.27	35.29	35.31	35.18	35.20	35.16	35.11	35.10	35.10	35.09	35.07	35.03	34.99	34.96	34.90	34.86	34.80	34.75	34.72	34.69	34.67
Distance from Boundary	-104.29	-100.00	-95.00	-90.00	-85.00	-80.00	-75.00	-70.00	-65.00	-60.00	-55.00	-50.00	-45.00	-40.00	-35.00	-30.00	-25.00	-20.00	-15.00	-10.00	-5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	155.00	160.00	165.00	170.00	175.00	180.00	185.00	190.00	195.00	200.00	205.00	207.83

Section B - B



Datum (m) 10

Existing Ground Levels	47.90	47.91	48.01	48.31	48.56	48.76	48.95	49.18	49.32	49.56	49.72	49.83	49.88	49.83	49.88	49.92	50.01	50.08	50.02	50.02	50.05	50.17	49.95	49.56	47.99	46.17	44.73	43.61	42.62	41.48	40.39	39.22	38.03	37.38	36.74	36.12	35.85	35.72	35.68	35.63	35.58	35.52	35.44	35.43	35.39	35.32	35.31	35.27	35.28	35.25	35.16	35.15	35.14	35.12	35.09	35.05	35.01	34.99	34.98
Distance from Boundary	-101.07	-100.00	-95.00	-90.00	-85.00	-80.00	-75.00	-70.00	-65.00	-60.00	-55.00	-50.00	-45.00	-40.00	-35.00	-30.00	-25.00	-20.00	-15.00	-10.00	-5.00	0.00	5.00	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00	55.00	60.00	65.00	70.00	75.00	80.00	85.00	90.00	95.00	100.00	105.00	110.00	115.00	120.00	125.00	130.00	135.00	140.00	145.00	150.00	155.00	160.00	165.00	170.00	175.00	180.00	181.87

Section A - A

Rev	Description	Approved	Date
A	For information		05-11-14

Client: Tonkin & Taylor

Drawn	ES
Designed	
Surveyed	Civil Services (HB) Ltd
Project	Fiji

Scale: H - 1:500 (A1), V - 1:500 (A1); H -1:1000 (A3), V -1:1000 (A3)

Title: Cross Sections A–A and B–B
Fiji Broadcasting Corp. site,
Naulu Road, Nasinu
Viti Levu, FIJI

Dwg. No.	T02
Job No.	14018
Revision	A

A-6-27

Appendix C: Geotechnical Investigation Data

- **Hand auger borehole Logs**
- **Scala Penetrometer results**

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH1
Hole Location: Proposed Transmitter House
SHEET 1 OF 1

PROJECT: Suva Radio | LOCATION: Suva, Fiji | JOB No: 751078

CO-ORDINATES: 3881776.56 mN, 1976764.8 mE
R.L.: 50.20 m
DATUM: Fiji Geodetic Datum 1986

DRILL TYPE: 50mm Hand Auger
DRILL METHOD: HAND AUGER
DRILL FLUID: N/A

HOLE STARTED: 16/10/14
HOLE FINISHED: 16/10/14
DRILLED BY: JWY
LOGGED BY: JWY CHECKED: ADP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL								50			SW	D	L				Sandy TOPSOIL, with minor organics and trace silt. Loose, dry.
ALLUVIAL SEDIMENTS							1				SM						Silty, fine SAND; light yellowish brown. Loose, dry.
							2										- minor orange brown mottling.
								49	1								- grades siltier.
																	- grades sandier.
							3										Silty, fine SAND, minor medium sand, trace fine gravel; light brown streaked red. Loose, dry.
											SW						Fine SAND, with minor silt and medium sand; light greyish brown. Loose, dry.
							4		2			M					- minor red streaks. - becomes moist.
								48									- mottled red.
							5										
		24 hours after drilling	100	HAND AUGER		144/72kPa	6		3		ML	W	VSt				Sandy SILT, trace clay; light brown streaked red. Very stiff, wet, low plasticity.
						143/75kPa											
						114/49kPa	7	47									
						114/77kPa						Sat					- becomes saturated.
						116/81kPa	8		4								Sandy SILT, trace fine gravels; light greyish brown. Very stiff, saturated, low plasticity.
						90/25kPa		46					St				- becomes minor medium gravels, becomes stiff.
							9				SW		L				Silty, fine SAND; dark grey. Loose, saturated.
							10		5				MD				- becomes medium dense.
																	END OF BOREHOLE AT 5m.
								45	6								
								44									
									7								

T+T DATATEMPLATE.GDT crg

Log Scale 1:35

BORELOG 751078.GPJ 5-Nov-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH2
Hole Location: Proposed Transmitter House
SHEET 1 OF 1

PROJECT: Suva Radio | LOCATION: Suva, Fiji | JOB No: 751078

CO-ORDINATES: 3881771.36 mN, 1976767.18 mE
R.L.: 49.91 m
DATUM: Fiji Geodetic Datum 1986

DRILL TYPE: 50mm Hand Auger
DRILL METHOD: HAND AUGER
DRILL FLUID: N/A

HOLE STARTED: 16/10/14
HOLE FINISHED: 16/10/14
DRILLED BY: JWY
LOGGED BY: JWY CHECKED: ADP

GEOLOGICAL										ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL											SW	D	L				Sandy TOPSOIL, trace silt, minor organics; dark brown. Loose, dry.
ALLUVIAL SEDIMENTS							1				SM						Silty, fine SAND; light brown, streaked red. Loose, dry.
							2	49	1								
							3										Silty, fine SAND, minor gravels; greyish brown streaked red. Loose, dry.
												M					- becomes moist.
							4	48	2								Fine SAND, some silt; greyish brown, streaked red. Loose, moist.
							5										
		24 hours after drilling	100	HAND AUGER		• 98/36kPa	6	47	3		ML		St				Sandy SILT; greyish red, streaked red. Stiff, wet, low plasticity.
						• 60/38kPa						W					
						• 156/94kPa	7						VSt				- becomes very stiff.
						• 117/36kPa	8	46	4			Sat					Sandy SILT, with trace fine gravel; light greyish brown. Very stiff, saturated, low plasticity.
						• 115/32kPa											
							9				SW		MD				Silty, fine SAND; dark grey. Medium dense, saturated.
							10	45	5				D				
																	END OF BOREHOLE AT 5m. Target depth.
								44	6								
								43	7								

T+T DATATEMPLATE.GDT crg

Log Scale 1:35

BORELOG 751078.GPJ 5-Nov-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH3
Hole Location: Proposed Access Road
SHEET 1 OF 1

PROJECT: Suva Radio		LOCATION: Suva, Fiji	JOB No: 751078
CO-ORDINATES:	3881833.75 mN 1976741.38 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 17/10/14 HOLE FINISHED: 17/10/14
R.L.:	42.31 m	DRILL METHOD: HAND AUGER	DRILLED BY: JWY
DATUM:	Fiji Geodetic Datum 1986	DRILL FLUID: N/A	LOGGED BY: JWY CHECKED: ADP

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
TOPSOIL													F				Silty TOPSOIL; brown. Firm, dry.
ALLUVIAL DEPOSITS		Groundwater not encountered.	100	HAND AUGER		71/29kPa 81/28kPa 104/49kPa 195/39kPa 203/33kPa 203/49kPa 187/42kPa 130/29kPa 143/33kPa 160/42kPa	1 2 3 4 5	42 41 40 39 38 37 36	1 2 3 4 5 6 7		ML SM	D M	St VSt H VSt VD				SILT, minor organics, trace clay; dark brown. Firm, dry. - becomes dark brown, mottled light brown. - becomes moist. - becomes with minor clay. - becomes hard. - becomes light brownish grey mottled brown. Becomes very stiff. 2.7m: iron stained gravels. Silty, fine SAND; dark greenish grey. Very dense, moist. **END OF BOREHOLE AT 3.6m.** Too stiff to auger.

T+T DATATEMPLATE.GDT crg

Log Scale 1:35

BORELOG 751078.GPJ 5-Nov-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH4
Hole Location: Mast Support Location
SHEET 1 OF 1

PROJECT: Suva Radio | LOCATION: Suva, Fiji | JOB No: 751078

CO-ORDINATES: 3881896.06 mN, 1976741.42 mE
R.L.: 35.50 m
DATUM: Fiji Geodetic Datum 1986

DRILL TYPE: 50mm Hand Auger
DRILL METHOD: HAND AUGER
DRILL FLUID: N/A

HOLE STARTED: 17/10/14
HOLE FINISHED: 17/10/14
DRILLED BY: JWY
LOGGED BY: JWY CHECKED: ADP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
SWAMP DEPOSITS		During Drilling	90	HA		• 24/20kPa		35			OL	W	S				Organic SILT, with rootlets; dark brown. Soft, wet, low plasticity.
																	- fibrous organics and rootlets.
												Sat					- becomes saturated.
			40	HA		• 16/8kPa			1								1
																	- poor recovery of risings.
						• 24/18kPa		34									
						• 38/16kPa			2								SILT, minor organics and fine sand; dark brown. Soft, saturated, low plasticity.
			10	HA			2										2
						• 59/24kPa		33									- poor recovery of risings, becomes stiff.
						• 52/39kPa			3		ML		St				3
ALLUVIAL DEPOSITS			40	HA		• 98/88kPa	3	32									Sandy SILT, trace fine gravels; grey. Stiff, saturated, low plasticity.
							4		4		SM		MD				Silty SAND, trace medium gravels; dark grey. Medium dense, saturated.
			100	HA													4
								31				W	H				Sandy SILT; greenish grey. Hard, wet, low plasticity, weakly cemented.
							5		5								5
																	END OF BOREHOLE AT 5m.
								30									Target depth.
									6								6
								29									
									7								

T+T DATATEMPLATE.GDT crg

Log Scale 1:35

BORELOG 751078.GPJ 5-Nov-2014

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH5
Hole Location: New Mast Location
SHEET 1 OF 1

PROJECT: Suva Radio | LOCATION: Suva, Fiji | JOB No: 751078

CO-ORDINATES: 3881917.35 mN, 1976804.49 mE
R.L.: 35.16 m
DATUM: Fiji Geodetic Datum 1986

DRILL TYPE: 50mm Hand Auger
DRILL METHOD: HAND AUGER
DRILL FLUID: N/A

HOLE STARTED: 17/10/14
HOLE FINISHED: 17/10/14
DRILLED BY: JWY
LOGGED BY: JWY CHECKED: ADP

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION / ROCK DESCRIPTION
SWAMP DEPOSITS		During drilling	10	HA		16/8kPa	1	35	0		OL	W	S				Organic SILT, with some rootlets; dark brown. Soft, wet.
						20/13kPa	2	34	1			Sat					- very poor recovery.
						26/16kPa											
						29/23kPa		33	2								
						16/10kPa											
						20/16kPa	3	32	3		ML						Sandy SILT; dark grey. Soft, saturated, low plasticity.
ALLUVIAL SEDIMENTS			70	HA							SW		L				Silty, fine SAND; dark grey. Loose, saturated, poorly graded.
			0	HA				31	4								- poor recovery.
			100	HA			4										- recovery improves.
ALLUVIAL SEDIMENTS			100	HA			5	30	5		SW	Sat	L				- trace gravels and medium sand. 5.1m: grades siltier. 5.4m: grades sandier.
																	Silty, medium to fine SAND, minor organics and trace coarse sand; dark grey. Loose, saturated.
								29	6								**END OF BOREHOLE AT 6m.** Target depth.
									7								

T+T DATATEMPLATE.GDT crg

Log Scale 1:35

BORELOG 751078.GPJ 5-Nov-2014

TONKIN & TAYLOR

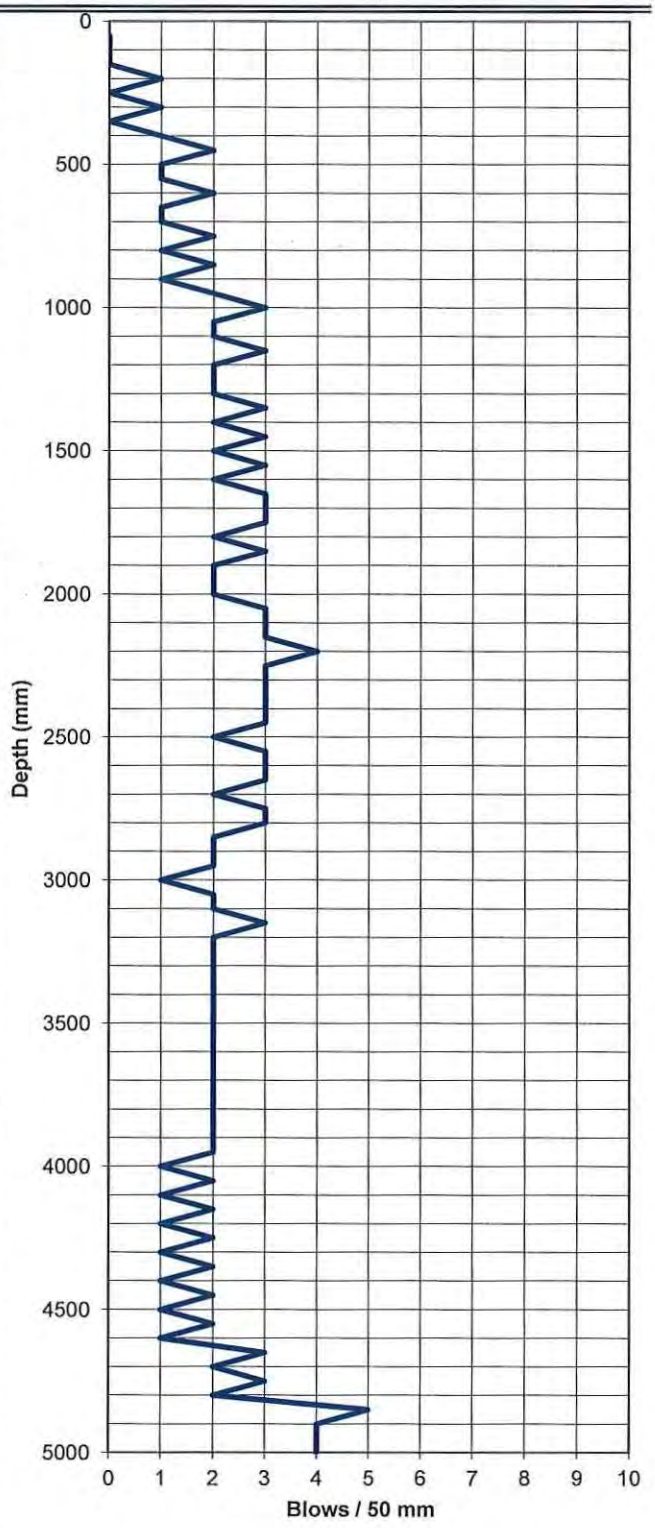
SCALA PENETROMETER LOG

Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *16/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC1*
Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	3
100	0	2600	3
150	0	2650	3
200	1	2700	2
250	0	2750	3
300	1	2800	3
350	0	2850	2
400	1	2900	2
450	2	2950	2
500	1	3000	1
550	1	3050	2
600	2	3100	2
650	1	3150	3
700	1	3200	2
750	2	3250	2
800	1	3300	2
850	2	3350	2
900	1	3400	2
950	2	3450	2
1000	3	3500	2
1050	2	3550	2
1100	2	3600	2
1150	3	3650	2
1200	2	3700	2
1250	2	3750	2
1300	2	3800	2
1350	3	3850	2
1400	2	3900	2
1450	3	3950	2
1500	2	4000	1
1550	3	4050	2
1600	2	4100	1
1650	3	4150	2
1700	3	4200	1
1750	3	4250	2
1800	2	4300	1
1850	3	4350	2
1900	2	4400	1
1950	2	4450	2
2000	2	4500	1
2050	3	4550	2
2100	3	4600	1
2150	3	4650	3
2200	4	4700	2
2250	3	4750	3
2300	3	4800	2
2350	3	4850	5
2400	3	4900	4
2450	3	4950	4
2500	2	5000	4



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

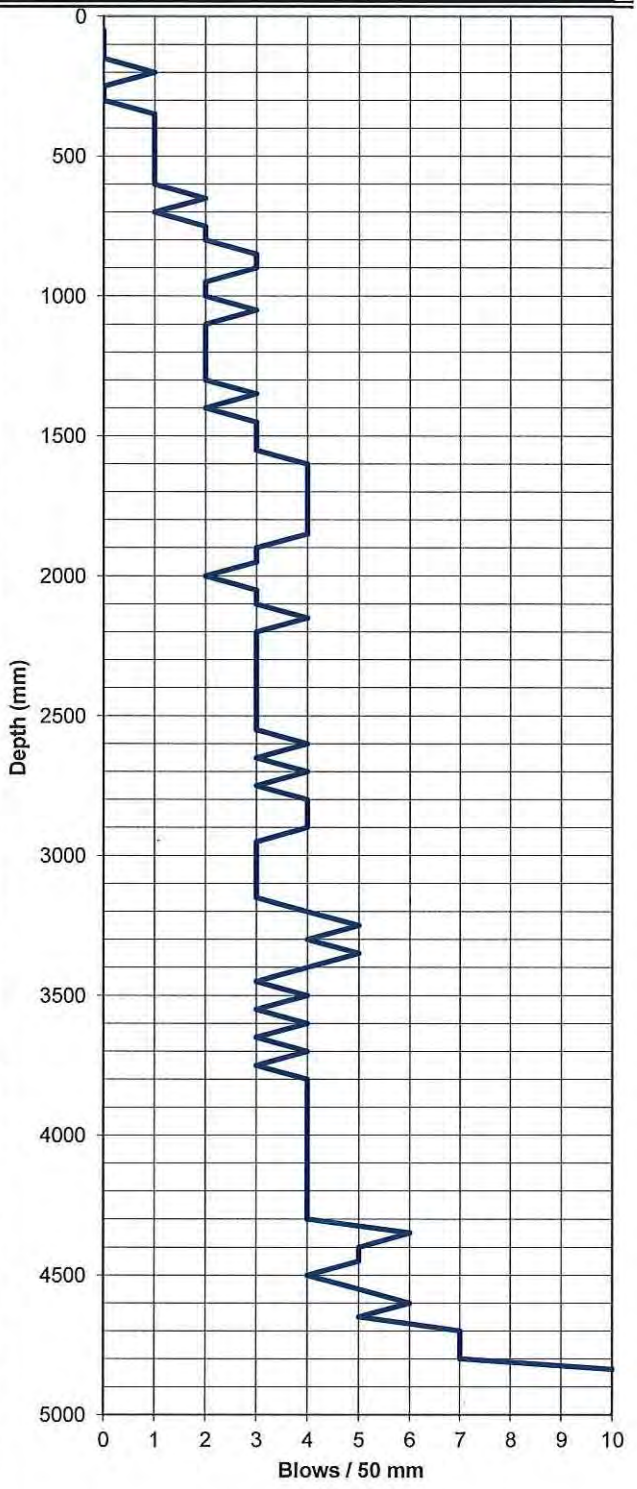
SCALA PENETROMETER LOG

Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *16/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC2*
Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	3
100	0	2600	4
150	0	2650	3
200	1	2700	4
250	0	2750	3
300	0	2800	4
350	1	2850	4
400	1	2900	4
450	1	2950	3
500	1	3000	3
550	1	3050	3
600	1	3100	3
650	2	3150	3
700	1	3200	4
750	2	3250	5
800	2	3300	4
850	3	3350	5
900	3	3400	4
950	2	3450	3
1000	2	3500	4
1050	3	3550	3
1100	2	3600	4
1150	2	3650	3
1200	2	3700	4
1250	2	3750	3
1300	2	3800	4
1350	3	3850	4
1400	2	3900	4
1450	3	3950	4
1500	3	4000	4
1550	3	4050	4
1600	4	4100	4
1650	4	4150	4
1700	4	4200	4
1750	4	4250	4
1800	4	4300	4
1850	4	4350	6
1900	3	4400	5
1950	3	4450	5
2000	2	4500	4
2050	3	4550	5
2100	3	4600	6
2150	4	4650	5
2200	3	4700	7
2250	3	4750	7
2300	3	4800	7
2350	3	4850	11
2400	3	4900	11
2450	3	4950	
2500	3	5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Scala 3.xlsx

TONKIN & TAYLOR

SCALA PENETROMETER LOG

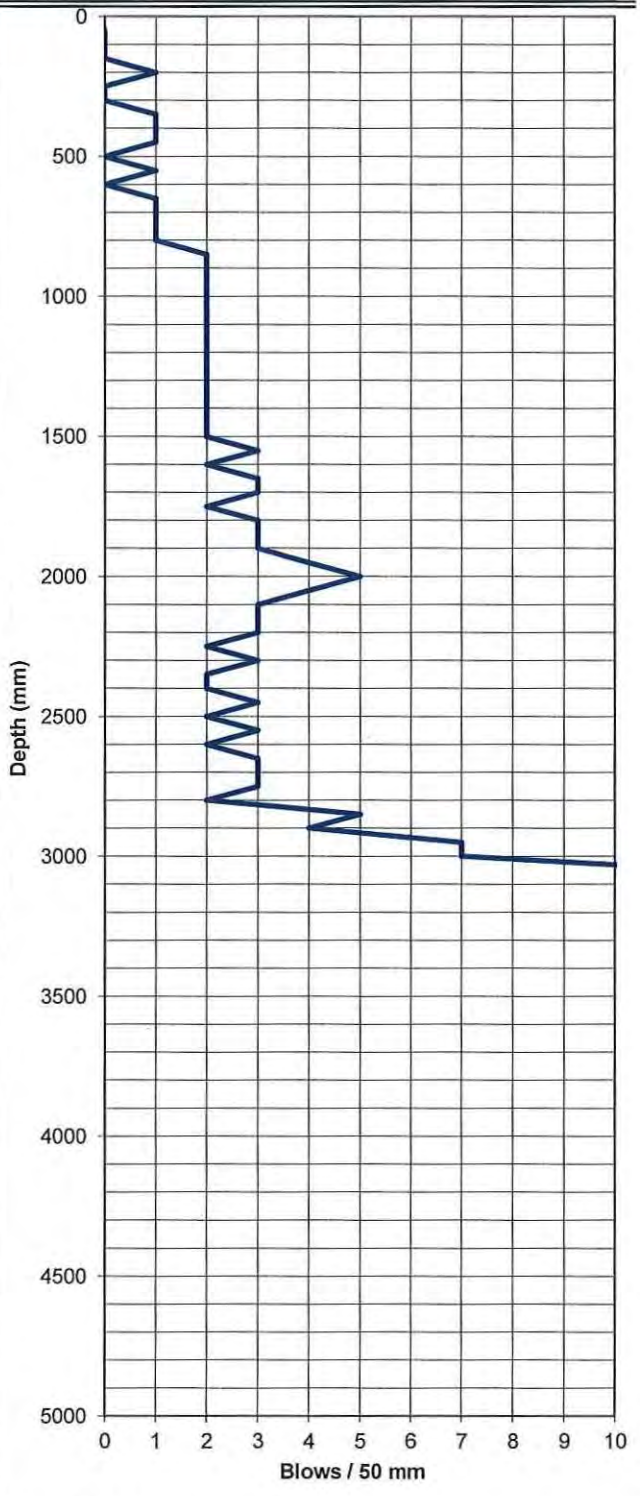
Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *17/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC3*
Sheet *1*
of *1*

mm Driven	No. of Blows
50	0
100	0
150	0
200	1
250	0
300	0
350	1
400	1
450	1
500	0
550	1
600	0
650	1
700	1
750	1
800	1
850	2
900	2
950	2
1000	2
1050	2
1100	2
1150	2
1200	2
1250	2
1300	2
1350	2
1400	2
1450	2
1500	2
1550	3
1600	2
1650	3
1700	3
1750	2
1800	3
1850	3
1900	3
1950	4
2000	5
2050	4
2100	3
2150	3
2200	3
2250	2
2300	3
2350	2
2400	2
2450	3
2500	2

mm Driven	No. of Blows
2550	3
2600	2
2650	3
2700	3
2750	3
2800	2
2850	5
2900	4
2950	7
3000	7
3050	12
3100	13
3150	
3200	
3250	
3300	
3350	
3400	
3450	
3500	
3550	
3600	
3650	
3700	
3750	
3800	
3850	
3900	
3950	
4000	
4050	
4100	
4150	
4200	
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Scala 4.xlsx

TONKIN & TAYLOR

SCALA PENETROMETER LOG

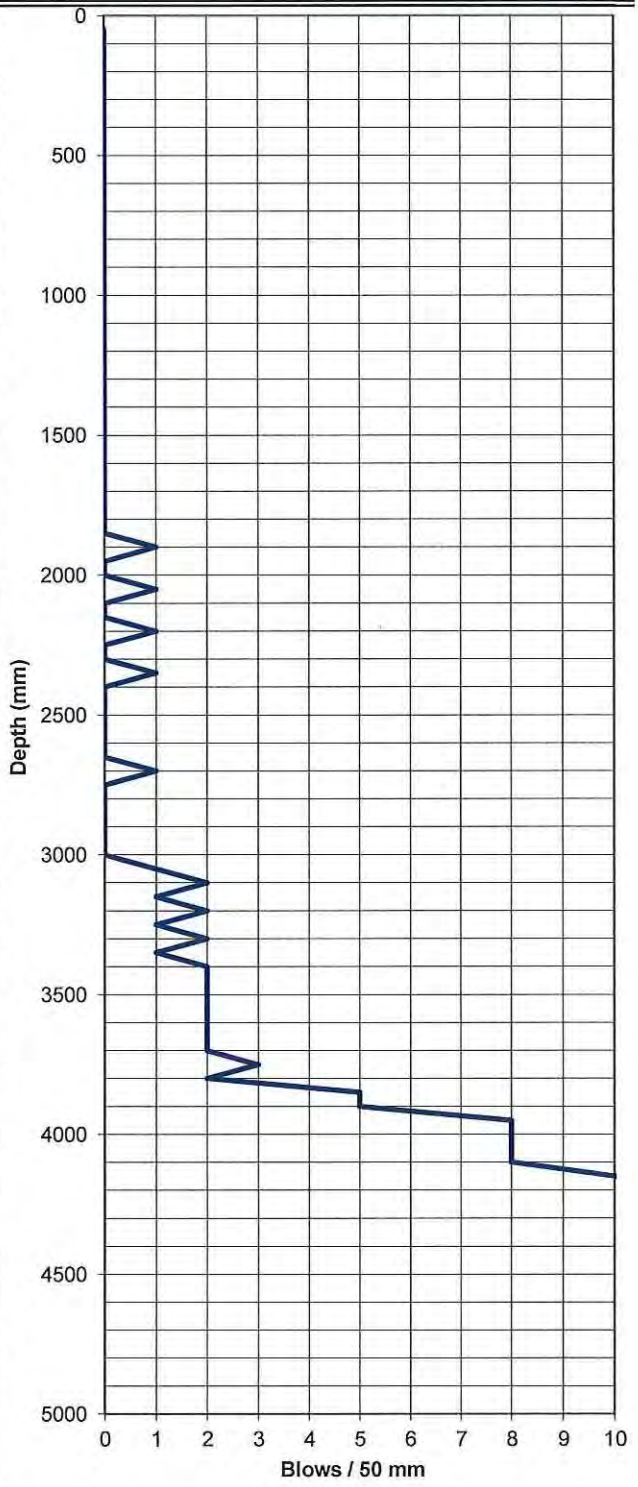
Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *17/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC4*
Sheet *1*
of *1*

mm Driven	No. of Blows
50	0
100	0
150	0
200	0
250	0
300	0
350	0
400	0
450	0
500	0
550	0
600	0
650	0
700	0
750	0
800	0
850	0
900	0
950	0
1000	0
1050	0
1100	0
1150	0
1200	0
1250	0
1300	0
1350	0
1400	0
1450	0
1500	0
1550	0
1600	0
1650	0
1700	0
1750	0
1800	0
1850	0
1900	1
1950	0
2000	0
2050	1
2100	0
2150	0
2200	1
2250	0
2300	0
2350	1
2400	0
2450	0
2500	0

mm Driven	No. of Blows
2550	0
2600	0
2650	0
2700	1
2750	0
2800	0
2850	0
2900	0
2950	0
3000	0
3050	1
3100	2
3150	1
3200	2
3250	1
3300	2
3350	1
3400	2
3450	2
3500	2
3550	2
3600	2
3650	2
3700	2
3750	3
3800	2
3850	5
3900	5
3950	8
4000	8
4050	8
4100	8
4150	10
4200	16
4250	
4300	
4350	
4400	
4450	
4500	
4550	
4600	
4650	
4700	
4750	
4800	
4850	
4900	
4950	
5000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

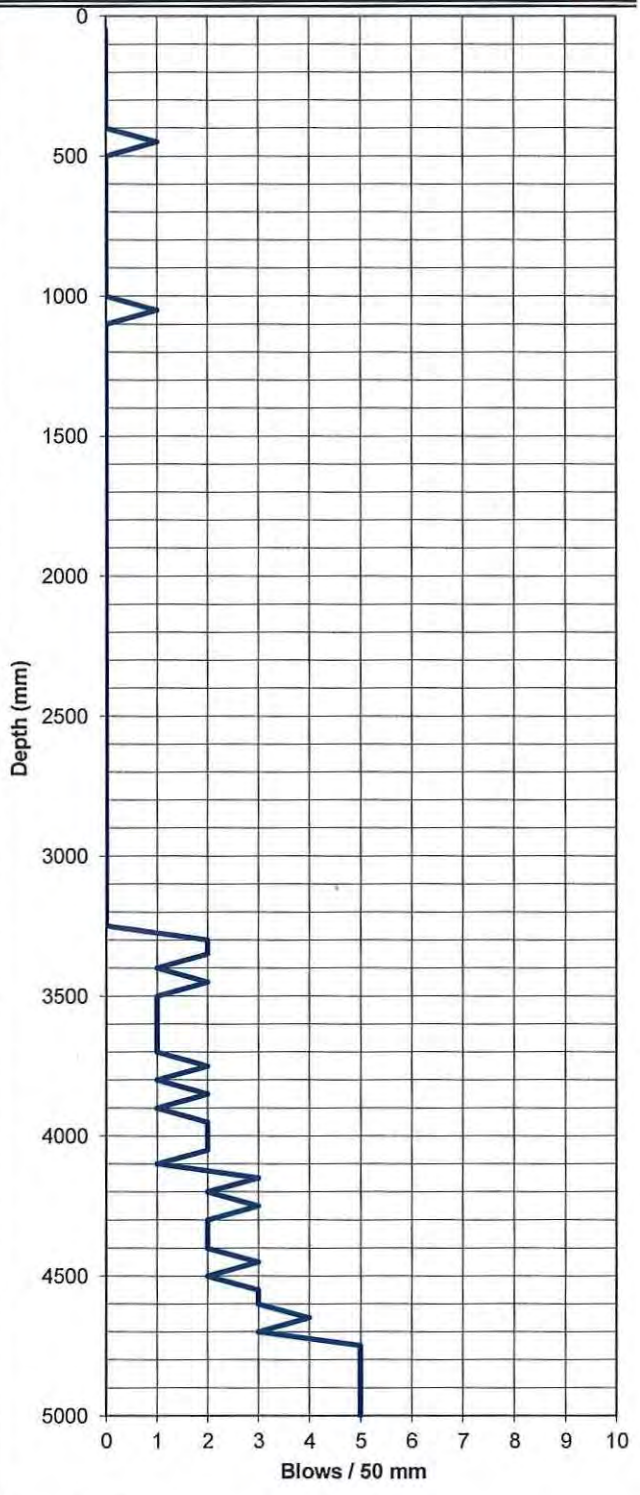
SCALA PENETROMETER LOG

Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *17/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC5*
Sheet *1*
of *2*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	0
100	0	2600	0
150	0	2650	0
200	0	2700	0
250	0	2750	0
300	0	2800	0
350	0	2850	0
400	0	2900	0
450	1	2950	0
500	0	3000	0
550	0	3050	0
600	0	3100	0
650	0	3150	0
700	0	3200	0
750	0	3250	0
800	0	3300	2
850	0	3350	2
900	0	3400	1
950	0	3450	2
1000	0	3500	1
1050	1	3550	1
1100	0	3600	1
1150	0	3650	1
1200	0	3700	1
1250	0	3750	2
1300	0	3800	1
1350	0	3850	2
1400	0	3900	1
1450	0	3950	2
1500	0	4000	2
1550	0	4050	2
1600	0	4100	1
1650	0	4150	3
1700	0	4200	2
1750	0	4250	3
1800	0	4300	2
1850	0	4350	2
1900	0	4400	2
1950	0	4450	3
2000	0	4500	2
2050	0	4550	3
2100	0	4600	3
2150	0	4650	4
2200	0	4700	3
2250	0	4750	5
2300	0	4800	5
2350	0	4850	5
2400	0	4900	5
2450	0	4950	5
2500	0	5000	5



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

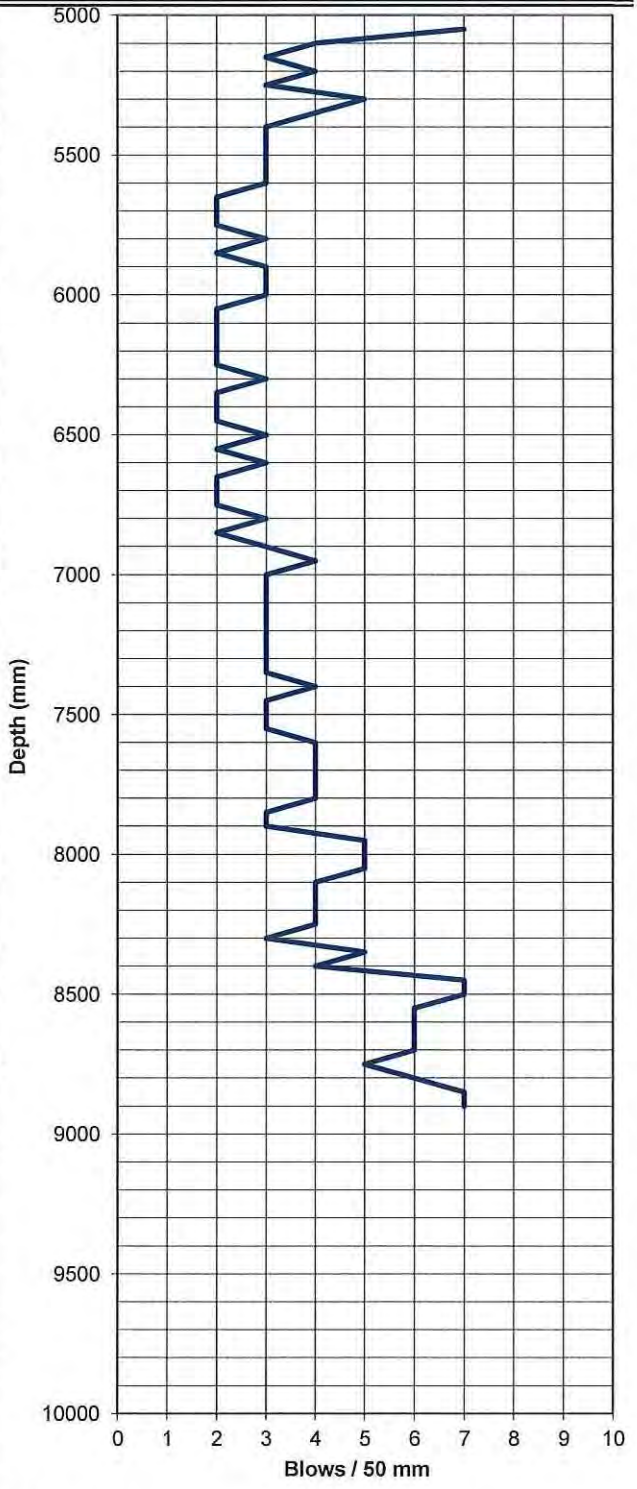
Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *17/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. ***SC5***
Sheet **2**
of **2**

mm Driven	No. of Blows
5050	7
5100	4
5150	3
5200	4
5250	3
5300	5
5350	4
5400	3
5450	3
5500	3
5550	3
5600	3
5650	2
5700	2
5750	2
5800	3
5850	2
5900	3
5950	3
6000	3
6050	2
6100	2
6150	2
6200	2
6250	2
6300	3
6350	2
6400	2
6450	2
6500	3
6550	2
6600	3
6650	2
6700	2
6750	2
6800	3
6850	2
6900	3
6950	4
7000	3
7050	3
7100	3
7150	3
7200	3
7250	3
7300	3
7350	3
7400	4
7450	3
7500	3

mm Driven	No. of Blows
7550	3
7600	4
7650	4
7700	4
7750	4
7800	4
7850	3
7900	3
7950	5
8000	5
8050	5
8100	4
8150	4
8200	4
8250	4
8300	3
8350	5
8400	4
8450	7
8500	7
8550	6
8600	6
8650	6
8700	6
8750	5
8800	6
8850	7
8900	7
8950	
9000	
9050	
9100	
9150	
9200	
9250	
9300	
9350	
9400	
9450	
9500	
9550	
9600	
9650	
9700	
9750	
9800	
9850	
9900	
9950	
10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

Scala 6.xlsx

TONKIN & TAYLOR

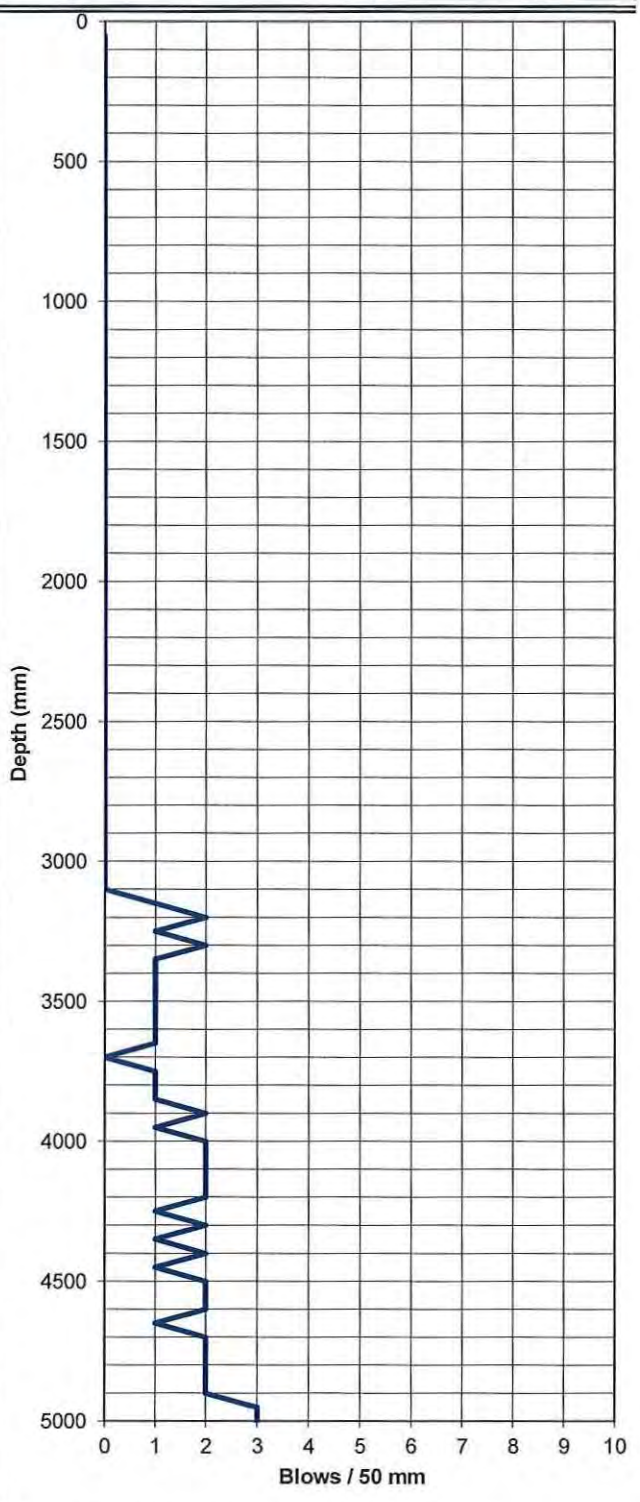
SCALA PENETROMETER LOG

Job No: *751078*
Project: *Suva Radio*
Location: *Suva*
RL:

Date: *19/10/2014*
Operated by: *JWY*
Logged by: *JWY*
Checked by:

Test No. *SC6*
Sheet *1*
of *1*

mm Driven	No. of Blows	mm Driven	No. of Blows
50	0	2550	0
100	0	2600	0
150	0	2650	0
200	0	2700	0
250	0	2750	0
300	0	2800	0
350	0	2850	0
400	0	2900	0
450	0	2950	0
500	0	3000	0
550	0	3050	0
600	0	3100	0
650	0	3150	1
700	0	3200	2
750	0	3250	1
800	0	3300	2
850	0	3350	1
900	0	3400	1
950	0	3450	1
1000	0	3500	1
1050	0	3550	1
1100	0	3600	1
1150	0	3650	1
1200	0	3700	0
1250	0	3750	1
1300	0	3800	1
1350	0	3850	1
1400	0	3900	2
1450	0	3950	1
1500	0	4000	2
1550	0	4050	2
1600	0	4100	2
1650	0	4150	2
1700	0	4200	2
1750	0	4250	1
1800	0	4300	2
1850	0	4350	1
1900	0	4400	2
1950	0	4450	1
2000	0	4500	2
2050	0	4550	2
2100	0	4600	2
2150	0	4650	1
2200	0	4700	2
2250	0	4750	2
2300	0	4800	2
2350	0	4850	2
2400	0	4900	2
2450	0	4950	3
2500	0	5000	3



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

TONKIN & TAYLOR

SCALA PENETROMETER LOG

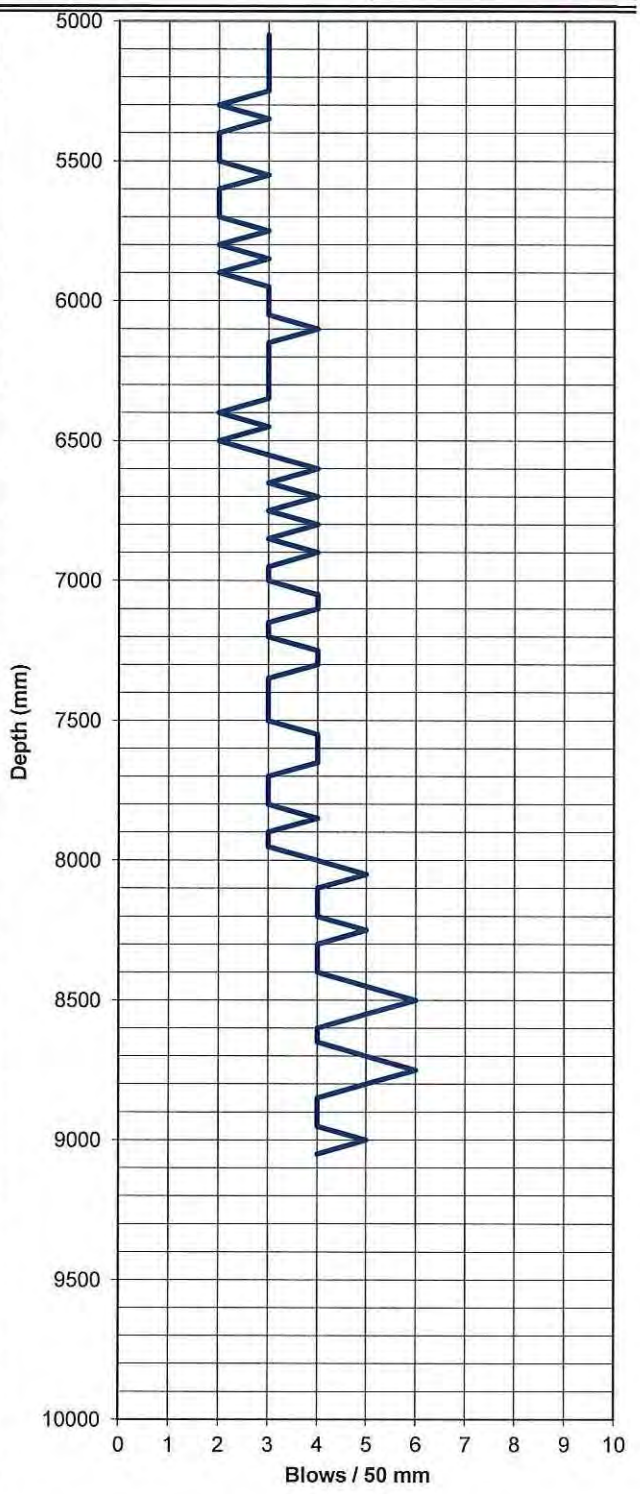
Job No: 751078
Project: Suva Radio
Location: Suva
RL:

Date: 17/10/2014
Operated by: JWY
Logged by: JWY
Checked by:

Test No. SC6
Sheet 2
of 1

mm Driven	No. of Blows
5050	3
5100	3
5150	3
5200	3
5250	3
5300	2
5350	3
5400	2
5450	2
5500	2
5550	3
5600	2
5650	2
5700	2
5750	3
5800	2
5850	3
5900	2
5950	3
6000	3
6050	3
6100	4
6150	3
6200	3
6250	3
6300	3
6350	3
6400	2
6450	3
6500	2
6550	3
6600	4
6650	3
6700	4
6750	3
6800	4
6850	3
6900	4
6950	3
7000	3
7050	4
7100	4
7150	3
7200	3
7250	4
7300	4
7350	3
7400	3
7450	3
7500	3

mm Driven	No. of Blows
7550	4
7600	4
7650	4
7700	3
7750	3
7800	3
7850	4
7900	3
7950	3
8000	4
8050	5
8100	4
8150	4
8200	4
8250	5
8300	4
8350	4
8400	4
8450	5
8500	6
8550	5
8600	4
8650	4
8700	5
8750	6
8800	5
8850	4
8900	4
8950	4
9000	5
9050	4
9100	
9150	
9200	
9250	
9300	
9350	
9400	
9450	
9500	
9550	
9600	
9650	
9700	
9750	
9800	
9850	
9900	
9950	
10000	



Test Method Used: NZS 4402:1988 Test 6.5.2 Dynamic Cone Penetrometer

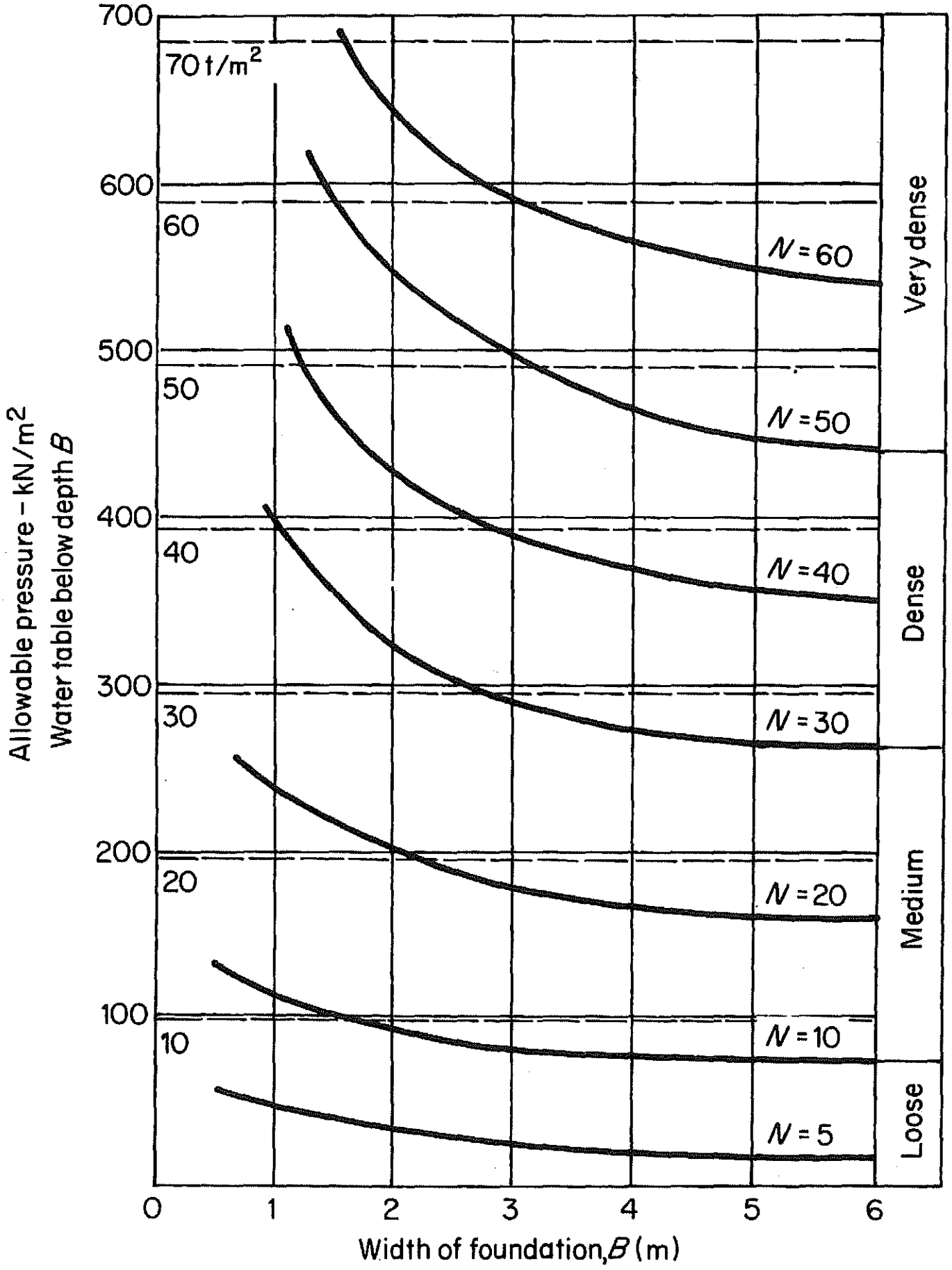


Fig. 2.19 Chart for estimating allowable bearing pressure for foundations in sand on basis of results of standard penetration test (Terzaghi and Peck[2.8]). N values are shown in blows per 300 mm.

Appendix D: **Laboratory testing**

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Your Job No.: 751078

Site : Suva Radio, Fiji

Our Job No.: 616417.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

BH No.:		1	1	2	2	3	3
Depth	(m)	1.0-1.5	3.0-3.5	2.0	3.5	0.5-1.5	2.0-3.0
Solid Density	(t/m^3)	2.68	2.69	2.65	2.66	2.78	2.80

Table 2: Solid Density

BH No.:		4	5
Depth	(m)	3.5	6.0
Solid Density	(t/m^3)	2.67	2.82

Remarks : The minimum mass for the test is less than the required by the method. Therefore the test results are not IANZ accredited.
The solid density was reported to the nearest 0.01 t/m^3.

Tested by: ST Date: 7/11/14 Checked by: AH Date: 7/11/14

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File: P:\616417.000\Working Material\BH4_3.5m_Wet Sieve.xlsx

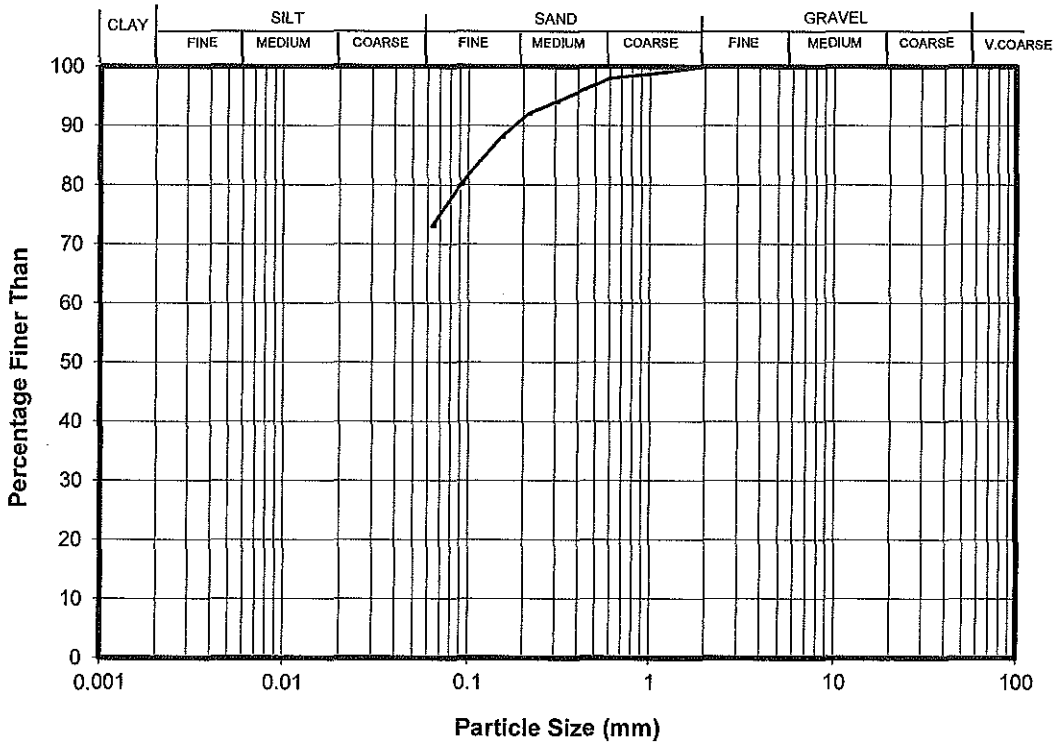
Page of **Your Job No.: 751078**

Site : **Suva Radio, Fiji** **Our Job No.: 616417.000**

BH No.: **4** Sample No.: **---** Depth (m): **3.5**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	100
3.35	100

Sieve (mm)	Total % Passing
2.00	100
1.18	99
0.600	98
0.425	96
0.300	94
0.212	92
0.150	88
0.090	80
0.063	73

Sample history : As received.

Sample Description : sandy SILT with some clay, soft to firm, light greenish-dark grey, mottled black.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

Entered by : ST Date : 7/11/14 Checked by : AH Date : 7/11/14

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Your Job No.: 751078

Site : Suva Radio, Fiji

Our Job No.: 616417.000

Test Method Used:NZS 4402:1986 Test 2.1 Determination of the water content

WATER CONTENT TEST RESULTS

Table 1: Water Content

BH No.:		1	1	2	2	3	3
Depth	(m)	1.0-1.5	3.0-3.5	2.0	3.5	0.5-1.5	2.0-3.0
Water Content	(%)	30.7	49.2	41.8	53.7	51.0	48.9

Table 2: Water Content

BH No.:		4	5
Depth	(m)	3.5	6.0
Water Content	(%)	72.9	56.7

Tested by: ST Date: 11/11/14 Checked by: AH Date: 11/11/14

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File: P:\616417.000\Working Data\PBH1_1.0-1.5m_Wet Sieve.xlsx

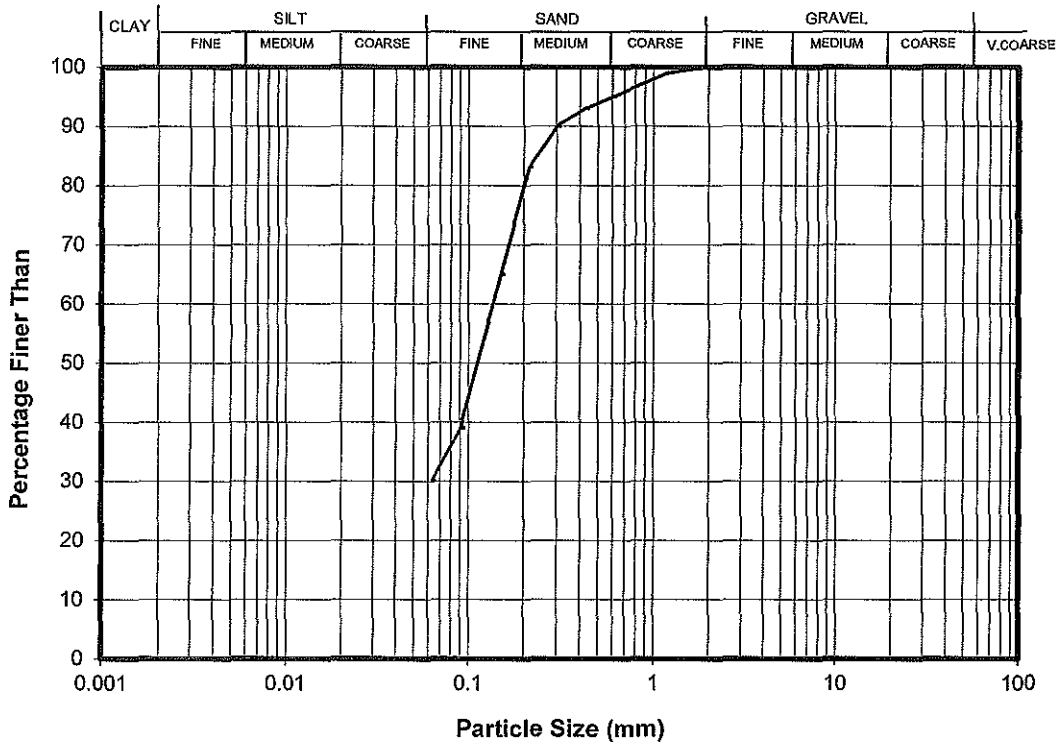
Page of **Your Job No.: 751078**

Site : **Suva Radio, Fiji** **Our Job No.: 616417.000**

BH No.: **1** Sample No.: --- Depth (m): **1.0-1.5**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	---
3.35	100

Sieve (mm)	Total % Passing
2.00	100
1.18	99
0.600	95
0.425	93
0.300	90
0.212	83
0.150	65
0.090	39
0.063	30

Sample history : As received.

Sample Description : silty SAND with minor clay, soft, light yellowish-greyish brown with light red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

Entered by : ST Date : 11/11/14 Checked by : AH Date : 11/11/14

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File: P:\616417.000\Working Material\BH1_3.0-3.5m_Wet Sieve.xlsx

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Your Job No.: 751078

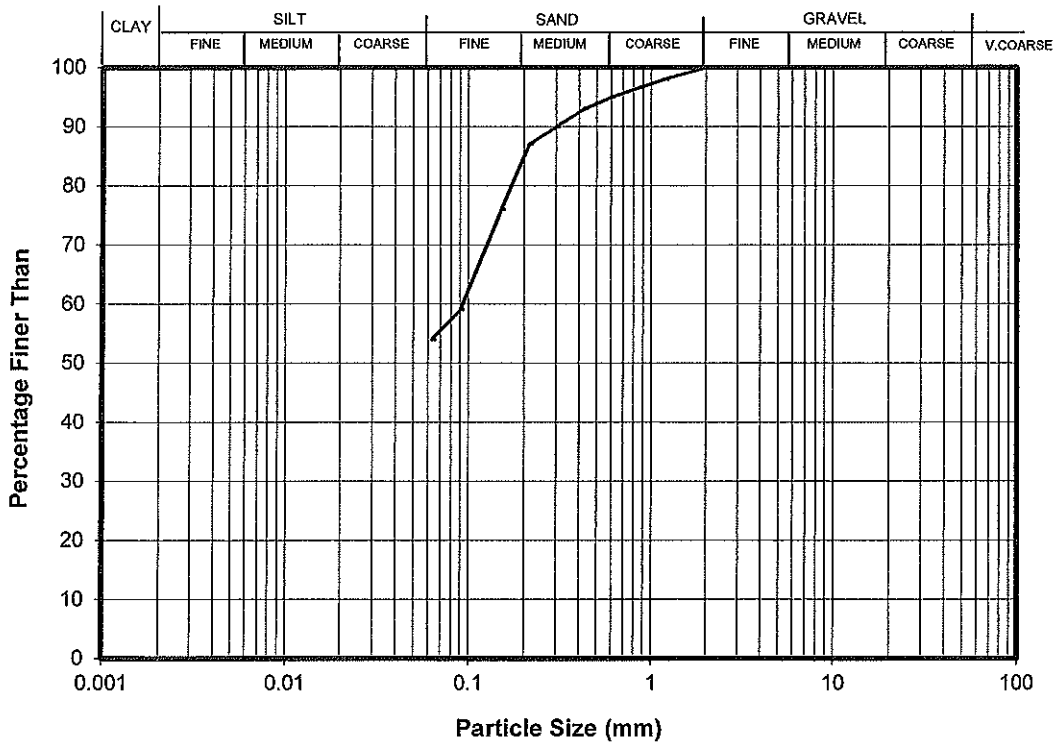
Site : **Suva Radio**

Our Job No.: 616417.000

BH No.: **1** Sample No.: **---** Depth (m): **3.0-3.5**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	---
3.35	100

Sieve (mm)	Total % Passing
2.00	100
1.18	98
0.600	95
0.425	93
0.300	90
0.212	87
0.150	76
0.090	59
0.063	54

Sample history : As received.

Sample Description : sandy SILT with minor clay, soft to firm, light yellowish brown with light red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

Entered by : ST Date : 11/11/14 Checked by : AH Date : 11/11/14

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File: P:\616417.000\Working Material\BH2_2.0m_Wet Sieve.xlsx

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Your Job No.: **751078**

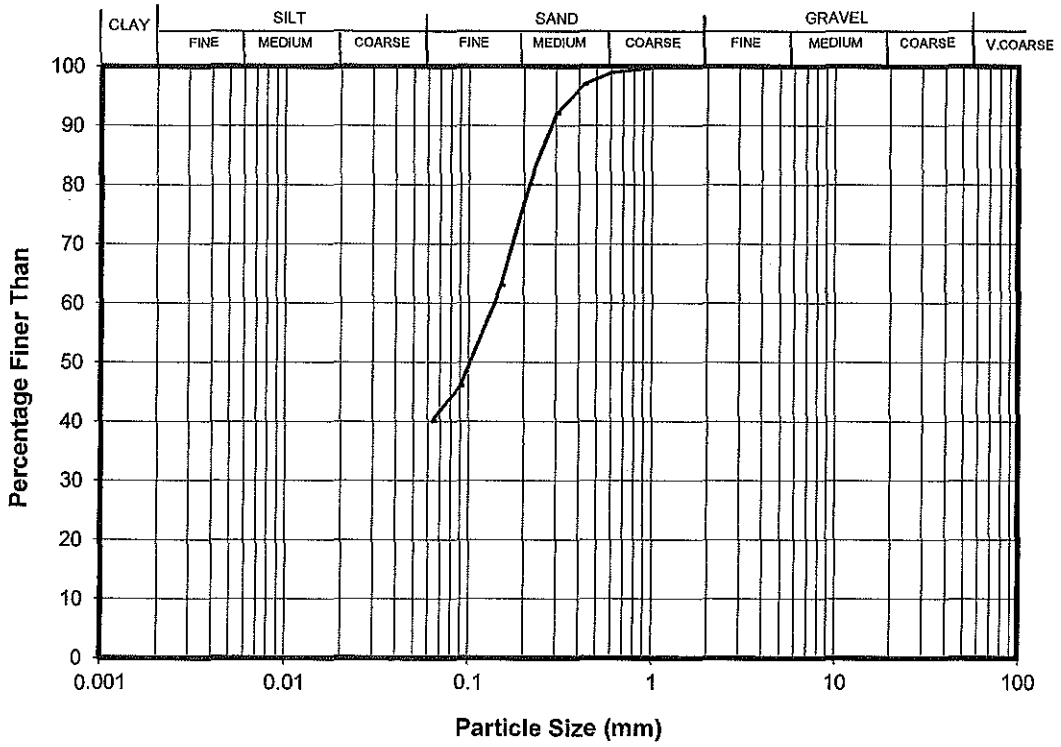
Site : **Suva Radio**

Our Job No.: **616417.000**

BH No.: **2** Sample No.: **---** Depth (m): **2.0**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	---
3.35	---

Sieve (mm)	Total % Passing
2.00	100
1.18	100
0.600	99
0.425	97
0.300	92
0.212	80
0.150	63
0.090	46
0.063	40

Sample history : As received.

Sample Description : silty SAND with minor clay, soft, light yellowish-greyish brown with light red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

Entered by : ST Date : 11/11/14 Checked by : AH Date : 11/11/14

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File: P:\616417.000\Working Material\BH2_3.5m_Wet Sieve.xlsx

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Your Job No.: **751078**

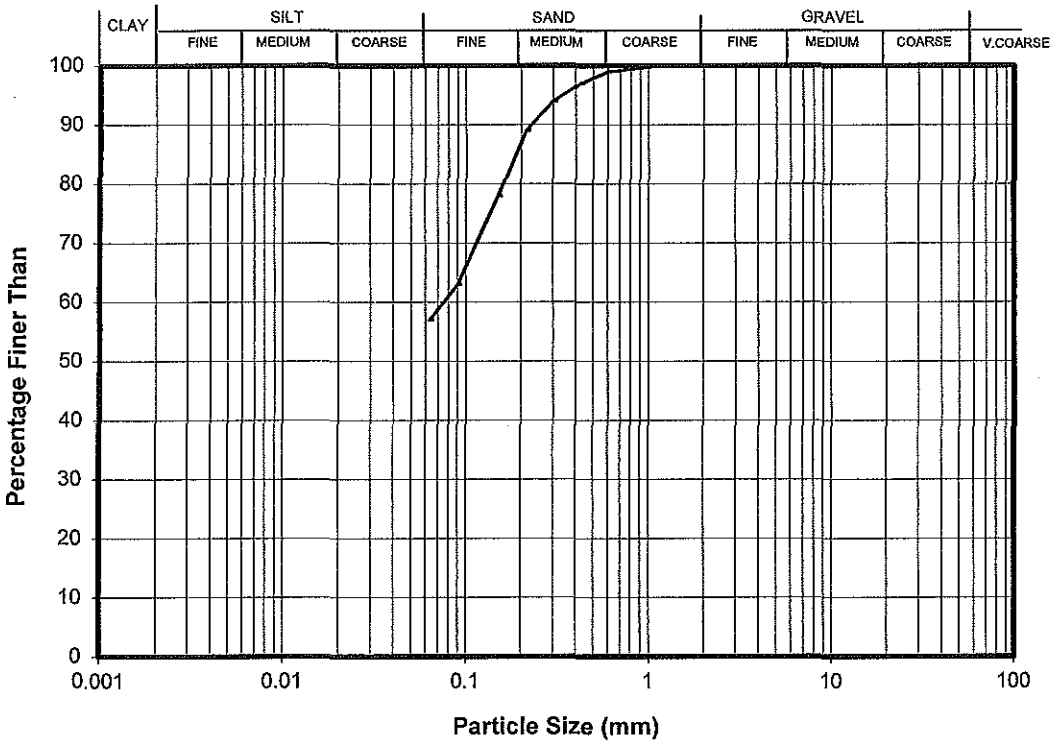
Site : **Suva Radio**

Our Job No.: **616417.000**

BH No.: **2** Sample No.: **---** Depth (m): **3.5**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	---
3.35	100

Sieve (mm)	Total % Passing
2.00	100
1.18	100
0.600	99
0.425	97
0.300	94
0.212	89
0.150	78
0.090	63
0.063	57

Sample history : As received.

Sample Description : sandy SILT with minor to some clay, soft, light yellowish-greyish brown with light red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

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Your Job No.: **751078**

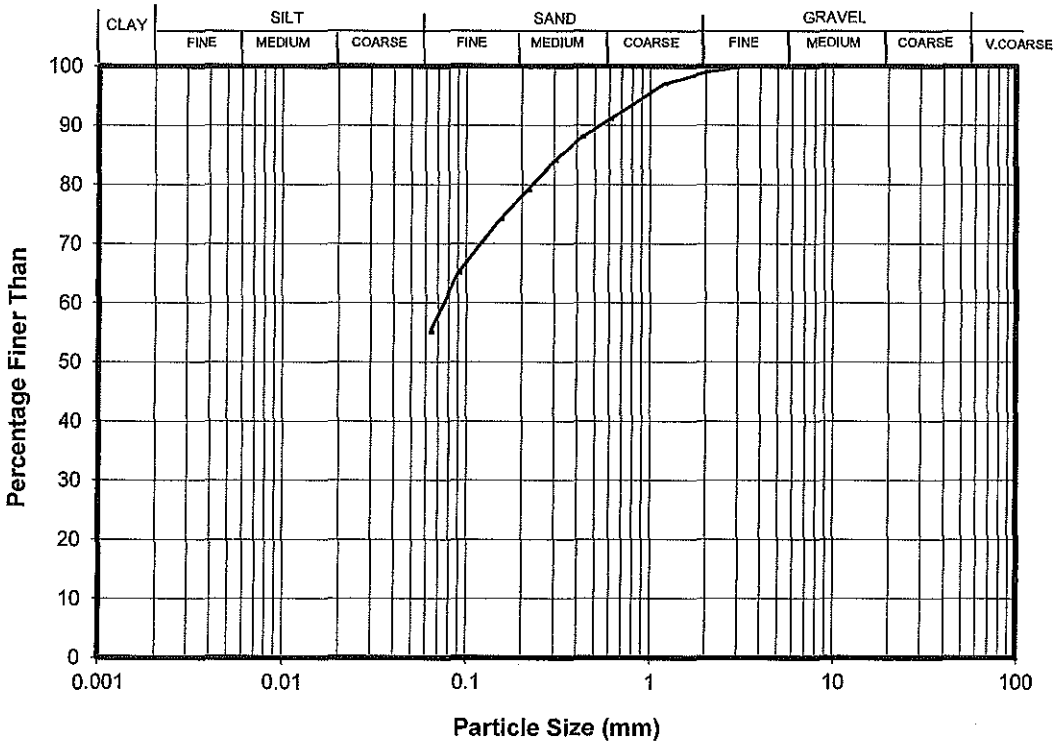
Site : **Suva Radio**

Our Job No.: **616417.000**

BH No.: **3** Sample No.: **---** Depth (m): **0.5-1.5**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	100
3.35	100

Sieve (mm)	Total % Passing
2.00	99
1.18	97
0.600	91
0.425	88
0.300	84
0.212	79
0.150	74
0.090	65
0.063	55

Sample history : As received.

Sample Description : sandy SILT with minor to some clay, soft, light yellowish brown, mottled red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

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File: P:\616417.000\Working Material\BH3_2.0-3.0m_Wet Sieve.xlsx

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Your Job No.: **751078**

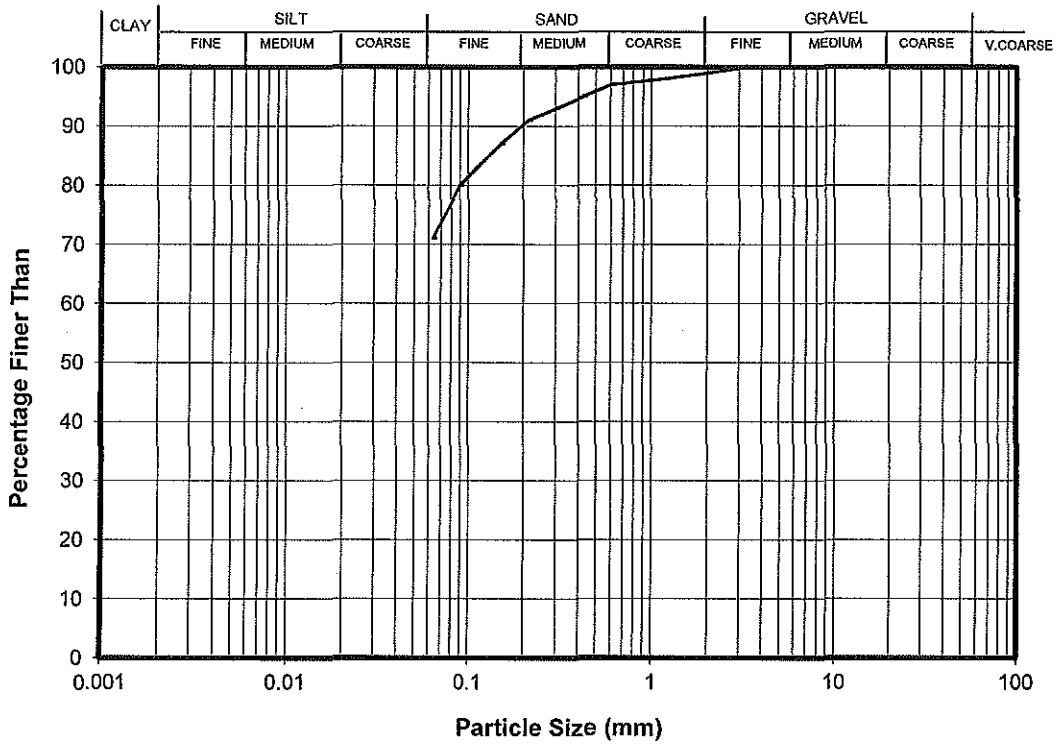
Site : **Suva Radio**

Our Job No.: **616417.000**

BH No.: **3** Sample No.: --- Depth (m): **2.0-3.0**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	---
4.75	100
3.35	100

Sieve (mm)	Total % Passing
2.00	99
1.18	98
0.600	97
0.425	95
0.300	93
0.212	91
0.150	87
0.090	80
0.063	71

Sample history : As received.

Sample Description : sandy SILT with minor to some clay, firm to stiff, light yellowish-greyish brown, mottled red.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

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Page of

Your Job No.: **751078**

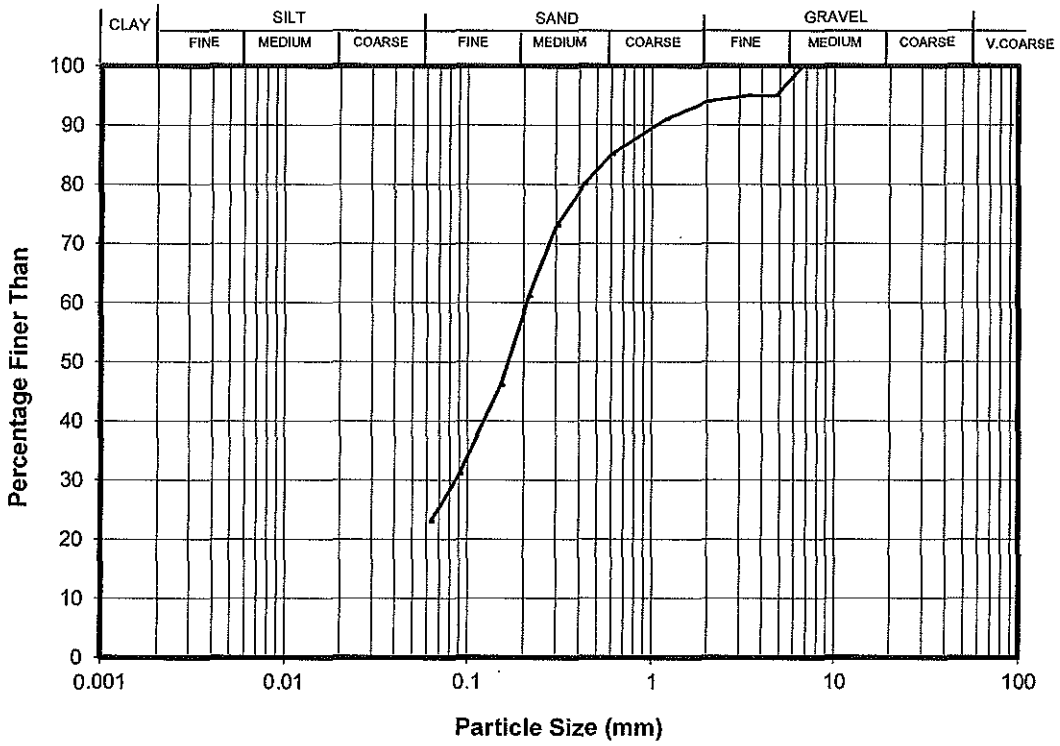
Site : **Suva Radio**

Our Job No.: **616417.000**

BH No.: **5** Sample No.: **---** Depth (m): **6.0**

Test Method Used : NZS 4402 : 1986 Test 2.8.1 Wet Sieve

PARTICLE SIZE ANALYSIS



Sieve (mm)	Total % Passing
63.0	---
53.0	---
37.5	---
26.5	---
19.0	---
13.2	---
9.50	---
6.70	100
4.75	95
3.35	95

Sieve (mm)	Total % Passing
2.00	94
1.18	91
0.600	85
0.425	80
0.300	73
0.212	61
0.150	46
0.090	31
0.063	23

Sample history : As received.

Sample Description : silty SAND with trace of clay and trace of organics, soft, light greenish-dark grey, mottled black.

Remarks : The percentage passing the finest sieve was obtained by difference.
The sample description is not IANZ accredited.

Entered by : ST Date : 11/11/14 Checked by : AH Date : 11/11/14

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ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

Yachiyo Engineering Company Ltd

The Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji
Second phase of investigations

Report prepared for:

Yachiyo Engineering Company Ltd

Report prepared by:

Tonkin & Taylor International Ltd

Distribution:

Yachiyo Engineering Company Ltd	2 copies
Tonkin & Taylor International Ltd (FILE)	1 copy

March 2015

Job No: 751078

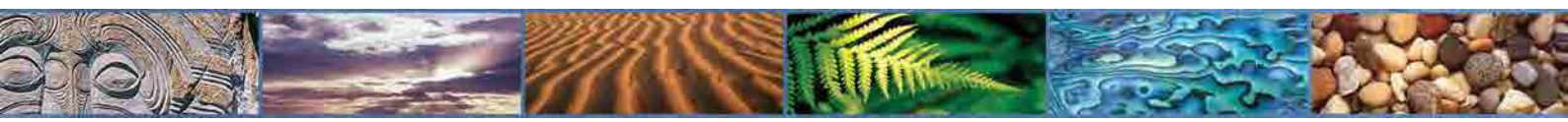

Table of contents

1 Introduction

1.1 General

Tonkin and Taylor International (T&TI) was engaged by Yachiyo Engineering Co., Ltd. (YEC) to undertake deep soil investigations for a proposed new medium wave radio antenna and transmission house (defined herein as 'the site') in Suva, Fiji.

The investigations have been carried out in accordance with the "Contract of Soil Explorations" provided to T&TI by YEC. The soil investigations comprised 4 machine drilled boreholes and pressuremeter testing at locations directed by the representative of YEC. Laboratory testing of recovered soil samples from the site was also undertaken. This work scope was agreed with YEC.

The geotechnical assessment was undertaken in accordance with our proposal dated 2 December 2014[1].

The scope of the geotechnical investigations has included:

- A review of relevant existing information held in T&TI archives.
- A site walkover by an engineering geologist from T&TI.
- Construction of a temporary access track to the borehole locations.
- Supervision of the construction of the access track.
- 4 Machine drilled boreholes to a maximum depth of 15.95m with SPT and shear vane testing at regular intervals.
- Pressuremeter testing at the location of BH1.
- Assessment of suitable foundation solutions for structures on the site.
- Preparation of this report outlining the geology, site subsurface conditions and presenting preliminary geotechnical information and recommendations to support the development of the site.

This report summarises the results of the soils investigations carried out at the site.

1.2 Project Description

The republic of Fiji comprises an archipelago of more than 332 islands, of which 110 are permanently inhabited, and more than 500 islets, amounting to a total land area of about 18,300 square kilometres (7,100 sq mi). The two major islands, Viti Levu and Vanua Levu, account for 87% of the population of almost 860,000. The capital and largest city, Suva, is on Viti Levu.

The proposed works are part of the 'The Rehabilitation of the Medium Wave Radio Transmission in the Republic of Fiji', located east of Suva, approximately 4km west of Nausori airport.

The project involves construction of a new medium wave antenna mast and transmission house as well as temporary roads needed for access across the site. Excavation of the slope between the transmission house and the antenna mast will be required to establish a suitable grade for the access road.

2 Site Description

The site is located at the end of Naulu Road, Naulu, Fiji. The Site lies to the east of Suva city on the city fringes. The site is approximately 12km from Suva CBD and 4km from Nausori Aiport.

[1] Tonkin and Taylor International Ltd. (2 December 2014) , Basic Design Study project for the Rehabilitation of the Medium Wave Radio Transmission for a site in Fiji- Stage 2, Deeper Soils Investigations

The site is located on a river terrace on the eastern outskirts of Suva. To the north, east and south of the site are the floodplains of the Rewa River. The Rewa River is located to the east of the site and the area surrounding the site consists of swamps and floodplain deposits with dense vegetative cover. The land to the west is largely residential with many small dwellings located along the western boundary of the site. The central section of the site comprises the existing buildings on gently sloping land (<5°) to the southwest. The banks of the terrace slope at approximately 20°.

The site, in its current layout includes an existing transmission house serving a telecommunications antenna. The telecommunications antenna is located slightly north of the current transmission house along a terraced portion of the site. The existing medium wave antenna is located to the south of the current transmission house.

The site of the proposed medium wave antenna is largely covered in vegetation, from small scrub and grass in the central section to dense bush located within the floodplains. Coconut palms lie along the western boundary of the site.

3 Summary of temporary access road construction

The works on site were completed between Wednesday 4 and 11 February 2015. The plant used consisted of three excavators and two bulldozers which were mobilised by Kwickshift to the site to complete the works. A temporary track was constructed using locally sourced fill from the site (weathered Suva Marl). The resulting track was approximately 200m in length and between 5-9m wide. The thickness of the fill placement over the swampy area was approximately 0.5m. Due to continued heavy rainfall the final completion of the access track was delayed until Wednesday 14 February.

4 Summary of the Soils investigations

4.1 Geotechnical Investigation Equipment

The geotechnical investigations were undertaken by Geotech Drilling International Ltd (GDI) under the supervision of T&TI. The machine drilled boreholes were performed using a tracked rig using HQTT (HQ Triple Tube) wireline techniques with Standard Penetration Testing (SPT) performed at regular intervals. A photo of the equipment used is shown in Figures 4.1 and 4.2 below.

Figure 4.1: GDI drilling rig used during the investigations.

Figure 4.2: Pressuremeter

4.2 General

The soils investigations were carried out in February 2015 and the scope of work was completed in accordance with 'Contract of Soils Explorations' - appended for convenience in Appendix A. All field tests were terminated in hard ground following at least 5m of SPT 'N' counts greater than 30.

The following tasks were completed for the soils investigation:

- Field test location 1
    - 1 Machine borehole to 15.95m below existing ground level.
    - 2 Pressuremeter tests (at depths of 8.3 and 8.8m below existing ground level)-Both tests did not record reliable results due to collapse of the borehole.
- Field test location 2
    - 1 machine drilled borehole to 11.45m below existing ground level.
- Field test location 3
    - 1 machine drilled borehole to 11.45m below existing ground level.
- Field test location 4
    - 1 machine drilled borehole to 15.95m below existing ground level.

The subsections below present a summary of the investigation work and laboratory results. Site investigation logs are presented in Appendix C and laboratory testing results are presented in Appendix D.

4.3 Machine borehole Investigations

The soil investigation testing, including machine drilled boreholes, was undertaken over a period of 4 days (9 February– 13 February 2015) at the site. In-situ shear strength testing was carried out in the machine drilled boreholes in cohesive materials using a calibrated pilcon shear vane and samples were taken for geotechnical laboratory testing. The subsurface soils were described in accordance with NZ Geotechnical Society guidelines and shear strengths are recorded on the borehole logs presented in Appendix C. Standard Penetration Testing (SPT) was conducted in the boreholes within cohesive materials and the Suva Marl bedrock.

4.3.1 Site 1- Field Test Location **1**

One machine drilled borehole was conducted at the Centre mast position (BH1). The machine drilled borehole extended to 15.95m. Groundwater was observed at 0.2m below existing ground level. The borehole was terminated once 5m of rock had been proven ('N'>30). Push tube samples were recovered at 3.5-4.0m and 9.5-10.0m. Pressuremeter testing was attempted within the borehole at depths of 8.3 and 8.8m below existing ground level. Testing did not record reliable results due to the collapse of the borehole.

4.3.2 Site 2- Field Test Location **2**

One machine drilled borehole was conducted at the eastern support position (BH2). The machine drilled borehole extended to 11.45m. Groundwater was observed at 0.2m below existing ground level. The borehole was terminated once 5m of rock had been proven ('N'>30). A Push tube sample was recovered at 1.5-2.0m.

4.3.3 Site 3- Field Test Location **3**

One machine drilled borehole was conducted at the western support position (BH3). The machine drilled borehole extended to 11.45m. Groundwater was observed at 0.2m below existing ground level. The borehole was terminated once 5m of rock had been proven ('N'>30).

4.3.4 Site 4- Field Test Location **4**

One machine drilled borehole was conducted at the northern support position (BH4). The machine drilled borehole extended to 15.95m. Groundwater was observed at 0.2m below existing ground level. The borehole was terminated once 5m of rock had been proven ('N'>30). Push tube samples were recovered at 2.0-2.5m, 5.0-5.5m and 9.5-10.0m.

5 Subsurface Conditions

5.1 Geological Setting

Published Geological information[2] suggests the site is underlain by Suva Marl of Miocene age. To the north, east and south the site is underlain by recent alluvium.

Observations on site confirmed the presence of alluvial deposits overlying the Suva Marl at depths of between 4.5-10.5m below existing ground level. Suva Marl was also observed in road cuttings of the temporary access road.

A map of the local geology is shown in Figure 5.1 below.

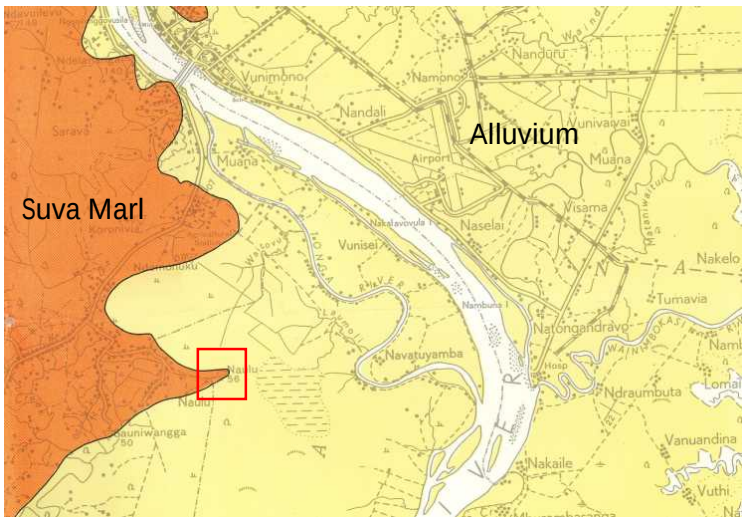

Figure 5.1- Published Geology of the Suva area- Ibbotson (1960). Site shown in red.

5.2 Ground and Groundwater Conditions

5.2.1 Site 1- Field test location **1**

The subsurface conditions for the central mast location are summarised in Table 5.1. The investigations extended to 15.95m below ground level.

[2] Ibbotson,P, 1960, *Geology of the Suva Area, Viti Levu*, Geological Survey Department, Suva, Fiji,

Table 5.1: Summary of ground conditions (Site 1-Central Mast position)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength (Cu) *	Typical SPT 'N' value
0-1.5m (Core loss 0.3-1.5m)	Fill	Sandy SILT, some clay, brown, soft, moist, low plasticity	N/A	0
1.5-2.6m (Core loss 2.0-2.3m)	Organics	ORGANICS with rootlets, trace silt, black, very soft, wet	N/A	0
2.6-4.5m (Core loss 4.0-4.4m)	Alluvial Sediments	Sandy SILT with some organics, dark brownish grey, very soft, wet, low plasticity	6 kPa	0
4.5-6.5m	Alluvial Sediments	Silty fine SAND, some organics and decomposed wood, dark brownish grey, saturated, loose	N/A	0
6.5-8.7m (Core loss 6.5-7.25m)	Alluvial Sediments	Sandy SILT, some carbonaceous material and trace coarse gravels, dark grey, very soft, saturated, low plasticity	5kPa	5
8.7-10.1m	Highly Weathered Suva Marl	Highly weathered SILTSTONE (Sandy SILT, some coarse gravels, dark grey, stiff, wet)	10kPa	N/A
10.1-10.5m (Core loss 10.1-10.5m)	Slightly Weathered Suva Marl	Slightly Weathered bluish grey SILTSTONE, extremely weak, well cemented	N/A	N/A
10.5-15.95m	Unweathered Suva Marl	Unweathered bluish grey SILTSTONE, trace carbonaceous inclusions, extremely weak, well cemented, massive,	N/A	39-57

*Measurements taken using hand held pilcon shear vane in the end of the HQ (63.5mm) diameter open-barrel.

Groundwater encountered at 0.2m below ground level.

5.2.2 Site 2- Field test location **2**

The subsurface conditions at the location of the eastern support location are summarized below. The investigations extended to 11.45m below ground level.

Table 5.2: Summary of ground conditions (Site 2-Eastern support position)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength (Cu)*	Typical SPT 'N' value
0.0-1.5m (core loss 0.2-1.5)	Fill	Sandy SILT, trace clay, brown, firm, wet, low plasticity	N/A	0
1.5-2.0m	Organics	Organics, some silt, fiberous with rootlets, blackish brown, very soft, wet, low plasticity	0kPa	0

2.0-4.0m	Organics	Organic SILT with rootlets, blackish brown, very soft, wet, low plasticity	6kPa	0
4.0-4.35m	Alluvial Sediments	Silty fine SAND, some organics including rootlets, dark brownish grey, loose, wet	N/A	1-5
4.35-4.90m	Slightly Weathered Suva Marl	Slightly weathered, dark bluish grey SILTSTONE, extremely weak, well cemented	N/A	N/A
4.90-11.45m (Core loss 5.45-5.6m)	Unweathered Suva Marl	Slightly weathered, dark bluish grey SILTSTONE, extremely weak, well cemented	N/A	30-50

*Measurements taken using hand held pilcon shear vane in the end of the HQ (63.5mm) diameter open-barrel.

Groundwater was encountered in this borehole at 0.1m below ground level.

5.2.3 Site 3- Field test location **3**

The subsurface conditions for location 3 are summarised below. The investigations extended to 11.45m below ground level.

Table 5.3: Summary of ground conditions (Site 3-Western support location)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength (Cu)*	Typical SPT 'N' value
0.0-1.75m (Core loss 0.2-1.75m)	Fill	Sandy SILT, trace clay, brown, firm, wet, low plasticity	N/A	0
1.75-3.8m (Core loss 3.5-3.7m)	Organics	Organics, with rootlets, blackish brown, very soft, wet, low plasticity	0-6kPa	0
3.8-4.6m	Alluvial Sediments	Silty Fine SAND, some organics, dark grey, loose, wet	N/A	N/A
4.6-5.0m	Slightly Weathered Suva Marl	Slightly weathered dark bluish grey SILTSTONE, extremely weak, well cemented	N/A	N/A
5.0-11.45m (Core loss 5.5-9.5m)	Unweathered Suva Marl	Unweathered dark bluish grey SILTSTONE, extremely weak, well cemented, carbonaceous	N/A	34-46

*Measurement taken using hand held pilcon shear vane in the end of the HQ (63.5mm) diameter open-barrel.

Groundwater was encountered at 0.1m below ground level.

5.2.4 Site 4- Field test location **4**

The subsurface conditions for location 4 are summarised below. The investigations extended to 15.95m below ground level.

Table 5.4: Summary of ground conditions (Site 4-Northern support location)

Depth (Below ground level)	Geological Unit	Soil Description	Soil Undrained shear strength (Cu)*	Typical SPT 'N' value
0.0-1.5m (Core loss 0.25-1.5m)	Fill	Sandy SILT, trace clay, brown, soft, wet, low plasticity	N/A	0
1.5-3.5m (Core loss 2.5-2.85m)	Organics	ORGANICS, fibrous with rootlets, minor silt blackish brown, very soft, wet, low plasticity	6kPa	0
3.5-4.45m	Organics	Organic SILT, some rootlets, minor fine sand, dark brownish grey, very soft, wet, low plasticity	N/A	0
4.45-5.5m	Alluvial Sediments	Medium to fine SAND, some silt, minor organics, minor gravels, dark grey, loose, wet	N/A	0
5.5-6.0m	Alluvial Sediments	Silty fine SAND, minor organics ad fine gravels, dark brownish grey, loose, saturated	N/A	0
6.0-6.4m	Alluvial Sediments	SILT, minor fine sand and organics, dark brownish grey, very soft, wet, low plasticity	N/A	0
6.4-7.7m	Alluvial Sediments	Silty fine SAND, trace calcareous inclusions, dark grey, loose, wet	N/A	0
7.7-8.45m	Alluvial Sediments	Silty fine SAND, some organics, minor fine gravel, trace coarse gravel, dark greyish brown, loose, wet, dark	N/A	0
8.45-9.2m	Highly Weathered Suva Marl	Highly Weathered SILTSTONE (Clayey Silt, some fine to medium gravel, bluish grey mottled brown, firm, wet, low plasticity)	UTP	N/A
9.2-10.4m	Highly Weathered Suva Marl	Highly Weathered SILTSTONE (Sandy SILT, trace clay and fine gravels, bluish grey, mottled brown, firm ,wet)	UTP	N/A
10.4-15.95m	Unweathered Suva Marl	Unweathered dark bluish grey SILTSTONE, extremely weak, well cemented, massive	N/A	43-53

*Measurement taken using hand held pilcon shear vane in the end of the HQ (63.5mm) diameter open-barrel.

Groundwater was encountered at 0.1m below ground level.

6 Geotechnical Laboratory Testing Results

The following laboratory testing has been performed from samples taken by push tube or core samples during the soils investigations. The full set of laboratory testing results are shown in Appendix E.

Tables 6.1-6.3 summarises the testing results from samples collected during the geotechnical investigations.

Table 6.1: Laboratory testing summary-UU Triaxial tests

Machine Borehole No.	Sample Depth (m)	Undrained Shear Strength Cu (kPa)
1	9.73-9.85	45-55
4	9.78-9.90	33-37

Table 6.2: Laboratory testing summary-Solid Density

Machine Borehole No.	Sample Depth (m)	Average Solid Density (t/m^3)
1	15.5	2.75
1	11.0	2.77
2	6.5	2.74
2	4.8	2.76
2	9.5	2.80
3	5.0	2.70
3	11.0	2.69
4	10.0	2.77
4	11.0	2.78

Table 6.3: Laboratory testing summary- UCS testing

Machine Borehole No.	Sample Depth (m)	Unconfined compressive strength (kPa)
1	15.20	2641
2	8.70	1868
3	10.50	2376
4	10.80	1701

7 Discussion and Engineering properties

Recommendations and opinions in this report are based upon data from 4 No Machine borehole tests from the following sites.

- Field test location 1- Mast Centre
- Field test location 2- Eastern support position
- Field test location 3- Western support position

- Field test location 4- Northern support position

The nature and continuity of the subsoil away from the test locations is inferred, but it must be appreciated that actual conditions could vary from the assumed model.

From the results of the soils investigation, geotechnical laboratory testing and also using published empirical relationships, we have assessed the engineering properties for the underlying soils at the four sites for the designer's consideration in the following subsections.

Actual ground conditions should be confirmed by a geotechnical engineer competent to judge whether the soils exposed in the foundation excavations are compatible with those described within this report.

7.1 Site Seismic Classification

7.1.1 General

It is appropriate to design the foundations and structure in accordance with the New Zealand Standard NZS 1170.5:2004[3] which is adopted in Fiji. From the geotechnical investigations undertaken we consider that the site should be classified as a Class C- (Shallow soil sites).

7.1.2 Importance Level

In accordance with NZS 1170.0:2002[4] which is adopted in Fiji we have completed this assessment on the basis that the proposed development will be an Importance Level 2 structure. If this is changed during detailed design then updates will be required to this report.

7.1.3 Peak Ground Acceleration

The probabilistic earthquake hazard assessment for Fiji prepared by Jones[5] provides recommendations with respect to estimated ground accelerations. Peak ground accelerations (PGAs) expected from the design earthquakes under serviceability limit state (SLS) and ultimate limit state (ULS) conditions are presented in Table 7.1 below.

Table 7.1: Design Peak Ground Accelerations

Design Life (years)*	Serviceability Limit State (SLS)		Ultimate Limit State (ULS)	
	Return Period	Peak Ground Accelerations	Return Period	Peak Ground Accelerations
50	1 in 25 years	0.07	1 in 500 years	0.28

** Design Life to be confirmed by the structural engineer/architect as appropriate. If different from that assumed, or if this changes during the project life then these values and the opinions in this report may require reviewing and amending as and where necessary.*

7.2 Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle Range

Summaries of the approximate soil parameters for boreholes 1-4 are included in Table 7.2 - 7.5. These have been assessed using results of the site investigations and laboratory testing.

[3] NZS 1170.5: 2004 *Structural design actions – Earthquake Actions (New Zealand).* SANZ.
[4] NZS 1170:0: 2002 *Structural design actions – Part 0: General Principles*
[5] Jones, T, 1997, *Probabilistic Earthquake Hazard Assessment for Fiji*, AGSO, Canberra, Australia,

Table 7.2: Summary of Solid Density, Undrained Shear Strength, Effective Cohesion and Internal Friction Angle-Field Test location **1**

Depth (Below existing ground level)	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength, Cu (kPa)	Effective Cohesion C' (kPa)	Effective Internal Friction Angle **ϕ** (deg)
0-1.5m (Core loss 0.3-1.5m)	Sandy SILT, some clay, brown, soft, moist, low plasticity	18	N/A	2	25
1.5-2.6m (Core loss 2.0-2.3m)	ORGANICS with rootlets, trace silt, black, very soft, wet	18	N/A	2	25
2.6-4.5m (Core loss 4.0-4.4m)	Sandy SILT with some organics, dark brownish grey, very soft, wet, low plasticity	18	6KPa	2	25
4.5-6.5m	Silty fine SAND, some organics and decomposed wood, dark brownish grey, saturated, loose	18	N/A	0	25
6.5-8.7m (Core loss 6.5-7.25m)	Sandy SILT, some carbonaceous material and trace coarse gravels, dark grey, very soft, saturated, low plasticity	18	5kPa	2	25
8.7-10.1m	Highly weathered SILTSTONE (Sandy SILT, some coarse gravels, dark grey, soft, wet)	18	10kPa	5	28
10.1-10.5m (Core loss 10.1-10.5m)	Slightly Weathered bluish grey SILTSTONE, extremely weak, well cemented	19	N/A	15	30
10.5-15.95m	Unweathered bluish grey SILTSTONE, trace carbonaceous inclusions, extremely weak, well cemented, massive,	19	N/A	15	30

Table 7.3: Summary of Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle- Field Test location **2**

Depth	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength, Cu (kPa)	Effective Cohesion C' (kPa)	Effective Internal Friction Angle **ϕ** (deg)
0.0-1.5m (core loss 0.2-1.5)	Sandy SILT, trace clay, brown, firm, wet, low plasticity	18	N/A	2	25
1.5-2.0m	Organics, some silt, fiberous with rootlets, blackish brown, very soft, wet, low plasticity	18	0kPa	2	25
2.0-4.0m	Organic SILT with rootlets, blackish brown, very soft, wet, low plasticity	18	6kPa	2	25
4.0-4.35m	Silty fine SAND, some organics including rootlets, dark brownish grey, loose, wet	18	N/A	0	25
4.35-4.90m	Slightly weathered, dark bluish grey SILTSTONE, extremely weak, well cemented	19	N/A	15	30
4.90-11.45m (Core loss 5.45-5.6m)	Slightly weathered, dark bluish grey SILTSTONE, extremely weak, well cemented	19	N/A	15	30

Table 7.4: Summary of Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle- Field Test Location **3**

Depth (Below existing ground level)	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength, Cu (kPa)	Effective Cohesion C' (kPa)	Effective Internal Friction Angle **ϕ** (deg)
0.0-1.75m (Core loss 0.2-1.75m)	Sandy SILT, trace clay, brown, firm, wet, low plasticity	18	N/A	2	25
1.75-3.8m (Core loss 3.5-3.7m)	Organics, with rootlets, blackish brown, very soft, wet, low plasticity	18	0-6kPa	2	25
3.8-4.6m	Silty Fine SAND, some organics, dark grey, loose, wet	18	N/A	0	25
4.6-5.0m	Slightly weathered dark bluish grey SILTSTONE,	19	N/A	15	30

	extremely weak, well cemented				
5.0-11.45m (Core loss 5.5-9.5m)	Unweathered dark bluish grey SILTSTONE, extremely weak, well cemented, carbonaceous	19	N/A	15	30

Table 7.5: Summary of Solid Density, Undrained Shear Strength, Cohesion and Internal Friction Angle- Field test location **4**

Depth	Soil Description	Unit Weight (KN/m^3)	Undrained Shear Strength, Cu (kPa)	Effective Cohesion C' (kPa)	Effective Internal Friction Angle **ϕ** (deg)
0.0-1.5m (Core loss 0.25-1.5m)	Sandy SILT, trace clay, brown, soft, wet, low plasticity	18	N/A	2	25
1.5-3.5m (Core loss 2.5-2.85m)	ORGANICS, fibrous with rootlets, minor silt blackish brown, very soft, wet, low plasticity	18	6kPa	2	25
3.5-4.45m	Organic SILT, some rootlets, minor fine sand, dark brownish grey, very soft, wet, low plasticity	18	N/A	2	25
4.45-5.5m	Silty Fine SAND, some organics, dark grey, loose, wet	18	N/A	0	25
5.5-6.0m	Silty fine SAND, minor organics ad fine gravels, dark brownish grey, loose, saturated	18	N/A	0	25
6.0-6.4m	SILT, minor fine sand and organics, dark brownish grey, very soft, wet, low plasticity	18	N/A	2	25
6.4-7.7m	Silty fine SAND, trace calcareous inclusions, dark grey, loose, wet	18	N/A	0	28
7.7-8.45m	Silty fine SAND, some organics, minor fine gravel, trace coarse gravel, greyish brown, loose, wet, dark	18	N/A	0	28
8.45-9.2m	Highly Weathered SILTSTONE (Clayey Silt, some fine to medium gravel, bluish grey mottled brown, firm, wet, low plasticity	18	UTP	5	28
9.2-10.4m	Highly Weathered SILTSTONE (Sandy SILT, trace clay and	19	UTP	5	28

	fine gravels, bluish grey, mottled brown, firm ,wet)				
10.4-15.95m	Unweathered dark bluish grey SILTSTONE, extremely weak, well cemented, massive	19	N/A	15	30

7.3 Foundation Design

7.3.1 General

Based on the site investigations at the Antenna location, the bearing capacities of the upper soil would not be adequate for shallow foundation design. It would not be feasible to construct deep pad foundations in very poor and wet ground. We also consider that the placement of large shallow pad foundations for the Antenna mast and supports could lead to large ground settlements.

Accordingly we consider that pile foundations would be suitable to support the proposed antenna and the antenna supports.

We recommend using a strength reduction factor of 0.5 (Φ_G=0.5) to give an ultimate limit state (ULS) bearing capacity, in accordance with New Zealand Design Standards (ref: NZS 1170). For serviceability limit state design we recommend a strength reduction factor of 0.33 (Φ_G=0.3) to give an allowable bearing capacity.

7.3.2 Piled Foundations

If the antenna loads are to be supported on piled foundations, these would need to be extended down to the Suva Marl rock material, found at a depth of approximately 10.5m bgl. Piles could be either driven steel tube or driven steel UC piles. The variation in rock levels based on our recent investigations (where rock has been observed at depths of between 4.5 – 10.5m bgl) should be taken into consideration.

The following strength reduction factor should be applied to the stated end bearing and skin friction capacities for ULS and working load design cases:

- Ultimate Limit State Strength reduction factor (ϕ_g) 0.5
- Working Load Strength reduction factor (ϕ_g) 0.33

Design criteria are presented below for these respective pile types.

7.3.2.1 Driven Piles

Driven steel UC piles may be considered to support the antenna. These would be driven to refusal into the Suva Marl rock.

The capacity of a driven pile may be calculated using pile driving formulae (e.g. Hiley), or using PDA (Pile Driving Analysis) equipment. If PDA testing is utilised, the ULS strength reduction factor can be increased from ϕ_g=0.5 up to ϕ_g = 0.75 provided that a minimum of 10% of the piles are tested.

We expect that the steel driven sections could penetrate 2 to 4 m into rock depending on the section size. Pile lengths are expected to be at least 12.5m below existing ground level.

Uncoated steel has the potential to corrode in contact with either the soil or atmosphere. Based upon published guidelines, we consider a corrosion rate of 0.015mm/face /year should be allowed for steel piles.

Table 7.7 displays pile capacities of driven universal column (UC) piles.

Table 7.7: Pile capacities of driven universal columns

Pile Material	Pile Size	Approximate driving energy required to install pile (tonne - metres)	Capacity to which piles may be driven to achieve - R_{Drive} (kN)	Maximum ultimate limit state capacity (kN)	
			Embedded within soil/weak rock	No pile testing (ϕ_g=0.5)	Dynamic Testing 10% of the piles (ϕ_g=0.75)
Steel - 300MPa grade	200UC46	2.3	1,000	500	750
	200UC52	2.6	1,140	570	850
	200UC60	3.0	1,320	660	990
	250UC73	3.5	1,600	800	1,200
	250UC89	4.4	2,000	1,000	1,500

If more than a single pile is required to support the design load, piles should be no closer than "3×D" c/c to minimise group effects; where D= pile diameter.

8 Applicability

This report has been prepared for the benefit of Yachiyo Engineering Company Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

During construction and excavation the site should be examined by an engineer competent to determine whether the exposed subsoils are consistent with those inferred in this report and in associated appendices. We would be happy to provide this service and believe your project would benefit from the continuity.

Tonkin & Taylor International Ltd

Environmental and Engineering Consultants

Report prepared by:

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Jamie Yule

Engineering Geologist

Reviewed for Tonkin & Taylor International Ltd by:

.....

Andy Pomfret

Project Manager

Authorised for Tonkin & Taylor International Ltd by:

.....

Chris Freer

Project Director

JWY
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Appendix B: Soils Explorations Plans

THE PROJECT FOR THE REHABILITATION OF THE MEDIUM WAVE RADIO TRANSMISSION IN THE REPUBLIC OF FIJI

CONTRACT OF SOILS EXPLORATIONS

STAGE 2, DEEPER SOILS INVESTIGATIONS

LOCATION GUIDES
(not to scale)

SOIL TEST LOCATION SCHEDULE

Name	Easting (m)	Northing (m)	RL (m)
MB1	1976825.5	3881918.5	35.1
MB2	1976837.0	3881883.7	35.1
MB3	1976789.7	3881925.9	35.2
MB4	1976849.8	3881945.8	34.8

SURVEY MARK SCHEDULE

Name	Easting (m)	Northing (m)	RL (m)
IT NAULU (TRIG)	1977010.03	3881722.55	47.92
IR(3) SO5572	1976734.84	3881638.53	49.59
IT Boundary (1)	1976725.32	3881786.69	50.21
IT Boundary (2)	1976817.28	3881789.66	50.33
IT Boundary (3)	1976865.26	3881767.05	50.08
IT Boundary (4)	1976720.75	3881932.40	35.52
IT Boundary (5)	1976844.42	3882042.20	34.81
BMNAIL1	1976771.52	3881733.96	50.00
BMNAIL2	1976786.17	3881696.86	49.04
OIT (Unknown)	1976725.95	3881769.12	50.24
OIT (Unknown)	1976728.01	3881706.67	49.33

Note:

BMNAIL1 is flush within concrete stay block between house and transmitter buildings.

BMNAIL2 is in concrete kerb alongside southern access to transmitter buildings yard.

Not all trees shown (generally only those along western site boundary, and those at the top of the slope north of existing buildings)

Four machine boreholes (MB1 - MB4) were conducted in February 2015.
A pressuremeter test was also conducted at site MB1.
The locations of MB1 - MB4 and the Access Road were supplied by YEC.
RLs listed for MB1-MB4 are the October 2014 ground levels at the supplied locations.

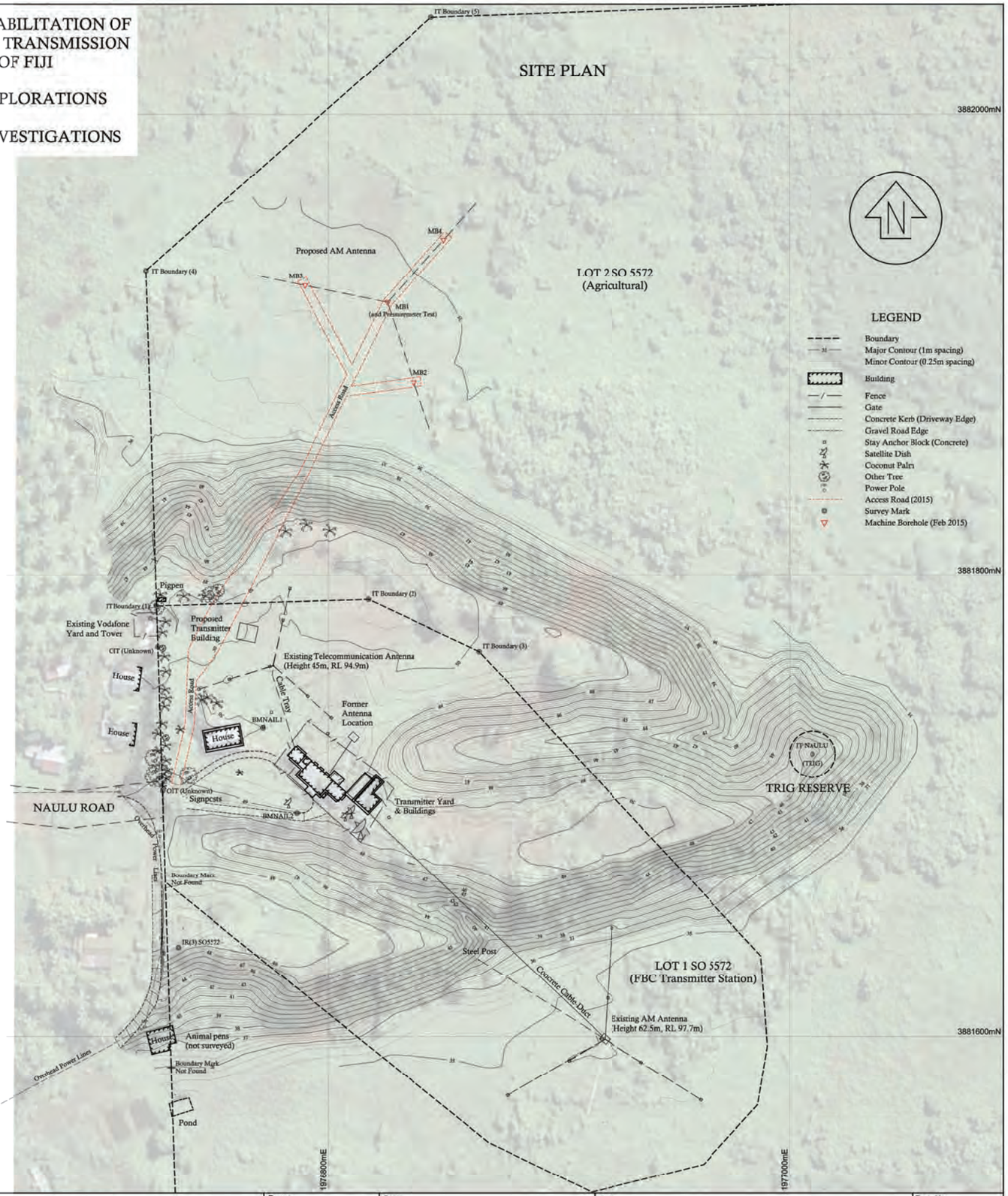
Survey Conducted 16 - 18 October 2014, using:

Sokkia GPS RTK (GNSS Receiver)
Model: GRX1/U
Serial Numbers: 633-00426
633-00141

Sokkia Total Station (Reflectorless)
Model: SET4130R3
Serial Number: 145240

SURVEY DATUM: FIJI GEODETIC DATUM 1986
(Coordinate and Bearing Origins from SO 5572)
HEIGHT DATUM: ASSUMED
(BMNAIL1 = 50.00m)

SITE PLAN



Revision	Description	Approved	Date
F	Access Road Location Added, and Machine Borehole Locations Amended		16-03-15
E	Deeper Soils Investigation Locations Added		20-02-15
D	Section Locations A - A and B - B Shown		05-11-14
C	Equipment Description Amended		30-10-14
B	Test Location Labels Amended		29-10-14
A	For Information		28-10-14

Client

Tonkin & Taylor

Drawn	ES
Designed	
Surveyed	ES
Project:	Fiji
Scale	1:1000 (A1) 1:2000 (A3)
Title	Topographical Survey Fiji Broadcasting Corp. site, Naulu Road, Nasinu Viti Levu, FIJI
Dwg. No.	T01
Job No.	14018
Revision	F

Date Plotted: Mon Mar 16 12:20:44 2015

A-6-77

Appendix C: Soils Explorations Logs

- BH1-BH4

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH1**

SHEET 1 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06694 °S 178.53106 °E	R.L. GROUND: 35.70m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
FILL	Sandy SILT, with some clay; brown. Soft, moist, low plasticity. 0.3-1.5m: CORE LOSS.	HQ3	20		35.5	0.5							24hrs after drilling			
ORGANIC ALLUVIAL DEPOSITS	ORGANICS, with rootlets, trace silt; black. Very soft, wet. 2-2.3m: CORE LOSS.	HQ3	100		35.0	1.0										
	Sandy SILT, with some organics; dark brownish grey. Very soft, wet, low plasticity.	HQ3	80		34.5	1.5										
	3.5-4m: Push Tube	PT		6kPa in barrel	34.0	2.0										
	4-4.4m: CORE LOSS.	HQ3	60		33.5	2.5										
	Silty, fine SAND, some organics and decomposed wood; dark brownish grey. Loose, saturated.			0kPa	33.0	3.0										
					32.5	3.5										
					32.0	4.0										
					31.5	4.5										
					31.0	5.0										

Rock Weathering: UW SW MW HW CW

Rock Strength: ES VS MS W VW EW

Defect Log: 50 10 1

Water Loss (%): 25 50 75

Box 1

Box2

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH1**

SHEET 2 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06694 °S 178.53106 °E	R.L. GROUND: 35.70m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
ORGANIC ALLUVIAL DEPOSITS	5-5.75m: CORE LOSS.					in barrel Sample	30.5	5.5										
	Silty, fine SAND, as above.			HQ3	50		30.0	6.0										
						5kPa in barrel Sample	29.5	6.5										
	6.5-7.25m: CORE LOSS.						29.0	7.0										
ALLUVIAL SEDIMENTS	Sandy SILT, some carbonaceous material and trace coarse gravels; dark grey. Very soft, saturated, low plasticity.			HQ3	50	Sample	28.5	7.5										
				SPT	30	N=5	28.0	8.0										
							27.5	8.5										
HW SUVA MARL	Highly weathered, Suva Marl (SILTSTONE). Soil Description: Sandy SILT, some coarse gravel; dark grey. Loose, wet.			HQ3	75		27.0	9.0										Box 2
						10kPa	26.5	9.5										
				PT			26.0	10.0										Box3

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH1**

SHEET 3 OF 4

PROJECT: Suva Radio
JOB No: 751078
LOCATION: FBC Site, Naulu Road, Suva

CO-ORDINATES: 18.06694 °S 178.53106 °E
DIRECTION:
ANGLE FROM HORIZ.:

R.L. GROUND: 35.70m
R.L. COLLAR:
DATUM: Assumed
SURVEY: WGS84

DRILLED BY:
LOGGED BY: JWY
CHECKED:
START DATE: 11/2/15
FINISH DATE: 11/2/15
CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES VS MS W EW								50 10 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
SUVA MARL	Slightly weathered, bluish grey SILTSTONE. Extremely weak, well cemented. 10.1-10.5m: CORE LOSS.			HQ3	55	UCS Sample	25.5	10.5				35						
	Unweathered, bluish grey SILTSTONE. Extremely weak, well cemented, massive. With trace carbonaceous material.			SPT	100	14 19 20 N=39	25.0	11.0										
				HQ3	100		24.5	11.5										
							24.0	12.0				100						
				SPT	100	13 20 26 N=46	23.5	12.5										
	Unweathered, bluish grey, fine SANDSTONE. Very weak, well cemented, massive.			HQ3	100		23.0	13.0										Box 3
							22.5	13.5				100						
				SPT	100	12 25 25 N=50	22.0	14.0										
	Unweathered, bluish grey SILTSTONE. Very weak, well cemented.			HQ3	100		21.5	14.5				100						
							21.0	15.0										Box4

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH1**

SHEET 4 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06694 °S 178.53106 °E	R.L. GROUND: 35.70m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
SUVA MARL	SILTSTONE, as above.			HQ3	100		20.5				100						
							15.5										
				SPT	100	13 24 27 N=57	20.0										Box 5
	END OF BOREHOLE AT 15.95m. Target depth.						16.0										

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH2**

SHEET 1 OF 3

PROJECT: Suva Radio	CO-ORDINATES: 18.06725 °S 178.53117 °E	R.L. GROUND: 36.00m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 9/2/15
			FINISH DATE: 9/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	ROCK DEFECTS Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Sandy SILT, trace clay; brown. Firm, wet, low plasticity.						36.0	0.0										
	0.2-1.5m: CORE LOSS.			HQ3	13		35.5	0.5										
							35.0	1.0										
ORGANIC ALLUVIAL DEPOSITS	Organics, some silt; black, fibrous with rootlets. Very soft, wet, low plasticity. 1.5-2m: Push Tube			PT			34.5	1.5										
	Grades to Organic SILT, with rootlets; blackish brown. Very soft, wet, low plasticity.					0kPa in barrel	34.0	2.0										
				HQ3	90		33.5	2.5										
	- becomes dark brownish grey.						33.0	3.0										
						6kPa in barrel	32.5	3.5										Box 1
	Silty, fine SAND, some organics including rootlets; dark brownish grey. Loose, wet.			HQ3	100		32.0	4.0										
SUVA MARL	Slightly weathered, dark bluish grey SILTSTONE. Extremely weak, well cemented.					UCS Sample	31.5	4.5				100						
							31.0	5.0										Box2

24hrs after drilling

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH2**

SHEET 2 OF 3

DRILLED BY:

LOGGED BY: JWY

CHECKED:

START DATE: 9/2/15

FINISH DATE: 9/2/15

CONTRACTOR: GB

PROJECT: Suva Radio

JOB No: 751078

LOCATION: FBC Site, Naulu Road, Suva

CO-ORDINATES: 18.06725 °S 178.53117 °E

DIRECTION:

ANGLE FROM HORIZ.:

R.L. GROUND: 36.00m

R.L. COLLAR:

DATUM: Assumed

SURVEY: WGS84

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES VS MS W EW								50 10 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
SUVA MARL	Unweathered, dark bluish grey SILTSTONE. Extremely weak, well cemented, massive, as above.			SPT	100	11 16 20 N=36	31.0	0.0										
	5.45-5.6m: CORE LOSS.			HQ3	85		30.5	5.5				100						
	- trace carbonaceous inclusions.			SPT	100	10 16 20 N=36	30.0	6.0										Box 2
				HQ3	100		29.5	6.5				90	Joint 85°, UN,SM, no infill, T, 30cm long.					
				SPT	100	14 20 31 N=51	29.0	7.0										Box 3
				HQ3	100	UCS Sample	28.5	7.5				100						
	- some biscuiting of core.						28.0	8.0										
				SPT	100	12 18 20 N=38	27.5	8.5										
							27.0	9.0										
								9.5										
							26.0	10.0										Box 4

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH2**

SHEET 3 OF 3

PROJECT: Suva Radio
JOB No: 751078
LOCATION: FBC Site, Naulu Road, Suva

CO-ORDINATES: 18.06725 °S 178.53117 °E
DIRECTION:
ANGLE FROM HORIZ.:

R.L. GROUND: 36.00m
R.L. COLLAR:
DATUM: Assumed
SURVEY: WGS84

DRILLED BY:
LOGGED BY: JWY
CHECKED:
START DATE: 9/2/15
FINISH DATE: 9/2/15
CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS MS W MW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
SUVA MARL	Unweathered, dark bluish grey SILTSTONE. Extremely weak, well cemented, massive, as above.			HQ3	100	Sample	26.5	0										
	- trace carbonaceous material.						25.5	10.5				100						
				SPT	100	14 20 30 N=50	25.0	11.0										Box 5
	END OF BOREHOLE AT 11.45m. Target depth.						24.5	11.5										
							24.0	12.0										
							23.5	12.5										
							23.0	13.0										
							22.5	13.5										
							22.0	14.0										
							14.5											
							15.0											

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH3**

SHEET 1 OF 3

PROJECT: Suva Radio	CO-ORDINATES: 18.06686 °S 178.53072 °E	R.L. GROUND: 35.70m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Sandy SILT, trace clay; brown. Firm, moist, low plasticity. 0.25-1.5m: CORE LOSS.			HQ3	20	0kPa in Barrel	35.5	0.5							24hrs after drilling			
							35.0	1.0										
	1.5-1.75m: CORE LOSS.						34.5	1.5										
ALLUVIUM	ORGANICS with rootlets and trace silt; blackish brown. Very soft, wet. 2-3.1m: CORE LOSS.			HQ3	40		34.0	2.0										
							33.5	2.5										
	ORGANICS, as above.			HQ3	27		33.0	3.0										
	3.5-3.7m: CORE LOSS.					6kPa in Barrel Sample	32.5	3.5										
	Silty, fine SAND, with some organics; dark grey. Loose, wet.			HQ3	87		32.0	4.0										
							31.5	4.5										
S MARL	Slightly weathered, dark bluish grey SILTSTONE. Extremely weak, well cemented.					UCS Sample	31.0	5.0										Box1

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH3**

SHEET 2 OF 3

PROJECT: Suva Radio
JOB No: 751078
LOCATION: FBC Site, Naulu Road, Suva

CO-ORDINATES: 18.06686 °S 178.53072 °E
DIRECTION:
ANGLE FROM HORIZ.:

R.L. GROUND: 35.70m
R.L. COLLAR:
DATUM: Assumed
SURVEY: WGS84

DRILLED BY:
LOGGED BY: JWY
CHECKED:
START DATE: 11/2/15
FINISH DATE: 11/2/15
CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
SUVA MARL	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES VS MS W EW								50 10 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
	Unweathered, bluish grey SILTSTONE. Extremely weak, well cemented. 5.45-6.5m: CORE LOSS.			SPT	100	11 16 18 N=34	30.5	5.5										Box 1
				HQ3	0		30.0	6.0				0						
				SPT	100	14 18 18 N=36	29.5	6.5										
				HQ3	100		29.0	7.0				100						
				SPT	100	12 20 20 N=40	28.5	7.5										Box 2
				HQ3	100		28.0	8.0										
							27.5	8.5				90	9.3m: Joint 70°, PL,SM,MN, clay infill					
				SPT	100	14 20 23 N=43	27.0	9.0										
							26.5	9.5										
							26.0	10.0										Box3

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH3**

SHEET 3 OF 3

PROJECT: Suva Radio	CO-ORDINATES: 18.06686 °S 178.53072 °E	R.L. GROUND: 35.70m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
SUVA MARL	SILTSTONE, as above.			HQ3	100	UCS Sample	25.5 / 10.5				100						
				SPT	100	19 22 24 N=46	25.0 / 11.0										Box 4
	END OF BOREHOLE AT 11.45m. Target depth.						24.5 / 11.5										
							24.0 / 12.0										
							23.5 / 12.5										
							23.0 / 13.0										
							22.5 / 13.5										
							22.0 / 14.0										
							21.5 / 14.5										
							21.0 / 15.0										

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH4**

SHEET 1 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06669 °S 178.53128 °E	R.L. GROUND: 35.40m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES VS S MS W VW EW								50 10 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
FILL	Sandy SILT, some clay; brown. Soft, moist, low plasticity. 0.25-1.5m: CORE LOSS.			HQ3	17		35.0	0.5							24 hrs after drilling			
HIGHLY ORGANIC ALLUVIAL DEPOSITS	ORGANICS, fibrous with rootlets; minor silt; brownish black. Very soft, wet. 2-2.5m: Push Tube.			HQ3	100		34.5	1.0										
				PT			34.0	1.5										
	2.5-2.85m: CORE LOSS.			HQ3	65		33.5	2.0										
	Grades to organic SILT, some rootlets, minor fine sand; dark brownish grey. Very soft, wet, low plasticity.					6kPa in Barrel	33.0	2.5										
				HQ3	80		32.5	3.0										
							32.0	3.5										
	Medium to fine SAND, some silt, minor gravels, minor organics; dark grey. Loose, wet. 4.7m: grades finer.						31.5	4.0										
							31.0	4.5										
						10kPa	5	5.0										Box 1

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH4**

SHEET 2 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06669 °S 178.53128 °E	R.L. GROUND: 35.40m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES VS S MS W VW EW								50 10 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
ALLUVIUM	5-5.5m: Push Tube.			PT		in Barrel	30.0	5.5										
	Silty, fine SAND, minor organics and fine gravels; dark brownish grey. Loose, saturated.			HQ3	100	Sample	29.5	6.0										
	SILT, minor fine sand and organics; dark brownish grey. Very soft, wet, low plasticity.																	
	Silty, fine SAND, trace calcareous inclusions; dark grey. Loose, wet.			SPT	100	0 0 0 N=0	29.0	6.5										
				HQ3	80		28.5	7.0										
	Grades to silty, fine SAND, some organics, minor fine gravel, trace coarse gravel; dark greyish brown. Loose, saturated.						28.0	7.5										
				SPT	30	0 0 0 N=0	27.5	8.0										Box 2
WEATHERED SUVA MARL	Highly weathered SILTSTONE. Soil Description: Clayey SILT, some fine to medium gravel; bluish grey mottled brown. Firm, wet, low plasticity.			HQ3	100		27.0	8.5										
	Grades to sandy SILT, trace clay, trace gravels; bluish grey mottled brown. Firm, wet.						26.5	9.0										
	9.5-10m: Push Tube			PT			26.0	9.5										Box3
							5	10.0										

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH4**

SHEET 3 OF 4

PROJECT: Suva Radio
JOB No: 751078
LOCATION: FBC Site, Naulu Road, Suva

CO-ORDINATES: 18.06669 °S 178.53128 °E
DIRECTION:
ANGLE FROM HORIZ.:

R.L. GROUND: 35.40m
R.L. COLLAR:
DATUM: Assumed
SURVEY: WGS84

DRILLED BY:
LOGGED BY: JWY
CHECKED:
START DATE: 11/2/15
FINISH DATE: 11/2/15
CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
	Highly weathered SILTSTONE, as above.					Sample	25.0										
SUVA MARL	Unweathered, dark bluish grey SILTSTONE. Extremely weak, well cemented, massive.			HQ3	100	UCS Sample	10.5				10						Box 3
				SPT	10	15 23 22 N=45	24.5 11.0										
				HQ3	100		24.0 11.5				100						
				SPT	100	16 23 24 N=47	23.5 12.0										
	- becomes very weak.			HQ3	100	UCS Sample	23.0 12.5				100						Box 4
	- becomes weak.			SPT	100	10 18 25 N=48	22.5 13.0										
				HQ3	25		22.0 13.5										
							21.5 14.0										
							21.0 14.5				100						Box5
							5 15.0										

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH4**

SHEET 4 OF 4

PROJECT: Suva Radio	CO-ORDINATES: 18.06669 °S 178.53128 °E	R.L. GROUND: 35.40m	DRILLED BY:
JOB No: 751078		R.L. COLLAR:	LOGGED BY: JWY
LOCATION: FBC Site, Naulu Road, Suva	DIRECTION:	DATUM: Assumed	CHECKED:
	ANGLE FROM HORIZ.:	SURVEY: WGS84	START DATE: 11/2/15
			FINISH DATE: 11/2/15
			CONTRACTOR: GB

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
SUVA MARL	Unweathered SILTSTONE, as above. 15-15.25m: CORE LOSS.			HQ3	25		20.0 / 15.5				100						
				SPT	100	12 23 30 N=53	19.5										Box 5
	END OF BOREHOLE AT 15.95m. Target depth.						16.0 / 19.0 / 16.5 / 18.5 / 17.0 / 18.0 / 17.5 / 17.5 / 18.0 / 17.0 / 18.5 / 16.5 / 19.0 / 16.0 / 19.5 / 5 / 20.0										

COMMENTS:

T+T DATATEMPLATE.GDT jlb

Log Scale 1:25

GENERAL LOG 751078BH2.GPJ 16-Mar-2015

Appendix D: Core Photographs

- BH1-BH4

Photograph 1- BH1 0.0-4.8m

Photograph 2- BH1-4.8-8.9m

Photograph 3- BH1-8.9-13.0m

Photograph 4-BH1-13.0-15.95m

Photograph 5- BH2-0.0-3.5m

Photograph 6- BH2-3.5-5.80m

Photograph 7- BH2-5.8-8.0m

Photograph 8- BH2-8.0-9.9m

Photograph 9- BH2-9.90-11.45m

Photograph 10- BH3-0.0-5.45m

Photograph 11-BH3-5.45-8.40m

Photograph 12- BH3-8.40-11.45m

Photograph 13- BH4-0.0-4.80m

Photopgraph 14- BH4-4.80-8.45m

Photopgraph 15-BH4-8.45-10.70m

Photograph 16-BH4-10.70-12.95m

Photograph 17-BH4-12.95-15.95m

Appendix E: Laboratory Testing

- UU Triaxial results
- Solid Density results
- UCS results

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Form No.:	TG
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Plate No.: Page of

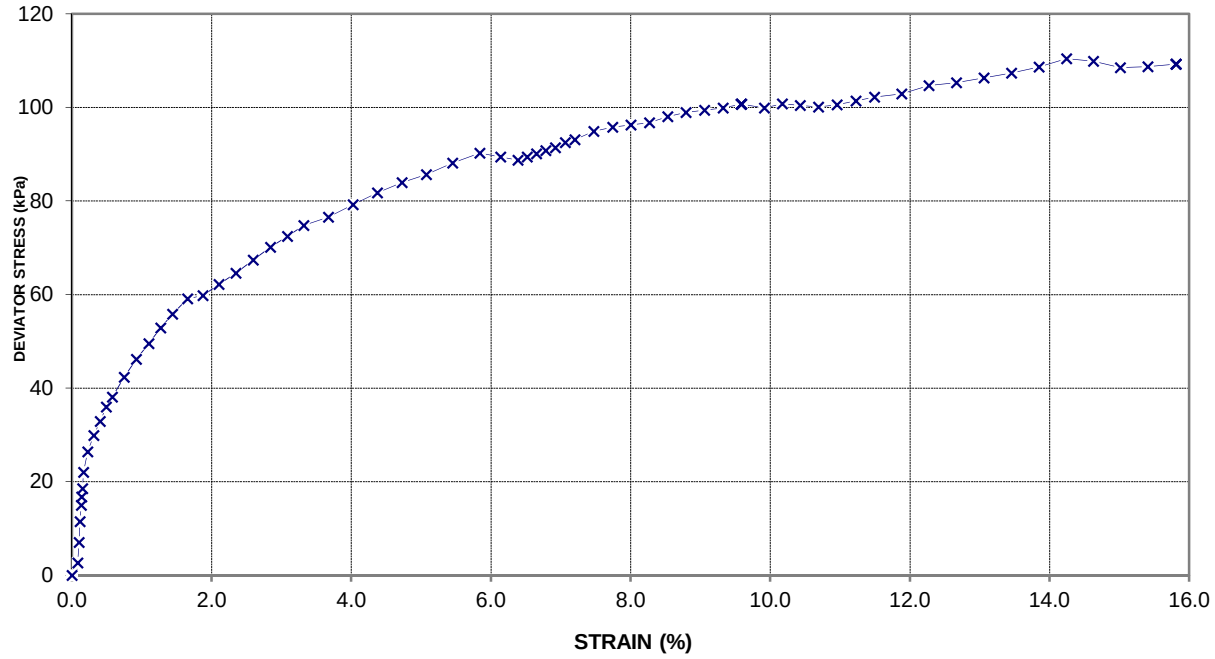
Site: Suva Radio Your Ref No.: 751078 Job No.: 616525.001

Test pit/Bh No.: BH1 Sample No.: 1 Depth: 9.73 -- 9.85 (m)

Test Method Used: BS 1377:Part 7:1990 Test 9 Determination of the Undrained Shear Strength in Triaxial Compression with Multistage Loading and without Measurement of pore Pressure

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

DEVIATOR STRESS VS STRAIN



Initial Sample Parameters:

Sample Height:	113.92	mm	Bulk Density:	1.73	t/m³
Sample Diameter:	53.66	mm	Dry Density:	1.13	t/m³
Height / Diameter:	2.12		Water Content:	53.3	%

Membrane Correction at Failure:

Membrane thickness:	0.5	mm	Correction:	1.41	kPa

Failure Value:

	Cell Pressure σ3 (kPa)	Axial Strain ε (%)	Corrected Maximum Deviator Stress σ1 - σ3 (kPa)	Shear Strength C_u (kPa)	Test Speed (mm/min)
Stage 1	85	5.84	90.19	45	0.82
Stage 2	170	9.59	100.71	50	
Stage 3	350	14.63	110.38	55	

Mode of Failure: Planar / Plastic.

Sample History: Undisturbed core trimmed at its natural moisture content.

Soil Description: SILT, with some clay, firm, bluish grey with orange brown stripes, medium to high plasticity, slightly dilatant. A trace of shell fragments were present.

Test Remarks: --

Entered by: Date: 26/02/15 Checked by: KMH Date: 27/02/15

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Plate No.: Page of

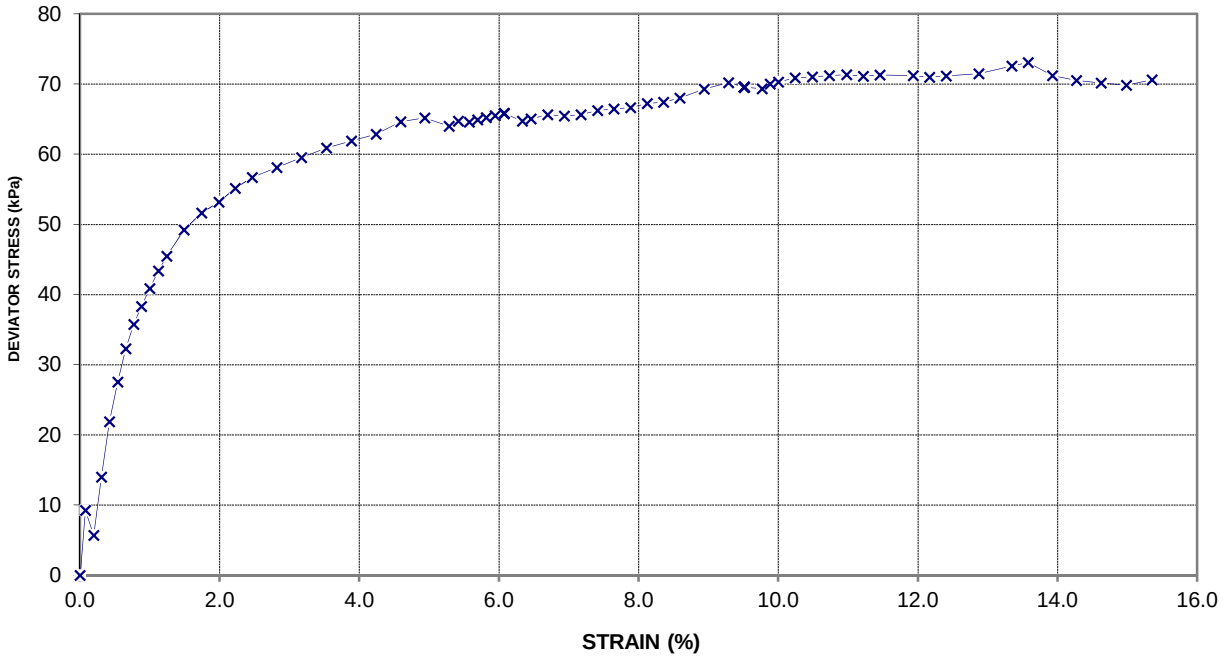
Site: Suva Radio Your Ref No.: 751078 Job No.: 616525.001

Test pit/Bh No.: BH4 Sample No.: 6 Depth: 9.78 -- 9.90 (m)

Test Method Used: BS 1377:Part 7:1990 Test 9 Determination of the Undrained Shear Strength in Triaxial Compression with Multistage Loading and without Measurement of pore Pressure

UNCONSOLIDATED-UNDRAINED COMPRESSION TEST

DEVIATOR STRESS VS STRAIN



Initial Sample Parameters:

Sample Height:	112.96	mm	Bulk Density:	1.73	t/m³
Sample Diameter:	53.67	mm	Dry Density:	1.13	t/m³
Height / Diameter:	2.10		Water Content:	52.7	%

Membrane Correction at Failure:

Membrane thickness:	0.5	mm	Correction:	1.46	kPa

Failure Value:

	Cell Pressure σ3 (kPa)	Axial Strain ε (%)	Corrected Maximum Deviator Stress σ1 - σ3 (kPa)	Shear Strength C_u (kPa)	Test Speed (mm/min)
Stage 1	85	6.07	65.80	33	0.80
Stage 2	170	9.29	70.17	35	
Stage 3	350	13.58	73.07	37	

Mode of Failure: Planar / Plastic.

Sample History: Undisturbed core trimmed at its natural moisture content.

Soil Description: SILT, with some clay and minor sand, soft, grey with orange brown, medium to high plasticity, slightly dilatant.

Test Remarks: --

Entered by: Date: 26/02/15 Checked by: KMH Date: 27/02/15

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File: P:\616525.000\Working material\Solid density_Summary.xlsx

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Your Job No.: 751078

Site : Suva Radio, Fiji

Our Job No.: 616525.000

Test Method Used:NZS 4402:1986 Test 2.7.2 Determination of Solid Density of Soil Particles - Vacuum Method

SOLID DENSITY TEST RESULTS

Table 1: Solid Density

BH No.:		1	1	2	2	2	3
Sample No.:		9	18	8	11	12	14
Depth	(m)	15.5	11.0	6.5	4.8	9.5	5.0
Average Solid Density	(t/m^3)	2.75	2.77	2.74	2.76	2.80	2.70

Table 2: Solid Density

BH No.:		3	4	4
Sample No.:		15	16	17
Depth	(m)	11.0	10.0	11.0
Average Solid Density	(t/m^3)	2.69	2.77	2.78

Remarks : The solid density was reported to the nearest 0.01 t/m^3.

Tested by: ST Date: 4/3/15 Checked by: AH Date: 4/3/15

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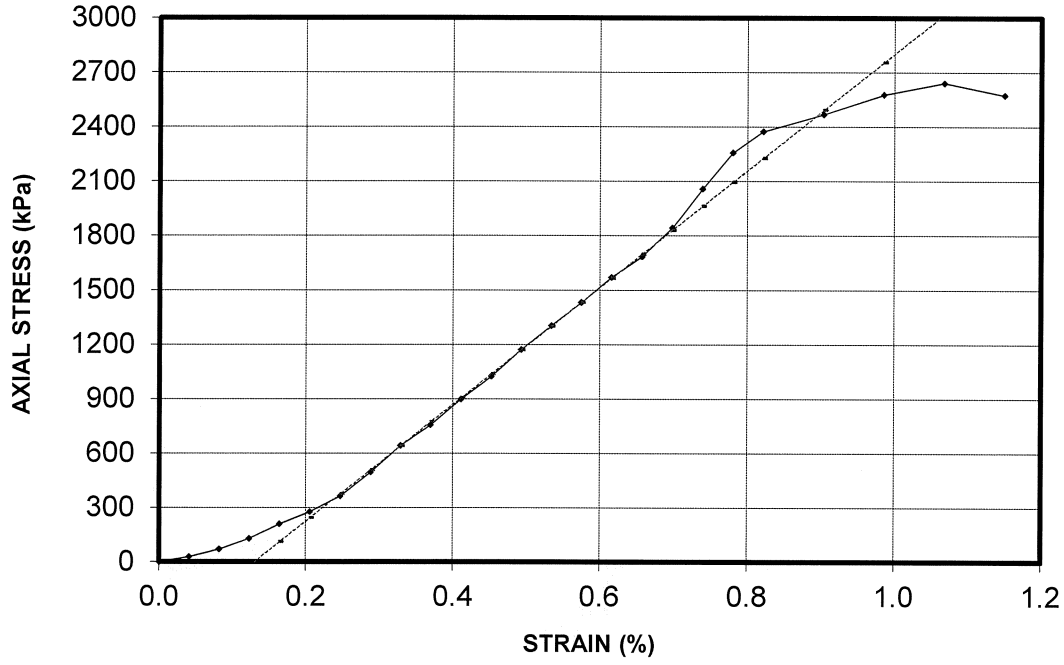
Your Job No.: 751078

Site: **Suva Radio, Fiji** **Our Job No.: 616525.000**

BH No.: **1** Sample No.: **2** Depth (m): **15.20**

Test Method Used: NZS 4402 :1986 TEST 6.3.1 Determination of the unconfined compressive strength of cohesive soil

UNCONFINED COMPRESSIVE STRENGTH TEST
AXIAL STRESS VS STRAIN



Sample Parameters:

Sample Height:	121.79	mm	Bulk Density:	1.86	t/m³
Sample Diameter:	60.37	mm	Dry Density:	1.38	t/m³
Test Height:	121.79	mm	Water Content:	34.4	%
Test H/D Ratio:	2.02				

Failure Value:

Axial Strain	Unconf. Compressive	Rate of Compression	Modulus of Elasticity
%	Strength (kPa)	(mm/min)	(MPa)
1.15	2641	0.16	322

Mode of Failure: Shear

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Light greenish grey, very weak, Suva Marl.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

Entered by: ST Date: 3/3/15 Checked by: AH Date: 3/3/15

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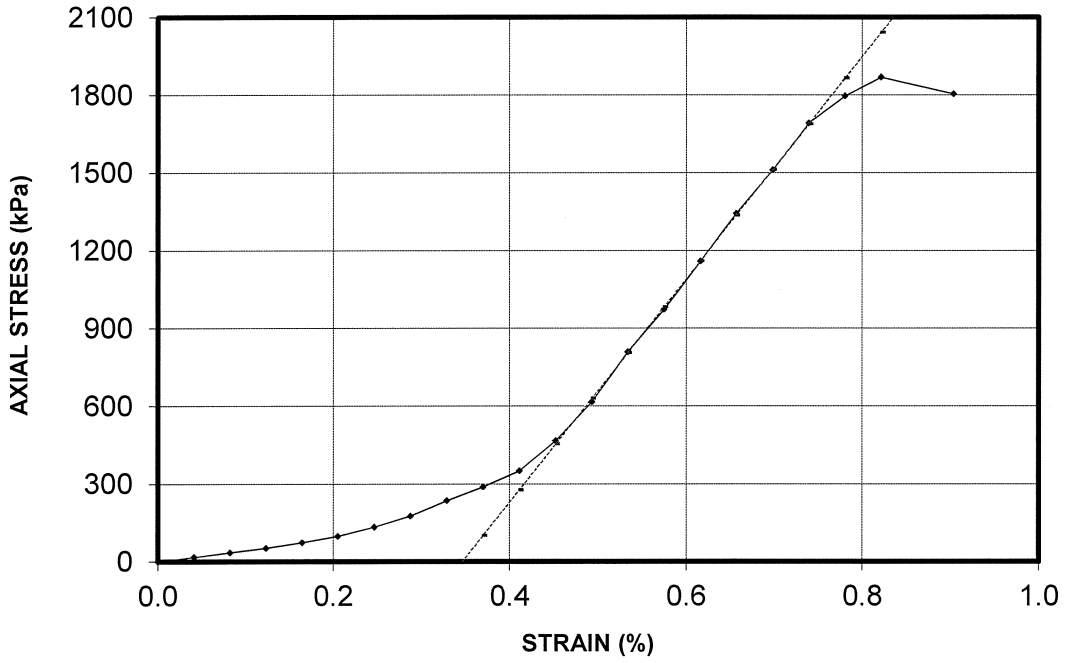
Your Job No.: 751078

Site: **Suva Radio, Fiji** **Our Job No.: 616525.000**

BH No.: **2** Sample No.: **3** Depth (m): **8.70**

Test Method Used: NZS 4402 :1986 TEST 6.3.1 Determination of the unconfined compressive strength of cohesive soil

UNCONFINED COMPRESSIVE STRENGTH TEST
AXIAL STRESS VS STRAIN



Sample Parameters:

Sample Height:	121.78	mm	Bulk Density:	1.84	t/m³
Sample Diameter:	60.14	mm	Dry Density:	1.35	t/m³
Test Height:	121.78	mm	Water Content:	35.7	%
Test H/D Ratio:	2.02				

Failure Value:

Axial Strain	Unconf. Compressive	Rate of Compression	Modulus of Elasticity
%	Strength (kPa)	(mm/min)	(MPa)
0.90	1868	0.16	430

Mode of Failure: Shear

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Light greenish grey, very weak, Suva Marl.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

Entered by: ST Date: 3/3/15 Checked by: AH Date: 3/3/15

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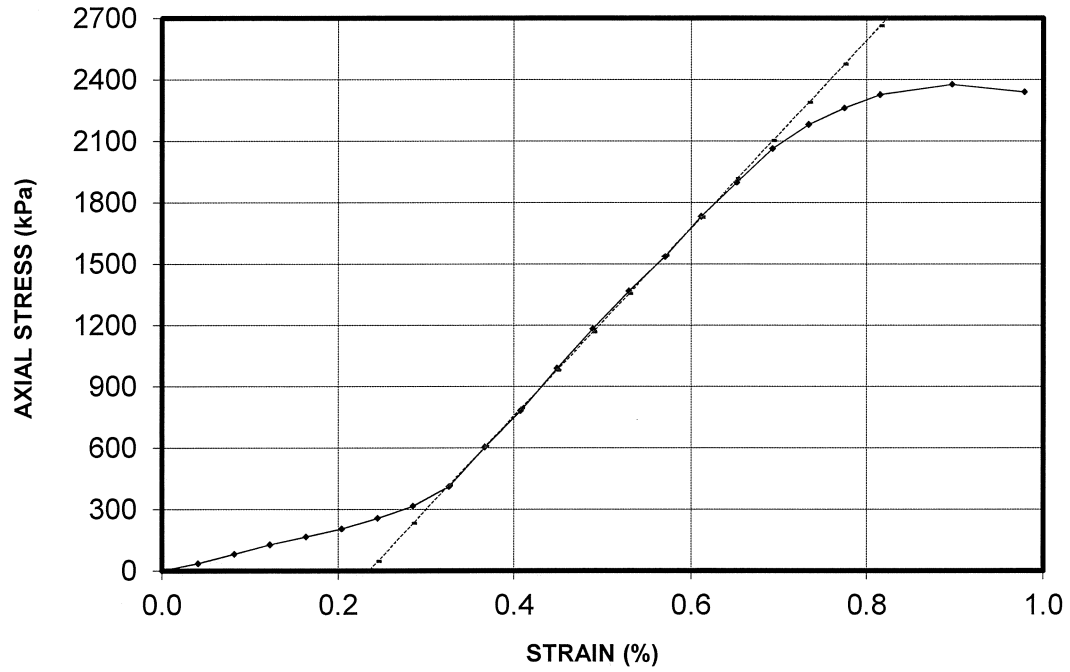
Your Job No.: 751078

Site: **Suva Radio, Fiji** **Our Job No.: 616525.000**

BH No.: **3** Sample No.: **4** Depth (m): **10.50**

Test Method Used: NZS 4402 :1986 TEST 6.3.1 Determination of the unconfined compressive strength of cohesive soil

UNCONFINED COMPRESSIVE STRENGTH TEST
AXIAL STRESS VS STRAIN



Sample Parameters:

Sample Height:	122.72	mm	Bulk Density:	1.88	t/m³
Sample Diameter:	60.10	mm	Dry Density:	1.40	t/m³
Test Height:	122.72	mm	Water Content:	34.4	%
Test H/D Ratio:	2.04				

Failure Value:

Axial Strain	Unconf. Compressive	Rate of Compression	Modulus of Elasticity
%	Strength (kPa)	(mm/min)	(MPa)
0.98	2376	0.17	459

Mode of Failure: Shear

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Light greenish grey, very weak, Suva Marl.

Test Remarks: Unconfined Compressive Strength reported to the nearest 1 kPa.
Modulus of Elasticity value reported based upon straight line portion of the curve and provided as indicative only.
Sample description and modulus of elasticity value reported are not IANZ accredited.

Entered by: SG Date: 3/3/15 Checked by: AH Date: 3/3/15

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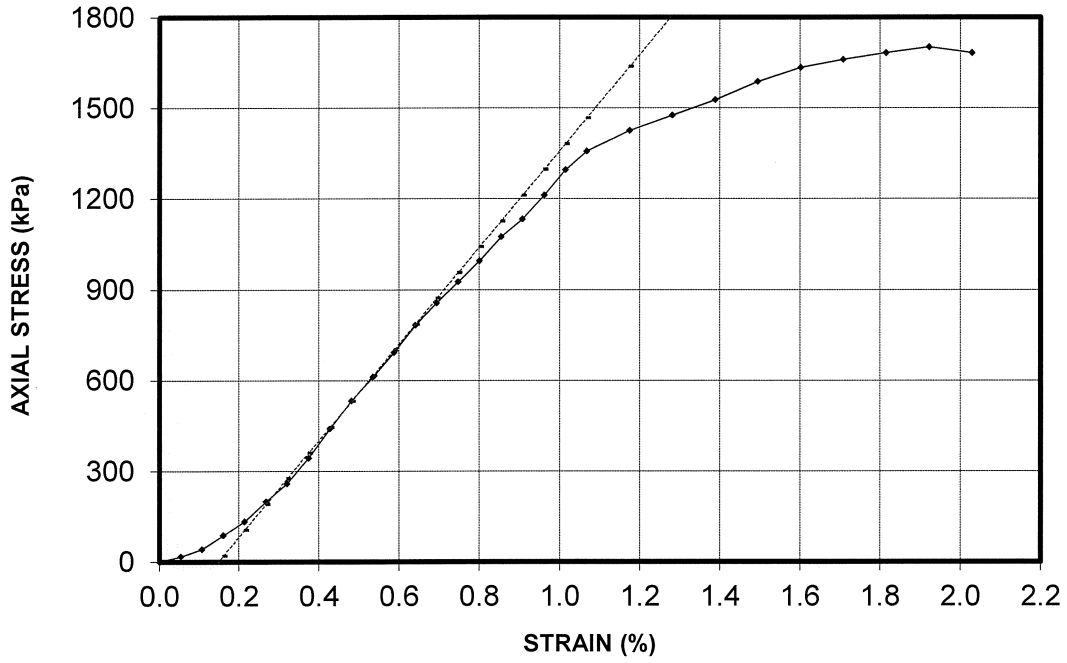
Your Job No.: 751078

Site: **Suva Radio, Fiji** **Our Job No.: 616525.000**

BH No.: **4** Sample No.: **5** Depth (m): **10.80**

Test Method Used: NZS 4402 :1986 TEST 6.3.1 Determination of the unconfined compressive strength of cohesive soil

UNCONFINED COMPRESSIVE STRENGTH TEST
AXIAL STRESS VS STRAIN



Sample Parameters:

Sample Height:	93.67	mm	Bulk Density:	1.86	t/m³
Sample Diameter:	60.16	mm	Dry Density:	1.37	t/m³
Test Height:	93.67	mm	Water Content:	35.6	%
Test H/D Ratio:	1.56				

Failure Value:

Axial Strain	Unconf. Compressive	Rate of Compression	Modulus of Elasticity
%	Strength (kPa)	(mm/min)	(MPa)
2.03	1701	0.21	159

Mode of Failure: Shear

Sample History: Undisturbed core trimmed at natural water content.

Sample Description: Light greenish grey, very weak, Suva Marl.

Test Remarks: The sample height to diameter ratio is less than the required 2. The strength may be lower, due to the h/d ratio.
Unconfined Compressive Strength reported to the nearest 1 kPa and provided as indicative only.
Modulus of Elasticity value reported is indicative only.
Sample description, UCS and modulus of elasticity value reported are not IANZ accredited.

Entered by: ST Date: 3/3/15 Checked by: AH Date: 3/3/15