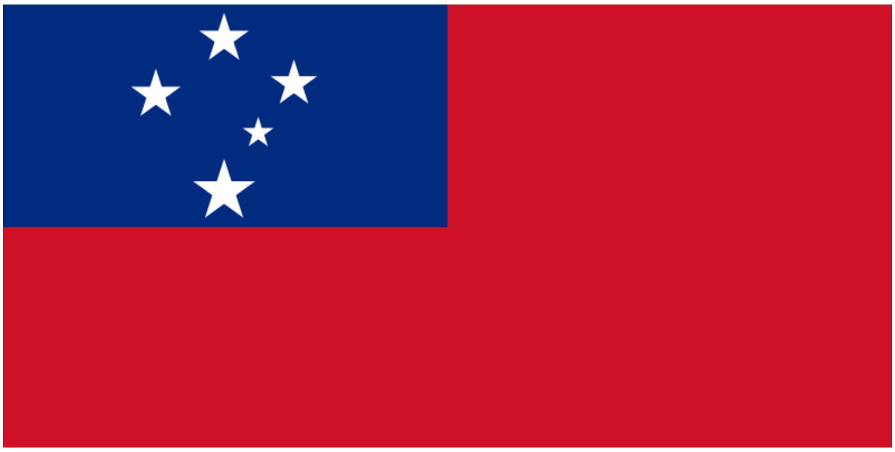
Survey of the Regional Distribution and Status of Asbestos-Contaminated Construction Material and Best Practice Options for its Management in Pacific Island Countries

Report for the Independent State of Samoa



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Contact Details

John O’Grady
Director
Contract Environmental Ltd
14 Wookey Lane,
Kumeu 0841
Auckland, New Zealand
jogrady@actrix.co.nz
ph +64 21 311 532

Dave Robotham
Associate Environmental Consultant
Geoscience Consulting (NZ) Ltd
P O Box 373
Christchurch 8140
New Zealand
david@nzgeoscience.co.nz
ph +64 3 328 9012

Gareth Oddy
Senior Environmental Scientist
Geoscience Consulting (NZ) Ltd
P O Box 373
Christchurch 8140
New Zealand
goddy@nzgeoscience.co.nz
ph +64 3 328 9012

Executive Summary

PacWaste (Pacific Hazardous Waste) is a four year (2013-2017), €7.85 million, project funded by the European Union and implemented by Secretariat of the Pacific Regional Environment Programme (SPREP) to improve regional hazardous waste management in 14 Pacific island countries plus Timor Leste, in the priority areas of healthcare waste, asbestos, E-waste and integrated atoll solid waste management.

Asbestos-containing wastes and materials are a major issue for many Pacific Island countries with a history of use of asbestos-containing building materials in construction. All forms of asbestos are carcinogenic to humans and inhalation of asbestos fibres that have become airborne can cause serious lung disease or cancer.

SPREP's regional priorities for asbestos management include conducting an inventory of the distribution of asbestos-containing materials (ACMs) in thirteen Pacific island countries, assessing the risks posed to human health by asbestos, progressive stabilization of high-risk facilities such as schools and occupied dwellings, and final disposal of ACM wastes in suitable locations.

PacWaste has commenced with a series of baseline surveys that will collect and collate information about the current status of all three hazardous waste streams targeted (healthcare waste, asbestos, E-waste) and its management in the South Pacific region and will identify best practice options for interventions that are cost-effective, sustainable and appropriate for Pacific island communities. These remedial interventions will be implemented in priority countries identified through the baseline survey.

This report aims to meet part of the objectives of SPREP'S Pacific Regional Solid Waste Management Strategy 2010–2015 and the regional hazardous waste strategies, 'An Asbestos Free Pacific: A Regional Strategy and Action Plan 2011'.

This report covers The Independent State of Samoa (hereafter referred to as Samoa) component of a survey of the regional distribution and status of asbestos-containing construction material, and best practice options for its management. The objectives of the survey are summarised as follows:

- To assess the status of, and management options for, asbestos throughout the Pacific region; and
- To develop recommendations for future management interventions, including a prioritised list of target locations.

The work was carried out by a consortium led by Contract Environmental Ltd and Geoscience Consulting (NZ) Ltd, under a contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union.

This report presents the information gathered for Samoa during a field visit undertaken by Gareth Oddy and Dave Robotham of Geoscience and John O'Grady of Contract Environmental between the 16th and 27th October 2014.

Survey Methodology

The survey work undertaken in Samoa included meetings with key government agencies, area-wide surveys of residential properties and targeted investigations of public and commercial buildings.

Samoa consists of two principal islands, Upolu and Savai'i, and eight islets, with a combined land area of 2,944 square kilometres (km^2). The island of Upolu, with an area of 1,125 km2, is the second largest island in Samoa. It has a population of approximately 140,000, including about 37,000 living in Apia, the nation's capital, which is located on the north coast. The rest of the population in Upolu lives in approximately 170 villages (ADB, 2013) primarily along a narrow coastal fringe around the island.

Due to the large population of Samoa spread over the two main islands of Upolu and Savai'i and eight small islets, a survey of each residential household was not feasible in the timeframes and budget of the project. A statistical approach was therefore adopted to ensure a sufficient number of residential properties were included in the survey to enable a reliable estimate of the number of houses with certain characteristics related to asbestos to be made.

The survey covered the islands of Upolu and Savai'i. The Upolu survey although concentrated on the capital city Apia also included the numerous villages located in Upolu. The survey of Savai'i included all towns and villages located on the coastal road that circumnavigates the island.

The basic approach taken for all property types was an initial visual assessment, usually from the roadside or property boundary, followed by closer inspection if the buildings appeared to contain potential ACMs, such as fibreboard cladding, roofing materials, or pipes. The information collected in the close-up inspections was recorded on the spot using a tablet-based application designed specifically for this project. In addition, samples of any suspect materials were collected for testing.

The collected samples were sent by courier to EMS Laboratories Incorporated in California, USA. Analysis was by Polarised Light Microscopy, which is a semi-quantitative procedure for identifying asbestos fibres, with a detection limit in the range of 0.1 to 1% on a surface area basis.

Risk Assessment

A systematic risk assessment approach was adopted in order to assess the relative risks of each building identified as containing ACMs. The method used was that given in the UK HSE guidance document '*Methods for the Determination of Hazardous Substances (MDHS100) Surveying, sampling and assessment of asbestos-containing materials (2001)*' and UK HSE guidance document '*A comprehensive guide to Managing Asbestos in premises (2002)*'. The method uses a simple scoring system to allow an assessment of the relative risks to health from ACMs. It takes into account not only the condition of the asbestos, but the likelihood of people being exposed to the fibres.

The risk assessment approach adopted presents algorithms that allow a score to be calculated for each ACM item observed or confirmed by laboratory analysis. The sites with high scores may present a higher risk to human health than those with lower scores.

Survey Outcomes

The Table below provides a summary of the Samoan census data and the survey data collected during this assessment.

Statistical Summary – Population and Households in Samoa

Region	Samoa	Apia Urban Area	North West Upolu	Rest of Upolu	Savai'i
Population	187,820	36,735	62,390	44,293	44,402
Households	28,182	6,003	9,507	6,237	6,435
Households surveyed	2800	1400	400	500	500
PACM identified	1	0	0	0	1

Source: 2011 Population Census of Samoa, Samoa Bureau of Statistics.

Based on the 2800 properties surveyed, a single residential building was suspected of containing PACM in the exterior material. Given the sample size and conclusion based upon it, if this estimate is extrapolated to include the remaining residential properties in Samoa then based on a 95% confidence with a margin of error of 1.76% the potential number of households in Samoa to contain ACM would be 10 houses. Caution should be used with any extrapolation of data and especially in this project as the residential buildings encountered on Upolu and Savai'i may differ from those on the outer islands where building resources are limited.

Asbestos fibres chrysotile, amosite and crocidolite have been detected in building materials in 18 of 48 samples analysed. The percentages of fibres detected ranged from 3 – 25% with chrysotile the most commonly detected asbestos fibre.

There are some loose sheets and broken asbestos that can be picked up easily – Fasitoo Tai Villag, the Meteorological Station, Apia, and probably other locations – e.g. an unoccupied building at Fagamalo. A residence at Paluai was also observed as having an asbestos roof.

The Meteorological Station also has a roof that needs to be removed. There is also other cladding and roofing that should be removed, including roofing at the disused timber treatment site at Utiloa, Savai'I, although this has earned a lower risk ranking because not many people visit the site.

The John Williams Building in Apia had an asbestos roof which tested positive. It was in the process of being demolished at the time of the inspection and hence became the subject of an investigation with recommendations to tighten up on site procedures and carry out a clean-up.

Cost Estimates

Pacific-wide cost estimates have been calculated for several remediation scenarios, as shown in the table below:

Summary of Costs for Various Remediation Options (Costs rounded to nearest $US)

Remediation Method	Cost per m² (face area) $US
Encapsulation	
Roofs:	
Encapsulate roof where there is no ceiling present below the roof	50.00
Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced	91.00
Cladding:	
Encapsulate wall cladding where there is no internal wall sheeting	26.00
Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated	18.00
Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)	66.00
Removal and Replacement	
Roofs:	
Remove and replace roof	96.00
Cladding:	
Remove and replace cladding	76.00
Miscellaneous	
Remove and replace floor tiles*	80.00
Pick up debris, pipes	40.00

**$US80 is the lower end of the cost spectrum for removing and replacing vinyl floor tiles and the cost could easily double (or more) for difficult removal projects. To balance this out, the vinyl tile matrix is stable and there is little risk of asbestos exposure unless they are badly deteriorating. Vinyl floor asbestos projects could therefore be lower down on the priority list.*

The above removal and replacement rates assume asbestos waste disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Recommendations and Prioritised List of Actions

ACM has been identified by this study to be present at several locations in Samoa. Based on an algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there are 12 sites in Samoa that are considered moderate to high risk with regards to the occupant's and/or publics potential exposure to asbestos. The remaining sites identified are considered to present a low to very low risk to human health. Management of the low risk sites will be required to ensure the risk to human health is not elevated further as the buildings condition deteriorates with age.

In addition, based upon a statistical approach utilising population, household and asbestos survey data adopted by this study, the number of properties potentially containing ACM in Samoa has been calculated based on 95% confidence level of the sample survey size to be 10. This is, however, based on the observance of only one house, that has been extrapolate to 10. Caution should be used with any extrapolation of data and especially in this project as the residential buildings encountered on Upolu and Savai'i may differ from those on the outer islands where building resources are limited.

The Tafaigata Landfill, located on the outskirts of Apia, Samoa, could be used for the disposal of asbestos waste. During the site visit from the Survey Team, however, ACM as well as other hazardous waste (medical waste) was observed to be being handled and disposed of inappropriately. Therefore for the purposes of disposing of ACM, the Tafaigata Landfill hazardous waste handling procedures would need to be improved/implemented or an alternative disposal location chosen.

Remediation of sites has been prioritised based on the level of risk posed to the building occupants and public at each site according to the methodology described in Section 2.

A summary of the recommended actions, estimated time and materials and estimated costs are included in the table below.

Remedial Cost Estimates for Samoa

Site Name	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)/ Volume (m^3)	Estimated Cost Range ($ USD)
Fasitoo Tai Village	ACM corrugated sheets	25	Remove loose ACM	3-5 m^3	
Customs House, Apia Port	Exterior Façade	22	Replace ACM Cladding	350 – 400 m^2	
Metrological Station, Apia	ACM Corrugated roof	21	Remove loose ACM (15m^3) and replace ACM Roof (200m^2)	200m^2 + 15m^3	
Femei Matafa Office of Statistics	Ceiling panel	20	Replace ACM ceiling panels	720 – 1,500 m^2	
University of South Pacific Savai'i	Loose former roofing pacm	20	Pick up all loose ACM and surface scrape of soil.	800 m^2 of land with loose ACM	
Paul VI College	ACM Corrugated roof	20	Replace ACM Roof	1,560 m^2	
Palaui Residential	ACM Roof sheet	20	Replace ACM Roof	150m^2	
John Williams Building	ACM Roof	20	Validate ACM removal conducted by contractors	2,000 m^2 of land with loose ACM in October 2014	
Manono-uta Church, Upolu	Vinyl tile	18	Remove vinyl flooring	350m^2	
Tuiala Power Station, Upolu	Vinyl Floor Control Room	17	Remove vinyl flooring	100-150m^2	
Safofu Church	Loose ACM	17	Replace ACM Roof	50m^2	
WSLAC House	Sunshade	17	Encapsulate/Isolate/Monitor	150-200m^2	
University of South Pacific Apia	Boiler Damaged ACM Roofing	15	Remove ACM	20 m^3	
Former Timber	Boiler pipe insulation	14	Remove ACM	5-10 m^3	

Treatment Site, Utuloa, Savai'i	Roof insulation	14			

The following recommendations are therefore made in relation to asbestos in Samoa:

a) It is recommended that the above higher priority asbestos work is carried out in Samoa as well as removal of all loose asbestos.
b) An asbestos roof has been spotted on one residence and another has loose asbestos around it. There may well be a few other residences with asbestos, but overall, the numbers are expected to be small. The few examples of asbestos on houses in Samoa should all be identified and remediated.
c) Any asbestos roofs found on houses in Samoa should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
d) The Tafaigata Landfill, located on the outskirts of Apia, Samoa, could be used for the disposal of asbestos waste, but it is recommended that proper management procedures are put in place, including placement in cells with immediate cover.
e) Before asbestos remediation takes place (and after if all the asbestos is not removed) it would be appropriate to set in place suitable asbestos management practices and procedures to deal with the ongoing risk posed to human health by asbestos exposure. This should be accompanied by an appropriate education and training programme.
f) Consideration should be given to Samoa passing suitable legislation to prevent the importation of any new asbestos sheeting and building products.

Contents

Definitions

ACM: "Asbestos Containing Material" – ie any material that contains asbestos.

Amosite: Brown or Grey Asbestos

Asbestos: The fibrous form of mineral silicates belonging to the Serpentine and Amphibole groups of rock-forming minerals, including amosite (brown asbestos), crocidolite (blue asbestos), chrysotile (white asbestos), actinolite, tremolite, anthophyllite or any mixture containing one or more of these

CEL: Contract Environmental Limited

Chrysotile: White Asbestos

Crocidolite: Blue Asbestos

EMS: EMS Laboratories Incorporated

External: Refers to the top or outside of roof sheeting or the outside of building/wall cladding

Friable: With respect to asbestos-containing material, means able to be crumbled, pulverised or reduced to powder by hand pressure when dry, and includes non-bonded asbestos fabric

GPS: Global Positioning System

Hazard: Is a potential to cause harm

IANZ: International Accreditation New Zealand

Internal: Refers to the underside of roof sheeting, or the inside of building/wall sheeting and structures therein

MCIL: Ministry of Commerce Industry and Labour

MDHS100: Methods for the determination of hazardous substances, surveying, sampling and assessment of asbestos-containing materials

MNRE: Ministry of Natural Resources and Environment, Samoa

Non-Friable: With respect to asbestos containing material means unable to be crumbled, pulverised or reduced to powder by hand pressure when dry

PACM: "Presumed Asbestos Containing Material" – ie any material presumed to contain asbestos, based on observation and knowledge of other relevant factors

PPE: Personal Protective Equipment

Practicable: Able to be done / put into practice having regard to:

- The severity of the hazard or risk in question
- The state of knowledge about the hazard or risk
- The availability and suitability of ways to remove or mitigate that hazard or risk
- The cost of removing or mitigating that hazard or risk

Risk: Is the likelihood of illness or disease arising from exposure to airborne asbestos fibres

SMF: Synthetic Mineral Fibres

SPREP: Secretariat of the Pacific Regional Environment Programme

1. Introduction

1.1 Purpose

This report covers the Samoan component of a survey of the regional distribution and status of asbestos-containing material (ACM), and best practice options for its management, in selected Pacific island communities. The objectives of the survey are summarised as follows:

- To assess the status of, and management options for, ACM throughout the Pacific region; and
- To develop recommendations for future management interventions, including a prioritised list of target locations.

The work was carried out by a consortium led by Contract Environmental Ltd and Geoscience Consulting (NZ) Ltd, under contract to the Secretariat of the Pacific Regional Environment Programme (SPREP), with funding provided by the European Union. The majority of information relating to the distribution of ACM in Samoa was obtained during a field visit undertaken by Gareth Oddy and Dave Robotham of Geoscience and John O'Grady of Contract Environmental between the 16th and 27th October 2014. The field visits were conducted with assistance from the Samoan Government and in particular the Ministry of Commerce, Industry and Labour (MCIL) and the Ministry of Natural Resources and Environment (MNRE).

1.2 Scope of Work

A copy of the Terms of Reference for this work is given in Appendix 1. It lists the following tasks:

1. *Collect and collate data on the location (geographic coordinates), quantity and condition of asbestos-containing building materials (including asbestos-containing waste stockpiles) in each nominated Pacific Island country;*

2. *Review, and recommend a prioritised list of local best-practice options for stabilisation, handling and final disposal of asbestos-contaminated materials in each nominated Pacific Island country (including review of existing local institutional, policy and regulatory arrangements);*

3. *Recommend and prioritise actions necessary to minimise exposure (potential and actual) of the local population to asbestos fibres for each nominated Pacific Island country. An approximate itemised national cost should be presented for each option identified;*

4. *Identify any local contractors who have the expertise and capacity to potentially partner with regional or international experts in future asbestos management work; and*

5. *Develop a schedule of rates for local equipment hire, mobilisation, labour, etc., to guide the development of detailed cost-estimates for future in-country asbestos remediation work.*

1.3 Background to Samoa

Samoa (officially the Independent State of Samoa) is an Oceanian country encompassing the western part of the Samoan Islands in the South Pacific Ocean. It became independent from New Zealand in 1962. Samoa is located south of the equator, about halfway between Hawaii and New Zealand in the Polynesian region of the Pacific Ocean. The total land area is 2,842 km^2 (consisting of the two large islands of Upolu and Savai'i which account for 99% of the total land area, and eight small islets.

These are the three islets in the Apolima Strait (Manono Island, Apolima and Nu'ulopa), the four Aleipata Islands off the eastern end of Upolu (Nu'utele, Nu'ulua, Namua, and Fanuatapu), and Nu'usafe'e off the south coast of Upolu. The main island of Upolu is home to nearly three-quarters of Samoa's population, and its capital city is Apia.

The climate is equatorial/monsoonal, with an average annual temperature of 26.5 °C, and a rainy season from November to April.

The Map of Samoa is shown in Figure 1 below.

Figure 1 – Map of Samoa

According to the Samoan Bureau of Statistics, 2011 population census, Samoa had a population of approximately 187,820 in 2011. Table 1 summarises the most recent census data for Samoa with regards to the population of each region and number of households included in the asbestos survey.

Table 1: Samoa 2011 Census – Population and Households by Region

Region	Samoa	Apia Urban Area	North West Upolu	Rest of Upolu	Savaii
Population	187,820	36,735	62,390	44,293	44,402
Households	28,182	6,003	9,507	6,237	6,435

Source: 2011 Population Census of Samoa, Samoa Bureau of Statistics.

1.4 Report Content and Layout

Section 2 of this report gives details of the methodology used for the study including the approach used for determining the survey coverage, the identification of specific target sites, procedures for site inspections and data capture, and sample collection and analysis. In addition, the relative importance of different sites was assessed using a risk assessment methodology, which is described in section 3.

The results of the survey are presented in section 4 of the report, with supporting information on the laboratory results given in section 5, and the risk assessment results in section 6.

Section 7 provides a generic discussion of possible management options for ACMs, and this is followed in section 8 by a specific analysis of the most appropriate options for those ACMs identified in Samoa.

Section 9 provides a review and analysis of existing national policies and legal instruments relevant to ACM management, while local contracting capabilities and costs are noted in section 10.

Section 11 contains a review of Samoan Policies and Legal Instruments.

Section 12 of the report provides a final discussion and a list of recommended actions, including cost estimates for those sites identified as priority targets for remediation.

Additional supporting information is given in a series of appendices.

2.0 Survey Methodology

2.1 Pre-Survey Desk Study

The survey work undertaken during the visit to Samoa included meetings with key government agencies, area-wide surveys across the islands of Upolu and Savai'i and specific investigations of 43 individual sites.

Prior to conducting the surveys and visiting Samoa, the survey team completed a desk study to enable a more targeted assessment of buildings potentially containing ACM. The desk study included contacting relevant local Government agencies in advance of the trip to evaluate if the agencies were aware of any buildings where ACM was a concern. In addition, the consultation aimed to evaluate local regulations and practices with respect to ACM identification, removal and disposal practices.

A second objective of the desk study was to evaluate the population distribution on the survey islands in order to prioritise which population centres and if possible which individual buildings should be included in the survey. The most recent census data was sought and reviewed in order to ensure a sufficient statistically representative number of residential buildings were included in the survey.

Where population centres were identified, existing aerial photographs and geographically positioned photographs (where available) provided on Google Earth were reviewed. The review of Google Earth photographs enabled the survey team to appreciate the typical types of building construction materials in the centres, an approximate age of the buildings and in certain cases possible asbestos containing material (PACM) was observed in photographs in Google Earth. Conclusions on any pacm observed in the photographs were to be verified during the surveys.

2.2 Survey Coverage

Samoa consists of two principal islands, Upolu and Savai'i, and eight islets, with a combined land area of 2,944 square kilometres (km^2). The island of Upolu, with an area of 1,125 km2, is the second largest island in Samoa. It has a population of approximately 140,000, including about 37,000 living in Apia, the nation's capital, which is located on the north coast. The rest of the population in Upolu lives in approximately 170 villages (ADB, 2013) primarily along a narrow coastal fringe around the island.

Due to the large population of Samoa spread over the two main islands of Upolu and Savai'i and eight small islets, a survey of each residential household was not feasible in the timeframes and budget of the project. A statistical approach was therefore adopted to ensure a sufficient number of residential properties were included in the survey to enable a reliable estimate of the number of houses with certain characteristics related to asbestos to be made.

The survey covered the islands of Upolu and Savai'i. The Upolu survey although concentrated on the capital city Apia also included the numerous villages located in Upolu. The survey of Savai'i included all towns and villages located on the coastal road that circumnavigates the island.

The statistical approach adopted is a technique commonly used in household marketing surveys and political polls. For a specified total population size the required sample numbers can be calculated to give a target level of confidence and uncertainty.

The statistical approach adopted required that a random method was used for selecting residential buildings to be surveyed and included in the sample size. In practice this involved selecting a cluster of properties at random when viewed from the road. The surveyor then undertook a more detailed inspection of the properties. Where possible samples of the building material were collected and tested in the field for indications of asbestos fibres.

2.3 Identification of Target Sites

In addition to residential households, the surveyed sought to identify public buildings and government owned industrial and commercial properties containing ACM. The primary focus of the survey was on residential properties and public buildings that would potentially present the most prolonged and thus significant risks for public exposure. Commercial and industrial buildings were included in surveys where they were observed in close proximity to residential housing and public areas.

The asbestos surveys had three main objectives. Firstly, it was, as far as reasonably practicable within the time available, to locate and record the location, extent and product type of any presumed or known ACMs. Secondly, it was to inspect and record information on the accessibility, condition and surface treatment of any presumed or known ACMs at the worst case scenarios. Thirdly, the survey aimed to determine and record the asbestos type, either by collecting representative samples of suspect materials for laboratory identification, or by making a presumption based on the building age, product type and its appearance.

A list of the people and organisations contacted during the visit, along with key points arising from the discussions, are summarised in Appendix 2.

During the initial week of the survey, the surveyors attended meetings with representatives from the Samoan government department responsible for hazardous waste, Ministry Natural Resources and Environment (MNRE) and also the department responsible for occupational health, the Department of Commerce, Industry and Labour (MCIL). The representatives provided information regarding asbestos regulations and potential state assets containing asbestos.

Other government departments and agencies were also contacted regarding the potential for asbestos to be present in government owned assets, including the Planning Urban Management Agency, Ministry of Education, and the Samoa Water Authority (SWA).

The remainder of the survey consisted of inspecting residential areas and government owned facilities including (but not limited to) schools, hospitals and healthcare centres, power stations, water treatment facilities, research centres and government administration buildings.

A total of 43 sites were surveyed in Samoa to assess for the presence of ACM.

2.4 Site Assessment Data Capture

Information was collected from each survey site using a tablet-based application designed specifically for this project. The software requires certain information to be recorded including location, type of facility, whether asbestos was identified, type, volumes, and most applicable remedial methodology. The software also allows for pictures to be taken of the sites and uses a Global Positioning System (GPS) to record where the pictures were taken. Information provided by owners/occupants of the building relating to its age, state of repairs, previous ACM knowledge was also recorded in the software.

The use of the application ensures that data is collected in a uniform manner across all of the surveyed countries regardless of the survey team members. Copies of all of the individual site assessment reports are available from SPREP.

2.5 Sample Collection Methodology

43 individual facilities / properties were identified as requiring a detailed site assessment due to their age, use, sensitive location or observations of suspected acm. In order to assess if potential ACM contained asbestos, samples were collected and analysed by a professional accredited laboratory in accordance with international standards.

Samples of suspected ACM were only collected if the following conditions were met;

- Permission was granted by the property owner;
- The work would minimise the disruption to the owner's operations;
- The sampling would not put the health and safety of occupants at risk;
- The areas to be sampled inside buildings were as far as possible unoccupied;
- Entry of other people not wearing personal protective equipment (PPE) to the sampling area was restricted;
- Where the material to be sampled could be safely pre-wet (i.e. excludes items with a risk of electrocution or where permission to wet a surface was not received); and
- Collection of a sample would not significantly damage the building material.

Where the above conditions were met, sampling was conducted following standard Geoscience Procedure and in accordance with international guidance provided by the United Kingdom Health & Safety Executive (UK HSE) and New Zealand Demolition and Asbestos Association (NZDAA).

The samples were collected in accordance with the following procedure;

- Sampling personnel must wear adequate personal protective equipment (PPE), as determined by the risk assessment (disposable overalls, nitrile gloves, overshoes and a half face respirator with P3 filters);
- Airborne emissions were controlled by pre- wetting the material to be sampled, with a fine water mist;
- Damaged portions of suspected acm were sought first where it will be easier to remove a small sample. The sample size collected was approximately 5 cm^2;
- Samples were obtained using pliers or a screwdriver blade to remove a small section from an edge or corner;
- A wet-wipe tissue was used between the pliers and the sample material to prevent fibre release during the sampling;
- All samples were individually sealed in their own sealable polythene bag which was then sealed in a second polythene bag;
- Water was sprayed onto the sample area to prevent fibre release;
- Sampling points were further sealed masking and PVC tape where necessary;

- Samples were labelled with a unique identifier and in the survey documentation; and
- Each sample was noted on a laboratory provided chain of custody and secured in a sealable container.

As with any environmental assessment, sampling of a media, in this case building material, can vary both spatially and temporally. Due to the wide scope of the survey including all residential and public buildings on the island, a limited number of samples were collected. The collection of samples was based on the aforementioned considerations but also with the project scope in mind. Where similar building materials were encountered at numerous sites, a single sample was considered sufficient to be used to base conclusions on. Also, where a large amount of PACM was identified at a single site, one sample of each main material identified was considered sufficient for this stage of the assessment.

2.6 Sample Laboratory Analysis

The samples were sent by courier to EMS Laboratories Incorporated (EMS) located in California in the United States of America for analysis. Analysis of the samples was performed by EMS using 'Polarised Light Microscopy'. According to EMS the analysis method is a semi-quantitative procedure with the detection limit between 0.1-1% by area and dependent upon the size of the asbestos fibres, sampling method and sample matrix. The type of asbestos fibre present was also reported with the three most common fibres types being chrysotile (white asbestos), crocidolite (blue asbestos) and amosite (brown asbestos).

The results for these samples are discussed in Section 4, and copies of the laboratory report are given in Appendix 3 of this report.

3.0 Risk Assessment Methodology

A systematic risk assessment approach was adopted in order to assess the risk that identified asbestos containing material presented to site occupants and if applicable the public. The risk assessment adopted was that provided by the UK HSE guidance document 'Methods for the Determination of Hazardous Substances (MDHS100) Surveying, sampling and assessment of asbestos-containing materials (2001)' and UK HSE guidance document 'A comprehensive guide to Managing Asbestos in premises (2002)'.

The documents present a simple scoring systems to allow an assessment of the risks to health from ACMs. They take into account not only the condition of the asbestos, but the likelihood of people being exposed to the fibres.

The risk assessment approach adopted presents algorithms that allow a score for each ACM item observed or confirmed by laboratory analysis, to be calculated. The sites with high scores may present a higher risk to human health than those with lower scores.

The risk assessment approach has two elements, the first algorithm is an assessment of the type and condition of the ACMs or presumed ACMs, and their ability to release fibres if disturbed. The final score for each ACM or presumed ACM depends on the type of ACM i.e. concrete v's lagging, the condition of the ACM, if there is any surface treatment and the actual type of asbestos (i.e. chrysotile (white), amosite (brown), or crocidolite (blue).

The second algorithm considers the ACM setting, likelihood of the ACM actually being disturbed and exposure to a receptor or many. The setting assessment therefore considers the normal occupant activity in that area of the site and the likelihood of disturbance. Each ACM is again scored and these scores are added to those for the material assessment to produce a total score.

3.1 ACM Assessment

UK HSE (2001) MDHS100 recommends the use of an algorithm to carry out the material assessment. The algorithm is a numerical way of taking into account several influencing factors, giving each factor considered a score. The algorithm in MDHS100 considers four parameters that determine the risk from an ACM: that is the ability to release fibres if disturbed. These four parameters are:

- product type;
- extent of damage;
- surface treatment; and
- asbestos type.

Each of the parameters is scored and added to give a total score between 2 and 12:

- materials with scores of 10 or more should be regarded as high risk with a significant potential to release fibres if disturbed;
- those with a score between 7 and 9 are regarded as medium risk;
- materials with a score between 5 and 6 are low risk; and
- scores of 4 or less are very low risk.

The material assessment algorithm shown in MDHS100 is reproduced in Table 2.

Table 2: MDHS100 Material assessment algorithm

Sample variable	Score	Examples of scores
Product type (or debris from product)	1	Asbestos reinforced composites (plastics, resins, mastics,roofing felts, vinyl floor tiles, semi-rigid paints or decorative finishes, asbestos cement etc)
	2	Asbestos insulating board, mill boards, other low density insulation boards, asbestos textiles, gaskets, ropes and woven textiles, asbestos paper and felt
	3	Thermal insulation (eg pipe and boiler lagging), sprayed asbestos, loose asbestos, asbestos mattresses and packing
Extent of damage/deterioration	0	Good condition: no visible damage
	1	Low damage: a few scratches or surface marks; broken edges on boards, tiles etc
	2	Medium damage: significant breakage of materials or several small areas where material has been damaged revealing loose asbestos fibres
	3	High damage or delamination of materials, sprays and thermal insulation. Visible asbestos debris
Surface treatment	0	Composite materials containing asbestos: reinforced plastics, resins, vinyl tiles
	1	Enclosed sprays and lagging, asbestos insulating board (with exposed face painted or encapsulated), asbestos cement sheets etc.
	2	Unsealed asbestos insulating board, or encapsulated lagging and sprays
	3	Unsealed laggings and sprays
Asbestos type	1	Chrysotile
	2	Amphibole asbestos excluding crocidolite
	3	Crocidolite
Total score		Out of 12

3.2 ACM Setting Assessment

The location of the ACM is equally important as the type and condition of the ACM when considering the potential risk to human health. There are four aspects presented in the HSE guidance, however this algorithm has been modified in this assessment with 'maintenance activity' not considered.

The removal of maintenance activity from the algorithm is due to the level of awareness of asbestos by the building management or owners at the majority of surveys was considered to be low. Therefore any maintenance undertaken is likely to be 'unplanned' with little or no controls around asbestos exposure. . In addition, the amount of maintenance was often extremely difficult to quantify through discussion with the building management contacts.

The three areas of the algorithm adopted which consider the potential risk posed by the ACM are;

- Occupant activity
- Likelihood of disturbance
- Human exposure potential

Each of the above parameters are summarised in the following sections.

Occupant activity

The activities carried out in an area will have an impact on the risk assessment. When carrying out the risk assessment the main type of use of an area and the activities taking place within it was taken into account. If the use was not able to be identified, a conservative approach was adopted based on potential uses given the type of building, condition of building and surrounding land use.

Likelihood of disturbance

The two factors that will determine the likelihood of disturbance are the extent or amount of the ACM and its accessibility/vulnerability. For example, asbestos soffits outdoors are generally inaccessible without the use of ladders or scaffolding, and on a day to day basis are unlikely to be disturbed. However, if the same building had asbestos panels on the walls they would be much more likely to be disturbed by occupant movements/activities especially if vehicles utilised the outdoor areas.

Human exposure potential

The human exposure potential depends on three factors:

- the number of occupants of an area,
- the frequency of use of the area, and
- the average time each area is in use.

For example, a hospital boiler which contains friable asbestos cladding in a room which is likely to be unoccupied for the majority of the day/week is a lower risk than say in a school classroom lined with an exposed asbestos cement roof, which is occupied daily for up to seven hours by 30 pupils and a teacher.

The algorithm adopted for ranking the ACMs setting is shown in Table 3.

Table 3: HSG227 (2002) Priority Assessment Algorithm

Assessment factor	Score	Examples of score variables
Normal occupant activity		
Main type of activity in area	0	Rare disturbance activity (eg little used store room)
	1	Low disturbance activities (eg office type activity)
	2	Periodic disturbance (eg industrial or vehicular activity which may contact ACMs)
	3	High levels of disturbance, (eg fire door with asbestos insulating board sheet in constant use)
Likelihood of disturbance		
Location	0	Outdoors
	1	Large rooms or well-ventilated areas
	2	Rooms up to 100 m2
	3	Confined spaces
Accessibility	0	Usually inaccessible or unlikely to be disturbed
	1	Occasionally likely to be disturbed
	2	Easily disturbed
	3	Routinely disturbed
Extent/amount	0	Small amounts or items (eg strings, gaskets)
	1	<10 m2 or <10 m pipe run.
	2	>10 m2 to ≤50 m2 or >10 m to ≤50 m pipe run
	3	>50 m2 or >50 m pipe run
Human exposure potential		
Number of occupants	0	None
	1	1 to 3

Assessment factor	Score	Examples of score variables
	2	4 to 10
	3	>10
Frequency of use of area	0	Infrequent
	1	Monthly
	2	Weekly
	3	Daily
Average time area is in use	0	<1 hour
	1	>1 to <3 hours
	2	>3 to <6 hours
	3	>6 hours
Total		Out of 21

Each of the parameters is scored and added together to give a total score between 0 and 21. The setting score is then added to the ACM score to provide an overall score and risk rating in order to rank the sites in order of priority for management and/or remedial action. The scoring system is detailed in Table 4.

Table 4: Risk Ranking Scoring

ACM Score	Setting Score	Total Score	Risk Rating
10 - 12	16 – 21	24 - 33	High risk – significant potential to release fibres if disturbed and significant risk to occupants
7 – 9	11 - 15	17 - 23	Moderate risk
5 – 6	8 - 10	12 - 16	Low risk
0 – 4	0 – 7	0 – 11	Very low risk

4.0 Asbestos Survey

4.1 Residential Survey Coverage

The majority of residential dwellings observed on both Upolu and Savai'i were constructed of concrete blocks, bricks, weatherboard and corrugated iron.

Information on the population distribution of Samoa was provided by the 2011 population census produced by the Samoan Bureau of Statistics. The population of Samoa in 2011 was approximately 187,820 in 2011.

The survey sample size was based upon a 95% confidence level and 1.76% margin of error. With 28,182 households across the nation the number of houses to be surveyed to ensure a statistically representative number of households was calculated to be 2433. In fact 2800 houses were surveyed.

4.2 Targeted Survey Coverage

Following consultation with the MCIL and MNRE in addition to the possible ACM sites from the desk study, a number of buildings discussed were shortlisted for a more detailed assessment. These included buildings of sufficient age considered possible to have been constructed of ACM such as the Metrological Survey buildings in Apia and the former timber mill and treatment site in Utuloa, Savai'i.

The remainder of the survey consisted of visits to government owned buildings, including those which were likely to be frequented by large numbers of individuals and that were built or likely to be built prior to 1990. The buildings included (but were not limited to) schools, hospitals and healthcare centres, libraries, research centres, government administration buildings, power stations and waste disposal facilities. Copies of all of the individual site assessment reports for Samoa are available from SPREP. The specific sites visited are listed in Table 5.

Table 5: Specific Sites Surveyed in Samoa.

Site Name	Date of Assessment	Suspected PACM?	Samples Collected of PACM?
1. Abandoned Property	24/09/2014	Yes	Yes
2. Apia Hospital	19/09/2014	Yes	Yes
3. Apia Library	19/09/2014	Yes	Yes
4. Apia Market	19/09/2014	Yes	Yes
5. Apia Meeting House	21/09/2014	Yes	Yes
6. Apia Port	18/09/2014	Yes	Yes
7. Central Bank of Samoa	22/09/2014	Yes	Yes
8. Church House	26/09/2014	Yes	Yes
9. Clean-fill Dump	22/09/2014	Yes	Yes
10. Customs	23/09/2014	Yes	Yes
11. Don Bosco Technical School	22/09/2014	Yes	Yes
12. Faamanatu School	21/09/2014	Yes	Yes
13. Fagamalo Village	25/09/2014	Yes	Yes
14. Fasitoo Tai Village	23/09/2014	Yes	Yes
15. Fasitoo Tai Primary School	23/09/2014	Yes	Yes
16. Femei Matafa Government Building	23/09/2014	Yes	Yes
17. Former Hospital Flats	23/09/2014	Yes	Yes
18. Former Medical Facility	23/09/2014	Yes	Yes
19. Hardware Store	23/09/2014	Yes	Yes

Site Name	Date of Assessment	Suspected PACM?	Samples Collected of PACM?
20. Lalovi Village	23/09/2014	Yes	Yes
21. Letoga Industrial Facility	23/09/2014	Yes	Yes
22. Lotofagu Health Centre	23/09/2014	Yes	Yes
23. Lumber Yard	23/09/2014	Yes	Yes
24. Manono-uta Church	23/09/2014	Yes	Yes
25. Manono-uta Village	23/09/2014	Yes	Yes
26. Meeting House	23/09/2014	Yes	Yes
27. MNREM Metrology Division	23/09/2014	Yes	Yes
28. Palauli Primary School	23/09/2014	Yes	Yes
29. Paul VI College	23/09/2014	Yes	Yes
30. Safotu Church	23/09/2014	Yes	Yes
31. Samaria Agalelei	23/09/2014	Yes	Yes
32. Samatau Church	23/09/2014	Yes	Yes
33. Samatau Primary School	23/09/2014	Yes	Yes
34. Samauga Village	23/09/2014	Yes	Yes
35. Savia School	23/09/2014	Yes	Yes
36. Siumu School	23/09/2014	Yes	Yes
37. Stephens Building	23/09/2014	Yes	Yes
38. Tafaigata Landfill	23/09/2014	Yes	Yes
39. Tuiala Power Station	23/09/2014	Yes	Yes
40. USP Apia	23/09/2014	Yes	No
41. USP Savai'I Centre	23/09/2014	Yes	Yes
42. Wilex Chocolate Factory	23/09/2014	Yes	Yes
43. WSLAC House	23/09/2014	Yes	Yes

5.0 Laboratory Results and Findings

5.1 Laboratory Results

A total of 48 samples of suspected asbestos containing material were collected in the Samoa survey from 32 individual sites. Laboratory analysis confirmed asbestos present at 15 of the 32 sites

A summary of the laboratory analytical results is provided in Table 6 while the full laboratory report is provided in Appendix 3 of this report.

Table 6: Sample Analytical Results

Site Name	Sample Name(s)	Sample Description/ Building Material Type	Asbestos Type and %
Letoga Industrial Facility, Upolu	Ind. 01	Insulation Material	None detected
	Ind. 02	Insulation Material	None detected
Apia Port, Upolu	Port.01	Cement Board	None detected
	Port.02	New Cement Board	None detected
	Port.03	Office Cement Board	None detected
Tuiala Power Station, Upolu	Power St.01	Insulation Material	None detected
	Power St.02	Vinyl Floor Control Room	**Chrysotile 2%**
Hardware Store, Apia, Upolu	Hardware Store – vinyl	New Vinyl Floor tile	None detected
	Hardware Store – cement board	New Cement Board	None detected
Apia Hospital, Upolu	Hosp.01	Vinyl Floor	None detected
	Hosp.02	Cement Board	None detected
Apia Market, Upolu	01	Cement Board	None detected
Lalovi Village, Upolu	SU01	Fibre cement waste by road	None detected
Manono-uta Church, Upolu	SU02	Vinyl tile	**Chrysotile 5%**
Fuamanautu School	SU03	Exterior board	None detected
Savia School	SU04	Exterior board	None detected
Lotofaga School	SU05	Exterior board	None detected
Government Meeting House, Apia	SU06	Roof tile	None detected
	SU07	Vinyl tile	None detected
Femei Matafa Office of Statistics, Apia	SU08	Ceiling panel	**Chrysotile 5%**
Metrological Station, Apia	SU09	PACM Corrugated roof	**Chrysotile 15%**
	SU10	Loose PACM fibre concrete	**Chrysotile 7%, Amosite 5%**
Wilex Chocolate Factory, Apia	SU11	Floor debris - fibre cement	None detected
	SU12	Boiler 1 – Insulation	None detected
	SU13	Boiler 2 – Insulation	None detected
Paul VI College	SU14	PACM Corrugated roof	**Chrysotile 15%**
	SU20	PACM loose	None detected
Ministry of Sports, Education & Culture	SU15	Ceiling panel	None detected
Tafaigata Landfill	SU16	AC water pipes	**Chrysotile 10%, Amosite 10%**
Fasitoo Tai Church	SU17	New internal fibre board	None detected
Fasitoo Tai Village	SU18	AC corrugated sheets	**Chrysotile 20%, Crocidolite 5%**
Customs, Apia Port	SU19	Exterior Façade	**Chrysotile 25%**
University of South Pacific Savai'i	SU21	Loose former roofing pacm	**Chrysotile 20%**
	SU23	Toilet block roof	**Chrysotile 15%**
Salelologa	SU22	Abandoned property – fibre cement	None detected
Palaui Residential	SU24	PACM Roof sheet	**Chrysotile 20%,**

Site Name	Sample Name(s)	Sample Description/ Building Material Type	Asbestos Type and %
			Crocidolite 3%
Safofu Church	SU25	Loose PACM	**Chrysotile 20%**
Fagamalo Village	SU26	Loose PACM	None detected
Samauga Village – former school	SU27	Exterior Façade	None detected
Former Timber Treatment Site, Utuloa, Savai'i	SU28	Boiler pipe insulation	**Chrysotile 15%**
	SU29	Roof insulation	**Chrysotile 15%**
	SU30	Waste insulation on ground	None detected
	SU31	Boiler insulation	None detected
Fagamalo – Unoccupied building	SU32	Loose PACM	**Amosite 10%, Chrysotile 7%, Crocidolite 5%**
John Williams Building	SU33	Removed sunshades	None detected
	SU34	ACM Roof	**Chrysotile 15%, Amosite 10%**
WSLAC House, Apia	SU35	WSLAC House sunshade	**Chrysotile 20%**
Apia Commercial Property back-up generator	SU36	Generator exhaust lagging	None detected

Some of the above locations are presented in Photos 1 - 10 below.

Photo 1 below shows the vinyl tiles in the Tuiala Power Station which tested positive for a low level of chrysotile. Photo 2 below shows the ceiling panels at the Femei Matafa Office of Statistics which tested positive. There may be other ceiling tiles containing asbestos in this building.

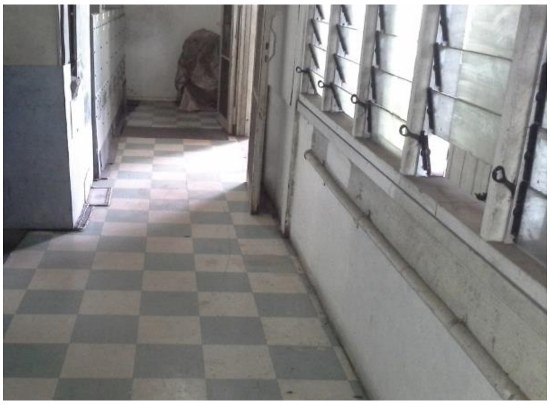

Photo 1 – Tuiala Power Station

Photo 2 – Office of Statistics

Photos 3 and 4 below are of the Meteorological Station in Apia. Photo 3 shows the roof and Photo 4 shows a small stack of asbestos. There is more asbestos debris scattered around the site.

Photos 3 and 4 – Meteroological Station, Apia

Photo 5 below shows the asbestos roof at Paul VI College and Photo 6 below shows loose AC sheeting at Fasitoo Tai Village.

Photo 5 – Paul VI College **Photo 6 – Fasitoo Tai Village**

Photo 7 below shows the exterior façade on the Customs Building at Apia Port and Photo 8 below shows the Toilet Block asbestos roof at USP Savai'i. There is also some asbestos debris from former roofing at USP Savai'i.

Photo 7 – Customs Building, Apia Port **Photo 8 – Toilet Block, USP Savai'i**

Photo 9 below shows the a derelict building at Fagamolo Village with a large amount of loose asbestos cladding debris and Photo 10 below shows the sunshades at the WSLAC Building in Apia.

Photo 9 – Loose Debris, Fagamolo Village

Photo 10 – WSLAC House Sunshades

5.2 Residences

Table 7 provides a summary of the Samoan census data and the survey data collected during this assessment.

Table 7: Statistical Summary – Population and Households in Samoa

Region	Samoa	Apia Urban Area	North West Upolu	Rest of Upolu	Savai'i
Population	187,820	36,735	62,390	44,293	44,402
Households	28,182	6,003	9,507	6,237	6,435
Households surveyed	2800	1400	400	500	500
PACM identified	1	0	0	0	1

Source: 2011 Population Census of Samoa, Samoa Bureau of Statistics.

Based on the 2800 properties surveyed, a single residential building was suspected of containing PACM in the exterior material. Given the sample size and conclusion based upon it, if this estimate is extrapolated to include the remaining residential properties in Samoa then based on a 95% confidence with a margin of error of 1.76% the potential number of households in Samoa to contain ACM would be 10 houses. Caution should be used with any extrapolation of data and especially in this project as the residential buildings encountered on Upolu and Savai'i may differ from those on the outer islands where building resources are limited.

Caution should be used with any extrapolation of data and especially in this project as the residential buildings encountered on Upolu and Savai'i may differ from those on the outer islands where building resources are limited. As the survey did not visit the outer islands confirmation that the findings can be assumed for the other islands will need to be made. Another limitation of the extrapolation is that the survey results are based largely on visual observations of the exterior of the residential buildings.

5.3 General Comments on the Results

Asbestos fibres chrysotile, amosite and crocidolite have been detected in building materials in 18 of 48 samples analysed. The percentages of fibres detected ranged from 3 – 25% with chrysotile the most commonly detected asbestos fibre.

There are some loose sheets and broken asbestos that can be picked up easily – Fasitoo Tai Villag, the Meteorological Station, Apia, and probably other locations – e.g. an unoccupied building at Fagamalo. A residence at Paluai was also observed as having an asbestos roof.

The Meteorological Station also has a roof that needs to be removed. There is also other cladding and roofing that should be removed, including roofing at the disused timber treatment site at Utiloa, Savai'I, although this has earned a lower risk ranking because not many people visit the site.

Only a single residential building was suspected of containing PACM in the exterior material (roofing), although this has been extrapolated to 10 residences, based on the survey size.

The John Williams Building in Apia had an asbestos roof which tested positive. It was in the process of being demolished at the time of the inspection and hence became the subject of an investigation – see Appendix 4.

6.0 Risk Assessment

Utilising the algorithms described in section 2 of this report and based on the laboratory analysis data of ACM samples (where available) and observations of the sites visited, the sites are listed in order of priority in Table 8.

Table 8: Risk Ranking Scores – Samoa

Site Name	Building Material Type	Asbestos Type and %	Risk Ranking Scores		
			ACM	Setting	Total Score
Fasitoo Tai Village	AC corrugated sheets	**Chrysotile 20%, Crocidolite 5%**	8	17	25
Customs House, Apia Port	Exterior Façade	**Chrysotile 25%**	5	17	22
Metrological Station, Apia	PACM Corrugated roof	**Chrysotile 15%**	6	15	21
Femei Matafa Office of Statistics	Ceiling panel	**Chrysotile 5%**	4	16	20
University of South Pacific Savai'i	Loose former roofing pacm	**Chrysotile 20%**	6	14	20
Paul VI College	PACM Corrugated roof	**Chrysotile 15%**	4	16	20
Palaui Residential	PACM Roof sheet	**Chrysotile 20%, Crocidolite 3%**	7	13	20
John Williams Building	ACM Roof	**Chrysotile 15%, Amosite 10%**	7	13	20
Manono-uta Church, Upolu	Vinyl tile	**Chrysotile 5%**	4	14	18
Tuiala Power Station, Upolu	Vinyl Floor Control Room	**Chrysotile 2%**	3	14	17
Safofu Church	Loose PACM	**Chrysotile 20%**	6	11	17
WSLAC House	Sunshade	**Chrysotile 20%**	4	13	17
Metrological Station, Apia	Loose PACM fibre concrete	**Chrysotile 7%, Amosite 5%**	7	9	16
USP Apia	Boiler insulation	**Assumed Amosite**	11	4	15
University of South Pacific Savai'i	Toilet block roof	**Chrysotile 15%**	4	10	14
Former Timber Treatment Site, Utuloa, Savai'i	Boiler pipe insulation	**Chrysotile 15%**	10	4	14
	Roof insulation	**Chrysotile 15%**	10	4	14
USP Apia	ACM Roofing	**Chrysotile 15%**	7	6	13
Tafaigata Landfill	AC water pipes	**Chrysotile 10%, Amosite 10%**	6	6	12
Fagamalo – Unoccupied building	Loose PACM	**Amosite 10%, Chrysotile 7%, Crocidolite 5%**	8	3	11

The risk assessment scoring and prioritisation presented in Table 8 above indicates that there are 12 sites assessed as presenting a moderate to high risk which would benefit from additional ACM management. The six remaining sites are considered to present a low to very low risk to occupants and the public and should continue to be monitored.

The ACM present at the former timber mill and treatment site in Utuloa, Savai'i presents a significant potential hazard, however, as the site is currently derelict and unoccupied there are no receptors. The nearest residential receptor is approximately 300 metres south of the site. The site is unsecured and evidence of people being on the site (walking tracks within the long grass) was observed during the site survey. It is recommended that the site is decommissioned appropriately to remove hazardous substances from the area, including residual timber treatment containers and associated contamination.

In addition the unoccupied former warehouse building located on the USP Apia campus should also be decommissioned. Although the building is no longer used it is located adjacent (approximately 10 metres north) of several occupied campus classrooms. The potential for asbestos fibres to become airborne and present a health risk to those adjacent to the site should remediated.

7.0 Remedial and Management Options

7.1 General

Based on all of the country visits made by the consultants for the PacWaste asbestos surveys, it is evident that:

a. The types of asbestos problems are relatively similar from country to country although there are very significant variations in incidence and quantity of asbestos.

b. Most asbestos is non-friable, or at least was non-friable when installed. Often the asbestos has deteriorated significantly and, in part at least, could be considered friable because of the risk of release of significant amounts of fibres on a regular basis. Certainly where fibres have been involved the asbestos becomes friable.

c. There has been almost no asbestos identified anywhere that was friable when installed. Remediation of the few friable (at least friable when installed) asbestos projects in the Pacific will need specialist management as exceptions.

d. The predominant form of asbestos is Chrysotile (White) Asbestos, although incidences of Amosite (Brown) Asbestos and Crocidolite (Blue) Asbestos do occur occasionally. Chrysotile is hazardous, but not as hazardous as the other forms of asbestos.

e. Labour rates are similar from country to country.

f. There will most likely be a need to bring in specialist supervision for any remedial work, and rates for that supervision will be similar throughout the Pacific.

g. The cost of materials in most countries is similar as almost all materials need to be imported from manufacturing countries with similar pricing structures.

h. There is some level of awareness of asbestos management techniques in all countries (and certainly more in the countries where there are significant amounts of asbestos). Generally, however, there is little expertise available to perform professional asbestos removals to the standard that would be required in, for example, Europe, UK, USA or Australia.

i. The correct equipment for properly managing asbestos remediation is not available in any of the countries visited, with the exception of some PPE and the simpler tools required for removal operations.

j. Safe and acceptable remediation techniques will be the same everywhere.

A case can therefore easily be made for a universal policy and set of procedures to be developed across the whole Pacific region for addressing asbestos problems.

7.2 Management Options

Where ACM or PACM has been identified then there are some management measures that can be taken immediately as follows:

- communicate with building/property owners, employees, contractors and others of its presence, form, condition and potential health risks associated;
- monitor the condition of the ACM;
- put a safe system of work in place to prevent exposure to asbestos.

7.2.1 Communicating ACM Hazard

Although every attempt was made during the survey work to communicate the potential level of risk apparent during the site visits, further consultation with the relevant regulator, site/building owners and occupants will be required based upon the findings and specifically the laboratory confirmation of the presence of ACM. Where an immediate significant risk to human health was apparent during the surveys, regulators were informed and actions taken to manage/remedy the situation.

All site owners and employees should be made aware of the location of any ACMs in the buildings identified. This is particularly important for maintenance workers or contractors who may directly disturb ACMs while working. A means of communicating with contractors who come on site to carry out other work must also be set up to prevent disturbance of ACMs without implementing the correct controls. The means of communication could include a site induction sheet or training session on the hazards presented by the ACM on site together with a formal contractor acknowledgement sheet.

If the location is a private residence then an information sheet could be handed out and an education / awareness programme initiated.

7.2.2 Monitor ACM

ACMs which are in good condition, sealed and/or repaired, and are unlikely to be disturbed, are of a lower risk than those which are damaged and in certain situations can be left in place. Often, encapsulation and management is a safer option than removal, which can result in the ACMs being disturbed further and potential further exposure to the building occupants. The on-going operations at the site will also factor into whether the ACM can be left on site. It should be noted, however, that effective encapsulation, especially of roofing, can be expensive.

If ACMs are left in place, the condition of the ACMs will have to be monitored regularly and the results recorded. A useful way of monitoring the condition of the ACMs is to regularly take photographs, which can be used to compare the condition over time. When the condition of the ACM starts to deteriorate, remedial action can be taken. The time period between monitoring will vary depending on the type of ACM, its location and the activities in the area concerned, but as a minimum should be at least once every 12 months.

7.2.3 ACM Safe System

Where an ACM is going to be left in place, one option would be to label or colour-code the material. This may work in an industrial environment, but may not be acceptable in a suite of offices or suitable in public areas, for example, retail premises. The decision to label or not will in part depend on confidence in the administration of the asbestos management system and whether communication with workers and contractors coming to work on site is effective.

Labelling and colour coding alone should not be relied upon solely as the only control measure. The physical labels and colour coding may deteriorate over time without sufficient maintenance.

7.3 Remedial Options

The management options of ACM outlined in Section 7.1 above are administration controls that can assist with effectively managing the risk ACM presents. However, in certain situations, administration controls may not be sufficient or the risk posed by the ACM by way of its damaged condition or setting sensitivity may present an unacceptable risk. Remedial measures for managing the ACM may include one or a combination of the following;

- protect/enclose the ACM;
- seal/encapsulate the ACM;
- repair of the ACM;
- removal of the ACM.

7.3.1 Protection / enclosure of ACMs

Protecting ACMs means the construction or placing of a physical barrier of some sort to prevent accidental disturbance of the ACM. This may mean placing a bollard in front of a wall panel of asbestos insulating board to prevent accidental damage by fork lift truck movements. Enclosing the ACM involves the erection of a barrier around it, which should be as airtight as possible to prevent the migration of asbestos fibres from the original material. Enclosing the ACM is a good option if it is in reasonable condition and in a low sensitivity environment.

If enclosure is chosen as the desired management option it is important that the existence of the ACM behind the enclosure is notified to all who may work or visit the site. Labelling on the enclosure to indicate the presence of the hidden ACM would assist with communicating the hazard. The condition of the enclosure should also be periodically monitored and the results of the inspection recorded.

7.3.2 Sealing or encapsulation of ACM

Encapsulation of an ACM is only suitable if the ACM is in good condition and in a low sensitivity environment. The additional weight of the encapsulant is also an important consideration and this may unwittingly cause delamination and possible damage to the ACM.

According to the UKHSE (2001) there are two types of encapsulants; bridging and penetrating encapsulants. Bridging encapsulants adhere to the surface of the ACM and form a durable protective layer. Bridging encapsulants include high build elastomers, cementitious coatings and polyvinyl acetate (PVA). The different types of encapsulants available will suit different circumstances and ACMs and should therefore be selected by a specialist in asbestos management to ensure the correct encapsulant is chosen.

Of the bridging encapsulants, high-build elastomers can provide substantial impact resistance as well as elasticity, and are reported to provide up to 20 years of life if undisturbed. Cementitious coatings are generally spray-applied and are compatible with most asbestos applications. They provide a hard-set finish, but may crack over time. PVA is used for sealing of asbestos insulating board and may be spray or brush applied. PVA is not suitable for use on friable ACMs such as insulation or sprayed coatings. PVA will only provide a very thin coating and may not be suitable as a long-term encapsulant.

Penetrating encapsulants are designed to penetrate into the ACM before solidifying and locking the material together to give the ACM additional strength. Penetrative encapsulants are typically spray-applied and will penetrate non-friable and friable asbestos materials, strengthening them as well as providing an outer seal.

The selection, preparation and application of encapsulants requires skill, knowledge and experience with asbestos remedial work.

7.3.3 Repair of the ACM

To be readily repairable, the damage should be minimal, therefore repair should be restricted to patching/sealing small areas where cracks or exposed edges have become apparent. Where significant damage has occurred it may be more cost effective to remove the ACM.

The repair methodology selected will largely depend on the type of ACM to be repaired. For example, small areas of damaged pipe or boiler lagging can be filled with non-asbestos plaster and if necessary wrapped with calico (cotton cloth). Small areas of damaged sprayed asbestos can be treated with encapsulant and, if necessary, an open mesh scrim of glass fibre or calico reinforcement used.

Damaged asbestos panelling or tiles can be sprayed with PVA sealant or a similar type of sealant such as an elastomeric paint. Asbestos cement products can be sealed using an alkali-resistant and water-permeable sealant or impermeable paint.

7.3.4 Removal of the ACM

Where ACMs have been identified that are not in good condition, or are in a vulnerable position and liable to damage, the remedial options described previously should be explored first. Where it is not practical to repair, enclose or encapsulate the ACMs, they will need to be removed. ACMs will also need to be removed if the area is due to undergo refurbishment which will disturb the ACM, or where a building is going to be demolished.

Rigorous safety procedures are required to be followed for the removal of ACM. Typically the following procedure should be followed for non-friable asbestos although some variations may be necessary from site to site.

a) Place warning barrier tape around the site at a minimum distance of ten metres, where practicable, and place warning signs to clearly indicate the nature of work.
b) The contractor shall wear protective disposable type overalls, gloves and at least a half face respirator with a P2 (and preferably a P3) replaceable filter.
c) Wet down the ACM to be removed and carefully remove any fasteners using hand tools. Attempt to remove the ACM intact – do not break it up, or throw it into a waste bin or skip.
d) Place asbestos material and debris in an approved asbestos waste bag and seal for disposal in accordance with local requirements. Sheets of asbestos cement product should be placed wet one on top of another into a skip lined with a heavy duty plastic liner, a portion of which remains outside the skip and is of sufficient size to cover the waste when the skip is full.

Vacuum asbestos removal area using a vacuum fitted with a high efficiency particulate air filter (HEPA filter).

Normally air monitoring is not required for the removal of non-friable asbestos containing materials, as if done correctly no excessive quantities of asbestos fibres should be generated. However, some operators prefer to undertake such monitoring to obtain evidence that no risks to health occurred during the removal exercise.

The whole project should be supervised by an experienced asbestos removalist. Certification processes are in place in several countries to make sure such removalists are suitably qualified and experienced.

In each case of an asbestos removal project a detailed **"Asbestos Removal Plan"** should be prepared that addresses the following matters:

1. Identification:

- Details of the asbestos-contaminated materials to be removed – for example, location/s, whether it is friable or non-friable, condition and quantity to be removed – include references to analyses.

2. Preparation:

- Consultation with regulators, owners and potentially affected neighbours
- Assigned responsibilities for the removal

- Programme of commencement and completion dates
- Consideration of other non-asbestos related safety issues such as safe working at heights
- Asbestos removal boundaries, including the type and extent of isolation required and the location of any signs and barriers
- Control of electrical and lighting installations
- Personal protective equipment (PPE) to be used, including respiratory protective equipment (RPE)
- Details of air monitoring programme
- Waste storage and disposal programme

3. Removal

- Methods for removing the asbestos-contaminated materials (wet or dry methods)
- Asbestos removal equipment (spray equipment, asbestos vacuum cleaners, cutting tools, etc)
- Details of required enclosures, including details on their size, shape, structure, etc, smoke-testing enclosures and the location of negative pressure exhaust units if needed
- Details of temporary buildings required for asbestos removal (eg decontamination units), including details on water, lighting and power requirements, negative air pressure exhaust units and their locations
- Other control measures to be used to contain asbestos within the asbestos work area. This includes dust suppression measures for asbestos-contaminated soil.

4. Decontamination:

- Detailed procedures for the workplace decontamination, the decontamination of tools and equipment, personal decontamination of non-disposable PPE and RPE, decontamination of soil removal equipment (excavator, bobcat etc)

5. Waste Disposal:

- Methods for disposing of asbestos waste, including details on the disposal of:
  - Disposable protective clothing and equipment and
  - Structures used to enclose the removal area

8.0 Selection of Possible Remedial Options

8.1 General

The flow chart presented below in Figure 2 has been adapted from that presented in UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'. It details the decision process adopted by this study in determining the most suitable management option for the majority of sites with ACM.

Figure 2: ACM Management Flow Chart

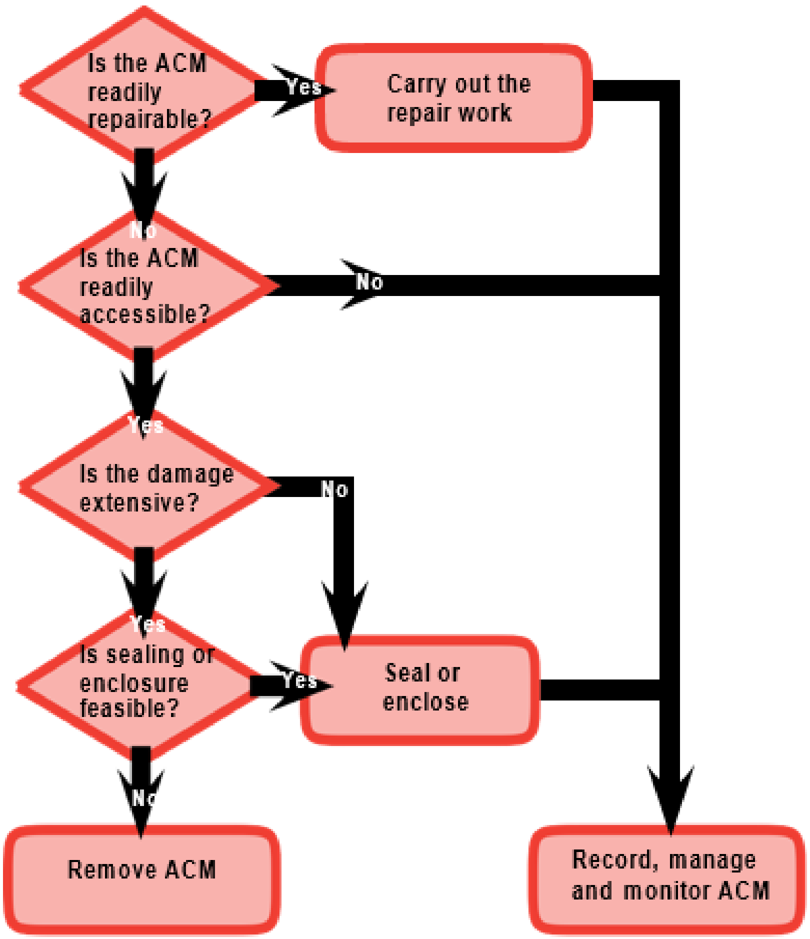

Figure adapted from; UKHSE HSG227 'A Comprehensive Guide to Managing Asbestos in Premises'.

Clearly there is a need to adopt a logical process such as above to select the correct management procedure in each case, and the flowchart above sets out such a procedure. There are some specific Pacific factors, however, that need to be considered.

8.2 Appropriate Asbestos Management for the Pacific

There are limited funds available for asbestos remediation in the Pacific and a wide range of health initiatives that may be deserving of funding besides asbestos remediation. It will therefore be necessary to prioritise which remediation projects are to be carried out, based on the risk ranking methodology and available funding. Whichever projects cannot be undertaken will need interim management until funding is available.

Management of un-remediated asbestos buildings is discussed in Section 7.2 above. The key factors in this management will be education and awareness so that minimising the generation of airborne fibres can be achieved.

Where remediation can be undertaken the first option that could be considered is encapsulation. Most asbestos roofs in the Pacific are, however, in a deteriorating condition and need to be encapsulated on the underside as well as the top surface. In most cases there is also a ceiling in place so the ceiling will need to be removed, as well as electrical and other services if they cannot be worked around. The top surface of the ceiling, as well as the services, must be treated as potentially contaminated with asbestos, especially if the asbestos roof is old, so the rooms below will need to be protected. The services and ceiling will then need to be returned or replaced as appropriate.

This process is expensive and, in fact may cause the project to be of a similar cost to removal and replacement of the roof. If there is no ceiling in place then the underside of the asbestos roof may, however, be able to be painted quite easily, although the project will still be an asbestos remediation project with all the resultant controls that must be put in place.

If an asbestos roof is encapsulated then it will still be necessary to replace any asbestos guttering and downpipes.

Asbestos cladding may be able to be satisfactorily encapsulated at a reasonable cost if it is in good condition. If there is also a wall cavity and an internal wall in good condition then there would be no need to encapsulate the inside of the asbestos cladding. Otherwise the inside would need to be encapsulated as well.

Encapsulation is discussed further in Section 8.3 below.

Removal of the asbestos roof would require all the appropriate asbestos management controls to be put in place as well as edge protection / fall arrest for safe working at heights and procedures for working on a brittle asbestos roof. Once the roof has been removed then the asbestos dust would need to be carefully vacuumed up in the ceiling space. Then a new roof would need to be put in place. With the hot conditions in the Pacific an insulating layer would also be required. Asbestos does have the merit of being cool to live under.

Removal is discussed further in Section 8.4 below.

8.3 Encapsulation

If encapsulation is to be used then several factors need to be considered as follows:

- Durability – the encapsulating system applied should last for a long time.
- There should be minimal (or preferably no) surface preparation involved as the high pressure washing and abrasive techniques normal for surface preparation for painting will generate a large amount of asbestos fibres.
- The encapsulant product should be simple to apply.
- Preferably the solar reflection should be enhanced by the use of light colours.

Normal priming type paints (especially oil or mineral turps based paints) generally do not bind well to asbestos cement roofs and cladding and special high quality alkali resistant primers are recommended prior to using a typical high quality 100% acrylic based exterior undercoat and exterior top coat system.

Alternatively, a semi-gloss, two-component epoxy paint suitable for metal, concrete, asbestos, cement and heavy machinery can be used. Such epoxy resin based paints exhibit long lasting durability under harsh conditions, such as acid, alkaline, salt and very humid conditions. Such paint can as used as a primer coat as well.

Another alternative is to use a special asbestos encapsulating system such as that offered by Global Encasement Inc (www.encasement.com). Global Encasement recommends for the Pacific a primer called "MPE" (Multi-Purpose Encapsulant) and a top coat called "Asbestosafe". MPE is promoted as not requiring any surface preparation and is described as a penetrating encapsulant. It does, however, require surfaces to be "clean and dry, and free of mould, mildew, chalking, dirt, grease and oil. In most cases old roofs in the Pacific would still therefore require surface preparation.

Based on coverage and cost per litre the Global Encasement paint systems are probably about 20-30% more expensive than high quality exterior acrylic paint systems and the cost of the paint (encapsulant) would in turn be about 40-50% of the overall cost of an encapsulating project, depending on labour costs. The additional cost of using a specialist coating like the Global Encasement systems may not therefore be that significant. Global Encasement do say that a 20 year life is expected while a high quality acrylic system is unlikely to last longer than 10-15 years. Global Encasement offer a guarantee for the 20 year life but it is a very limited and conditional guarantee.

The following steps would be typical for a roof asbestos encapsulation project:

a) Prepare asbestos removal plan, set up asbestos boundaries and signage, prepare PPE and decontamination area.
b) Set up scaffolding to both sides of building for access to roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems.
c) Spray with a particle capture technology such as Foamshield (www.foamshield.com.au) to the inside of the ceiling space before removal of the ceiling. This will control any asbestos dust in the ceiling space before removal of the ceiling. Alternatively the ceiling space could be vacuumed thoroughly if safe access is possible to all the ceiling space.
d) Lay down black plastic sheeting to the floor of each room, remove all ceiling linings and place all rubbish into suitable containers for disposal (plastic lined bins or fabric bags such as "Asbags" – see Photos 11 & 12 below) for correct removal & disposal. All ceiling material will need to be treated as asbestos-contaminated as debris and fibres fall from the roofing with roof movement and wear.
e) Disconnect & remove all electrical items, ceiling fans, lights, extractor fans. Vacuum thoroughly and store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work.
f) Vacuum the underside of the existing roof sheeting and all timber roof framing. After removal of ceiling materials and plastic, vacuum all the inside of the premises.
g) Spray 3 coats of protective paint system (pre-coat, undercoat and top coat) to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated.
h) Supply & fix appropriate ceiling sheeting to ceilings of all rooms. Supply & fix timber battens to all sheet joints & to perimeter of each room.
i) Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets & perimeter battens.
j) Reposition all wiring for lights & fans and connect up all fittings as previously set out.

k) Spray 3 coats of specialist paint finish (pre-coat, undercoat and top coat) to all the exterior roof area according to painting specifications.
l) Remove, and contain for disposal, asbestos gutters and downpipes from both sides of the building and supply & install new suitable box gutters (e.g. Colourbond) with down pipe each side leading to water tank.
m) Remove asbestos boundaries and signage and decontamination area and decommission from site.

NB: All vacuuming will need to be done with a specialist vacuum cleaner fitted with a high efficiency (HEPA) filter.

Asbags are fabric bags in various sizes with lifting strops – see photos below. There are special ones for roofing sizes.

Photos 11 & 12: Asbags in use

8.4 Removal

Removal of friable asbestos will need to be carried out with specialist asbestos contractors who will not normally be available in Pacific countries.

Removal of non-friable asbestos roofs and cladding will need to be done according to appropriate protocols and will again need specialist supervision and training.

The following steps would be typical for a roof asbestos removal project:

a) Prepare asbestos removal plan, set up asbestos boundaries and signage, prepare PPE and decontamination area.
b) Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems.
c) Spray the entire roof with a water based PVA solution.
d) Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic & taped shut. Roof sheeting and all materials, (ridging, barge flashing, gutters etc) to be loaded into suitable containers for disposal (plastic lined bins or fabric bags such as "Asbags") for correct removal & disposal.
e) Vacuum clean the existing ceiling & roof space, (rafters, purlins, ceiling joists) with a suitable vacuum cleaner fitted with a HEPA filter.
f) Supply & fit heavy duty tarpaulins to keep the roof waterproof before installation of new roofing.

The new roof sheeting, insulation, guttering and downpipes should be durable (long life and resistant to corrosion from marine environments. Suitable insulation will also need to be installed to keep the building cool.

One option where a large amount of roofing is to be installed is to use a roof roll forming machine and form the roofs locally. Roofing materials could then be cut to suit and purchase of the sheet metal rolls would be cheaper than the finished roofing sheets. Of course the capital cost of the roll forming machine would need to be included in the cost calculations. It may also be appropriate to use aluminium rolls which would be corrosion resistant in marine environments.

Alternatively suitable roofing materials can just be imported such as Colourbond Ultra Grade, which is suitable for corrosive marine environments.

The following steps would be typical for a roof replacement project:

a) Supply & fit suitable roof netting over existing purlins & fix in place ready to support suitable insulation such as 50mm thick, foil coated, fiberglass insulation.
b) Supply & lay a top layer of sisalation foil over the fibreglass insulation blanket as a dust and moisture barrier.
c) Supply & screw fix suitable roofing material such as Colourbond Ultra Grade corrugated roofing, including for ridging & barge flashings.
d) Supply & fix suitable guttering such as Colourbond box guttering to both sides of the roof & include for one downpipe each side, feeding to a tank.

8.5 Options Specific to Samoa

Table 9: Possible Remedial Options – Samoa

Site Name	Building Material Type	Asbestos Type and %	Risk Score	Applicable Remedial Options			
				Repair	Isolate	Encapsulate	Remove
Fasitoo Tai Village	AC corrugated sheets	Chrysotile 20%, Crocidolite 5%	25	×	×	×	✓
Customs House, Apia Port	Exterior Facade	Chrysotile 25%	22	×	×	×	✓
Metrological Station, Apia	PACM Corrugated roof	Chrysotile 15%	21	×	×	×	✓
Femei Matafa Office of Statistics	Ceiling panel	Chrysotile 5%	20	×	✓	✓	✓
University of South Pacific Savai'i	Loose former roofing pacm	Chrysotile 20%	20	×	×	×	✓
Paul VI College	PACM Corrugated roof	Chrysotile 15%	20	×	×	×	✓
Palaui Residential	PACM Roof sheet	Chrysotile 20%, Crocidolite 3%	20	×	×	×	✓
John Williams Building	ACM Roof	Chrysotile 15%, Amosite 10%	20	×	×	×	✓
Manono-uta Church, Upolu	Vinyl tile	Chrysotile 5%	18	×	×	✓	✓
Tuiala Power Station, Upolu	Vinyl Floor Control Room	Chrysotile 2%	17	×	×	✓	✓
Safofu Church	Loose PACM	Chrysotile 20%	17	✓	✓	×	✓

Site Name	Building Material Type	Asbestos Type and %	Risk Score	Applicable Remedial Options			
				Repair	Isolate	Encapsulate	Remove
WSLAC House	Sunshade	Chrysotile 20%	17	×	✓	✓	✓
University of South Pacific Apia	Boiler Damaged ACM Roofing	Assumed amosite	15	×	×	×	✓
Former Timber Treatment Site, Utuloa, Savai'i	Boiler pipe insulation	Chrysotile 15%	14	×	✓	×	✓
	Roof insulation	Chrysotile 15%	14	×	✓	×	✓

In the majority of sites presented in Table 9, the asbestos is either friable or is damaged asbestos concrete material beyond repair. Encapsulation or isolation of these types of asbestos is not considered a suitable long term strategy, therefore removal of the ACM is the preferred remedial method.

Although the Samoan Ministry of Labour OHS Team have legislation which means contractors must now have a permit to remove ACM, the survey team witnessed inappropriate ACM removal being completed at an Apia building refurbishment. Therefore it is recommended that ACM remedial works are supervised or conducted in entirety by contractors with New Zealand or Australian asbestos removal accreditation, such as the New Zealand Certificate of Competence (COC) scheme.

During the survey in October, the John Williams Building in Apia was found to be undergoing renovation works. During the visit, the survey team met with the site contractors and the building's owner to discuss the renovation works and the observed likely presence of ACM in the roofing sheets. During discussions, the contractors stated that all ACM had been removed from the building and disposed of at the Tafaigata Landfill. Staff completing the ACM removal were not wearing appropriate PPE, undertaking necessary mitigation controls nor handling and disposing of the ACM sufficiently. The Samoan OHS were contacted and visited the site. The building renovations were estimated to have been completed in November/December 2014. Consequently the ACM presenting the risk to human health may have already been removed. Given the inappropriate removal methods observed, ACM may still be present at ground level and specifically in the contractors ACM storage yard in the car park to the south of the site.

9.0 Disposal

9.1 Relevant International Conventions

The three options for disposal of ACM and asbestos-contaminated wastes are as follows:

a) Local burial in a suitable landfill
b) Disposal at sea
c) Export to another country with suitable disposal

These three alternatives are discussed below.

Several International Conventions may be relevant to sea disposal and export of asbestos. These conventions and their status as at 2011 are set out in Table 10 below.

Table 10: Related International Conventions

Country	Rotterdam Convention	Basel Convention	London Convention & Protocol*	Waigani Convention	Noumea Convention
Australia	Y	Y	Y*	Y	Y
Cook Islands	Y	Y		Y	Y
FSM		Y		Y	Y
Fiji				Y	Y
Kiribati		Y	Y	Y	
Marshall Is	Y	Y	*		Y
Nauru		Y	Y		Y
New Zealand	Y	Y	Y*	Y	Y
Niue				Y	
Palau				Not ratified	
PNG		Y	Y	Y	Y
Samoa	Y	Y		Y	Y
Solomon Is			Y	Y	Y
Tonga	Y	Y	Y*	Y	
Tuvalu			Y	Y	
Vanuatu			Y*	Y	

Source; SPREP (2011) 'An Asbestos-Free Pacific: A Regional Strategy and Action Plan'

Later in 2011 Palau also became a party to the Basel Convention.

The Rotterdam Convention (formally, the *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade*) is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged to make sure that producers within their jurisdiction comply.

The Convention covers asbestos as one of its listed chemicals but not Chrysotile asbestos. The Convention, however, is for the purpose of managing imports of products and not wastes.

The London Convention and Protocol, and the Noumea Convention and associated Dumping Protocol are both relevant to the issue of dumping at sea and hence are discussed in Section 9.3 below.

The Basel and Waigani Conventions are relevant to the issue of export of waste to another country and are hence discussed in Section 9.4 below.

9.2 Local Burial

In order for local burial of ACM and asbestos-contaminated wastes to occur in a local landfill that takes general refuse, there must be a suitable landfill available as follows:

a) The landfill must be manned and secure so that no looting of asbestos materials can occur.

b) The landfill must have proper procedures for receiving and covering asbestos waste. A suitable hole must be excavated, the asbestos waste placed in the hole, and the asbestos waste covered with at least one metre of cover material. The asbestos waste should be buried immediately on receipt at the landfill.

c) Machinery must be available to enable the excavation and covering to occur.

d) The location of the asbestos should be logged or an asbestos burial area designated.

e) Records of dates and quantities should be kept.

The alternative to burial in a local landfill is to construct a special monofill for asbestos waste. This landfill could be lined and sealed once it is full. This process is expensive, however, and would only be justified where there is a large amount of asbestos for disposal.

The other factor to consider in relation to local disposal is whether such a practice is acceptable to the local people. A programme of consultation is necessary to determine if this is the case.

9.3 Disposal at Sea

The international convention governing sea disposal is the *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*, (the London Convention), which has the objective to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter (International Maritime Organization (IMO)). The *1996 "London Protocol"* to the Convention which came into force in March 2006 updates the convention to prohibit the dumping of any waste or other matter that is not listed in Annex 1 to the Protocol.

Annex 1 to the Protocol covers the following wastes

1. Dredged material
2. Sewage sludge
3. Fish waste, or material resulting from industrial fish processing operations
4. Vessels and platforms or other man-made structures at sea.
5. Inert, inorganic geological material
6. Organic material of natural origin
7. Various bulky inert items – iron, steel, concrete etc.
8. Carbon dioxide streams form carbon dioxide capture processes for sequestration

Probably asbestos would come under the category of inert inorganic geological material.

Any dumping of such Annex 1 wastes requires a permit from the country of origin and is limited to those circumstances where such wastes are generated at locations with no land disposal (or other disposal) alternatives. The 1996 protocol also prohibits the exports of wastes or other matter to non-Parties for the purpose of dumping at sea.

The decision to issue a permit is to be made only if all impact evaluations are completed and the monitoring requirements are determined. The provisions of the permit are to ensure that, as far as practicable, any environmental disturbance and detriment are minimised and the benefits maximised. Any permit issued is to contain data and information specifying:

1. The types and sources of materials to be dumped
2. The location of the dumpsite(s)
3. The method of dumping
4. Monitoring and reporting requirements.

It should be noted that the overall thrust of the Convention (as amended by the Protocol), as set out at the start of the Protocol is to eliminate pollution of the sea caused by dumping and to protect and preserve the marine environment. The Protocol also recognises the particular interests of Small Island Developing States. It would be fair to say, therefore, that even if the dumping of asbestos met the requirements of the Convention and Protocol, it would probably be contrary to the overall thrust of the Convention and Protocol, particularly if such dumping was initiated by Small Island Developing States.

If asbestos was dumped at sea, the following information would be needed (in terms of Annex 2 of the Protocol), in order for a permit to be issued:

1. Full consideration of alternatives
2. Full assessment of human health risks, environmental costs, hazards (including accidents), economics, and exclusion of future uses.

The other relevant convention is the *Convention for the Protection of the Natural Resources and Environment of the South Pacific Region* (1986), known also as the SPREP Convention or Noumea Convention. This Convention, along with its two Protocols, is a comprehensive umbrella agreement for the protection, management and development of the marine and costal environment of the South Pacific Region. It is the Pacific region component of UNEP's Regional Seas Programme which aims to address the accelerating degradation of the world's oceans and coastal areas through the sustainable management and use of the marine and coastal environment. In order to protect the environment in the Pacific region, through the Noumea Convention the Parties agree to take all appropriate measures in conformity with international law to prevent, reduce and control pollution in the Convention Area from any source, and to ensure sound environmental management and development of natural resources.

One of two associated protocols is the Dumping Protocol which aims to prevent, reduce and control pollution by dumping of wastes and other matter in the South Pacific. Annexes associated with the protocol would permit the dumping of asbestos provided such dumping did not present a serious obstacle to fishing or navigation. A General Permit would be needed, however, that covers a number of matters including impacts on the marine environment and human health and whether sufficient scientific knowledge exists to determine such impacts properly. Parties are required to designate an appropriate authority to issue permits.

Again the overall thrust of the Noumea Convention and its associated Dumping Protocol is to eliminate pollution of the sea caused by dumping and to protect and preserve the marine environment. Again it would be fair to say, therefore, that even if the dumping of asbestos met the requirements of the Convention and Dumping Protocol, it would probably be contrary to the overall thrust of the Convention and Dumping Protocol.

Given all the above, it may still possibly be the best option to dump the asbestos at sea. In order to successfully carry out such dumping several operating requirements would need to be met as follows:

1. The asbestos waste would need to be sealed completely and packed so that it could be loaded and unloaded satisfactorily. Probably it would best be wrapped in plastic and then placed in fabric bags fitted with loading strops. “Asbags” would meet these criteria and have a maximum 3 tonne capacity.
2. There must be a way of loading the asbestos waste satisfactorily. A shore-based crane could load asbestos in Asbags.
3. There must be a means of sea transport. A barge that towed a raft would be suitable, or a vessel with sufficient deck space.
4. There must be a safe way to unload the waste asbestos at sea. If a vessel was available with a crane with at least 3 tonne capacity at a reasonable reach then that would meet this requirement. Otherwise a shore-based crane or crane truck (Hiab) could be tied to a raft. The raft would need to have side protection around its perimeter and operating personnel would need life jackets.
5. A suitable dumping location would need to be found that a) was deep enough to ensure that no asbestos would ever return to shore; and b) had no environmental sensitivity. It is likely that such a location would be some distance from shore.

It is evident that an operation that was able to meet the permit requirements of Annex 2 of the London Protocol and the operating requirements listed above would be an expensive one. Dumping at sea would, aside from any other considerations, therefore only be considered if there was a large enough amount of asbestos waste to justify it.

9.4 Export to Another Country

The final disposal option that should be considered is export to another country. Asbestos waste is a hazardous waste in terms of both the Basel Convention and the Waigani Convention.

The *Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal*, (the Basel Convention), is an international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous wastes from developed to less developed countries. The Convention is also intended to minimise the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation. The Basel Convention states clearly that the trans-boundary movement of hazardous wastes and other wastes should be permitted only when the transport and the ultimate disposal of such wastes is environmentally sound.

The *Convention to Ban the Importation into Forum Island Countries of Hazardous and Radioactive Wastes and to Control the Trans-boundary Movement of Hazardous wastes within the South Pacific*

Region, known also as the Waigani Convention, entered into force on the 21st October 2001. It represents the regional implementation of the international regime for controlling the trans-boundary movement of hazardous wastes. The objective of the Convention is to reduce and eliminate trans-boundary movements of hazardous and radioactive waste, to minimise the production of hazardous and toxic wastes in the Pacific region and to ensure that disposal of wastes in the Convention area is completed in an environmentally sound manner.

The two countries that border the Pacific and are able to receive asbestos waste are Australia and New Zealand. Both countries are parties to both the Basel Convention and the Waigani Convention. All Pacific countries that are part of the asbestos project are party to either the Basel or the Waigani Conventions or both. In terms of trans-boundary movement, therefore, asbestos wastes could be moved from these Pacific countries to Australia or New Zealand.

Australia is not known to have ever received asbestos waste but discussions with the Hazardous Waste Section of the Australian Department of the Environment confirmed that, in terms of the Basel and Waigani Consent requirements, there would be no problem importing asbestos waste into Australia if it was done properly and safely and met other legislative requirements such as Customs and Biosecurity.

Permits are currently held to import asbestos waste into New Zealand from New Caledonia, French Polynesia and Niue. The New Zealand Government is currently funding a project to import a large amount of waste asbestos from Niue into New Zealand for disposal. This is being done under the Waigani Convention.

Potentially also, Fiji could accept waste asbestos from other Pacific countries as it has a well-run landfill at Naboro near Suva with all the controls necessary to receive asbestos. It does receive asbestos waste from within Fiji in a properly managed way. At present, however, Fiji is a party to the Waigani Convention but not the Basel Convention so it would only be able to receive asbestos waste from Waigani Convention parties.

A suitable landfill must be found in the importing country, a suitable ship and shipping route is needed, and biosecurity concerns need to be addressed. Asbestos is regarded as a Class 9 Dangerous Good for shipment purposes.

9.5 Disposal in Samoa

The Tafaigata Landfill, located on the outskirts of Apia, Samoa, was visited by the Survey team in October 2014. During the site visit, ACM as well as other hazardous waste (medical waste) was observed to being handled and disposed of inappropriately. Therefore for the purposes of disposing of ACM, the Tafaigata Landfill hazardous waste handling procedures would need to be improved/implemented or an alternative disposal location chosen.

10.0 Cost Considerations

A typical example of local Pacific costs has been obtained from Central Meridian Inc in Nauru, which is a contracting company that has worked for 14 years in Nauru and employs about 60 staff (see Appendix 5). Costs will likely vary according to local conditions but rates have been cross checked against established rates in New Zealand, and also informally with contractors in other Pacific countries, and it is believed that the figures put forward are reasonable for preliminary budgeting purposes.

10.1 Encapsulation

For the encapsulation option, cost build ups have been prepared for roofs and wall cladding based on the Central Meridian estimate. The Central Meridian costs have been changed from AUD to USD at an exchange rate of 0.8, and the figures have been reduced by 10% based on the assumption that cheaper prices could be obtained by competitive tendering, and also based on reconciliation with established rates in New Zealand.

The full cost build ups are presented in Appendix 5 and a summary is presented as follows:

<u>Roof Encapsulation</u>

Costs:

- Encapsulate roof where there is no ceiling present below the roof: USD49.64/m2 of roof (face area)
- Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced: USD90.79/m2 of roof (face area)

Assumptions:

- Rates have been built up based on a roof of a single storey building with a floor area of 14m x 12m with a roof pitch of 30 degrees. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.

<u>Cladding Encapsulation</u>

Costs:

- Encapsulate wall cladding where there is no internal wall sheeting: USD25.92/m2 (face area)

- Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated: USD17.92/m2 (face area)
- Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)

Assumptions:

- Rates have been built up based on a single storey building with a floor area of 14m x 12m and walls 2.4m high. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.

10.2 Removal and Replacement

For the removal and replacement option cost build ups have been prepared for roofs and wall cladding based on the Central Meridian estimate. As for the encasement option, the Central Meridian costs have been changed from AUD to USD at an exchange rate of 0.8, and the figures have been reduced by 10% based on the assumption that cheaper prices could be obtained by competitive tendering, and also based on reconciliation with established rates in New Zealand.

The full cost build ups are presented in Appendix 5 and a summary is presented as follows:

<u>Roof Removal and Replacement</u>

Cost:

- Remove and replace roof: USD96.31/m2 (face area)

Assumptions:

- Rates assume that the existing roofs are replaced with Colourbond Ultra grade roof sheeting (for sea spray environments) with 50mm of foil coated fibreglass insulation (to address heat issues).
- Rates have been built up based on a roof of a single storey building with a floor area of 14m x 12m with a roof pitch of 30 degrees. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.

- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- A 10% contingency has been allowed for tidying up any damaged or inadequate rafters purlins and barge boards.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.
- Rates assume asbestos waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

<u>Cladding Removal and Replacement</u>

Costs:

- Remove and replace cladding: USD76.04/m2 (face area)

Assumptions:

- Rates assume that the existing cladding is replaced with a cement fibre board with treated timber battens to make water tight. An allowance has also been made to wrap the building in foil and to apply two coats of paint to complete the works.
- Rates have been built up based on a single storey building with a floor area of 14m x 12m and walls 2.4m high. Extra will be required for scaffolding for buildings greater than 1 storey high.
- Rates assume that work is done in a tradesman like fashion to New Zealand or Australian standards, including compliance with applicable safety requirements relating to working at height and working with asbestos.
- Rates allow for an independent SPREP appointed representative to oversee works to ensure quality, safety and commercial requirements are complied with.
- Rates do not allow for any costs relating to disruption of the usual activities undertaken in the building being worked on – eg moving furniture in and out.
- A 10% contingency has been allowed for tidying up any damaged or inadequate framing.
- Rates are approximate only and there will be country specific variances depending on the availability of resources and materials.
- Rates assume asbestos waste secure wrapping and disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

Table 11: Summary of Costs for Various Remediation Options (Costs rounded to nearest $US)

Summary of Costs for Various Remediation Options (Costs rounded to nearest $US)

Remediation Method	Cost per m² (face area) $US
Encapsulation	
Roofs:	
Encapsulate roof where there is no ceiling present below the roof	50.00
Encapsulate roof where there is an existing ceiling below the roof that needs to be removed and replaced	91.00
Cladding:	
Encapsulate wall cladding where there is no internal wall sheeting	26.00
Encapsulate wall cladding where there is internal wall sheeting in good condition, which means only the exterior needs to be encapsulated	18.00
Encapsulate wall cladding where there is internal wall sheeting in poor condition, which must be treated as asbestos contaminated and removed and replaced: USD65.92/m2 (face area)	66.00
Removal and Replacement	
Roofs:	
Remove and replace roof	96.00
Cladding:	
Remove and replace cladding	76.00
Miscellaneous	
Remove and replace floor tiles*	80.00
Pick up debris, pipes	40.00

**$US80 is the lower end of the cost spectrum for removing and replacing vinyl floor tiles and the cost could easily double (or more) for difficult removal projects. To balance this out, the vinyl tile matrix is stable and there is little risk of asbestos exposure unless they are badly deteriorating. Vinyl floor asbestos projects could therefore be lower down on the priority list.*

The above rates assume asbestos waste disposal to a suitable nearby local landfill. If the waste needs to be exported or if sea disposal is being considered, then this will need to be costed as an extra.

10.3 Local Contractors

An objective of the study was to identify any local contractors who may have the expertise and capacity to potentially partner with regional or international contractors with expertise in asbestos management, repair and removal. Attempts were made to identify and contact potentially suitable contractors prior to the visits in order to schedule meetings when the survey team were in the country. In addition, government officials were also requested to provide the details of potentially suitable contractors.

During discussions with the MCIL Occupational Safety & Health department of the Samoan Government, with the recent introduction of the Occupational Safety & Health Regulations 2014, contractors were now not allowed to commence asbestos removal work unless they have an asbestos removal licence issued by the commissioner. At the time of the survey, given the relatively new regulations, no contractors in Samoa held such a licence.

10.4 Indicative Cost Information

A Samoan based company undertaking asbestos removal in the South Pacific provided cost estimates for the removal of a variety of ACM. The contractors are approved by the Fijian OHS department to remove asbestos in Fiji but at the time of writing not Samoa. The cost estimates are summarised in Table 12.

Table 12: Costs of Materials in Samoa

Item	Cost (US$)
Removal of ACM wall cladding	Price $40 to $50 per m2
Removal of ACM vinyl floor tiles	Price $50 per m2
Removal of ACM roofing	Price $50 to $60 per m2

Indicative day rates for labour as well as truck and driver obtained in other Pacific Island Countries have been provided in the absence of Samoa rates. The rates are provided as an indicative guide to potential costs and exclude personal protective equipment and other consumables required during asbestos removal/repair work. The rates are summarised in Table 13.

Table 13: Costs of Materials in Samoa

Item	Cost (US$)
Rubberised acrylic primer	$115 per 5 Gal
Rubberised acrylic exterior finish	$70 to $115 per 5 Gal
Landfill Disposal – Tafaigata Landfill	TBC

Indicative day rates for labour as well as truck and driver obtained in Samoa are provided in Table 14. The rates are provided as an indicative guide to potential costs and exclude personal protective equipment and other consumables required during asbestos removal/repair work.

Table 14: Indicative Rates – Samoan Contractor

Item	Cost (USD $/hr)
Supervision	$28
Leading Foreman	$8
Labour	$5
Driver	$5
Truck and driver	$49

There are numerous variables associated with producing a cost estimate for the management and removal of ACM at the identified properties. Costs would be dependent upon the buildings location and condition of the structure. As ACM is present it indicates the building is likely to be at least 30 years old and may require other structural engineering repairs or upgrades prior to removing and replacing the ACM.

The scope would need to be defined on a site by site basis and based on consultation with all of the properties stakeholders. However a building contractor firm operating in several South Pacific nations has stated that costs to remove and replace ACM with iron cladding could vary from $70 - $180 USD / m^2.

11.0 Review of Samoan Policies and Legal Instruments

11.1 National Laws and Regulations

The Occupational Safety and Health Act 2002, No.5 came into force in 2004. The Act applies to all workplaces including schools and hospitals. The Act is administered by the MCIL. In June 2014 the Occupational Safety and Health Regulations 2014 were introduced. Part 11 of the regulations covers Hazardous Substances while section 65 specifically relates to work with asbestos. The regulations state that a licence is required to remove asbestos cement greater than $10m^2$ in area, or greater than $0.5m^2$ in area of insulation.

Also enacted in Samoan legislation relevant to this study are the Lands Surveys and Environment Act 1989 and the Waste Management Act 2010. Both pieces of legislation are administered by MNRE. The Waste Management Act 2010 covers the collection and disposal of solid wastes and the management of all wastes in Samoa, especially hazardous waste. The Act provides for registration and licensing of waste operators, permits for dumping and incinerating wastes and sets environmental standards for the management of waste.

There is no legislation in place to prevent the importation of any new asbestos sheeting and building products. It should be noted that new asbestos building products are being imported into several countries in the Pacific, based on surveys carried out as part of this project.

11.2 National Strategies and Policies

With the exception of the SPREP (2011) 'An Asbestos-Free Pacific: A Regional Strategy and Action Plan' there are currently no national strategies or policies related to asbestos implemented in Samoa.

11.3 International Conventions

Should ACM be removed from the identified buildings in this study, options for disposal include-existing or proposed local hazardous waste facilities/landfills and international hazardous waste landfills. Several international conventions control the trans-boundary movement of hazardous waste such as asbestos.

Samoa is a party to the Basel Convention and Waigani Convention.

12.0 Recommended Actions for Minimising Asbestos Exposures

12.1 Discussion

ACM has been identified by this study to be present at several locations in Samoa. Based on an algorithm adopted as part of the risk assessment to prioritise asbestos management, this study has identified that there are 12 sites in Samoa that are considered moderate to high risk with regards to the occupant's and/or publics potential exposure to asbestos. The remaining sites identified are considered to present a low to very low risk to human health. Management of the low risk sites will be required to ensure the risk to human health is not elevated further as the buildings condition deteriorates with age.

In addition, based upon a statistical approach utilising population, household and asbestos survey data adopted by this study, the number of properties potentially containing ACM in Samoa has been calculated based on 95% confidence level of the sample survey size to be 10. This is, however, based on the observance of only one house, that has been extrapolate to 10 based in turn on the sample size. Caution should be used with any extrapolation of data and especially in this project as the residential buildings encountered on Upolu and Savai'i may differ from those on the outer islands where building resources are limited.

The Tafaigata Landfill, located on the outskirts of Apia, Samoa, could be used for the disposal of asbestos waste. During the site visit from the Survey Team, however, ACM as well as other hazardous waste (medical waste) was observed to be being handled and disposed of inappropriately. Therefore for the purposes of disposing of ACM, the Tafaigata Landfill hazardous waste handling procedures would need to be improved/implemented or an alternative disposal location chosen.

Remediation of sites has been prioritised based on the level of risk posed to the building occupants and public at each site according to the methodology described in Section 2.

A summary of the recommended actions, estimated time and materials and estimated costs are included in Table 15.

Table 15: Remedial Cost Estimates for Samoa

Site Name	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)/ Volume (m^3)	Estimated Cost Range ($ USD)
Fasitoo Tai Village	ACM corrugated sheets	25	Remove loose ACM	3-5 m^3	
Customs House, Apia Port	Exterior Façade	22	Replace ACM Cladding	350 – 400 m^2	
Metrological Station, Apia	ACM Corrugated roof	21	Remove loose ACM (15m^3) and replace ACM Roof (200m^2)	200m^2 + 15m^3	
Femei Matafa Office of Statistics	Ceiling panel	20	Replace ACM ceiling panels	720 – 1,500 m^2	
University of South Pacific Savai'i	Loose former roofing pacm	20	Pick up all loose ACM and surface scrape of soil.	800 m^2 of land with loose ACM	
Paul VI College	ACM Corrugated roof	20	Replace ACM Roof	1,560 m^2	

Site Name	ACM	Risk Score	Recommended Remedial Actions	ACM Area (m^2)/ Volume (m^3)	Estimated Cost Range ($ USD)
Palaui Residential	ACM Roof sheet	20	Replace ACM Roof	150m^2	
John Williams Building	ACM Roof	20	Validate ACM removal conducted by contractors	2,000 m^2 of land with loose ACM in October 2014	
Manono-uta Church, Upolu	Vinyl tile	18	Remove vinyl flooring	350m^2	
Tuiala Power Station, Upolu	Vinyl Floor Control Room	17	Remove vinyl flooring	100-150m^2	
Safofu Church	Loose ACM	17	Replace ACM Roof	50m^2	
WSLAC House	Sunshade	17	Encapsulate/Isolate/Monitor	150-200m^2	
University of South Pacific Apia	Boiler Damaged ACM Roofing	15	Remove ACM	20 m^3	
Former Timber Treatment Site, Utuloa, Savai'i	Boiler pipe insulation	14	Remove ACM	5-10 m^3	
	Roof insulation	14			

12.2 Recommendations

The following recommendations are therefore made in relation to asbestos in Samoa:

A. It is recommended that the above higher priority asbestos work is carried out in Samoa as well as removal of all loose asbestos.
B. An asbestos roof has been spotted on one residence and another has loose asbestos around it. There may well be a few other residences with asbestos, but overall, the numbers are expected to be small. The few examples of asbestos on houses in Samoa should all be identified and remediated.
C. Any asbestos roofs found on houses in Samoa should preferably be removed rather than encapsulated as encapsulation of roofs costs only a little less than removal and removal is a permanent solution.
D. The Tafaigata Landfill, located on the outskirts of Apia, Samoa, could be used for the disposal of asbestos waste, but it is recommended that proper management procedures are put in place, including placement in cells with immediate cover.
E. Before asbestos remediation takes place (and after if all the asbestos is not removed) it would be appropriate to set in place suitable asbestos management practices and procedures to deal with the ongoing risk posed to human health by asbestos exposure. This should be accompanied by an appropriate education and training programme.
F. Consideration should be given to Samoa passing suitable legislation to prevent the importation of any new asbestos sheeting and building products.

Appendix 1: Edited Copy of the Terms of Reference

Background

Asbestos-containing materials were in wide use in the past in Pacific Island countries for housing and building construction. The region is subject to periodic catastrophic weather and geological events such as tsunamis and cyclones which are highly destructive to built infrastructure, and as a consequence, asbestos has become a significant waste and human health issue in many Pacific countries. However, quantitative data on the location, quantity and condition of asbestos is not available for the region. This data is needed to define the problem and plan for future actions. This project will contribute to improved management of regional asbestos waste through collection, collation and review of such data on the location, quantity and status of asbestos-containing building materials in priority Pacific Island countries.

SPREP has received funding from the European Union under the EDF10 programme to improve the management of asbestos waste in priority Pacific Island countries.

The work for this consultancy is located in the following Sub-regions and countries;

- Sub-region A, (Nauru):
  Nauru
- Sub-region B, (Micronesia):
  FSM, Kiribati, Marshall Islands, Kiribati
- Sub-region C, (Melanesia):
  Fiji, Solomon Islands, Vanuatu
- Sub-region D, (Polynesia):
  Cook Islands, Niue, Samoa, Tonga, Tuvalu

Objective

Pacific asbestos status and management options are assessed and future intervention recommendations presented on a regional basis to identify prioritised areas for future intervention.

Scope of Work

The scope of work for this consultancy covers the following tasks:

Tasks
For each of the sub-regions and countries above, the Consultant will:

1. Collect and collate data on the location (geographic coordinates), quantity and condition of asbestos-containing building materials (including asbestos-containing waste stockpiles) in each nominated Pacific Island country.

2. Review, and recommend a prioritised list of local best-practice options for stabilisation, handling and final disposal of asbestos contaminated materials in each nominated Pacific Island country (including review of existing local institutional, policy and regulatory arrangements).

3. Recommend and prioritise actions necessary to minimise exposure (potential and actual) of the local population to asbestos fibres for each nominated Pacific Island country. An approximate itemised national cost should be presented for each option identified.

4. Identify any local contractors who have the expertise and capacity to potentially partner with regional or international experts in future asbestos management work.

5. Develop a schedule of rates for local equipment hire, mobilization, labour, etc., to guide the development of detailed cost estimates for future in-country asbestos remediation work.

Project Deliverables

1. Final report detailing the location, quantity and status of asbestos-containing building materials (including asbestos-contaminated waste stockpiles) for each Pacific Island country identified in the work region(s).

2. Final report providing recommendations for local best-practice options including local institutional and policy arrangements for national asbestos management for each Pacific Island country identified in the work region(s).

3. Final report identifying local labor and equipment hire rates and availability of in-country asbestos management expertise for each Pacific Island country identified in the work region(s).

4. Final report presenting costed priority actions necessary to minimise the exposure of the local population to asbestos fibres for each Pacific Island country identified in the work region(s).

Project Timeframe

All final reports completed and submitted to SPREP within twenty (20) weeks from signature of the contract.

Appendix 2: Organisational Details and List of Contacts

Fuatino M Leota
Principal Chemicals and Hazardous Waste Management Officer
Division of Environment and Conservation
Ministry of Natural Resources and Environment (MNRE)
Apia, Samoa
Email: fuatinol@gmail.com
Ph: +685-67200 Ext 266

Met with Fuatino Leota and discussed locations where asbestos may occur in Samoa, findings to that point and the role of MNRE). Methods of dealing with asbestos and remediating asbestos sites were also discussed. Fuatino Leota has responsibility for the management of asbestos waste and policy issues relating to asbestos in Samoa.

Toni Atilua
Operations Manager
Electric Power Corporation
Apia, Samoa
Ph: +685-7565602

Met with Toni Atilua and discussed likely places where asbestos may arise in the Electricity Industry in Samoa. Also visited Tuiala Power Station and took samples.

Katenia Rasch
Samoa Water Authority
Apia, Samoa
Ph: +685-20409

Met with Katenia Rasch who confirmed that there has been very little use of asbestos cement water pipes in Samoa.

Filomena Nelson
Disaster Management Coordinator
Ministry of Natural Resources and Environment (MNRE)
Apia, Samoa
Email: filomena.nelson@mnre.gov.ws
Ph: +685-770661

Met with Filomena Nelson and discussed the issue of asbestos when dealing with asbestos. The handling of asbestos waste needs to be incorporated into disaster planning. Filomena Nelson was keen to get a list of asbestos sites in Samoa to incorporate into Samoa disaster planning.

Ferila Brown
Planning and Urban Management Agency (PUMA)
Ministry of Natural Resources and Environment (MNRE)
Apia, Samoa
Email: ferila.brown@mnre.gov.ws
Ph: +685-67200

Met with Ferila Brown and discussed planning issues related to asbestos, including how the removal of asbestos from Samoa should be a desirable planning issue, including the banning of asbestos imports.

Appendix 3: Laboratory Reports

EMS LABORATORIES INC.
117 W. Bellevue Drive, Pasadena, CA 91105-2548 626-568-4065

National Institute of Standards and Technology (NIST) NVLAP Lab Code 101218-0
California Department of Health Services Environmental Testing Laboratory ELAP 1119
County Sanitation Districts of Los Angeles County ID No. 10120
AIHA Laboratory Accreditation Programs, LLC 101634

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #:	1 of 7
		REPORT #:	0162955
		PROJECT:	PLM ANALYSIS
CONTACT:	John O'Grady	DATE COLLECTED:	09/18/2014
REFERENCE:	Samoa-spread	COLLECTED BY:	
METHOD:	EPA 600/R-93/116	DATE RECEIVED:	10/02/2014
		ANALYSIS DATE:	10/08/2014

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-001 IND site.01	Insulation, Yellow/Brown, Non-homogeneous, Fibrous, tease, friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%
0162955-002 IND Site.02	Insulation, Gray, Homogeneous, Fibrous, tease, friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	95% 5%
0162955-003 Port.01	Cement Board, Gray/Blue, Non-homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0162955-004 Port.02	Cement Board, Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%
0162955-005 Port.03	Cement Board, Gray/White, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0162955-006 Power st.01	Insulation, White, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%

EMS LABORATORIES INC 117 W Bellevue Drive / Pasadena CA 91105-2548 / 626-568-4065

CUSTOMER:	Contract Environmental 119 Johnson Rd. West Melton Christchurch NZ	PAGE #: REPORT #: PROJECT:	2 of 7 0162955 PLM ANALYSIS

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-007 Power st.02	Floor Tile, Green, Homogeneous, Solid, melt, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	2%	Non-Fibrous Material	98%
0162955-008 Hardware store - Vinyl	Vinyl, Black, Non-homogeneous, Rubbery, ash, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0162955-009 Harware store Cement Board	Cement Board, Gray, Homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0162955-010 Hospital.01	LAYER 1 Floor Tile, Brown, Homogeneous, Solid, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 1 95%	None Detected		Non-Fibrous Material	100%
	LAYER 2 Mastic, Yellow/Gray, Non-homogeneous, Sticky, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 2 5%	None Detected		Non-Fibrous Material	100%
0162955-011 Hospital.02	Cement Board, Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	40% 60%
0162955-012 flea Market.01	Cement Board, Gray, Homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	40% 60%
0162955-013 SU01	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 26°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-014 SU02	LAYER 1 Floor Tile, Red, Homogeneous, Solid, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 1 95%	Chrysotile	5%	Non-Fibrous Material	95%
	LAYER 2 Mastic, Black, Homogeneous, Sticky, melt, non-friable Note: 26°C, 1.55 Oil	LAYER 2 5%	Chrysotile	5%	Non-Fibrous Material	95%
0162955-015 SU03	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0162955-016 SU04	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%
0162955-017 SU05	Gray/Blue, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%
0162955-018 SU06	Shingle, Black, Non-homogeneous, Tar-Like, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	15% 85%
0162955-019 SU07	Vinyl Floor Tile, Gray, Homogeneous, Solid, melt, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0162955-020 SU08	Ceiling Panel, Gray/White, Non-homogeneous, Solid, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	5%	Cellulose Fiber Non-Fibrous Material	25% 70%

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-021 SU09	Gray, Non-homogeneous, Solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0162955-022 SU10	Gray, Non-homogeneous, Solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	7% 5%	Non-Fibrous Material	88%
0162955-023 SU11	Gray, Homogeneous, Granular, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Non-Fibrous Material	100%
0162955-024 SU12	White/Brown, Non-homogeneous, Fibrous, tease, friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	95% 5%
0162955-025 SU13	White/Gray, Non-homogeneous, Fibrous, tease, friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Mineral Wool Non-Fibrous Material	95% 5%
0162955-026 SU14	Gray, Non-homogeneous, Solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0162955-027 SU15	Gray/White, Non-homogeneous, Fibrous, tease, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	40% 60%
0162955-028 SU16	Brown/Gray, Non-homogeneous, Solid, crush, non-friable Note: 27°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	10% 10%	Non-Fibrous Material	80%
0162955-029 SU17	Gray/White, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	30% 70%

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-030 SU18	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile Crocidolite	20% 5%	Non-Fibrous Material	75%
0162955-031 SU19	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	25%	Non-Fibrous Material	75%
0162955-032 SU20	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0162955-033 SU21	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0162955-034 SU22	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%
0162955-035 SU23	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0162955-036 SU24	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile Crocidolite	20% 3%	Non-Fibrous Material	77%
0162955-037 SU25	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0162955-038 SU26	Roof, Black, Non-homogeneous, Tar-Like, melt, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	15% 85%

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-039 SU27	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	25% 75%
0162955-040 SU28	Gray, Non-homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0162955-041 SU29	Gray, Non-homogeneous, Fibrous, tease, friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	15%	Non-Fibrous Material	85%
0162955-042 SU30	LAYER 1 Insulation, Yellow, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 50%	None Detected		Fibrous Glass Non-Fibrous Material	95% 5%
	LAYER 2 Roof, Black, Non-homogeneous, Tar-Like, melt, non-friable Note: 28°C, 1.55 Oil	LAYER 2 50%	None Detected		Fibrous Glass Non-Fibrous Material	15% 85%
0162955-043 SU31	Insulation, Yellow, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	95% 5%
0162955-044 SU32	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Amosite Crocidolite Chrysotile	10% 5% 7%	Non-Fibrous Material	78%
0162955-045 SU33	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	40% 60%
0162955-046 SU34	Gray, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile Amosite	15% 10%	Non-Fibrous Material	75%

BULK SAMPLE ANALYSIS FOR ASBESTOS CONTENT BY POLARIZED LIGHT MICROSCOPY

Laboratory ID - Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
0162955-047 SU35	Gray/Green, Non-homogeneous, Solid, crush, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	Chrysotile	20%	Non-Fibrous Material	80%
0162955-048 SU36	White, Homogeneous, Fibrous, tease, non-friable Note: 28°C, 1.55 Oil	LAYER 1 100%	None Detected		Fibrous Glass Non-Fibrous Material	90% 10%

Analyst - Wesene Sebhat

Approved Signatory Laboratory Director

The EPA method is a semi-quantitative procedure. The detection limit is between 0.1-1% by area and dependent upon the size of the asbestos fibers, the means of sampling and the matrix of the sampled material. The test results reported are for the sample(s) delivered to us and may not represent the entire material from which the sample was taken. The EPA recommends three samples or more be taken from a "homogeneous sampling area" before friable material is considered non-asbestos-containing. Negative floor tile samples may contain significant amounts (>1%) of very thin fibers which cannot be detected by PLM. Confirmation by TEM is recommended by the EPA (Federal Register Vol.59, No.146). Asbestos fibers bound in a non-friable organic matrix may not be detected by PLM. Alternative preparation methods are recommended. This report, from a NIST-accredited laboratory through NVLAP, must not be used by the client to claim product endorsement by NVLAP or any agencyof the U.S. government. This report shall not be reproduced, except in full, without the written approval of EMS Laboratories, Inc. Samples were received in good condition unless otherwise noted.

NVLAP

NVLAP Lab Code: [illegible]

Appendix 4: John Williams Building Report

John Williams Building, Apia, Samoa

Assessment undertaken on 26 September 2014

1. Introduction

A visit was made to the John Williams Building in Apia, Samoa on 26 September 2014 as part of the asbestos component of the EU/SPREP PacWaste Project. This asbestos work covers 11 countries with the first stage of work including an assessment of asbestos arisings and a prioritised list of local best practice options for management. The visit was made by staff from the New Zealand consultants Geoscience Consulting Ltd.

The John Williams Building was included in the project following discussions held with Mr John Mulholland of Fletcher on 22 September 2014. The discussion highlighted that Fletchers during a tender submission to renovate the building had previously tested the roofing material which confirmed it contained asbestos. Mr Mulholland also stated that their tender had been unsuccessful and South Pacific Cladding (SPC) were the chosen contractors.

2. Asbestos Survey

The site survey was conducted by Gareth Oddy of Geoscience Consulting (NZ) Ltd commencing at approximately 09:00 am on Friday 26 September 2014. The John Williams Building is located at the junction of Cross Island Road and Beach Road in Apia, Samoa. Surrounding properties include commercial, residential and a church.

During the site visit commencing at approximately 09:15, the renovation works were observed to be still ongoing with the main contractors South Pacific Cladding (SPC) present on site. The survey was conducted by Gareth Oddy of Geoscience. During the site visit, Mr Oddy requested to speak with the contractor foreman, Mr Patrick Boon to assess if asbestos removal had been conducted and to determine if the works to remove acm were being completed in a satisfactory state.

During the meeting, Mr Boon stated that the building was built by Mainzeal over 30 years ago. He also added that there were lots of rumours of asbestos material being present in the facades but he was confident it was fibreglass. According to Mr Boon the fibreglass facade material removed from site was taken to the Tafaigata Landfill site.

The survey included a review of the external building cladding and internal building material easily accessible and visible to the surveyors. The survey also included a review of surrounding building uses as well as a site walkover of the immediately surrounding public areas including car parking and footpaths.

During the survey, the building construction was noted to be a concrete six storey structure undergoing renovation upgrades including partially complete aluminium cladding to all facades. The roofing material was considered to be predominately metal, however a section of what appeared to be the former roof was visible in the north east corner of the building. The former roof material appeared to be similar in appearance to super six corrugated asbestos cement sheeting.

Pieces of what appeared to be asbestos containing material (ACM) were identified at the window sill on the sixth floor as well being observed on a neighbouring property roof, several scaffolding boards, window ledges, footpaths, the rear car park and SPC compound. The ACM pieces varying in size from approximately 5 - 150 mm were observed on the ground (see photograph 4) surrounding the building covering an area of approximately 500m2. No renovation staff were observed to be wearing suitable PPE for a site containing damaged asbestos materials.

A large stockpile of damaged roofing sheets was observed within the SPC compound to the south of the John Williams Building and south of an adjacent office and residential building.

Photographs of the building and surrounding area taken during the initial site survey on 26th September 2014 are presented below;

Photograph 1: View north of John Williams Building.

Photograph 2: Damaged roofing material observed on 6th floor of John Williams Building.

Photograph 3: View south west from sixth floor of damaged roofing material on scaffolding boards.

Photograph 4: View north west of damaged roofing material on footpath of Cross-Island Road;

Photograph 5; View south west to south east in SPC compound;

Photograph 6: View north in SPC compound of damaged roofing sheets;

Photograph 7; View south west towards John Williams. Former roof (in green) being removed.

3. Post Survey Recommendations

Following the survey, Geoscience met with Ms Jade Tavane of SPREP on Friday 26th September 2014 to discuss the findings. Mr Oddy of Geoscience also met with Si'ili' Aumua Isaia Lameko the deputy chief executive of the Occupational Safety & Health Department of the Ministry of Commerce, Industry and Labour (MCIL) to discuss the survey and potential asbestos identified.

Initial recommendations were made by Geoscience that the renovation works should cease immediately until the asbestos can be removed by a Samoa Ministry of Commerce, Industry and Labour asbestos approved contractor. Additional recommendations including additional personal protective equipment in the form of disposable overalls and P2/3 respirators would be necessary for all personnel working in the building undertaking the removal of asbestos. Further recommendations regarding the safe work method for the removal of any material containing asbestos including wetting the area with a fine mist of water and removing the roofing sheets manually (i.e. no power tools) and in a way that does not break the sheets should be conducted.

We recommend that work at the site ceases immediately to prevent further potential exposure to contractor staff and the public surrounding the site and occupying the building to asbestos fibres. Access to the site should be restricted with areas containing acm barricaded off until it can be all safely removed by a trained and competent asbestos removal contractor who is approved by the Samoan Government.

Following the closure of the site, work should begin to decontaminate the site of acm and asbestos fibres by an approved asbestos removal contractor experienced in asbestos decontamination. This would include the use of an asbestos vacuum cleaner with HEPA filter to be used on all floors and surfaces to collect dust and debris into sealed air tight containers for appropriate disposal in Tafaigata Landfill as hazardous waste.

External land would also be 'picked over' to remove larger pieces of acm debris. While this decontamination work is being conducted, access to the site would be via a decontamination zone.

Access to the site would be restricted to solely the decontamination team to avoid further dispersion of acm and potentially further unnecessary exposure.

To prevent exposure to asbestos fibres, all staff involved handling of acm material and those working within the building should wear respiratory protection. At a minimum this shall include masks with a minimum P2 level of particulate protection. Half face respirators with asbestos fibre filters shall also be made available for workers where required.

Air monitoring for asbestos fibres should be conducted during the removal of suspected asbestos material from the site and remainder of building material to assess whether mitigation measures are adequate for the protection of adjacent receptors.

The stockpile of roofing sheets that are suspected to contain asbestos are being stockpiled in an unsatisfactory condition in an area adjacent to public areas, a church and residential buildings. The material should be placed inside heavy duty plastic bags and sealed. The bags should then be disposed of at the landfill in a hazardous waste dedicated cell.

The Contractor SPC shall also ensure that appropriate application of a dust suppressant is used to minimise the generation of dust and airborne asbestos fibres at the site.

A detailed asbestos survey that includes extensive air monitoring and the taking of wipe and dust samples should be carried out immediately to assess whether fibres from the site are airborne. Once the results of the survey are available and if and where asbestos is identified, then a detailed asbestos removal plan should be prepared and implemented without delay. Elements of this plan are presented above.

The Samoan MCIL, should also be notified of the above issues and recommendations.

The recommendations made are based solely on visual observations made and at this stage have not been confirmed by laboratory analysis. However given experience of other similar aged buildings and other similar roofing material in the pacific together with Fletchers previous test information, a cautious approach should be adopted to the roofing material removal.

For and on behalf of Geoscience Consulting (NZ) Ltd and Contract Environmental Ltd,

Gareth Oddy
Senior Environmental Scientist

John O'Grady
New Zealand Asbestos Certificate of Competence No 7186

Appendix 5: Build Up to Costs for Remediation Options

Four scenarios have been costed:

1. Encapsulate asbestos roofing
2. Encapsulate asbestos exterior wall cladding
3. Remove and replace asbestos roofing
4. Remove and replace asbestos exterior wall cladding

Build ups are mostly based on costs provided by Central Meridian Inc based in Nauru, cross checked against costs in New Zealand.

It is noted that the costs prepared are for preliminary budgeting purposes only. Costs may vary according to local requirements, but we anticipate that the amounts allowed will be adequate to get the work done.

For the cost build ups prepared we have taken the Central Meridian rates, priced in Australian dollars, and converted them to United States dollars at an exchange rate of 0.8. We have then deducted 10% for savings that we anticipate would be achievable through competitive tendering of the work.

Provision has also been made for the works to be overseen by a SPREP appointed asbestos expert. The actual cost for this item will depend on the programme of works achievable and it is noted that this expert could also complete any contract administration and act as engineer to the contract ensuring safety, quality and commercial requirements are achieved.

Central Meridian Quote

central meridian inc

PO Box 106
Republic of Nauru
Central Pacific
T 674 557 3731
AH 674 557 3813
E pfcmnauru@gmail.com
paulfinch1954@gmail.com

02.12.14

Quotation: 6814

Mr John O'Grady
Contract Environmental Ltd.

Cost estimates to undertake various asbestos removal work.

Dear John,

As requested I have detailed below costs to undertake various items of work involved in the removal of asbestos roof sheeting and replacement with colourbond corrugated roofing.

A full schedule of work to be undertaken during the removal and replacement process is detailed to -provide a clear build-up of costs and the relevant stages of work involved.

All work will be undertaken to the relevant NZ & Australian standards for asbestos removal & disposal.

REMOVAL OF EXISTING ASBESTOS ROOF SHEETING.
The costings detailed below are based on a roof area of 165m2. This is a standard size of many of the houses on Nauru with asbestos roof sheeting.
The cost of set up & removal of existing roofing is based on our historical costs for undertaking a number of similar roof removals on the island.
There are additional costs included as detailed:
(a) purchase of a 60 Litre Foamer unit at a price of $5,000.00 (including ocean freight & 10% import duty.) The cost of this is spread over the removal of 20 roofs.
(b) purchase of specialist vacuum cleaner with HEPA filter at a price of $2,000.00 (including freight & 10% import duty.)
(c) delivery to a central staging point for removal off island.

Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective clothing, (PPE) for staff & disposal.
$1,400.00

Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems
$2,200.00

Coat the roof with a sprayed on water based PVA solution.
$1,250.00

Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic & taped shut. Roof sheeting and all materials, (ridging, barge flashing, gutters etc) to be loaded into 'Asbags' for safe removal.
All removed materials will be taken and stored at a suitable staging point ready to be loaded into containers for removal from Nauru.
$4,465.00

Vacuum clean the existing ceiling & roof space, (rafters, purlins, ceiling joists) with a specific vacuum cleaner with a HEPA filter. (dispose of contents of cleaner into an 'Asbag' for correct disposal $325.00

Supply & fit heavy duty tarpaulins to keep the roof waterproof before installation of new roofing. $300.00

TOTAL COST FOR REMOVAL OF EXISTING ROOFING & GUTTERS $9,940.00

INSTALLATION OF NEW ROOF SHEETING, INSULATION, GUTTERING, DOWNPIPES.
We have quoted for Ultra grade of colourbond roof sheeting. This has a greater protective coating & is better for an oceanside environment. (Long life heavy duty).
The sq metre costs & grade of materials for this work are the same as that for the TVET school project in Yaren we have recently completed to AusAID Standard.

Supply & fit 'Kiwisafe' roof netting over existing purlins & fix in place ready to support the 50mm thick, foil coated, fiberglass insulation. Supply & lay a top layer of sisalation foil over the fibreglass insulation blanket. $2,541.00

Supply & screw fix Colourbond Ultra grade corrugated roofing, including for ridging & barge flashings. $7,722.00

Supply & fix Colourbond box guttering to both sides of the roof & include for one downpipe each side, feeding to a tank. $1,060.00

TOTAL COST FOR SUPPLY & FIXING OF NEW ROOF, ROOF INSULATION & GUTTERS & DOWN PIPES. $11,323.00

NB A contingency of 10% may need to be added as necessary for repairs to roof purlins and rafters.

RETENTION OF EXISTING ASBESTOS ROOF SHEETING AND FULL ENCAPSULATION WITH CORRECT PAINT SYSTEM. INCLUDING REMOVAL & REPLACEMENT OF EXISTING CEILINGS.
The square area of ceiling to be replaced & painting to be undertaken is based on a house size of 14m x 12m in size. (168 m2)
Work involved in this process is as follows and detailed below:

Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective clothing, (PPE) for staff & disposal.
$1,400.00

Set up scaffolding to both sides of building to assist in removal of roof sheeting & to remove asbestos guttering from building. Set up anchor point for fall arrest systems
$2,200.00

Spray with Foamshield to the inside of the ceiling space before removal of the sheeting.
$475.00

Disconnect & remove all electrical items, ceiling fans, lights, extractor fans. Allow to store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work. $350.00

Lay down black plastic sheeting to floor of each room, remove all ceiling linings and place all rubbish into Asbags for correct removal & disposal. $1,850.00

Vacuum with specialist cleaner the underside of the existing roof sheeting and all timber roof framing. After removal of ceiling materials vacuum clean all the inside of the premises with vacuum cleaner with specialist HEPA filter. $350.00

Prepare correct paint product to seal & spray 2 coats of protective paint system to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated. A total of 3 coats to be applied. $2,050.00

Supply & fix 4.8mm Masonite sheeting to ceiling of all rooms. Supply & fix 40x10mm timber batten to all sheet joints & to perimeter of each room. $6,370.00 (Standard Ceiling liner)

Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets & perimeter battens. $1,425.00

Reposition all wiring for lights & fans and connect up all fittings as previously set out. $450.00

Prepare to apply 3 coats of specialist paint finish to all the exterior roof area according to painting specifications. $2,250.00

Remove and dispose of correctly asbestos gutters to both sides of the building and supply & install new colourbond box gutters with down pipe each side leading to water tank. $1,760.00

TOTAL COST FOR FULL PAINT ENCAPSULATION OF EXISTING ROOF SHEETING, INCLUDING FOR REMOVAL & REPLACEMENT OF EXISTING CEILINGS & ALL ASSOCIATED WORK. $20,930.00

Thank you for the opportunity to provide a quotation & I await your instructions.

Yours truly,

Paul Finch
Central Meridian Inc.

Build up to Encapsulation of Asbestos Roofing

BUILD UP TO RETENTION OF EXISTING ASBESTOS ROOF SHEETING AND FULL ENCAPSULATION WITH CORRECT PAINT SYSTEM, INCLUDING REMOVAL AND REPLACEMENT OF EXISTING CEILINGS.

The costing detailed below are based on building area of 168m2 (14m x 12m). For roof area multiply by 1.15 to account for the pitch, which gives an area of 193m2.

This estimate assumes that there is an existing ceiling in place within the building, which would need to be treated as asbestos contaminated and removed. Once the ceiling was removed the building would need to be cleaned of asbestos fibres, the existing roof encapsulated, and the ceiling then reinstated. The items relating to the ceiling removal are shaded in blue, and if there was no ceiling then these items could be deducted from the budgeted costs.

The estimate does not include any costs related to removing items from within the building prior to starting works, or putting them back, or any costs relating to the disruption of normal activities in the affected building.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Set up scaffolding to both sides of building to remove asbestos guttering from building and provide safe access to the roof. Set up anchor point for fall arrest systems.	2,200.00	1,760.00	1,600.00
Spray ceiling with Foamshield, or similar particle capture system, to the inside of the ceiling space before removal of the sheeting.	475.00	380.00	345.45
Disconnect and remove all electrical items, ceiling fans, lights, extractor fans. Allow to store safely ready for reconnection after new ceilings are installed. Ensure all wiring is made safe for ongoing work.	350.00	280.00	254.55
Lay down black plastic sheeting to floor of each room, remove all ceiling linings and place all rubbish into Asbags for correct removal and disposal.	1,850.00	1,480.00	1,345.45
After removal of ceiling materials vacuum clean all the inside of the premises with a vacuum cleaner with HEPA filter. Then vacuum the underside of the existing roof sheeting and all timber roof framing.	350.00	280.00	254.55

Prepare correct paint product to seal and spray 3 coats of protective paint system to the underside of all the asbestos roof sheeting. Ensuring that all surface areas are correctly coated.	2,050.00	1,640.00	1,490.91
Supply and fix 4.8mm Masonite sheeting to ceiling of all rooms. Supply and fix 40x10mm timber batten to all sheet joints and to perimeter of each room. (Standard ceiling liner)	6,370.00	5,096.00	4,632.73
Paint with 2 coats of acrylic ceiling paint to all new ceiling sheets and perimeter battens.	1,425.00	1,140.00	1,036.36
Reposition all wiring for lights and fans and connect up all fittings as previously set out.	450.00	360.00	327.27
Apply 3 coats of specialist paint finish to all the exterior roof area according to painting specifications.	2,250.00	1,800.00	1,636.36
Remove gutters to both sides of the building and supply and install new colourbond box gutters with down pipe each side leading to water tank. Transport asbestos contaminated materials to central collection point for disposal (cost of disposal not included).	1,760.00	1,408.00	1,280.00
Oversight by SPREP appointed asbestos management expert	2,875.00	2,300.00	2,300.00
Total	**23,805.00**	**19,044.00**	**17,521.82**
Work back in to a m2 rate for encapsulating asbestos roofs where there is a ceiling present (per area of roof assuming the roof has a 30 degree pitch)		/ 193m2	90.79
Work our alternate rate for where there is no ceiling			
Deduct ceiling related costs shaded in blue			-7,941.82
Adjusted cost for a 168m2 building			9,580.00
Adjusted m2 rate for encapsulating an asbestos roof where there is no ceiling present (per area of roof assuming the roof has a 30 degree pitch)		/ 193m2	49.64

Build Up to Encapsulating Asbestos Cladding

BUILD UP TO RETENTION OF EXISTING ASBESTOS WALL CLADDING AND FULL ENCAPSULATION (INSIDE AND OUT) WITH CORRECT PAINT SYSTEM.

The estimate assumes work is completed in a building 14m x 12m in size = 168m2 (single storey - 2.4m high). Assuming windows and doors account for 10% of building exterior, the total cladding area would be approximately 360m2.

This estimate assumes that there is no internal wall sheeting (eg plaster board) and that the asbestos containing material is exposed. For a scenario where there is internal wall sheeting in good condition within the building, only the exterior would need to be treated. Items where savings could be made in this scenario are shaded in blue.

In a situation where there is internal wall sheeting in poor condition that would need to be removed and replaced, an extra $40/m2 would need to be allowed for as an extra over cost.

The estimate does not include any costs related to removing items from within the building prior to starting works, or putting them back, or any costs relating to the disruption of normal activities in the affected building.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Vacuum clean all the inside of the premises with Vacuum cleaner with specialist HEPA filter. Then vacuum the inside of the existing cladding and all timber framing.	350.00	280.00	254.55
Prepare correct paint product to seal and spray 3 coats of protective paint system to the **outside** of all the cladding. Ensuring that all surface areas are correctly coated. A total of 3 coats to be applied.	3,960.00	3,168.00	2,880.00
Prepare correct paint product to seal and spray 3 coats of protective paint system to the **inside** of all the cladding. Ensuring that all surface areas are correctly coated.	3,960.00	3,168.00	2,880.00
Oversight by SPREP appointed asbestos management expert	2,875.00	2,300.00	2,300.00
Total	**12,545.00**	**10,036.00**	**9,332.73**
Work back in to a m2 rate for encapsulating wall cladding inside and out (per face area of cladding)		/ 360m2	25.92

Work out alternate rate for where there is adequate internal wall sheeting which would mean that the interior of the asbestos cladding would not need to be encapsulated.		
Deduct interior encapsulation costs		-2,880.00
Adjusted cost		6,452.73
Adjusted m2 rate for encapsulating asbestos cladding where there is adequate internal wall sheeting (per face area of cladding)	/ 360m2	17.92
Work out alternate rate for where the internal wall sheeting is in poor condition and would need to be stripped out and replaced.		
Add in cost of removing the existing interior walls and replacing after encapsulation		14,400.00
Adjusted cost (360m2 of cladding)		23,732.73
Adjusted m2 rate for scenario where internal wall sheeting is in poor condition and also needs to be stripped out and replaced.	/ 360m2	65.92

Build Up to Removing and Replacing Asbestos Roofing

BUILD UP TO REMOVAL OF EXISTING ASBESTOS ROOF SHEETING.

The costing detailed below are based on building area of 168m2 (14m x 12m). For roof area multiply by 1.15 to account for the pitch, which gives an area of 193m2.
The costs are as worked out with Central Meridian, who are an experienced contractor based in Nauru.
Transport and packaging costs are allowed for bring asbestos containing materials to a central point but disposal costs are excluded and treated separate.

Purchase of a 60 Litre FoamShield unit at a price of $5,000.00 (including ocean freight and 10% import duty) is allowed for and the cost of this is spread over the removal of 20 roofs.

Purchase of specialist vacuum cleaner with HEPA filter at a price of $2,000.00 (including freight and 10% import duty) is allowed for and the cost of this is spread over the removal of 20 roofs.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE) for staff.	1,400.00	1,120.00	1,018.18
Set up scaffolding to both sides of building to assist in removal of roof sheeting and to remove asbestos contaminated guttering from building. Set up anchor point for fall arrest systems.	2,200.00	1,760.00	1,600.00
Coat the roof with a sprayed on water based PVA solution.	1,250.00	1,000.00	909.09
Carefully remove the roof sheeting by unscrewing, (not breaking) the roof sheets. All roof sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic and taped shut. All removed materials will be taken and stored at a suitable staging point ready to be disposed of.	4,465.00	3,572.00	3,247.27
Vacuum clean the existing ceiling and roof space, (rafters, purlins, ceiling joists) with a specialised vacuum cleaner with a HEPA filter. Dispose of contents of cleaner into an 'Asbag' for correct disposal	325.00	260.00	236.36
Supply and fit heavy duty tarpaulins to keep the roof waterproof ready for installation of new roofing.	300.00	240.00	218.18

Oversight by SPREP appointed asbestos management expert.	2,875.00	2,300.00	2,300.00
Total	12,815.00	10,252.00	9,529.09

Work back in to a m2 rate / 193m2 49.37

BUILD UP TO INSTALLATION OF NEW ROOF SHEETING, INSULATION, GUTTERING, DOWNPIPES.

The cost estimate allows for Colourbond Ultra grade roof sheeting and 50mm of foil coated fibreglass insulation. This has a greater protective coating and is better for an oceanside environment. (Long life heavy duty.)

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Supply and fit 'Kiwisafe' roof netting over existing purlins and fix in place ready to support the 50mm thick, foil coated, fiberglass insulation. Supply and lay a top layer of sisalation foil over the fibreglass insulation blanket.	2,541.00	2,032.80	1,848.00
Supply and screw fix Colourbond Ultra grade corrugated roofing, including for ridging and barge flashings.	7,722.00	6,177.60	5,616.00
Supply and fix Colourbond box guttering to both sides of the roof and include for one downpipe each side, feeding to a tank.	1,060.00	848.00	770.91
NB A contingency of 10% may need to be added as necessary for repairs to roof purlins and rafters.	1,132.30	905.84	823.49
Total	**12,455.30**	**9,964.24**	**9,058.40**

Work back in to a m2 rate / 193m2 46.93

SUMMARY OF COSTS TO REMOVE ROOF AND REPLACE WITH NEW ROOF

Cost to remove old roof	49.37
Cost to install new roof	46.93
Total cost to remove and replace asbestos roofing (per m2 of roof area)	**96.31**

Remove and Replace Asbestos Cladding

BUILD UP TO REMOVAL AND REPLACEMENT OF ASBESTOS WALL CLADDING.

The estimate assumes work is completed on a building 14m x 12m in size = 168m2 (single storey - 2.4m high). (Assume windows and doors account for 10% of building exterior, the total cladding area would be approximately 360m2).

If a building was two stories it is recommended that USD12.00 is added per m2 for scaffolding. This figure is a rough estimate only but should provide adequate coverage.

Item	AUD estimate (based on Central Meridian costings)	Convert to USD (0.8 exchange rate)	Reduce by 10% to account for competitive tendering
Establish asbestos boundaries, mark out the property, set up relevant warning signage around the property, decontamination entry points, personal protective equipment (PPE).	1,400.00	1,120.00	1,018.18
Coat the walls with a sprayed on water based PVA solution.	1,875.00	1,500.00	1,363.64
Carefully remove the existing cladding. All wall sheets to be stacked onto plastic sheeting sitting on bearers for ease of removal. Sheeting to be fully wrapped in plastic and taped shut. All misc asbestos contaminated material to be loaded into 'Asbags' for safe removal. All removed materials will be taken and stored at a suitable staging point ready to be disposed of.	6,697.50	5,358.00	4,870.91
Vacuum clean the existing wall cavities with a vacuum cleaner with a HEPA filter. (Dispose of contents of cleaner into an 'Asbag' for correct disposal	325.00	260.00	236.36
Wrap the building in building foil, supply and fix composite cement board sheeting to exterior of buildings. Supply and fix treated 40mmx10mm timber batten to all sheet joints.	18,000.00	14,400.00	13,090.91
Paint with 2 coats of acrylic paint to all new wall cladding sheets and perimeter battens.	3,060.00	2,448.00	2,225.45
NB A contingency of 10% may need to be added as necessary for repairs to framing.	3,135.75	2,508.60	2,280.55
Oversight by SPREP appointed asbestos management expert.	2,875.00	2,300.00	2,300.00
Total	**37,368.25**	**29,894.60**	**27,386.00**

Work back in to a m2 rate for removing and replacing asbestos cladding (per face area of cladding)	/ 360m2	76.07