Initial Environmental Examination for new SHPP schemes

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Samoa Renewable Development and Power Rehabilitation Project Preparation

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Prepared by STR + P&P for the Asian Development Bank

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Abbreviations

ADB	Asian Development Bank
ASL	Above Sea Level
CEAR	Comprehensive Environmental Assessment Report
CEMP	Construction Environmental Management Plan
COEP	Codes of Environmental Practice
DEC	Division of Environment and conservation
EIA	Environmental Impact Assessment
EMP	Environmental management plan
EPC	Electric Power Corporation
FD	Forest Division
GHG	Greenhouse gas
GoS	Government of Samoa
IEA	Initial Environmental Assessment
IEE	Initial environmental examination
KBA s	Key Biodiversity Area
kW	Kilowatt
MAF	Ministry of Agriculture and Fisheries
MFAT	Ministry of Foreign Affairs and Trade
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finances
MW	Megawatt
MWCSD	Ministry of Women, Community and Social Development
MWTI	Ministry of Works, Transport and Infrastructure
NGO	Non-government organisation
NUS	National University of Samoa
PEAR	Preliminary Environmental Assessment Report
PMU	Project management unit
PSEP	ADB Power Sector Expansion Project
PUMA	Planning and Urban Management Act 2004
SPESP	Samoa Power Expansion Project Sector Project
SPREP	South Pacific Regional environmental Program
SROS	Scientific Research Organisation of Samoa
USP	University of South Pacific
WRD	Water Resources Division

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1. Executive Summary

The objective of the proposed project is to assist the government's efforts to reduce the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally sound source of electricity for the consumers, the project proposed to construct and implement 7 small hydropower schemes and to rehabilitate existing 3 hydropower schemes damaged by recent cyclone (Evan 2009).
The following new hydropower plant schemes are prioritized by EPC to be included in the project: (i) Fuluasou; (ii) Faleata; (iii) Tafitoala; (iv) Faleaseela, v) Vaipu, vi) Tiapapata, vii) Vaisigano. The rehabilitation of existing power plants includes: (i) Samosoni Hydropower; (ii) Fale ole Fee hydropower; (iii) Alaoa Hydropower.
Two "Initial Environment Examination Reports" has been prepared: one Report for the rehabilitation and another one for the new schemes sub-projects. The present IEE deals with the creation of new infrastructures. A Resettlement Plan (RP) has been prepared to assess and address potential resettlement impacts associated with land that may be taken or affected during project implementation for all hydropower plant schemes under this Project.
Most of the potential impacts generated by the sub-projects constructions works like forest clearance for the opening of access roads, soil pollution by spill, soil erosion, noise from engines and works, and riverbanks degradation, etc. can be easily reduced or avoided if the mitigation measures contained in the EMP are correctly implemented and monitored.
Ecological flow should be developed for all sites.
The possibility of fish pass structures will be studied during final design stage.
A grievance redress mechanism will be developed for any complain issued by near-by residents.
The Vaipu and Vaisigano sub-project are at an early stage of preparation and more information should be collected before confirming their feasibility.
The Vaipu sub-project development depends on the results of the river flow measurements, which weren't available at the time of this assessment. The Vaigafa River from which the water should be abstracted to be pumped into the Afulilo reservoir feeds also two waterfalls, which are main tourist attractions in Samoa. Water abstraction could affect drastically these spectacular waterfalls.
For this sub-project, there are three options for the pipeline route from the intake site.
One option, the most rentable one, that goes directly to the penstock leading to the powerhouse should be rejected as it crosses the last wetland in Samoa with endemic and threaten species. The two others leading to the Afulilo reservoir along the main road are more acceptable.
The Vaisigano sub-project is a large dam project and because of its size and the various constructions foreseen it should undergo a full environmental assessment. Moreover this sub-project is located in the Vaisigano catchment, which is an area officially recognised for its biodiversity: the key Biodiversity Area (KBA). It also known as an important Bird's place where the Samoan threatened and endemic species are thriving. Since a number of HPPs already exist in the Vaisigano catchment area, it will be necessary to study the consequences of a new dam in the western tributary of the Vaisigano East Branch on the existing HPPs. The Alaoa HPP intake is located several km upstream, in the same valley as the proposed dam. If the dam will be realised, the currently damaged Alaoa intake and long headrace channel would become obsolete.

Fuluasou

The Fuluasou HPP project is predominantly in a highly impacted area where further development is unlikely to impact on populations of any rare or endangered species of bird, plant, mammal, reptile, invertebrate or freshwater fish. The ecological significance of the proposed Fuluasou hydropower project is relatively low. The site was formerly a

hydro power plant but due to damage is not in current use. However, there is some forest surrounding the existing dam and reservoir and along the penstock alignment so the preservation of native tree species and replanting of native tree species are recommended around the dam and reservoir, and along the penstock route. The upper Fuluasou catchment is located within the Apia Catchments Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation and is also a critical watershed area for Samoa supplying water for much of Apia. Careful management of this catchment is essential.

Tiapapata

The Tiapapata HPP project is in a remote, forested and steep area that has some important ecological values including a large number of native birds and patches of native forest. The proposed development is likely to result in significant forest clearance for road construction, and later construction of HPP infrastructure including a water intake, water race, headpond, penstock and a powerhouse. The project requires construction works to occur within remote areas of forest over a considerable distance from the intake to the proposed powerhouse. The proposed infrastructure development at the Tiapapata HPP will have the greatest impact of any project on native wildlife such as the endangered Manumea and Mao since this development will occur in deeper parts of the forest, away from current developments. It is also located in the Vaisigano Key Biodiversity Area (KBA). This area is not only important for the Manumea bird but also for other Samoan native birds. The threatened parrot finch and the Samoan broadbill, and seabirds breed in this area particularly along the penstock route.

Faleaseela

The Faleaseela HPP project is in a modified catchment and is unlikely to result in significant impacts on native biodiversity as long as forest clearance is kept to a minimum and construction of works is designed to maintain stream flows.

Although the fish diversity in the Faleaseela River is moderate, the crustacean diversity is high. The bird diversity is also high and the site is important for a number of rare and endangered birds such as the Maomao and the Samoan Broadbill. Because this site is on the forest edge the development is unlikely to substantially increase predation rates on endangered bird nests by invasive nest predators. However it may impact bird populations in other ways particularly through loss of habitat

Faelata

The Faleata HPP project is in a modified catchment but with some important biodiversity values. Although the fish diversity in the Faleata River is moderate, there are two endemic fish in the stream and the crustacean diversity is high. The bird diversity is also high and the site is important for a number of rare and endangered birds such as the Mao and the Samoan Broadbill and possibly the Manumea. The upper headwaters of the Faleata River are in the Upland Savaii Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation.

The two proposed HPP options will have varying impacts on native biodiversity. Option A (using the current SWA intake and penstock) would have little impact on the native biodiversity since the majority of the infrastructure is already in place, apart from the powerhouse, there would be little or no increase in the current extraction rates from the river and little good quality forest would have to be removed. However, option B (installing a new intake to take more water, constructing a new penstock, powerhouse and tailrace) would require considerably more development with a road proposed along the pipeline thereby reducing habitat for native species and also removing more water from the stream, which will impact on freshwater biodiversity. Because this site is on the forest edge it is unlikely to substantially increase predation rates on birds by invasive nest predators.

Tafiotala

The Tafitoala HPP project is in a modified catchment but with some important biodiversity values. The fish diversity in the Tafitoala River is high, with two, possibly three, endemic fish in the stream. The crustacean diversity is also high. There is also a large Tongan flying fox roost near the proposed intake site (*Pteropus tonganus*). The bird diversity is quite low however.
Some forest clearance will be required for this HPP especially at the intake site. Construction works may disturb the flying fox roost and will have impacts on local avifauna. The proposed penstock, powerhouse and tailrace are in already highly modified areas and the impact to the native biodiversity will be minimal.

Adaptation of climate change is already included in the design in relation to the protection from flooding of the powerhouse, with the calculation of the occurrence, normally for a 50 years maximum climatic event, set now to 100 years

These subprojects, without Vaipu and Vaisigano, will achieve a net reduction of greenhouse gas emissions of around **6,070** tons of CO2 per year. This corresponds to a fuel savings amount of **2,265** litres for electricity generation.

2. Background

1. The proposed project has been included in ADB's Country Operations Business Plan 2012-2014 and country Partnership Strategy (2008-2012). The project will be financed through ADB grants and a Loan from ADB's Asian Development Fund (ADF). The energy sector in Samoa is highly vulnerable to rising international oil prices, characterized by a heavy reliance on imported petroleum rather than on renewable energy sources for power generation. Sixty percent of the electricity is generated by diesel generators, 38.9% by hydropower plants, 1% by biofuel (coconut oil) plants, and 0.1% by solar generators. For the power utility, the Electric Power Corporation (EPC), fossil fuel is by far the single largest expense item representing 74% of total generation costs and 51% of overall costs. The utilities power asset management is still under development, hence power distribution system has about 20% losses, and the average tariff of electricity fluctuates between $0.40 - $0.55 per kilowatt hour (kWh). Developing indigenous and renewable energy sources is a viable solution for achieving energy sector priorities, as it will deliver socially acceptable, technically feasible, and affordable electricity services.

2. Samoa comprises two main islands; Savai'i and Upolu, where the capital city Apia is situated, and two isolated outer islands. EPC's power system in Savai'i and Upolu, each has independent grids, while small stand-alone solar and diesel generation schemes operate on the two isolated outer islands. The total installed power generation capacity mix of EPC in 2011 was 42 megawatt (MW), composed of 30 MW diesel generators, 11 MW run of river hydropower plants, 1 MW biofuel power plants, and small distributed solar generators in the few kilowatt (kW) range, generating about 121.4 gigawatt-hour (GWh) of electricity. About 95% of the population has access to grid electricity, while the remaining 5% is connected to small diesel generators or solar systems.

3. The objective of the proposed project is to assist the government's efforts to reduce the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally sound source of electricity for the consumers, the project proposed to construct and implement 4 small hydropower schemes and to rehabilitate existing 3 hydropower schemes damaged by recent cyclone.

4. Under the Loan - Power Sector Expansion Project, technical feasibility and environmental studies for small hydropower schemes of four rivers in Upolu and one river in Savaii was undertaken. No Resettlement Plan (RP) was prepared for the sub-projects. The four rivers studies for the feasibility study are in Upolu: Faleseela, Tafitoala, Fuluasou and Vaisigano West Branch (Tiapapata), and two in Savaii are Faleata and Sili/Vaitai. However, Electric Power Company (EPC) has prioritized 4 new hydropower schemes and rehabilitation of three existing schemes for this proposed Renewable Energy Development and Rehabilitation Project. The proposed project is located in the island of Upolu. The project include 2 components: (i) component one comprises the implementation of new hydropower schemes; (ii) component two includes the rehabilitation and invest plan for existing power plants damaged by cyclone.

5. The following new hydropower plant schemes are prioritized by EPC to be included in the project: (i) Fuluasou; (ii) Faleata; (iii) Tafitoala; (iv) Faleaseela, v) Vaipu, vi) Tiapapata, vii) Vaisigano. The rehabilitation of existing power plants includes: (i) Samosoni Hydropower; (ii) Fale ole Fee hydropower; (iii) Alaoa Hydropower.

6. Two “Initial Environment Examination Reports” has been prepared: one Report for the rehabilitation and another one for the new schemes sub-projects. The present IEE deals with construction of new infrastructures. A Resettlement Plan (RP) has been prepared to assess and address potential resettlement impacts associated with land that may be taken or affected during project implementation for all hydropower plant schemes under this Project.

7. . The present IEE, deals with the creation of new infrastructures and has been prepared in accordance with applicable laws and regulations of GOS and safeguard policies of ADB on Environmental Impact Assessment. Given that the detailed technical design of the hydropower schemes will be done during implementation of the project, an actualisation of these IEE and a full EIA whenever deemed necessary will be prepared. The Ministry of Finance (MOF) is the project executing agency and the EPC is the project implementing agency.

8. The Project will have the following Outcomes and Outputs – The Output and the 3 main Outcomes of this project are:

- Outputs of Outcome (i): Development of a renewable source of energy
- Output 1 – Increase hydro generation and hence reduce diesel fuel consumption
- Output 2 – Reduce cost of electricity or minimize fluctuations due to diesel fuel price increases
- Output 3 -Sustainable development

3. Project description

9. Samoa is an oceanic, volcanic archipelago with a land area of 2,820km2. It is composed of two main islands, Upolu (1,115km2) and Savai'i (1,700km2) (refer Map in Figure 1) and seven small islands.

The capital of Samoa is Apia, which is located on the island of Upolu. Samoa's economy is reliant on foreign imports (20-25 per cent of GDP), remittances (25 per cent of GDP), and foreign aid.

Fisheries, construction and, agriculture and small-scale manufacturing also contribute to GDP.

Figure 1 Map of Samoa (source: http://www.lib.utexas.edu/maps/islands_oceans_poles/western_samoa.jpg)

10. The hydropower plant schemes under this project are located in the island of Upulo and the island of Savai'

3.1 Component 1: Implementation of 5 SHPP schemes

3.1.1 Fuluasou

key data: **730 kW; 2,770 MW/a; 5.7 MUSD**

11. This project will be based on the former HPP scheme installed at this area. The old scheme is out of service already for many years and from the penstock and powerhouse with the generation units only some fragments left. The new project will use the still existing concrete dam, the old penstock route and the location of the powerhouse

Intake:

12. Existing concrete dam, refurbishment without major technical changes.

Reservoir: as existing, there will not be changes of extension or water level since the dam will not be changed neither storage capacity: the existing reservoir will be excavated/desilted to re-establish the original storage capacity

Headrace:

13. A new penstock will be installed from the dam down to the powerhouse. A buried penstock is proposed. The route will be the same as for the old penstock, where required smaller adaptations of the rout to the current situation can be done during detail design. The penstock rout follows in the upper section the access road and afterwards runs through an area with some settlements and a golf course. Thus no forest clearance is required.

Powerhouse:

14. The new powerhouse will be located at the plot of the former powerhouse, adjacent to the riverbed. Thus the tailrace water can be released directly back into the riverbed. Next to this plot currently a new substation with a new National Control Center for the transmission grid is in installation

Access road:

15. There is an existing access road to the intake as well as to the powerhouse

Grid connection:

16. The connection point to the grid is in the new Fuluasou substation. An earth laid cable connection is proposed

3.1.2 Tiapapata

key data: **510 kW 3,240 MWh/a 6.0 MUSD**

17. The intake of this new HPP scheme is located on the western branch of the Vaisigano River. The powerhouse will be located at the middle branch, thus the diverted water from the western branch will be discharged into the middle branch, upstream of the existing intake for the Alaoa HPP. Thus, the diverted water can be used two times, first from the new Tiapapata HPP scheme and afterwards a second time from the existing Alaoa HPP.

Intake:

18. A Tyrolean weir with sand trap is proposed, no reservoir

Headrace:

19. The headrace consists of two sections, a channel/pipe section from the intake to a head pond and from there a penstock to the powerhouse. An alternative option could be a continuous penstock from the intake to the powerhouse. The entire headrace route is located in forest area, thus forest clearance is required for the penstock route

and a temporary access road during construction.

Powerhouse:

20. The new powerhouse will be located adjacent to the riverbed of the middle branch. Thus the tailrace water can be released directly into the riverbed. Site and forest clearing is required.

Access road:

21. New access roads must be constructed. One access rioad will be constructed from the cross-island road down a slope to the intake and the second from the existing Alaoa middle branch intake up to the powerhouse. The detailed route must be defined during detail design but will be in a forest area, thus forest clearance is required.

Grid connection:

22. The connection point to the grid is at the existing Alaoa HPP. An earth laid cable connection is proposed.

3.1.3 Faleaseela

key data: **190 kW 1,060 MWh/a 2.2 MUSD**

23. This project is a new HPP scheme. The intake and powerhouse are located on the Faleaseela River upstream of the village.

Intake:

24. A Tyrolean weir with sand trap is proposed, no reservoir

Headrace:

25. The headrace consists of a penstock. The upper section runs down a slope to the existing access road, following this road till to the powerhouse location. Forest clearance is required only for the upper section.

Powerhouse:

26. The new powerhouse will be located adjacent to the riverbed. Thus the tailrace water can be released directly into the riverbed. Site and forest clearing is required.

Access road:

27. Short new access roads must be constructed from the existing road up to the intake and down to the powerhouse. The detailed route must be defined during detail design but will be in a forest area, thus forest clearance is required.

Grid connection:

28. The connection point to the grid is in the village to the 22kV South coast feeder.

3.1.4 Faleata

key data: **550 kW 1,050 MWh/a 1.8 MUSD**

29. This project is a drinking water HPP scheme on Savai' island. The same water, which is used from the SWA water treatment plant for water supply will be, used prior for power generation. The technical details must be defined during detail design, dependent on the hydrological data and the SWA requirements. Two options are possible: using only the required water amount for water supply or use all available water of the river and discharge the surplus water after the HPP to the river bed.

Intake:

30. The existing SWA intake or optionally a new Tyrolean weir with sand trap is proposed, no reservoir

Headrace:

31. The headrace consists of a penstock, either the existing SWA pipe or a new penstock, replacing the existing one on the same route.

Powerhouse:

32. The new powerhouse will be located on the area of the SWA treatment plant. Dependent on the option, a new tailrace must be constructed

Access road:

33. The existing access road leads close to the intake and has to be extended. For the access to the powerhouse the existing road to the water treatment plant can be used.

Grid connection:

34. The connection point to the grid is to the existing power line at the water treatment plant.

3.1.5 Tafitoala

key data: **460 kW 1,680 MWh/a 4.8 MUSD**

35. This project is a new HPP scheme. The intake is located at the western branch of the river and as well as the powerhouse upstream of the village.

Intake:

36. A Tyrolean weir with sand trap is proposed, no reservoir

Headrace:

37. The headrace consists of a penstock. The upper section runs down a slope to the existing access road, following this road till to the powerhouse location. Forest clearance is required only for the upper section.

Powerhouse:

38. The new powerhouse will be located adjacent to the riverbed. Thus the tailrace water can be released directly into the riverbed. Only minor site and forest clearing is required.

Access road:

39. Short new access roads must be constructed from the existing road up to the intake and down to the powerhouse. The detailed route must be defined during detail design but will be in a forest area, thus forest clearance is required.

Grid connection:

40. The connection point to the grid is in the village to the 22kV South coast feeder.

3.1.6 Vaipu

41. The proposed scheme foresees the construction of a pumping station at the Vaigafa stream near Vaipu and to pump water up to the Afulilo reservoir, or directly into the penstock of the Taelefaga HPP. Additional power can be generated by the usage of this water by the existing Taelefaga HPP. The gain of energy results from the fact that the water has to be pumped up only 70m, but can then be used with a gross head of 299m for power generation.

42. The feasibility study presents three possible options:

- Option 1: Pumping line along the existing road.

- Option 2: Pumping line half way up the existing road, then cross country towards the dam and finally by gravity into the reservoir.
- Option 3: Pumping line directly to the power conduit of the Taelefaga HPP and connecting in front of the existing tunnel.

key data

43. 320kW 700 MWh/a 1,450 MUSD

Intake:

44. Tyrolean weir with sand trap

Headrace:

45. Penstock 1,6 km

Pumping station

3.1.7 Vaisigano

key data

46.

Intake:

47. A 80 m height rock fill dam of an approximately length of 90m

Reservoir

48. Of 60m depth containing 1 million m3 extending 700m upstream

Powerhouse:

49. Will be located approx. 2000m downstream, in the vicinity just upstream of the existing Samasoni intake/the Fale ole Feh powerhouse

Access road:

50. Approx. 1200m from the Alaoa powerhouse upstream till to the dam location

Figure 2: Map of the project Area

4. Institutional, Regulatory frameworks and Policies

4.1 Institutional framework

51. This project will be developed under the Ministry of Finance (MOF).

- **The implementing agency is EPC.**

52. As the sole provider of electricity in Samoa, the Electric Power Corporation (EPC) continually reforms itself to fulfill its core function, which is to generate, transmit, distribute and sell electricity. Currently, the Corporation with the exception of the Upolu streetlights installation implements also non-core functions:

- Design of power system,
- Installation and maintenance of generation equipment,
- Installation of some distribution and utilization equipment,
- Repair of motor vehicles,
- Perform Government Community Service Obligations (CSOs),

53. Initially under the Ministry of Works Transport and Infrastructure it became independent (Corporate body) in 2011 but with strong links with its former Ministry.

4.1.1 The other relevant institutions directly concerned by the project are:

- **Ministry of Natural Resources and Environment (MNRE)**

54. The ministry of Environment has several principal divisions covering all aspects of the environment: i) Disaster Management, ii) Environment and Conservation, iii) Forest Division, iv) Global Environment Facility, v) Land management, vi) Meteorology, vii) PUMA, viii) Renewable Energy, ix) Water Resources.

MNRE is the Implementing Agency for the IWRM (GEF) and the Hycos project (EU) through its WRD, and for the SSDP (ADB) through PUMA, in particular for the capacity building component.

55. The main divisions concerned by the project are:

  - The PUMA (Planning and Urban Management Act 2004)

56. The Agency reviews and assesses the EIA being submitted by the proponent. This process ensures that all the relevant information is included to ensure that an informed decision is easily made about the proposed development. The EIA must be in accordance with the EIA Regulations 2007. The review of EIA reports for major developments is usually submitted to the Board for a decision while sometimes the Agency may process and make its decision on the approval of EIAs for minor developments.

  - Division of Environment Conservation
  - Division of Water Resources

57. Controls the water resources or the watershed under the Water Resources Management Act 2008-2011

58. The domain of the sector includes the regulation, development and use of all fresh water resources as well as the receiving coastal waters in Samoa. Over the years, sanitation has evolved as a priority issue in the sector. It is responsible for water resource management and includes policy and regulation, watershed management, hydrological and hydro-geological investigation, and water quantity monitoring. This Division has the appropriate equipment for water management and monitoring.

- Division of Forestry is in charge of delivering permits to harvest trees (Forestry harvesting Permit)

- **Ministry of Works, Transport and Infrastructure (MWTI))**

59. It regulates the construction of buildings and issue building permits, to construct, maintain and manage the public assets, in the project case, the construction of access roads.

Each Government Department or agency is responsible for the construction and maintenance of its buildings

The Ministry of Works, Transport and Infrastructure (MWTI) is responsible for drainage and storm water management, especially in relation to the development of road infrastructure and power lines.

- **Ministry of Finances (MOF)**

60. This project has been placed under this Ministry because it is financed by external aid.

- **Ministry of Women, Community and Social Development (MWCSD)**

61. Any land acquisition needed under this project will have social implications and transformations and each case will have to refer to this Ministry.

The Ministry of Women, Culture and Social Development (MWCSD) through its Internal Affairs Division, is facilitating in the provision and improvement of water supply and sanitation services in Village Managed Schemes (VMS), and assisting MNREM in water resources management at community level.

- **Ministry of Commerce, Industry and Labour (MCIL)**

62. It regulates labour conditions and the contractors and its manpower will have to comply with Samoan Legislation.

- **The Samoa Water Authority**

63. The Samoa Water Authority (SWA) is the national service provider of water supply and more recently for sanitation, sewerage and wastewater treatment. The SWA also monitor their own water supplies and have a water quality laboratory to support these activities. Because the drinking water is collected in the same river where SHPP will be or are installed it requires good coordination between EPC and SWA.

- **The Ministry of Agriculture and Fisheries MAF**

64. The Ministry of Agriculture, Forestry and Fisheries (MAFF) is responsible for the promotion, and sustainable development and management of irrigation services, and assists MNREM/WRD in the prevention and monitoring of uncontrolled clearance of forests for agriculture in watershed areas.

It is related to the project for the conservation of the watershed through the control of the crop field's development

- **The Ministry of Health**

65. The Ministry of Health (MOH) is responsible for water quality monitoring, inspection and investigation of water safety issues.

- **Indirectly the other institutions concerned are:**
- the SROS (Research institution)
- the Samoa University

66. These institutions may be called on for specific analysis if needed during the monitoring phase.

4.2 Legal framework

67. The relevant regulatory framework for this project is the following:

4.2.1 Lands, Surveys and Environment Act 1989

68. Section 95 of the Act outlines the principal functions of the Ministry of Natural Resources and Environment (MNRE) which include:

69. Advising the Minister on all aspects of environmental management and conservation including:
    - the potential environmental impact of a public or private development proposal; and
    - to act as the advocate of environmental conservation at Government, its agencies, and other public authorities with advice on procedures for the assessment and monitoring of environmental impacts.

70. Relevant to the PEDAP is Section 23, which covers the purchase of private land or Government interest in land. Under this section, the Government may, with the approval of the Minister, purchase any freehold land, or the interest of a lessee in any Government land for a Government purpose.

4.2.2 Planning and Urban Management Act 2004

71. The Planning and Urban Management Act 2004 (PUMA) sets out the framework for the planning, use, development, management and protection of land in Samoa. It describes the process where an environmental impact assessment will be required as follows:

72. Section 42: Environmental Impact Assessment –

(1) The Agency may require an applicant under Section 37 to provide an environmental impact assessment in relation to the proposed development to which the development application relates.

(2) Where the Agency decides that an environmental impact assessment shall be prepared, the format, structure, subject matter of any such assessment and any other related matter, shall be specified in writing by the Agency to the applicant and the applicant shall comply with the Agencies requirements under this section

The Act also outlines the process of notification of applications and also the submissions on development applications.

4.2.3 Environmental Impact Assessment Regulations 2007

73. EIA's in Samoa are regulated by the Environmental Impact Assessment Regulations 2007

(Regulations). The Planning and Urban Management Agency (PUMA) administer the EIA process, establishing what level of EIA is required, the aspects that need to be included and the process for review and approval.

74. When an EIA is required under Section 42 of the PUMA Act, it must be prepared and provided in the manner prescribed under these regulations.

75. Section 4 of the regulations prescribes the two forms of EIA:
    1) A Preliminary Environmental Assessment Report (PEAR) and;
    2) 2) A Comprehensive Environmental Assessment Report (CEAR).

A PEAR is required when the Agency considers an activity requiring consent is not likely to have a significant adverse impact on the environment. A CEAR is required when a development is likely to have a significant adverse impact on the environment.

76. Under Section 34 of the PUMA Act, all development needs consent, unless a

sustainable management plan or regulations provides otherwise.

77. The Regulations also outline:
- Baseline and compliance monitoring (Section 8);
- Reviews of the environmental assessment (Section 9 and 10); and
- Public Consultation (Section 11).

Schedules attached to the Regulations detail the content of the PEAR and CEAR.

78. From MFAT Environmental and Social Impacts Guideline (30August 2012 Document ID: 6111649)

The following categories reflecting the level of impact or risk and the type of impact assessment required development

Category	Description	Assessment
A	The Activity has the potential to cause significant adverse impacts considered irreversible or unprecedented, and which extend beyond the physical footprint of the Activity	Comprehensive impact assessment covering the full range of environment and/or social impacts, and impact management plan
P (A)	Same as for 'A' but where Activity is being implemented by a Partner agency	Impact assessment and management procedures by the Partner will be evaluated and, if required, supplementary work requested to ensure conformity with the requirements of this policy
B	The Activity has the potential to cause adverse site-specific impacts, which are potentially reversible or more easily mitigated than for category 'A'. As part of the design phase an impact assessment is to be conducted covering adverse impacts only, along with an impact management plan demonstrating how these will be addressed	Impact assessment and impact management plan covering adverse impacts only
P(B)	Same as for 'B' but where Activity is being implemented by a Partner agency	Impact assessment and management procedures by the Partner will be evaluated and, if required, supplementary work requested to ensure conformity with the requirements of this policy
C	Minimal or no adverse impacts	None – no further action needed

79. Examples of category A

• New airstrips, ports, and related transport infrastructure
•Activities taken place within or immediately adjacent to nationally or internationally designated area of conservation or heritage
• Large-scale industrial or agricultural Activity
• Large-scale land reclamation or coastal development
• Large-scale commercial fishing and logging
• Large-scale forestation/reforestation, including logging operations
• Large-scale aquaculture/marine culture
• Use of mangroves or wetlands
• Dams or other large-scale water impoundments
• Water drainage, abstraction, or irrigation schemes of medium- or large-scale

80. Example Activities: Category B

• Maintenance or rehabilitation of roads, airstrips and other infrastructure
• Construction of new minor roads and medium-scale infrastructure such as public utilities
• Agro-industry projects of small and medium-scale
• Small-scale coastal developments
• Small-scale dams and water impoundment, irrigation and drainage schemes

• Small and medium-scale aquaculture and marine aquaculture
• Small and medium-scale wind and solar farms
• Small-scale bio-energy development
• Small and medium-scale commercial fishing and logging

81. Example Activities: Category C

• Scholarships
• Technical assistance
• Workshops and meetings
• Research and extension in natural resources
• Replacement small-scale infrastructure (e.g. new electricity pylons) and maintenance of existing installations
• Capacity and institutional strengthening
• Health and education programs that do not include infrastructure
• Business mentoring

82. PEAR shall contain the following particulars:

(a) a brief description of the development proposal;

(b) a brief description of the area to be affected and the nature of the proposed change to the area (including a location map and site plan);

(c) a brief justification for the development proposal;

(d) a summary of the stakeholder consultation undertaken, the general issues raised, and responses to those issues;

(e) an assessment of all reasonably foreseeable adverse and positive environmental impacts, including long-term and short-term, primary and secondary consequences;

(f) an indication of possible alternatives to mitigate any identified adverse environmental impacts; and

(g) an indication of measures that the proponent intends to take to mitigate or avoid identified adverse environmental impacts.

4.2.4 Water permit and water management Act

83. This project will need to apply for a Water permit as it directly deals with waters resources and also have to comply with the Water Management Act related to the protection of watershed.

4.2.5 Forest act

84. Some sub-projects will have to log trees to open access roads, and thus should apply for a tree-harvesting permit.

4.2.6 Samoa Codes of Environmental Practice 2006

85. The Samoa Codes of Environmental Practice (COEP) have been prepared (2006) to define methods and/or procedures to be followed by consultants, designers and contractors. They seek to avoid or mitigate adverse environmental effects that may arise out of infrastructure development projects or maintenance work. The COEP is to be implemented for the planning, design and construction of all development works where development consent is required under PUMA.

Though these Codes refers essentially to road construction, guidance on public consultation, land acquisition and slope and soil protection, campsites, archaeological discovery, drainage, Earthworks Plan, Erosion and Sedimentation Measures, etc.

86. There are three implementation mechanisms for the COEP:

1. Use of the COEP is specified in the Terms of Reference for the design of works. The relevant design directives stated in the COEP should also be incorporated in the Terms of Reference;
2. Use of the COEP is specified in the specifications for the construction of physical works. The relevant suggested specifications stated in the COEP should also be incorporated in the specifications.
3. Environmental approvals are granted with the condition that works proceed under the provisions of the COEP.

87. There are 14 COEP which were prepared under the PUMA which include:

- COEP 1 – Administrative Procedures;
- COEP 2 – Road Planning, Design and Construction;
- COEP 3 – Consultation;
- COEP 4 – Land Acquisition and Compensation;
- COEP 5 – Construction Camps;
- COEP 6 – Road Construction Erosion Control;
- COEP 7 – Slope Stability;
- COEP 8 – Quarry Development and Operations;
- COEP 9 – Gravel Extraction;
- COEP 10 – Coastal Protection;
- COEP 11 – Drainage;
- COEP 12 – Traffic Control During Construction;
- COEP 13 – Earthworks; and
- COEP 14 – Cellular Telecommunications Facilities.

Of these, COEP 2, 3, 4, 6, 7, 9,11, 12 and 13 are particularly relevant to the project.

4.2.7 Security and Emergency

Disaster and Emergency Management Act 2007

88. This act gives guidance of the role, responsibility and actions to be taken after a disaster like typhoons or tsunamis.

There is no regulation related to anticipation of these disasters.
The Fire and Emergency Service Act 2007 is specifically related to fire.
EPC has not prepared an early warning and emergency preparedness Plan.
Though it is not internationally required to have a Early Warning and Emergency Preparedness Plan for Small HPP or HPP without reservoirs, EPC should nevertheless develop such a Plan in the future mainly to be prepared to face extreme situations.

4.2.8 Obtaining permit for new HPP

89. To build new HPP two consent should be obtained by:
    - An application for a water permit should be lodge to the Water Resources Division of the MNRE and
    - An application delivered by PUMA (MNRE)

When a project belongs to the competency of several Authorities (Agencies) and could have potentially significant environmental effects, the section 44 of the PUMA Act 2004 states that PUMA will consult appropriate Authorities by sending a referral to the relevant Authorities requesting comments. The answer of the Authority will be made within 10 days, unless the Agency will needs more information.
The timeframe to obtain a permit for a project depends on its complexity and the number of Agencies involved.

ANNEX 1:

Figure 1: Referral requirements and procedures

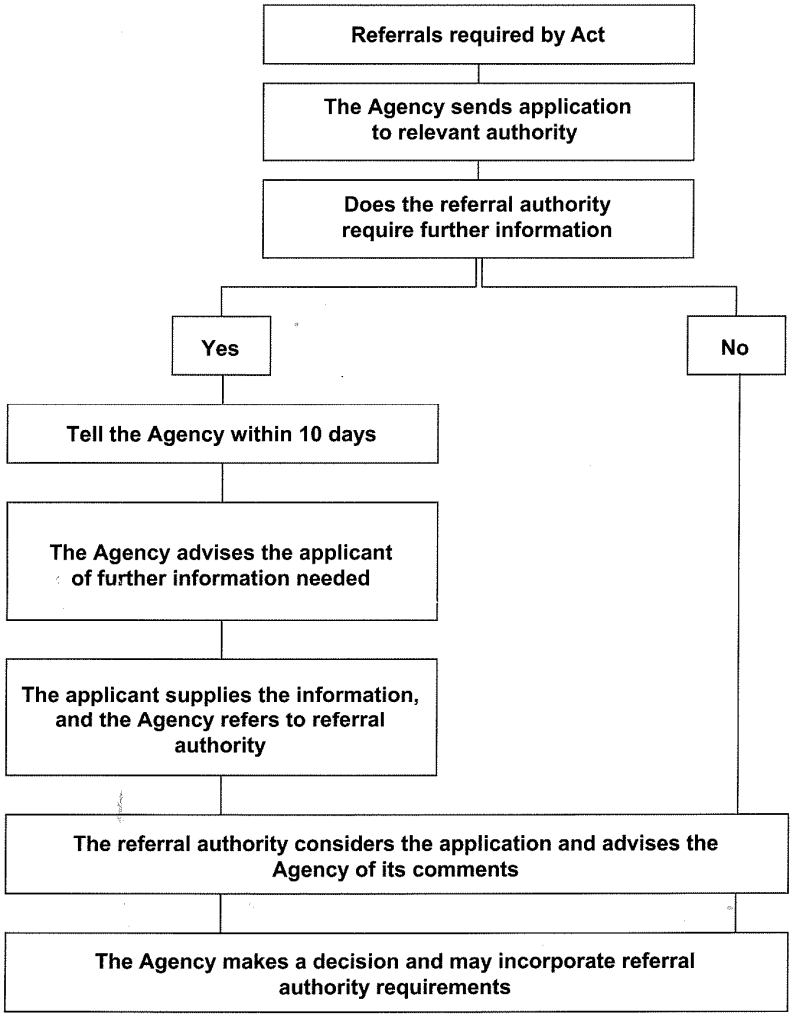

Figure 3:Referral chart Sources: PUMA Info sheet Referrals - Oct 2008

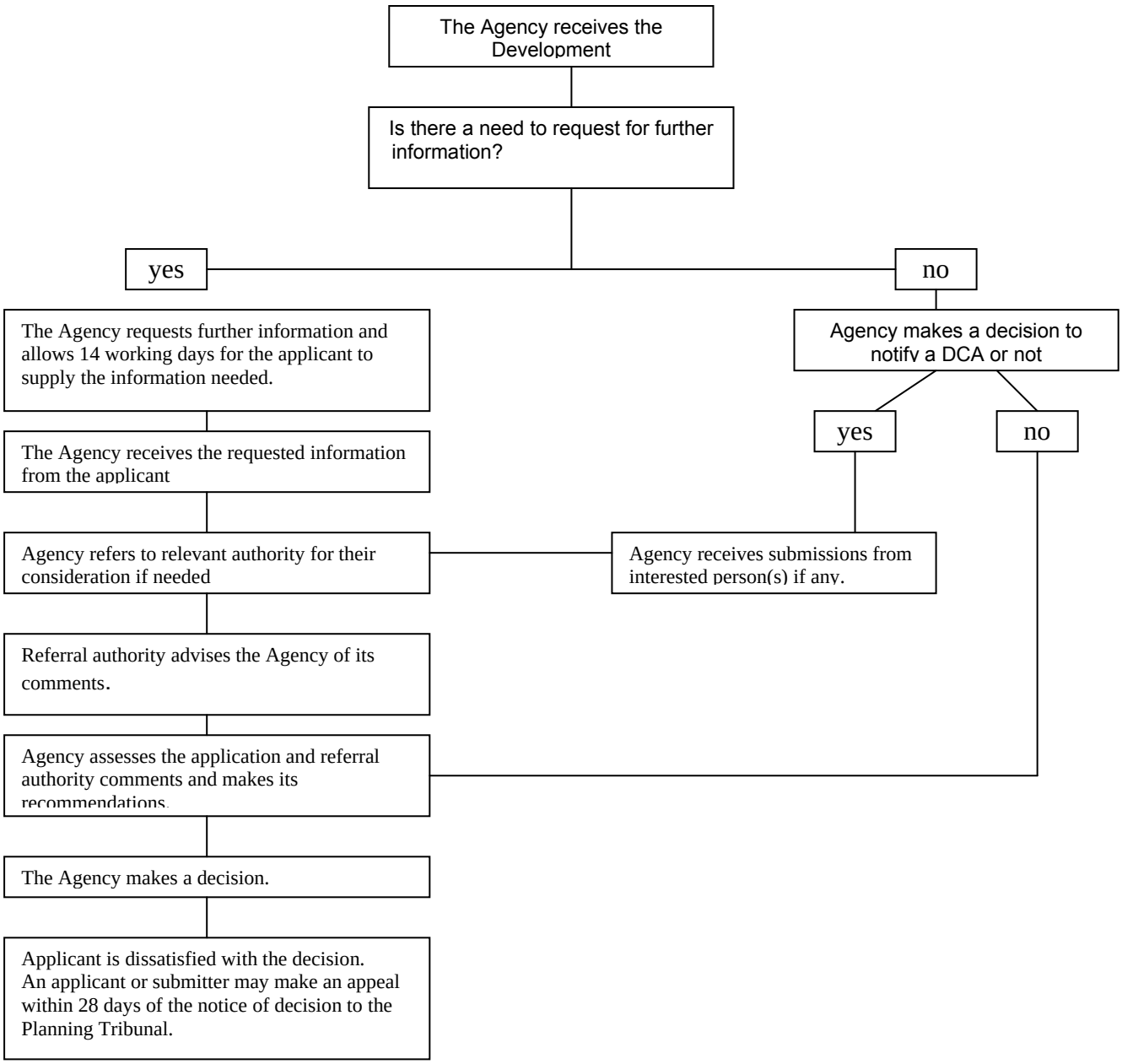

Figure 4: Development Consent Application chart, May 2009

4.2.9 Protection of Wildlife Regulations 2004

90. These regulations deal solely with the protection of flying endemic species. Under these regulations no person is allowed to harm flying species endemic to Samoa unless approval is granted by the Minister of Natural Resource and Environment. Flying endemic species are defined as any of the following:
- Flying fox;
- Pigeon;
- Crimson crown fruit dove;
- Wattle honeyeater; and
- Cardinal honeyeater.

Harm is defined as trap, shoot, kill or otherwise destroy.

4.3 Policies

4.3.1 Cultural and Natural Heritage Conservation Policy 2004

91. This policy provides the framework for the conservation, preservation, use, allocation and sustainable management of heritage resources. It also seeks to improve approaches to heritage planning by ensuring that the preservation of natural and cultural heritage are fully recognized and taken into account in the formulation and implementation of development programs.

4.3.2 Planning for Climate Change Policy

92. This policy addresses national responses to Climate Change as identified in the National Environment Management Strategy (NEMS) 1993. The local risks from greenhouse warming are defined as: coastal inundation; shoreline retreat; more severe and frequent storms and wave condition; enhance coastal sedimentation and threat to infrastructure and services.

4.3.3 Policy Statement on Biological Diversity

93. This policy statement provides the framework for the conservation, sustainable use and management of Samoa's terrestrial and marine biodiversity including the protection of endemic and native species and the control of invasive species.

4.3.4 Statement of Economic Strategy (SES) 2000 – 2001

94. Samoa's Economic Strategy seeks to encourage private sector led, and broader based growth in outputs and employment, as well as facilitating social development. The education and health sectors are a high priority in order to provide people with greater opportunities to advance themselves. Significant support is also given to rural development programmes to improve power distribution, transport infrastructure, and communications to create more opportunities for those in Savai'i and the rural areas of Upolu, where lowest income levels tend to occur.

4.3.5 Strategy for the Development of Samoa (SDS) 2008 -2012

95. The Vision for the 2008-2012 Strategy for the Development of Samoa is for 'Improved Quality of Life for All'.

The achievement of the vision relies on implementing the seven national development goals of SDS 2008–2012, which in turn requires effective implementation of development strategies in the three priority areas of economic policies, social policies and public sector management and environmental sustainability. The goals included:

- Sustained Macroeconomic Stability;
- Private Sector Led Economic Growth and Employment Creation;
- Improved Education Outcomes;
- Improved Health Outcomes;
- Community Development: Improved Economic and Social Well-being and Improved Village Governance;
- Improved Governance; and
- Environmental Sustainability and Disaster Risk Reduction.

4.3.6 Energy Sector Plan 2012 - 2016

96. The key guiding document for all energy projects in Samoa is the Energy Sector Plan, published by the Samoa Ministry of Finance in December 2012. This plan supersedes the National Energy Policy (2007) and the Strategic Action Plan (2008). Samoa has a "Carbon Neutral by 2020" goal approved by Cabinet in 2010, with the Energy Sector Plan as the guiding document for this goal.

As part of the PEDAP a 100% Renewable Energy Roadmap for Samoa is being developed by ITP separately.

4.4 Relevant International Agreements

97. According to the Samoan Ministry of Foreign Affairs and Trade, Samoa is a party to the following
Environment Conventions and Treaties[1]1.

- Agreement establishing the South Pacific Regional Environment Program (SPREP), 1993;
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1986;
- Protocol for the Prevention of Pollution of the South Pacific Region by Dumping, 1990;
- Convention on the Conservation of Nature in the South Pacific, 1976;
- United Nations Framework Convention on Climate Change, 1992;
- Kyoto Protocol to the Framework Convention on Climate Change, 2005;
- Convention on Biological Diversity, 1992;
- Vienna Convention for the Protection of the Ozone Layer, 1985;
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1987;
- United Nations Convention to Combat Desertification, 1994;
- Convention concerning the Protection of the World Cultural and Natural Heritage, 1972;
- Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998;
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and
their Disposal, 1989;
- Convention on Persistent Organic Pollutants, 2001;
- Convention on Wetlands of International Importance, 1971;
- Convention on International Trade in Endangered Species of Wild Fauna, 1973;
- Convention of Migratory Species, 1979;
- Protocol concerning Cooperation in combating Pollution Emergencies in the South Pacific
Region, 1990;
- Carthagena Protocol on Biosafety to the convention of Biological Diversity, 2003;
- International Plant Protection, 1951;
- International Treaty on Plant and Genetic Resources for Food and Agriculture, 2001;
- Plant Protection Agreement for the South East Asia & Pacific Region, 1956;
- Strategic Approach to International Chemicals Management, 2007.

4.5 Relevance of Legal, Policy, and Administrative Frameworks

98. The Samoan policies and frameworks assessed above support the development of new small Hydro Power Plants. This includes the Strategy for the Development of Samoa, which seeks to improve the overall quality of life for Samoan.

Key, policy or administrative frameworks that support the project are:

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[1] 1 http://www.mfat.gov.ws/Convention treaties.html

- Statement of Economic Strategy (SES) which supports development program to improve power distribution, transport infrastructure, and communications, in order to create more opportunities for those in Savai'i and the rural areas of Upolu, where lowest income levels tend to occur.
- Energy Sector Plan. This is the key guiding document for all energy projects in Samoa.

Samoa has a "Carbon Neutral by 2020" goal approved by Cabinet in 2010, with the Energy Sector Plan as the guiding document for this goal.

4.6 ADB requirements

4.6.1 Environmental Requirements

99. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. **Samoa Renewable Development and Power Rehabilitation Project** has been assigned Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects.

100. For this Project an Initial Environmental Examination (IEE) is required. This IEE has been prepared under the provisions of the ADB's safeguard policy document[2], which requires a number of considerations not normally included in the Samoan EIA such as:
    (i) project level grievance redress mechanism;
    (ii) climate change mitigation and adaptation;
    (iii) occupational and community health and safety requirements, including emergency preparedness and response);
    (iv) economic displacement that is not part of land acquisition;.

101. It has been determined by the PPTA team that a Project IEE prepared under the provisions of the ADB's safeguard policy would fully satisfy all the requirements for a PEAR under the **PUMA Environmental Impact Assessment Regulations 2007**.

102. The ADB's climate change efforts are guided by five strategic priorities:
    • expanding the use of clean and renewable energy;
    • encouraging sustainable transport and urban development;
    • promoting climate-resilient development;
    • strengthening policies, governance, and capacities; and
    • managing land use and forests for carbon sequestration..

The proposed renewable energy project is in line with these priorities.

4.6.2 Environmental, Health, and Safety Guidelines 2002

103. ADB's SPS applies pollution prevention and control technologies and practices consistent with international best practices as reflected in internationally recognized

[2] ADB. 2009. *Safeguard Policy Statement.*

standards such as the World Bank Group's Environmental, Health and Safety Guidelines. The Guidelines provide the context of international best practice and contribute to establishing targets for environmental performance. The air and noise standards in the EHS guidelines will be used in parallel with local standards (where they exist) throughout this document.

Occupational and community health and safety, as laid out in the EHS Guidelines, will be a crosscutting assessment for all subprojects.

5. Description of the environment

104. This section borrows heavily from the 'State of the Environment Report, Ministry of Natural Resources and Environment, 2013'.

5.1 Biophysical

5.1.1 Climate

105. Samoa has a wet tropical climate with temperatures ranging between 17°C and 34°C and an average temperature of 26.5°C. Average humidity for the capital Apia is 83 %. The average annual rainfall is about 2,000 mm with about 75 per cent of the precipitation occurring during November- March.

Due to the predominance of moisture-bearing southeasterly trade winds, the northwest parts of the main islands, as well as the southeast side of Savai'i, are rain shadow areas, receiving about half the rainfall of the highland areas.

Samoa is affected by tropical cyclone patterns with the cyclone season in November to March.

Cyclone Evan struck Upolu in December 2012. A weather monitoring mast at Mt. Fiamoe measured wind at a peak of 46m/s at 28m above ground, in a ten-minute average, with a maximum 3-second gust of 59m/s being recorded in the same 10-minute interval. Cyclone Evan was thought to be the worst to hit Samoa in over two decades.

5.1.2 Geography

106. The topography of Samoa is rugged and mountainous with about 40 per cent of Upolu and 50 per cent of Savai'i characterized by steep slopes descending from volcanic ridges. The interior of both main islands is still covered with mountain forests and, in the case of the highest peaks on Savai'i, covered in cloud forest. These areas also contain volcanic peaks with the Upolu crestal ridge rising to 1,100m. Savai'i has more and younger volcanic cones with the highest peak reaching 1,848m at Mt. Silisili. Western Savaii and northwest Upolu are almost devoid of surface streams, corresponding to the rain shadow and sub-surface drainage.

5.1.3 Geology

107. The Samoan islands are composed almost wholly of basic volcanic rocks such as olivine basalt, picrite basalt and olivine dolerite. Most of the soils are formed from weathered basaltic volcanic flows, including pahoehoe and aa lava types, scoria and volcanic ash. Soils are generally clay in texture, free draining, porous and relatively shallow.

A coral reef surrounds the islands for nearly half of the coastline, except where there are steep cliffs and where young lava flows have filled the lagoon. Coral sand is found along most of the coastline, up to 5 m from sea level. Alluvium is not common, but forms the parent material for the most versatile soils.

Earth tremors continue on a frequent basis in Samoa (as measured by the MNRE Meteorology Division at Mulinuu, Apia) and Samoa remains vulnerable to future volcanic activity. The last recorded eruptions were all on Savai'i in 1902 and 1905-1911.

108. Samoa islands are subject of violent earthquakes. The last one occurred in 2009. The epicenter was far away in the Pacific so few damages were noted on structures in villages and in Apia. The Tsunami resulting from this earthquake has affected the southwestern part of Upulu and destroyed many habitats where 115 persons

perished.

5.1.4 Ecology

109. It is estimated that Samoa supports 775 native vascular plant species of which approximately 30%
of the angiosperms are endemic. There are about 280 genera of native angiosperms. In addition, there are about 250 introduced plant species and 47 threatened plants. Samoa's fauna consists of 21 butterfly species, 11 species of reptiles, 43 resident bird species eight of which are endemic, and three flying fox species (Samoa NBSAP 2001).
Samoa's unique biodiversity is a result of its geographic isolation, which has led to the evolution of unique species and communities of plants and animals, many of which are indigenous to only one island or island group within the Pacific region. These species usually have small population sizes, making them particularly vulnerable to loss from over-exploitation and habitat degradation. 11 terrestrial and 65 marine species found in Samoa are listed as globally threatened on the 2009 IUCN Red List of Threatened Species. It is thought that the true number of threatened species in Samoa is significantly higher than this.

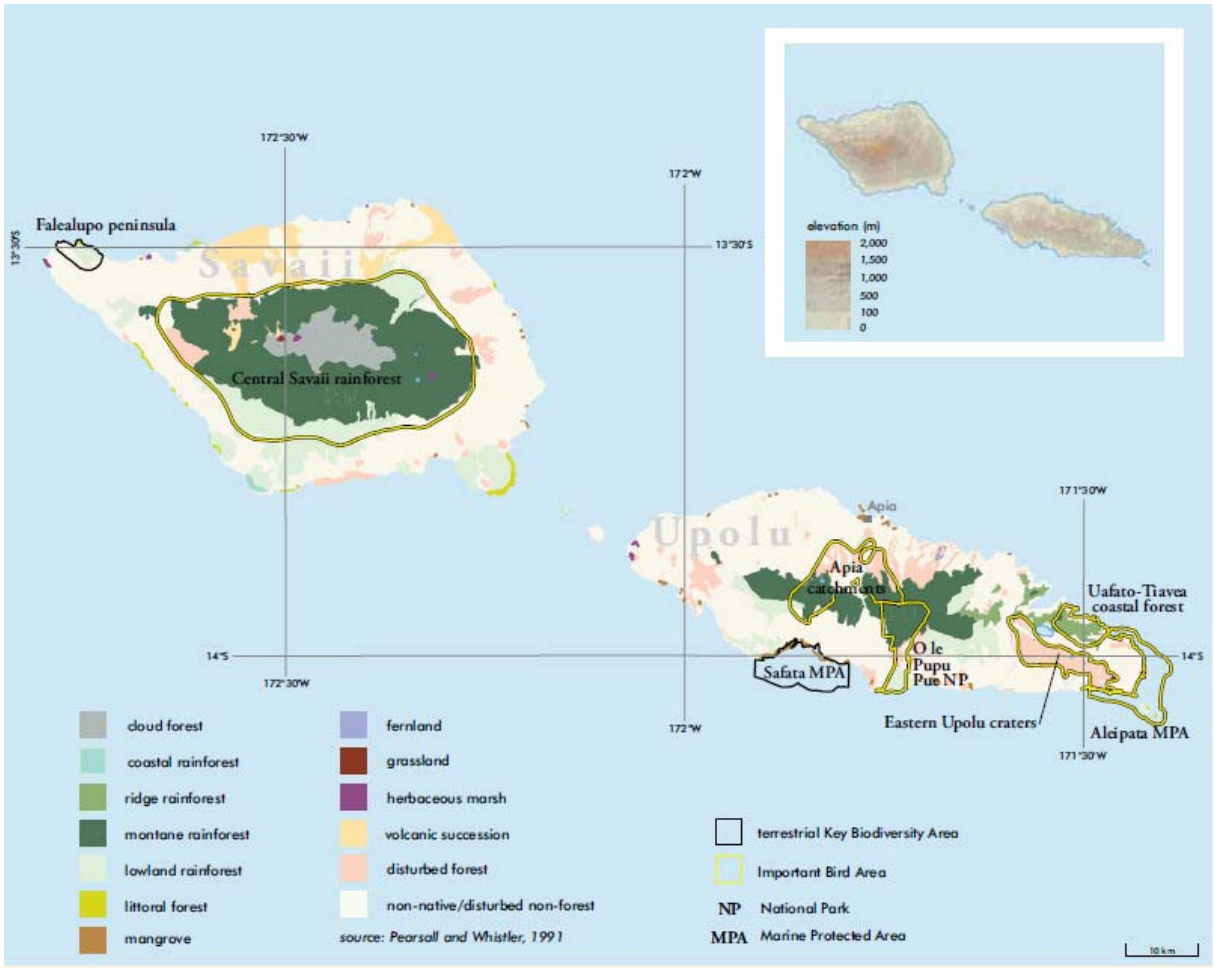


Figure 5: Terrestrial Key Biodiversity Areas and Native Vegetation for Upolu and Savai'i. (Source: Priority Sites for Conservation in Samoa: Key Biodiversity Areas)

5.1.5 Flora

110. A 1992 survey classified Samoa's vegetation into 19 plant communities within five broad categories, as follows:

- Littoral vegetation: Four communities of vegetation situated on the seashore were recognised: herbaceous strand or beach; littoral shrub-land; Pandanus scrub; and littoral forest whereby much of these types have been lost or degraded. The best remaining examples are at Aleipata Islands, O Le Pupu-Pue National Park and sites on the South (central) coast of Savai'i.
- Wetland vegetation: Four communities are recognised: coastal marsh; montane marsh; mangrove scrub/forest; and swamp forest. There has been a very serious loss of wetlands, particularly in the lowlands, and only a few intact areas of each type remain.
- Rainforest: Four communities are recognised on an altitudinal gradient: coastal; lowland; montane; and cloud forest. Cloud forests are restricted to Savai'i with the summit reaching over 1800 m. The few remaining significant areas of coastal forest are at the Aleipata Islands, Apolima and possibly Tafua Crater. The montane habitat is considered to have the richest flora of any forest community in the country. On Upolu, no montane sites were found that had good forest or were recovering (from cyclone damage) and there was substantial impact from several weeds. On Savai'i, the forests are recovering faster at higher elevations where there is little human activity, whereas the process is much slower at lower areas where forest cutting has added to the problem.
- Volcanic vegetation: Two communities, lowland volcanic scrub and upland volcanic scrub, are recognised and these occur only on recent lava flows on Savai'i.
- Disturbed vegetation: Four communities derived from a combination of human activities and weather are recognised: managed land; secondary scrub; secondary forest; and fernlands.

111. About 25% of the plants found in Samoa are endemic and 32% are endemic to the Samoan archipelago. A further 500 or so species of plants have been introduced to the islands since the first

Samoans brought the coconut, taro and other species for cultivation about 3,000 years ago. Currently about half the plants in Samoa are exotic. While some of these plants are beneficial for agriculture, others are considered destructive weeds.

5.1.6 Avifauna

112. Bird Life International records 81 bird species in Samoa. This includes 31 breeding native land birds, one possibly extinct native land bird (the Samoan Moorhen), 4 breeding introduced birds, approximately 10 breeding seabirds and 35 migrants or vagrants. Nine of the land birds are endemic to Samoa and another seven are regional endemics or near endemics.

Twelve species are globally considered to be Restricted Range species, but not classed as of immediate conservation risk. Six species are considered to be of national conservation concern as determined through the National Biodiversity Strategy and Action Plan.

Sea/shore birds

113. There is a gap in the knowledge of population numbers and breeding status of seabirds in Samoa making it difficult to review and update the existing list of seabird species of conservation concern.

Based on the available literature, approximately 12 seabird and shorebird species that are of global or national conservation concern have been recorded in Samoa.

Several seabird species of global concern are either passage migrants, visitors or status unknown in Samoa. These include the Phoenix Petrel (*Pterodroma alba*); Tahiti Petrel (*Pseudobulweria rostrata*); Collared Petrel (*Pterodroma brevipes*) and Polynesian Storm Petrel (*Nesofregetta fuliginosa*). The globally threatened Bristle-thighed Curlew (*Numenius tahitiensis*) is a regular northern winter migrant in small numbers.

5.1.7 Fauna

Terrestrial Mammals

114. Bats:

There are 13 species of terrestrial mammal now present in Samoa. Of these, only three are native, two flying foxes (or fruit bats), the Samoan Flying-fox (*Pteropus s. samoensis*) and the Tongan or White-necked Flying-fox (*P. tonganus*). A small insectivorous bat, the Sheath-tailed Cave Bat (*Emballonura semicaudata*) is now believed to be extinct in Samoa. The flying foxes are important for the long-term survival of the forests as they pollinate the flowers of many species and also disperse the seeds of the fruits that they eat throughout the forest. It has been estimated that almost one in three Samoan forest trees depend on flying foxes in some way.

5.2 Protected Area and Key Biological Areas

115. Key Biodiversity Areas (KBA) support the regular occurrence of one or more globally threatened species assessed as Critically Endangered, Endangered, or Vulnerable according to the IUCN Red List.

Terrestrial KBAs cover a total of 940 km^2 or approximately 33% of the total land area of Samoa, including representation of 12 of the 13 native terrestrial vegetation communities in the country.

The seven marine KBAs cover approximately 173 km^2 or 23% of the inshore reef area of Samoa.

Currently, six of the eight terrestrial KBAs and three of the seven marine KBAs have been completely or partially established as conservation areas by the Government of Samoa or by local village communities and two additional KBAs have small community based fisheries sites within their boundaries.

The first National Park established in Samoa was the O Le Pupu-Pue National Park in Togitogiga, in 1978. Two new national parks have since been established, including Mauga o Salafai, the first to be located on Savai'i, and Lake Lanoto'o which is the first Ramsar Convention Wetland site in Samoa at the center of the volcanic ridge on Upolu.

Protected forest area consists of existing and proposed national parks and nature reserves, community conservation areas. All forest area outside protected forest is by definition considered production forest.

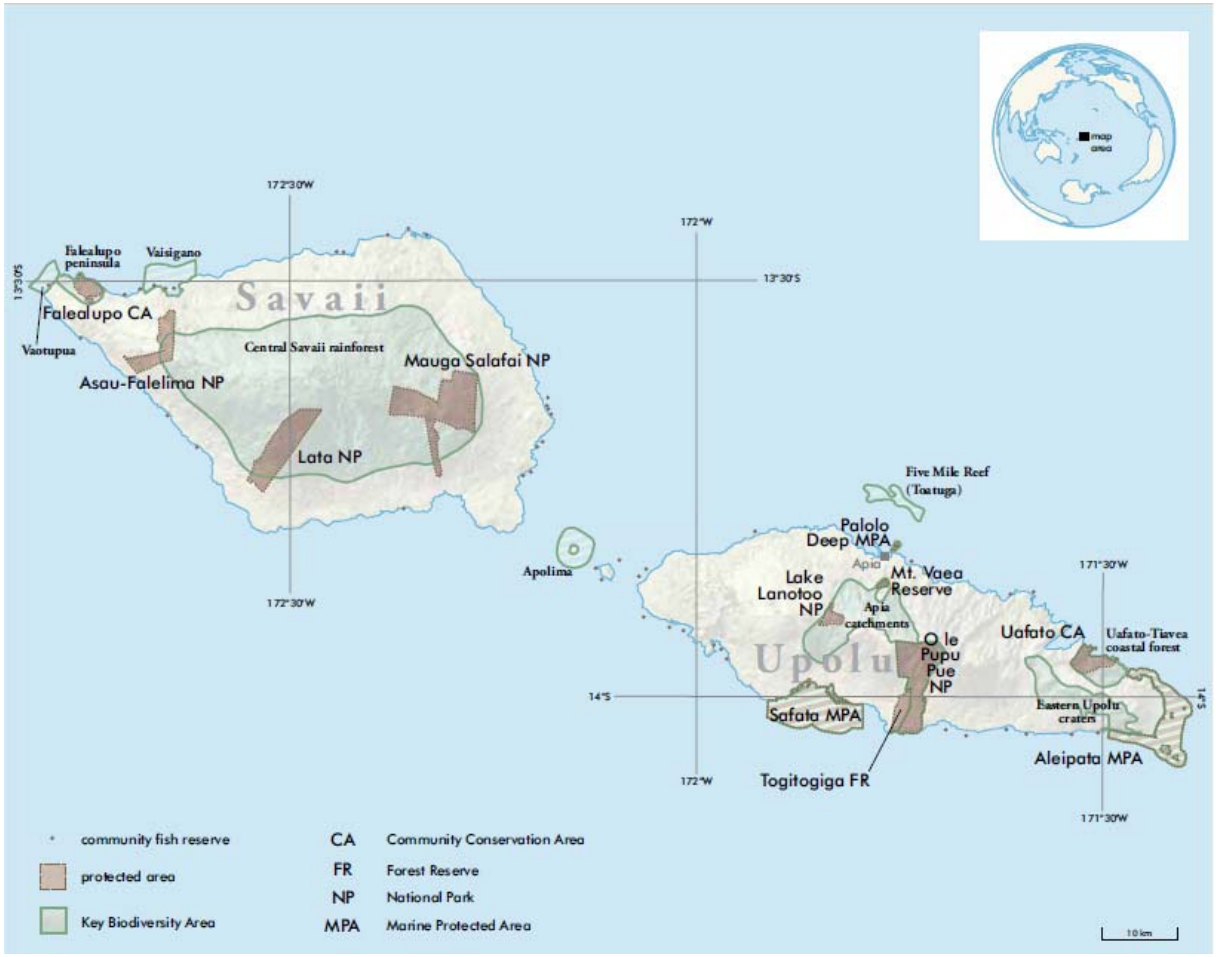


Figure 6: Terrestrial Key Biodiversity Areas and Native Vegetation (source: Priority Sites for Conservation in Samoa: Key Biodiversity Areas)

5.3 Socio-economic

116. Further consideration on socio-economic and land tenure issues are developed in a stand alone document related to the Resettlement Plan

5.3.1 Economy

117. Samoa's economy is dominated by subsistence agriculture and related activities, which support around 75 per cent of the total population, including almost the entire rural population. The economy is also dominated by external aid and by remittances from Samoans residing and working abroad.

Samoa's economy has suffered from tropical cyclones. The destruction of tree crops, forests and infrastructure by cyclones has affected economic performance, especially primary production, and these impacts on the environment and the people could be felt for over three years after each cyclone. More recently, Cyclone Evan struck in December 2012. Its economic impact is still unknown but could be as significant as that which resulted from the 2009 Tsunami.

5.3.2 Transport

118. The two main islands are well served by coastal ring roads and Upolu has three cross-island roads.

The completion of the current road improvement program should see all the main roads upgraded and tar-sealed. The main international port is Apia, with an inter-island ferry service operating between Mulifanua at northwest Upolu and Salelologa at southeast Savai'i. The islands were once linked by air service between Faleolo near Mulifanua on Upolu and Maota near Salelologa on Savai'i, but this air service was discontinued in 2006. Another airport is located in North-West Savai'i at Asau. The main international airport is Faleolo Airport in northwest Upolu.

5.3.3 Water Sources

119. Historically, community water supplies from groundwater have been derived from coastal springs commonly found around the coastal villages. Groundwater is most readily available from freshwater lenses, but aquifer yields are constrained by the risk of inducing saline intrusion. With the high rainfall and virtually no drought period, the flows of such springs are sustained throughout the year. There are minor perched aquifers, held up by less permeable strata, which may be of local significance for inland springs.

Despite high rainfall occurring between October and March, many parts of Samoa are devoid of perennial streams and rivers due to the high permeability of the underlying volcanics. The driest areas are found in northwest Upolu and northwest Savai'i. Rainwater is harvested and widely practiced in dryer areas of the country such as in western Savai'i.

Surface water is abstracted from catchment areas of the central highlands of Upolu and south-east of Savai'i. There are 28 surface water intakes on Upolu producing an average of 42.5 million m_3 of water per year and two on Savai'i (Patamea and Sili).

5.3.4 Energy

120. The EPC operates 22kV transmission networks on Upolu and Savai'i and is in the process of completing staged upgrades to transmission and generation infrastructure through the ADB's Power Sector Expansion Project. While the bulk of Samoa's existing transmission network is via overhead cable, newer sections of the network include underground cabling.

Upolu currently has a combination of hydro-generation and diesel generation as the primary source of electricity. The main Upolu power station, located at Tanugamanono, has been in operation since the mid-1970s.

EPC operates four run-of-river and one dam-based hydroelectric power stations with a total capacity of around 12MW. Hydro generators on Upolu generated a total of 35.248 GWh in 2010/11, representing 36% of Samoa's total electricity. This was slightly less than typical due to the prevailing drought conditions at the time.

Station	**Type**	**Year Commissioned**	**No**	**Capacity (kW)**	**Derated Capacity**
Taelefaga	Dam-Reservoir	1992	1	2,000	2,000
			2	2,000	2,000
Lalomauga	Run of River	1984	1	1,850	1,700
			2	1,850	1,600
Samasoni	Run of River	1981	1	950	640
			2	950	720
Fale-ole-Fee	Run of River	1985	1	1,600	1,400
Alaoa	Run of River	1959		1,000	1,000
Total				**12,200**	**11,060**

Table1 outlines the existing hydro generators in Upolu.

121. Under the EPC Expansion Plan, a new diesel power station has been constructed at Fiaga, in the area of Aleisa, and replace the existing Tanugamanono power station in the EPC expansion plan. The

Fiaga power station consists of four new diesel engines (5.78MW each) all-generating at 11kV.

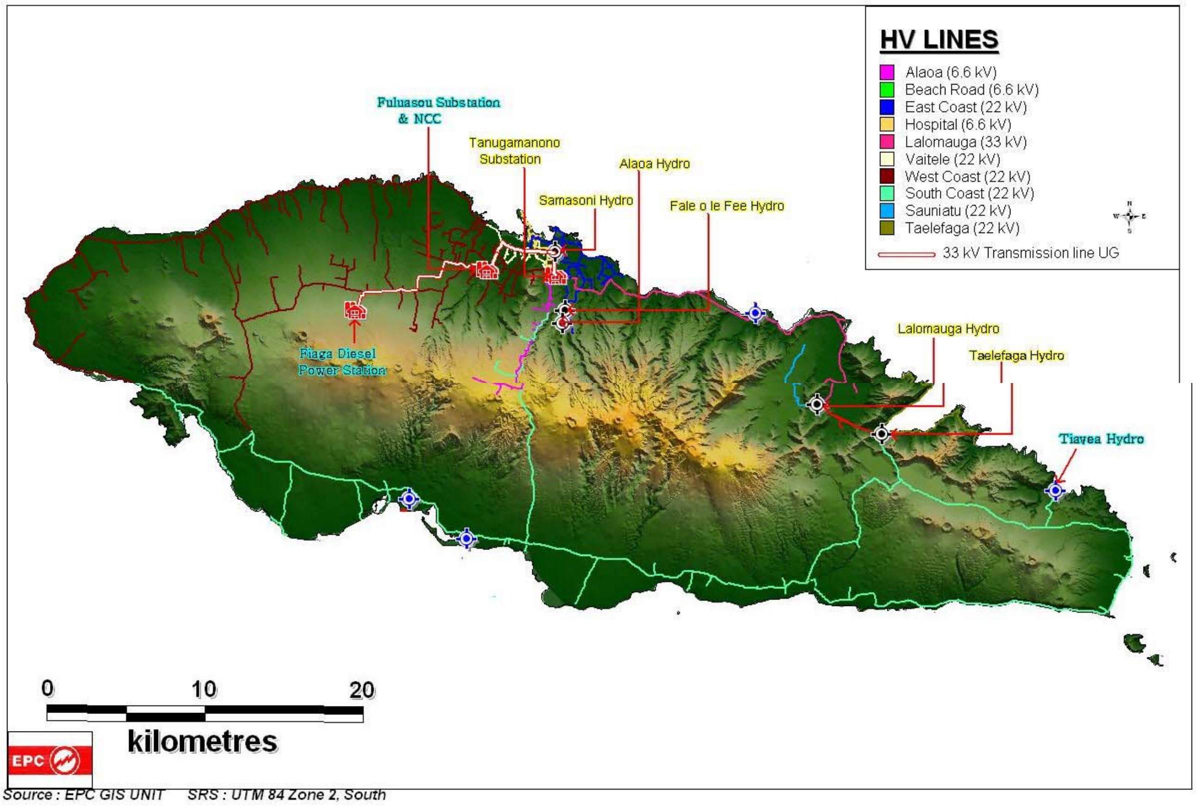
Also, three existing diesel units will be relocated from Tanugamanono to Fiaga generating at 6.6kV.

New transmission lines of 33kV connect Fiaga Power Station to the new Fuluasou Substation, which supplies 22kV feeders. Tanugamanono will continue to operate as a substation serving distribution feeders and terminating transmission line from five existing hydro projects. A new underground transmission cable will connect Fuluasou to Tanugamanono. There will be a total of 10 feeders fed from three major substations supplying on Upolu.

The overwhelming majority of Upolu's load is located in the Apia area, with the remainder spread out around the coastal ring and the cross-island road. Some sections of the network experience poor power quality. Upolu had a peak demand of 13.5 MW in 2000.

Savai'i's loads are somewhat higher in the Salelologa area, but are generally distributed around the island along the coastal road. Power quality problems are common at the northern end of the island near Asau, due to the distance from the power station. Savai'i load profiles are predominantly residential, with a steady daytime load of 800kW – 1MW and an evening peak of up to 3MW.

All electric generation on Savai'i is currently diesel generation located at the Salelologa Power Station, which has six diesel engines, all generating at 400/415 volts. Two 22kV feeders transits and distribute electricity out to the consumers namely the Puapua Feeder that goes along the north coast and the Asau Feeder on the south coast. The peak load in Savai'i is about 2.8MW. Figure 4.4 and Figure 4.5 shows the grid system on Savai'i and Upolu.



Source : EPC GIS UNIT SRS : UTM 84 Zone 2, South

Figure 7: EPC's grid network on Savai'i (Source: EPC)

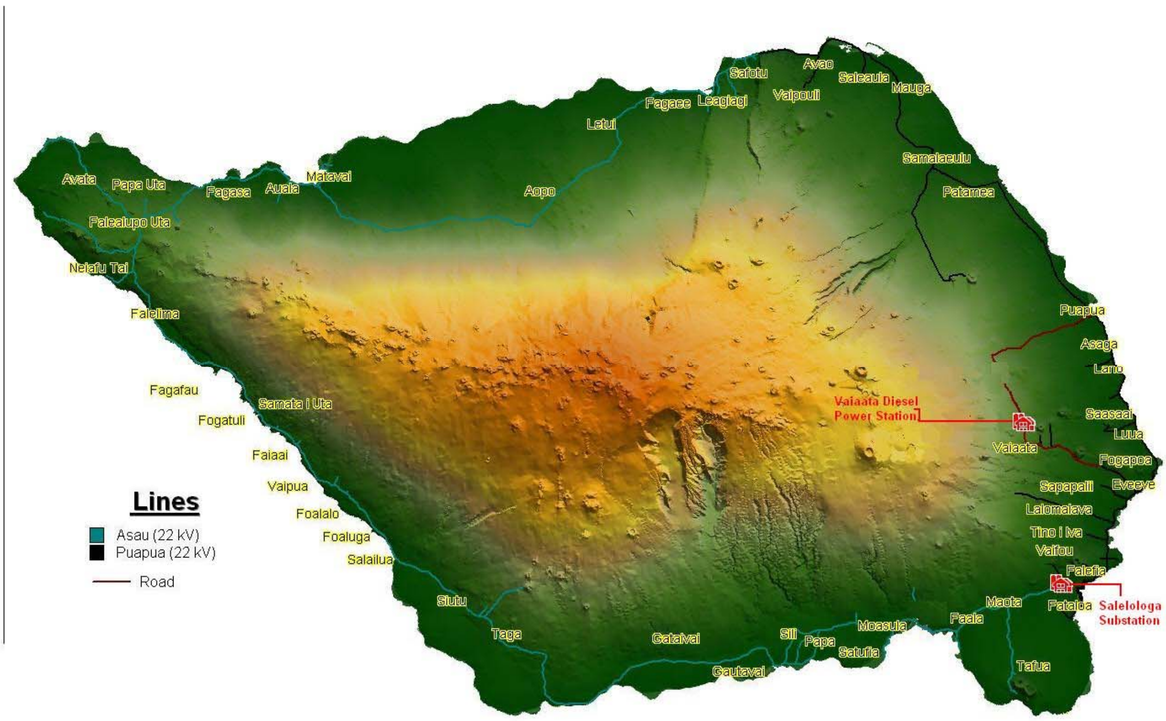


Figure 8: EPC's grid network on Upolu (Source: EPC)

Renewable Energy Projects

122. There are a number of different renewable energy projects underway and planned for both Upolu and Savai'i. These include:

1. 550kW of grid-connected solar PV (150kW on Savai'i and 400kW on Upolu) installed through the Pacific Environment Community (PEC) fund. This project is led by EPC and is expected to be completed in end-2013. Installation is to be on EPC-owned sites.
2. 2. 4MW by 7.2 million KWh per year of grid-connected solar PV to be installed and operated by Solar Samoa Ltd, an independent power producer (IPP), under a Power Purchase Agreement (PPA) with EPC. Since signing of the PPA no site development or construction has commenced.
3. 4MW by 31 MKWh per year of grid-connected biogas generation to be installed and operated by a Biogen3, an IPP, under a PPA with EPC. This project is pending environmental and financial approval.
4. EPC are currently running an Expression of Interest for up to 2 by 2 MW of grid connected solar under an IPP arrangement. Request for Proposal is scheduled to be advertised in August 2013.
5. New Zeeland government grant funded 1.2 MW grid connected solar system on Upolu to be commissioned by September 2014. Owned and operated by EPC.
6. Proposals for reducing diesel by Biodiesel produced locally from coconut oil are being evaluated in July 2013 for implementation at end of the year. Private investor financed. (12 Ml/y, EPC; transportation consumption uses the double) it will reduce 10% of national diesel consumption
7. 6. Feasibility studies have been completed for five new hydro power schemes, 3 on Upolu and 1 Savai' through the ADB's Power Sector Expansion Project (PSEP) and are expected to be installed in the next future.
8. The 13.5kva Apolima Island mini-grid solar PV system, now in its sixth year of operation, is owned and managed by EPC and has experienced no major maintenance issues to date.
9. Wind data collection is continuing to develop a wind farm on Opolu and Savai'. IPP to develop a private project.

5.3.5 Landuse

123. The landscape on Upolu and Savai'i generally consists of a narrow coastal plain, with rocky, rugged, volcanic terrains making up the inner parts of the islands[5]. The vegetation in these areas is primarily composed of lowland and montane rain forests, with small areas of riverine, swamp, mangrove, and beach forest. The islands have undergone extensive deforestation, as a consequence of timber operations and clearance of land for agriculture. A large proportion of the lowland forest on Savai'i and Upolu has been cleared or highly modified, but the montane forests are less disturbed and have a rich variety of endemic flora and fauna[6].

In the rural communities, land remains primarily under customary ownership and a large proportion of it is currently under cultivation.

Land use capability assessments in 1990 categorised Samoa's land into four main classes:

1. Land with few limitations for agricultural use (39,600 ha);
2. Land with moderate limitations for agricultural use and few limitations for forestry use
3. Land with severe limitations for agricultural use and moderate to severe limitations for forestry use (59,400 ha); and
4. Land unsuitable for agricultural or forestry use (69,000 ha).

The predominant land use, apart from indigenous forests, is agriculture. A common land use pattern in most villages consists of a residential area with a village common ground or malae on about a kilometre-wide strip of land along the coastline. Immediately inland is a mixed

cropping zone of fruit trees, bananas and coconuts, and further inland is a zone of primary food crops of taro, taamu and yams.

5.3.6 Land ownership

124. There are four types of land ownership in Samoa with over 80 per cent of total land under customary ownership. The rest is divided between freehold, Government, and land vested in Samoa Trust Estates Corporation (STEC) and Samoa Land Corporation (SLC).

About 15% of land in Samoa is publicly owned and is generally known and recognized as Government land. Under statutory law, access to Government land is through lease or exchange of either freehold land or customary land. Freehold land takes up 4% of the total land area.

Landowners independently manage their own lands. These can be alienated in any manner desired by the owner, be it through sale, gifting, leasing, licensing or exchange. However, alienation to no citizens or overseas residents is prohibited under the Alienation of Freehold Land Act 1972 unless granted consent by the Head of State.

Customary land vested in accordance with Samoan custom and usage, are primarily managed by the matai who is the head of an extended family. As trustee for his/her family, the matai is responsible for the management and allocation of the land for various uses by family members.

These lands are protected from alienation by sale by the Constitution of the Independent State of Samoa 1960, except by way of lease or license in accordance with the Alienation of Customary Land Act 1965.

An emerging form of land tenure is leased land, which is land under lease arrangements between the leasor (landowner) and the leasee (applicant). All types of land, whether Government, freehold or customary, can be leased out to individuals, corporations and community or to private investors. In this regard, leasing can provide a viable option to access the land necessary for private sector growth. Ideally, leasing allows the use of land without alienating it from traditional landowners.

The Government closely controls the leasing of customary land. The Minister of MNRE, as the trustee of customary lands, is vested with the power to manage and administer lease arrangements between the leasor and the leasee. The Minister's involvement in land leasing is designed to ensure that landowners are protected from entering into inappropriate land deals or making unwise decisions, and to prevent alienation of customary land or ownership from the landowner.

5.3.7 Cultural heritage

125. For the moment MNRE is in charge for the implementation of the Cultural Heritage law. This law has not been revised as the Samoan Law Reform proposed to create a separate body, the Samoan Heritage Authority.

Some sites show evidence of very early of human presence. For Fale o Le Feh to allow construction of infrastructures archaeological remains had to be removed and transplanted away from HPP site.

126. The Samoan Code of Environmental Practices (2006) states that" Should any archaeological sites be discovered during any stage of gravel extraction works such work shall cease immediately and MNREM notified forthwith. On no account shall extraction work continue until authorised by MNREM.

MNREM shall arrange an evaluation of the site in association with archaeologists before making any decision as to whether or not extraction works may proceed. A suggested specification is:

If the contractor locates any archaeological site or suspected archaeological site he shall immediately cease operations and notify the engineer forthwith. On no account shall extraction work continue until authorised by the PUMA”

6. Environmental impacts and mitigation measures

6.1 Introduction

127. The environmental management plan covers all phases of subproject implementation from preparation through commissioning and operation. It aims to ensure the monitoring of environmental impacts and implementation of mitigation measures. The EMP will be incorporated into the construction, operation and management of each sub component.

128. Environmental protection measures will i) mitigate environmental impacts, ii) achieve compliance with national environmental regulations and ADB safeguard standards, iii) provide compensation or offsets for lost environmental resources, and iv) when possible enhance environmental resources.

129. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures or compliance with regulations

To ensure that mitigation measures contained in the EMP are successfully implemented appropriate steps have to be taken to ensure that:

- The present EMP is included in the tender documents
- The contractor prepare its own EMP (contractor EMP)
- The tender document specify that the contractor will engage experienced staff to care for the environment management and monitor the effectiveness of the mitigation measures
- The contractor submit to EPC and PUMA its contractor management plan for approval (site clearance, site drainage, waste and material management, pollution control, traffic, noise and dust management)
- Contractor recruit qualified and experienced staff to oversee implementation of environmental and safety measures specified in the EMP
- Project documents are disclosed and made available to public
- There is a redress grievance mechanism made known to the public prior the start of the project
- EPC has manpower to oversee EMP implementation in all project sites and have regular support of international expertise

6.2 Environmental impacts

130. Considering that there will be a tender for each site and not a tender for each type of activity, the EPM is organised in such way that each contractor winning a bid will find all information relevant to the pre construction, construction phase for a definite site..

Each of the 8 sites has been treated separately as the activities planned for each site differ from one site to the other and affect the environment in a different way. Existing sites will only have some reconstruction activities when new sites will see the development of a complete range of construction and equipment: opening for access road, installation of intake and headrace, construction of a powerhouse.

For each site, potential impacts have been assessed according to the type or sequence of activity planned as they may affect differently the environment and are situated at different geographic locations of the site.

The EMP presents mitigative measures and associate monitoring actions. These have identical number so can be easy referenced and crosschecked.
The EMP provide details on the monitoring requirement
If unexpected impacts occur during project construction phase and operation phase, EPC and the contractor will update the EMP.
Final design will be completed after taking into account the results of the flora and fauna survey.
The environmental management plan covers all phases of subproject implementation from preparation through commissioning and operation. It aims to ensure the monitoring of environmental impacts and implementation of mitigation measures. The EMP will be incorporated into the construction, operation and management of each sub component.

131. Environmental protection measures will i) mitigate environmental impacts, ii) achieve compliance with national environmental regulations and ADB safeguard standards, iii) provide compensation or offsets for lost environmental resources, and iv) when possible enhance environmental resources.

132. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures or compliance with regulations

133. The receiving environmental factors selected are:
    1. noise
    2. air pollution
    3. aquifers and river pollution
    4. soil pollution
    5. social, cultural, health and safety issues
    6. environment and biodiversity

134. The impacting factors or/and mitigation measures occur during the three phase
    - pre construction
    - construction
    - operation

135. Not all environment factors are concerned or impacted for each phase, only those concerned are appearing in the text.

6.3 Mitigation measures

136. The mitigation measures will be incorporated into tender document-s, construction contracts, and operational management procedures. Contractors and the implementing agencies will implement these measures. The effectiveness of these measures will be controlled by the monitoring plan. The monitoring plan will assess the need to reinforce or change the mitigation measures.

Ecological flow

137. The Government of Samoa has not developed minimum ecological flow requirements for rivers and streams within Samoa. The actual ecological flow proposed by MNRE is not a national standard but this institution is currently working to transform the actual recommendation of 95% of flow duration curve into a national standard.

Determining precise minimum ecological flow guidelines for permanent streams within Samoa will require long term monitoring of fauna over several seasons to determine precise timings and magnitude of migrations for feeding and breeding requirements. However, several general suggestions can be made based on knowledge of the fauna.

138. Firstly, the majority of indigenous fauna species are adapted to the temporal impermanence of island waterways and have diadrom[3]ous life history strategies (A, FC, COB) that allow population persistence through recolonization of newly available freshwater habitats. So, in most cases, even if a stream dries up entirely the fauna will be able to recolonize. In addition, most species have prodigious climbing ability and will be able to surmount natural waterfalls. However some manmade structures, particularly hanging culverts and long, enclosed pipes may hinder re-colonization. Where the entire flow is channeled through a long pipe or into a headpond, as is the case in some sites, recolonization of upper waterways is hindered for fishes in particular. In this case, part of the natural low-flow should be diverted around the manmade structures and allowed a natural flow to the lower courses.

139. An ideal fish-way for a culvert crossing a stream (Kapitzke, 2010) should allow for:
Slope: as flat as possible; should not exceed 1:100.
Water depth: minimum 0.2-0.5 m.
Velocity: maximum 1 m/s preferred 0.3 m/s.
Length: maximum 6 m without resting areas.
Width: to width of stream.
Bottom roughness should simulate natural streambed morphology.

140. To determine a rough minimum ecological flow the biologist of the Biological Rapid Assessment recommend calculating a 7-day Mean Annual Low Flow (MALF) to give an indication of the low flows experienced by each catchment. In order to maintain steady populations of fishes in upper catchment areas the rapid Assessment Scientists Team recommend *at least 80% of this MALF value for each catchment be available external to manmade structures for migration purposes*

6.4 Environmental monitoring

6.4.1 Monitoring program

141. The Project monitoring program will focus on the environment within the project's area of influence. The program considers the scope of monitoring and frequency

6.4.2 Monitoring parameters

142. The monitoring program will focus on parameters, which can be monitored visually by appropriate local specialists and equipment.

6.4.3 Monitoring management

143. During construction, the EPC will make appropriate arrangements for monitoring according to the progress of implementation. Monitoring reports will be made available to the EPC and PUMA (MNRE) as required, on a monthly basis during construction. When complaints are received from the public (either directly or via the formal grievance redress mechanism), monitoring staff will conduct additional inspections immediately.

6.4.4 Monitoring costs

144. The continuing activities of the EPC monitoring during construction will be funded from

[3] Truly migratory fishes which migrate between the sea and fresh water.

the construction budget. EPC ongoing monitoring costs will be covered by their operational budget

6.5 Implementation responsibilities

The Implementing Agency

145. The implementing agency for this project is the EPC with its technical department to supervise these aspects and the social and environmental unit to supervise the social and environmental aspects.

At this stage it is not clear under which form the project will be implemented.
It depends of the type of sub-projects and the sites.
Some sub-project may be implemented under an Engineer Procure and Construction Contract, when other sub-projects may be implemented under more simplified form where the contractor will only implement plans and arrangements designed by EPC.
Implementation of mitigation measures and monitoring of these measures during the construction and operational phases will be the responsibility of EPC and of the MNRE, specifically the PUMA division.
Incidentally, if specific needs arise, the help of the research institution (Scientific Research Organisation of Samoa) may be sought.
The construction and rehabilitation impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents

Capacity building requirements

146. The EPC has a unit dedicated to social and environmental matters. The environment officer will be in charge of supervising the implementation of the EMP and its monitoring. The environmental officer is alone to cover all EPC activities and do their monitoring. It is advisable to temporary reinforce the EPC environmental capacity by seeking the assistance of an international expertise to ensure the proper integration of the EMP measures into the contractor work plan and the preparation of the Contractor EMP.

International expertise will be contracted and paid from the grant budget and will provide intermittent assistance to the EPC environment division helping it to fulfil its supervision and monitoring responsibilities. The expertise will also provide monitoring reports for the ADB (see terms of reference in Annex 1)
The EPC environment Officer with the guidance of the international expertise will undertake the incorporation of EMP provisions into the contract documents

The Contractor

147. The contractors will be engaged by EPC for construction and rehabilitation activities.

Each contractor will be responsible for the implementation of construction and rehabilitation activities for one site.
The contractors will have the responsibility for implementing the impact mitigation measures in the construction phase and the EPC Environment Officer will supervise their performance.
The EPC contractor will include staff to be specifically responsible for preparation and implementation of the CEMP. Based on the detailed design of the Project, the contractor will be required to prepare the CEMP, which describes the contactor's construction methodology and measures and plans for implementing the EMP as specified in the tender contract. This includes maintaining a site diary and a grievance registry. The CEMP shall be approved by the EPC prior to the contractor's mobilization to the site. The contractor will be required to report on the implementation status of the EMP to EPC.

The MNRE

148. It is a large minister with competency over several matters, ranging from forest, water resources, to biodiversity, land management. With its PUMA division, it ensures

compliance with environmental legislation. It has the appropriate equipment to perform the necessary measures needed in the monitoring program.

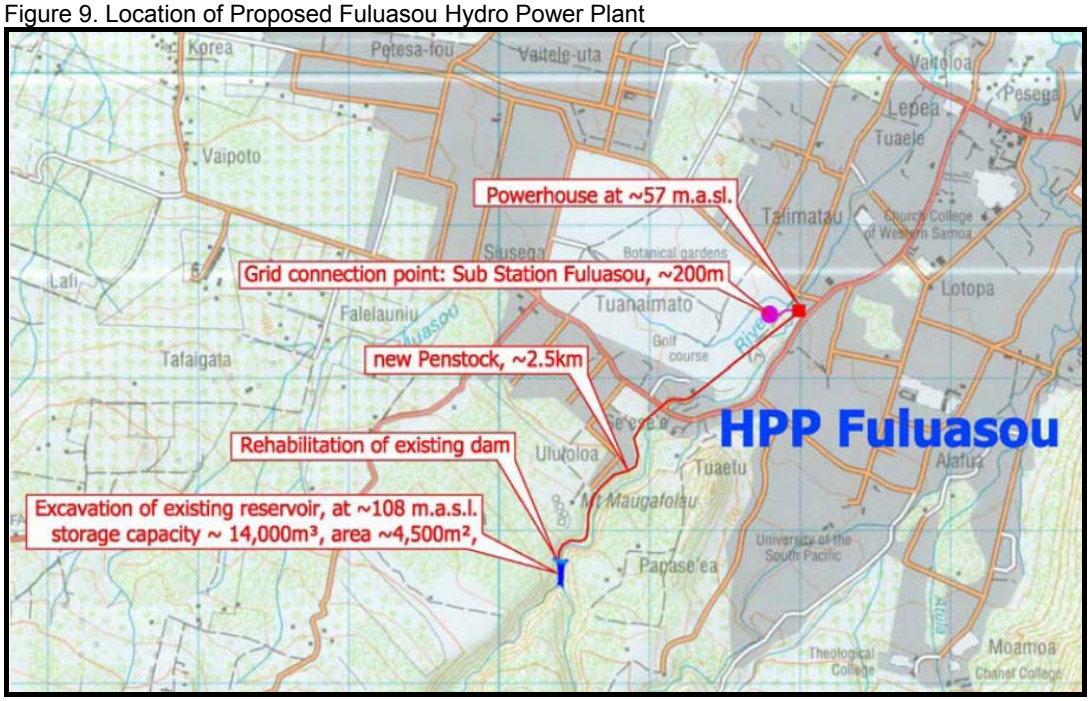
EPC will cooperate with MNRE for the monitoring of the EMP mitigation measures.

6.6 Fuluasou

6.6.1 Site Description

149. The proposed Fuluasou hydropower scheme is located 5km southwest of central Apia close to a built up area in the vicinity of Tuaefu and Ululoloa villages.

Figure 9. Location of Proposed Fuluasou Hydro Power Plant



6.6.2 Geophysical Information

150. The proposed hydro power plant is located in the c 4,300 ha Fuluasou catchment on the relatively young Salani volcanics (100,000 to 200,000 years old) which are deeply weathered with deep gorges and valleys (Kear and Wood 1959).

6.6.3 Catchment status and condition

151. The Fuluasou catchment is a critical catchment for Apia providing much of the water supply for the western part of the town and also for northwest Upolu. The Samoa Water Authority (SWA) has a water supply intake on the eastern branch of the Fuluasou River inland from the Fuluasou reservoir and a water treatment works inland from Ululoloa village.

152. The headwaters of the catchment are in the forested central mountains of Upolu around Lake Lanoto'o, The catchment has two main river branches, which meet at the Fuluasou reservoir or dam and then flow northwards into Vaiusu Bay (see figure 1).

153. While the headwaters of the catchment are well wooded, the lower portion of the

catchment below 60 m asl is highly disturbed and built-up with housing, roads and other infrastructure (refer figures 1 and 2). The vegetation of the upper catchment is mostly secondary forest dominated by invasive weedy trees such as *Albizzia chinensis*, *A. falcataria*, *Castilla elastica* and *Funtumia elastica*.

6.6.3.1 Vegetation types

Intake (dam)

154. Tava forest on east slope and east branch, upstream on west branch is more open with grass

The vegetation of the upper catchment is described mostly as secondary forest, with some areas of medium forest on the western branch of the Fuluasou river (FAO 2005) and small pockets of native forest on steep slopes. The pockets of native forest remaining in the catchment are dominated by tava (Pometia pinnata) especially on the steepest slopes.

Power station

155. Disturbed- Albizzia seman, Albizzia chinensis

The lower catchment, below the Tueafu bridge at 60m asl is highly disturbed and mostly built up, except for a narrow riparian strip of secondary trees (eg Albizzia species, Semania seman, Castilla elastica), grasses and invasive weeds.

156. No rare or endangered plants have been recorded in the project area.

6.6.3.2 Freshwater Biodiversity Values

157. The freshwater biodiversity of both Fuluasou sites visited is quite depauperate with only two fish species and two crustacea recorded at each site. The two fish species are both introduced species, sometimes considered pest species because they can quickly reproduce and take over low flow habitats while the crustacea are both common species. No rare, threatened or endemic fish species were recorded in the Fuluasou catchment.

6.6.3.3 Birds

158. Fourteen bird species were recorded at the Fuluasou site, with another two species not observed but possibly present. No threatened bird species or birds of special conservation interest were recorded at the site.

6.6.3.4 Presence of cultural and recreational heritage assets

159. No cultural or heritage sites were observed, or are known from the Fuluasou HPP site. However, the reservoir site is a popular swimming area for local residents, as are other places on the Fuluasou river near the Tuaefu bridge, between the reservoir and the power plant.

6.6.4 Ecological Significance of the HPP Site

160. The Fuluasou HPP project is predominantly in a highly impacted area where further development is unlikely to impact on populations of any rare or endangered species of bird, plant, mammal, reptile, invertebrate or freshwater fish. The site was formerly a hydro power plant but due to damage is not in current use. However, there is some

forest surrounding the existing dam and reservoir and along the penstock alignment so the preservation of native tree species and replanting of native tree species are recommended around the dam and reservoir, and along the penstock route, as well as in the catchment area more generally.

Although the ecological significance of the proposed Fuluasou hydro power project is relatively low with no threatened biodiversity recorded, the upper Fuluasou catchment is located within the Apia Catchments Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation (see figure 2). This KBA contains important habitat for a number of threatened species such as the manumea, mao, tolaifatu, and pea vao (CI, MNRE AND SPREP 2010) which have been recorded in the more mountainous and remote parts of the KBA. The Fuluasou catchment is also a critical watershed area for Samoa supplying water for much of Apia and as such needs to be managed carefully in order to retain, or ideally enhance, its provision of clean water and other ecosystem services. EPC can help improve the condition of the catchment by working closely with SWA and MNRE on catchment restoration activities such as tree planting programs that will stabilise stream banks, minimise erosion and landslips and maintain biodiversity.

Figure 10. Vegetation of the Project Site (Key Biodiversity Map)

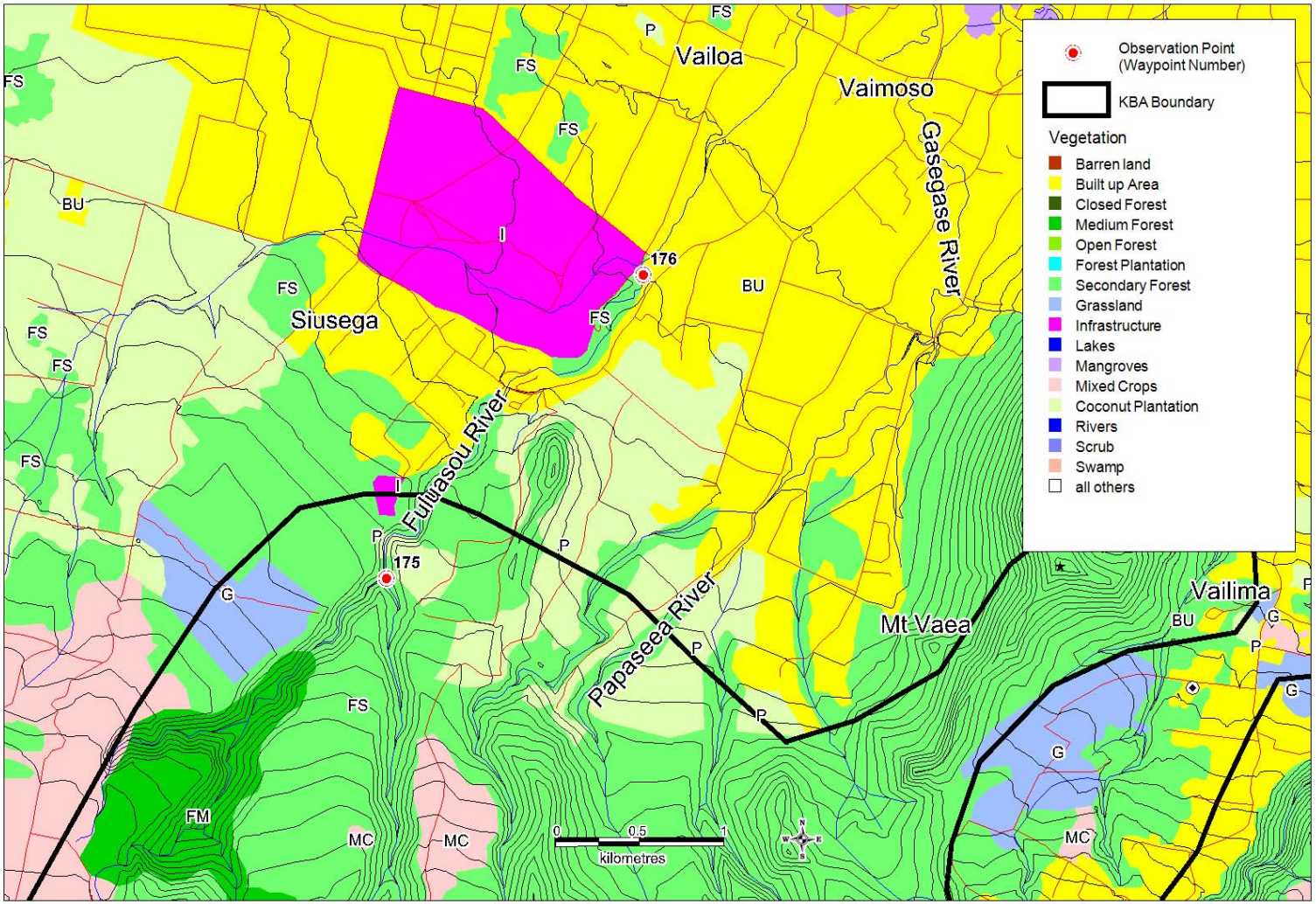


Plate 1. The Fuluasou reservoir looking northwards towards the dam. Note healthy vegetation on valley slopes.. Photo by James Atherton

Plate 2. The Samoa Water Authority is currently dredging silt from the reservoir causing significant siltation downstream. Upstream from this point the river is stagnant and has large number of invasive Livebearers present (*Poecilia Mexicana*). Photo by James Atherton.

6.6.5 The proposed activities

161. This project will be based on the former HPP scheme installed at this area. The old scheme has been out of service already for many years and from the penstock and powerhouse with the generation units only some fragments left. The new project will use the still existing concrete dam, the old penstock route and the location of the powerhouse.

Reservoir:

162. It will be excavated/desilted to re-establish the original storage capacity

Headrace:

163. A new penstock will be installed from the dam down to the powerhouse. A buried penstock is proposed. The route will be the same as for the old penstock, where required smaller adaptations of the rout to the current situation can be done during detail design. The penstock rout follows in the upper section the access road and afterwards runs through an area with some settlements and a golf course. Thus no forest clearance is required.

Powerhouse:

164. The new powerhouse will be located at the plot of the former powerhouse, adjacent to the riverbed. Thus the tailrace water can be released directly back into the riverbed. Next to this plot currently a new substation with a new National Control Centre for the transmission grid is in installation

Grid connection:

165. The connection point to the grid is in the new Fuluasou substation. An earth laid cable connection is proposed

6.6.6 The Potential impacts and mitigation measures

6.6.6.1 Preconstruction

166.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Though there is no habitat close to the dam that might be affected by noise, some settlements are situated at the entrance of the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to reinforce the dam.

1.b the national noise standard in the national legal framework[4] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance by putting a road sign close to the entrance of the access road, make announcements in papers and media and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected to avoid disturbance too

[4] PUMA, Noise Policy October 2011

early or at night or on Sundays or public holidays[5]. Contractor has to be informed.

3 Aquifers and River pollution

3.a during rainy periods, trucks circulating on the access road in muddy conditions can damage the surface leading to erosion of sediments and run-off into the river.

Mitigation measures:

3_a See 5_b gravel the road

4 Soil

4.a erosion resulting from works and access road threaten river water quality.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

5. Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an Emergency and Preparedness Plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use.

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled prior to any use to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE

[5] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.d Working conditions are dangerous

Mitigation measures:

5_d the national regulation about Occupational Health and Safety will be applied[6] to ensure workers security mainly for those working above the void

6 Environment and biodiversity

6.a the dam has changed the river ecosystem by stopping the fish from migrating upstream

6.b) the new dam may change the river ecosystem and the river flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measure:

6_a Though the dam already separates the River in two parts for over 30 years, biologic investigation should be done to assess the need and the feasibility to restore the river into its initial shape before the dam construction. This will include a study for a fish pass.

6_b) an ecological flow should be developed to assure continuity and surviving of river ecosystems. To monitor the effect of ecological flow an initial biological and chemical assessment of the river should be performed.

6_c identify and mark large native trees for preservation

6.6.6.2 Construction

167.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Though there is no habitat close to the dam that might be affected by noise, some settlements are situated at the entrance of the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to reinforce the dam.

1.b the national noise standard in the national legal framework[7] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[8]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable

2- Air pollution:

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[6] Occupational Safety and Health Act 2002

[7] PUMA, Noise Policy October 2011

[8] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements close to the entrance of the access road

2.b overloaded trucks generating dust during transport of sediments or material

Mitigation measures:

2_a , reduce speed at the entrance of the access road; inform truck drivers, spay water in dry season. Utilize equipment and vehicles with low emissions as far as practicable

2_b avoid overloading trucks when transporting sand to avoid dust emission during transport, cover stockpiles and trucks

3 Aquifers and River pollution

3.a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3.b when repairing the dam some elements like rubbles may fall in the river and pollute it

3.c the river may be affected by involuntary spill of sediments when extracting from the reservoir resulting of heaving silting of the river waters

3.d the contractor may be tempted to stop the river flow to facilitate the dam repairs resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like special nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when refurbishing the dam with concrete, during new penstock burying and during construction of new powerhouse to avoid spilling in the river waters chemical substances, construction material, sand or erosion. If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b avoid dropping in the river rubbles from the dam

3_c diversion of water in the reservoir to leave a flow untouched is necessary

3_d investigation should be done to confirm that the river dries out regularly. If it is confirmed, the river flow should not be stopped too long mainly during the dry season when the aquatic live weakened by low water and hypoxia conditions. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous, upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4 Soil

4.a some parts of the dam may have to be slightly excavated to reinforce its structure leaving rubbles around the dam site

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material
The sediments excavated from the reservoir have a valuable cost and will be sold for road or other construction.

4.c construction works mainly during penstock burying along the steep road may induce rive bank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and Sedimentation Control Plan is implemented

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and implement a Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5. Social and cultural aspects, health and safety

Safety and circulation

5.a Traffic circulation could be dangerous if it is not properly organised, as the access road is just one lane width. The access road is fairly narrow possibility for a truck to find a safe place to pull over is scarce because the access road is narrow with steep edges.

Mitigation measure:

5_a the contractor will have to organise its vehicles passing. Somebody should be posted at the entrance and another one at the site with cellular phones or a radio to give clearance to use the access road Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads.

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.
Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

Working Safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[9] to ensure workers security mainly for those working above the void

6. Environment, Vegetation and Biodiversity

There is no need for forest clearing, as the infrastructures already exist.

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_c Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

168. After completion of in-stream works, all disturbed areas should be:

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

169. Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem

[9] Occupational Safety and Health Act 2002

- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.6.6.3 Operation

170.

5 Social and cultural aspects, health and safety

5.c The HPP premises are not secured by fencing leading to HPP infrastructure vandalising, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_c HPP premises should be secured including penstock if not buried.
Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,
The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be developed to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE.
Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well
Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted
Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)
Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

Most important impacts

171. River pollution from poisonous substances and siltation during construction phase and rehabilitation of the dam

Special attention should be given to SWA intake at the bottom of the dam to prevent any pollution. The contractor should contact SWA and seek their advice on how to best conduct the repair on the dam without spoiling the water intake

Table of FULUASOU Potential Impacts during Construction Phase

Source of Impacts / Environmental factors	Refurbishing of the Dam	Excavation of Reservoir	Headrace: installation of new penstock	Installation of a new Powerhouse	Existing Access road	Connexion to Grid by earth laid cable
Noise	1_Excess noise at the entrance of access road	1_Excess noise at the entrance of access road	1_Excess noise at the entrance of access road	1_Excess noise at the entrance of access road	NA	NA
Air pollution	2_Dust due to circulation of trucks	2_Dust due to circulation of trucks	2_Dust due to circulation of trucks	2_Dust due to circulation of trucks	2_Dust due to circulation of trucks and non gravelled road	NA
Safety and circulation	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions	3_a) Poor control of engines circulation resulting in loss of time and danger 3_b) soiling of main road in muddy conditions
River pollution	4_b) River pollution by construction material used to rehabilitate the dam 4_c) River pollution by rubbles 4_e) loss of aquatic life	4_d) River pollution by excavating sediments from reservoir	4_b) river pollution by construction material, rocks and sediments	4_b river pollution by construction material, rocks and sediments	4_a) River pollution from degraded access road	NA
Soil	5_a) site pollution by left rubbles 5_b) site pollution by oil spill and leftover construction material	5_b) site pollution by oil spill and leftover construction material	5_b) site pollution by oil spill and leftover construction material	5_b) site pollution by oil spill and leftover construction material	5_b) site pollution by oil spill and leftover construction material	NA
Social aspects	No respect of local OHS regulations	No respect of local OHS regulations	No respect of local OHS regulations 6_b) destruction of archaeological remains	No respect of local OHS regulations 6_b) destruction of archaeological remains	No respect of local OHS regulations	No respect of local OHS regulations 6_b) destruction of archaeological remains
Environment and biology (forest clearance, loss of habitats)	7_a) dam has changed the existing river ecology 7_b Dam has change the river flow	NA	NA	NA	NA	NA

Mitigation and Monitoring Table FULOUASOU

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents near the access road of forthcoming works A **Grievance Redress Mechanism** ready	Residents near the entrance of the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	River Pollution											
Passing of trucks and engines on the access road	**3.a** degradation of access road leads to river pollution	Gravel access road (see also 5-b gravel the access road)	All access road	Prior to the start of construction	Contractor	EPC	Included in contracted construction costs	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and wok sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											

[10] **as listed in IEE**

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Passing of trucks and engines on access road and main roads	**5.b** the main roads are soiled	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river Study for a fish pass	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of	Quarterly	EPC	EPC	Included in project costs

	Mitigation and/or Enhancement Measures						Monitoring Plan				
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		Grievance mechanism implemented Utilise quiet and sound proof equipment						working hours				
	2.a-2b Dust due to truck circulation	Reduce speed along access road, inform truck drivers, Spray water in dry season Avoid overloading trucks Cover stockpiles and trucks Utilize vehicles with low emission	Residents near the entrance and along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a-3.b-3.c** river polluted by spill during refurbishing of the dam, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river developed in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period specifically when dam repairing and penstock burying	Contractor	EPC/PUMA	Included in contracted construction costs	River water quality (turbidity control)	Monthly during instream construction y	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.d loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Or investigation proves that river flow stops in dry season Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.a** construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During intake construction, burying of penstock and construction of powerhouse	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation and burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again erosion bare areas	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of circulation Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a- 6.b** reduction of flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control of downstream river flow compared to upstream flow Contractor	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs

			Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
								report				
Construction works	**6.c** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

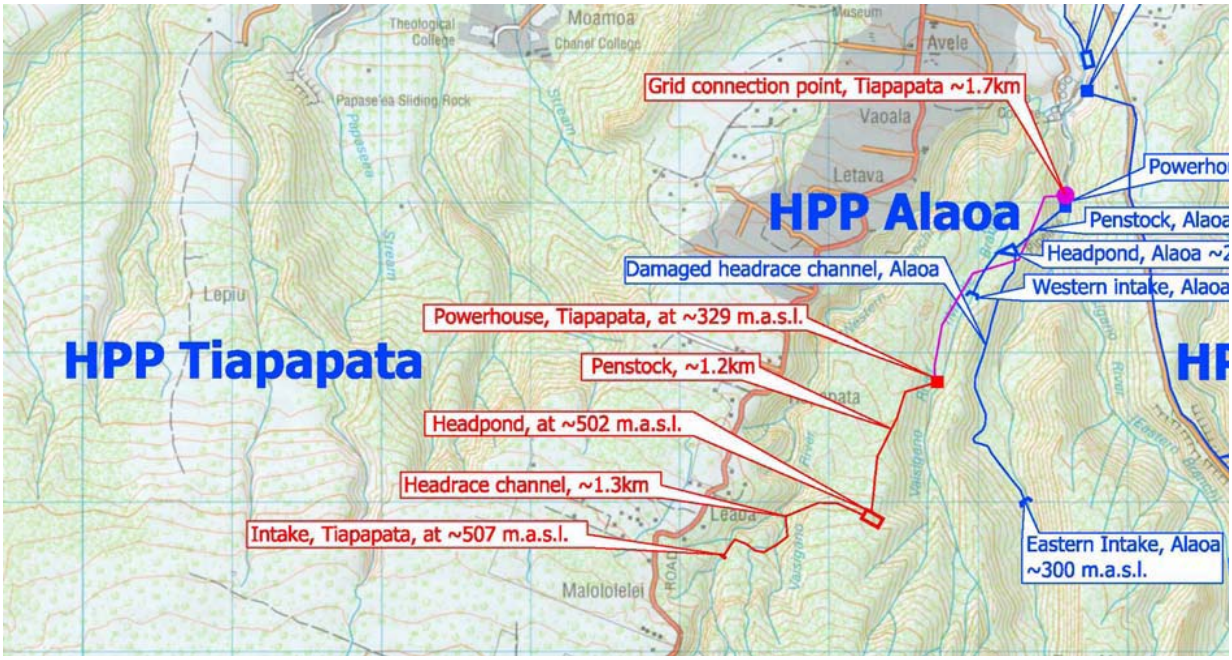
		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[10]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**					
		development activities									

6.7 Tiapapata

6.7.1 Site Description

172. The Tiapapata hydropower scheme is a proposed HPP located 7km south of central Apia.

Figure 11. Location of Proposed Tiapapata Hydro Power Plant



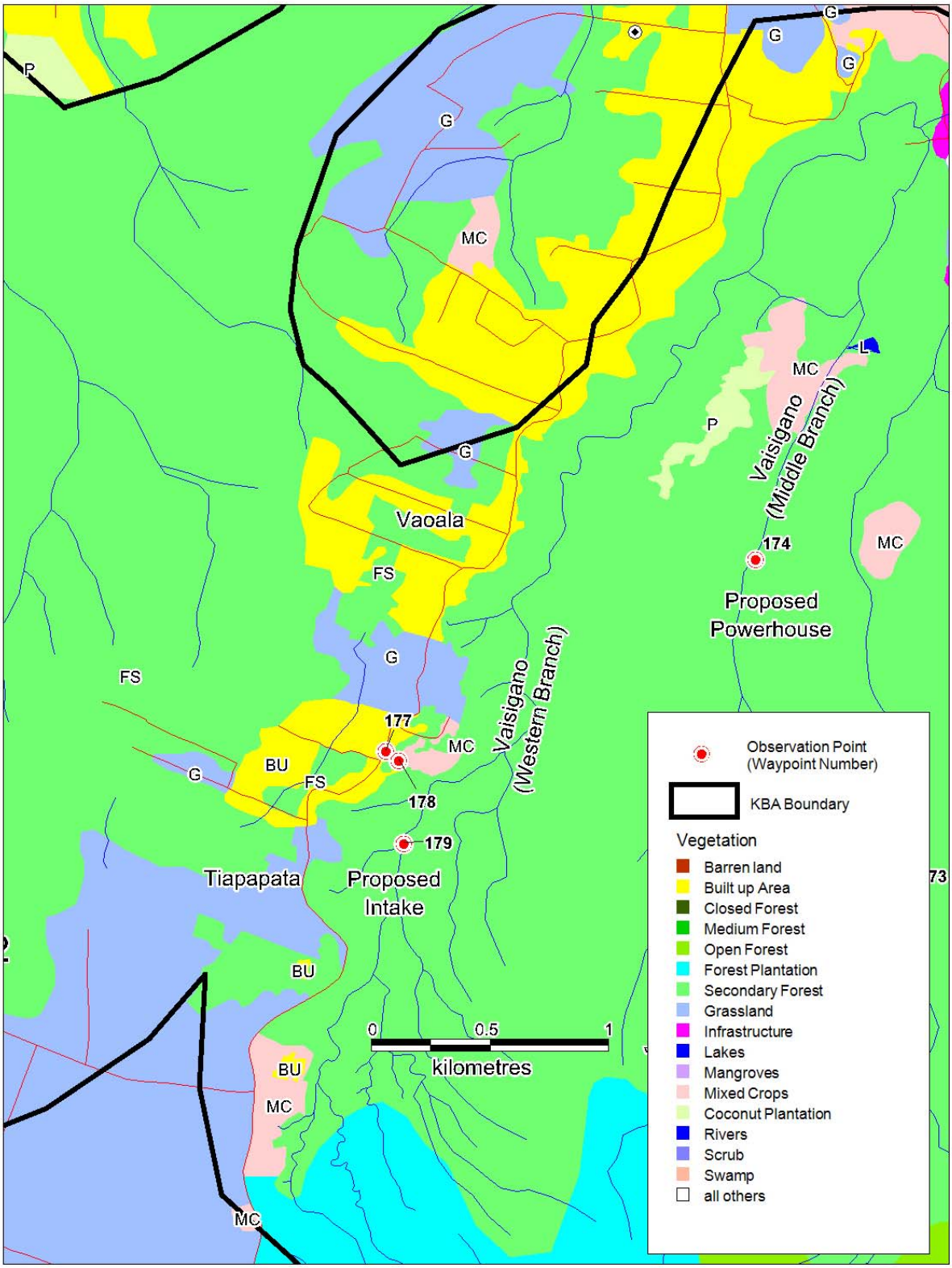


Figure 12. Vegetation of the Project Site

6.7.2 Geophysical Information

173. The proposed intake of the hydro power scheme is located on the western branch of the Vaisigano river but with a headrace and penstock leading to a powerhouse on the middle branch of the Vaisigano river. The geology of this area is classified as the

relatively young Salani volcanics (100,000 to 200,000 years old), which are deeply weathered with deep gorges and valleys (Kear and Wood 1959).

6.7.3 Catchment status and condition

174. The proposed intake, penstock and power house of the Tiapapata HPP are located in the western (intake) and middle (powerhouse) branches of the c 3,300 ha Vaisigano catchment. The Vaisigano catchment is the most critical catchment for Apia providing much of the water supply for the town. The Samoa Water Authority (SWA) has a number of water supply intakes in the Vaisigano River including one upstream from the proposed intake for the Tiapapata HPP and a main treatment works at Alaoa downstream from the proposed powerhouse for the Tiapapata HPP.

The headwaters of the Vaisigano catchment is in the forested central mountains of Upolu around Mount Le Pue and Mt Fito. The Vaisigano catchment has three main river branches (eastern, middle and western) which meet at Alaoa, (see figure 1).

While the headwaters of the Vaisigano catchment are well wooded, they were severely impacted by landslips during and after cyclone Evan (December 2012). Large areas of steep slopes in the upper catchment are still devoid of trees and although covered with grasses and other shrubs, remain a further erosion risk in heavy rainfall.

6.7.3.1 Vegetation types

175. The vegetation of the upper Vaisigano catchment is secondary forest (FAO 2005). The riparian strip is composed of weedy invasive trees such as Albizzia falcataria, Albizzia chinensis and Castilla elastica and to a lesser degree Spathodea campanulata (African tulip). The steeper slopes have a few remnant Pometia pinnata (tava), Dysoxylum huntii (maota mea) and other native trees. At the proposed intake the areas of landslip are covered in grass, invasive gingers and Aphelandra aurantiaca (fiery spike).

176. No rare or endangered plants have been recorded in the project area.

6.7.3.2 Freshwater Biodiversity Values

177. The fish biodiversity of both Tiapapata sites visited is low with no fish species recorded at the proposed Tiapapata power plant and only two at the proposed intake, both common indigenous species. However, the crustacean diversity at both sites is high with five species reported from both the proposed power plant and the intake sites. All the crustacea recorded were common indigenous species. No snail species were recorded at either site.

6.7.3.3 Birds

178. Twenty one bird species were recorded at the Tiapapata HPP site, with another species not observed but possibly present. At least three bird species breed in the area. A number of rare and endangered birds were reported in the area including Maomao , the Samoan broadbill and potentially the Manumea which has been observed in this area outside the survey period. This area exibits high bird diversity.

6.7.3.4 Presence of cultural and recreational heritage assets

179. No cultural heritage sites were observed at the Tiapapata HPP sites.

6.7.4 Ecological Significance of the HPP Site

180. The Tiapapata HPP project is in a remote, forested and steep area that has some important ecological values including a large number of native birds and patches of native forest. The proposed development is likely to result in significant forest clearance for road construction, and later construction of HPP infrastructure including a water intake, water race, headpond, penstock and a powerhouse. The project requires construction works to occur within remote areas of forest over a considerable distance from the intake to the proposed powerhouse (approx. 2.5km).

Although the fish diversity in the upper Vaisigano River is low (most probably due to complete extraction of river flow at the Alaoa HPP intake), the catchment remains a critical watershed area for Apia and as such needs to be managed carefully in order to retain, or ideally enhance, its provision of clean water and other ecosystem services.

Of the eight HPP sites assessed for EPC, the proposed infrastructure development at the Tiapapata HPP will have the greatest impact of any project on native wildlife such as the endangered Manumea and Mao since this development will occur in deeper parts of the forest, away from current developments. Most of the Vaisigano catchment is located within the Apia Catchments Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation (see figure 2). This KBA contains important habitat for a number of threatened species such as the Tooth-billed pigeon (Manumea), Mao (Maomao), Samoan broadbill (tolaifatu), and Samoan flying fox (pea vao) (CI, MNRE AND SPREP 2010).

The proposed HPP may impact Manumea and other native pigeon populations by: 1) opening this area to increased hunting pressure, 2) increasing the number and abundance of invasive predator species and thus increase the mortality of chick, egg and potentially adult birds, and 3) reducing the core habitat (food and nest trees) by removing key feeding and nesting trees. This development is also likely to impact the Mao by increasing predation rates of adults and chicks by invasive mammals and by removing food and nest trees. This is also an important site for other native Samoan birds and both the locally threatened parrot finch and the Samoan broadbill breed in this area. Breeding seabirds are also using this area with large numbers of brown noddies, tropicbirds and white terns breeding in the trees within this catchment particularly along the site of the proposed headrace and penstock.

Plate 4. The site of the proposed intake for the Tiapapata HPP (waypoint number 179). Note signs of landslides and open scrubby vegetation on slopes. Photo by James Atherton.

Plate 5. Sampling fish at the site of the proposed tailrace for the Tiapapata HPP. Photo by James Atherton.

Plate 6. The site of the proposed powerplant and tailrace for the Tiapapata HPP (waypoint number 174). Photo by James Atherton

6.7.5 The proposed activities

181. The intake of this new HPP scheme is located on the western branch of the Vaisigano river. The powerhouse will be located at the middle branch, thus the diverted water from the western branch will be discharged into the middle branch, upstream of the existing intake for the Alaoa HPP. Thus, the diverted water can be used two times, first from the new Tiapapata HPP scheme and afterwards a second time from the existing Alaoa HPP.

Intake:

182. A Tyrolean weir with sand trap is proposed, no reservoir

Head race:

183. The headrace consists of two sections, a channel/pipe section from the intake to a head pond and from there a penstock to the powerhouse. An alternative option could be a continuous penstock from the intake to the powerhouse. The entire headrace route is located in forest area, thus forest clearance is required for the penstock route and a temporary access road during construction.

Power house:

184. The new powerhouse will be located adjacent to the riverbed of the middle branch. Thus the tailrace water can be released directly into the riverbed. Site and forest clearing is required.

Access road:

185. New access roads must be constructed. One from the cross-island road down a slope to the intake and the second from the existing Alaoa middle branch intake up to the powerhouse. The detailed route must be defined during detail design but will be in a forest area, thus forest clearance is required.

Grid connection:

186. The connection point to the grid is at the existing Alaoa HPP. An earth laid cable connection is proposed.

6.7.6 The Potential impacts and mitigation measures

6.7.6.1 Preconstruction

187.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats close to the entrance and along the access road situated in the suburbs of Apia might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to construct the channels, the head pond, the penstock and the powerhouse.

1.b the national noise standard in the national legal framework[11] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works ion advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid disturbance too early or at night or on Sundays or public holidays[12]

4 Soil

4.a erosion resulting from works and access road threaten river water quality.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

5. Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding. .

Mitigation measures:

5_a an emergency plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor

[11] PUMA, Noise Policy October 2011

[12] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use.

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.d Working conditions are dangerous

Mitigation measures:

5_d the national regulation about Occupational Health and Safety will be applied[13] to ensure workers security mainly for those working above the void

6 Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake

6.b the construction of access road and intake infrastructures destroy sensitive vegetation, biotopes and riverbed. There are some old fields close or in the middle of the river but most of the area seems to be unexploited and at some places well preserved, mainly on the river sides

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6_b design the access road in the upper part to avoid too much disturbance of river and riverbanks.

Evaluate the surface to be cleared and design a Reforestation Plan in agreement with MNRE/Water Resource Division and Ministry of Agriculture

6.7.6.2 Construction

188.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats close to the entrance and along the access road situated in the suburbs of Apia might be affected by noise and will have to

[13] Occupational Safety and Health Act 2002

endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to construct the channels, the head pond, the penstock and the powerhouse. The national noise standard in the national legal framework[14] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[15]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable

2- Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements close to or along of the access road

Mitigation measures:

2_a reduce speed at the on the access road; inform truck drivers; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the construction of the intake resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when constructing the intake and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion. If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works

3_b diversion of water to leave a flow untouched is necessary. . Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[16], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on

[14] PUMA, Noise Policy October 2011

[15] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

[16] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c the upper part of the river has very steep banks, erosion could rapidly occur if appropriate steps aren’t taken to protect river banks and access road banks

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have developed a Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised, as the access road will be just one lane width at the upper part of the road. The area has many crop fields and habitat entrances or access to SWA reservoirs and engines and trucks may restrict access to the location during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the various locations. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads.

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.

Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

Working safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[17] to ensure workers security mainly for those working above the void

6- Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_ Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream between the intake and the powerhouse.

6.c forest clearing, mainly in the upper part of the site, could destroy valuable tree species or species harbouring endangered animal species

6.d riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be developed to assure continuity and surviving of river ecosystems.

6_c valuable trees species should identified and preserved whenever possible during the opening of upper access road, intake, penstock and powerhouse constructions. The equivalent of surface deforested should be replanted according to the Reforestation Plan

6_d Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

189. After completion of in-stream works, all disturbed areas should be:

[17] Occupational Safety and Health Act 2002

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

190. Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.7.6.3 Operation

191.

5 Social and cultural aspects, health and safety

Safety

5.c The HPP premises are not secured by fencing leading to HPP infrastructure vandalising, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_c HPP premises should be secured including penstock if not buried. Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,
The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed and forest cover resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be developed to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. The access road to the upper part of the river should locked and regularly controlled.
Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well

Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted
Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)
Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

Most important impacts

192. River pollution from poisonous substances and siltation during construction phase (access road, channel, head pond)

Disappearing of important biotopes, specifically in the upper part of the river (intake, channel, head pond). It is a rather untouched area.
Protection from soil erosion as the access to the upper part of the river is very steep

Mitigation and Monitoring Table TIAPAPATA

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[18]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents near the access road of forthcoming works A **Grievance Redress Mechanism** ready	Residents near and along the of access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and wok sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Passing of	**5.b** the main roads are	Gravel the main	Access road	Prior to the start of	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project

[18] **as listed in IEE**

			Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[18]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
trucks and engines on access road and main roads	soiled	road whenever necessary		construction								costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river Study for a fish pass	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
Construction of the access road and intake structures	**6.b** damage to some well preserved parts of the river	Design of access road should avoid disturbing too much the river and the river banks Evaluation of surface needed to be cleared and compensate by reforestation of the catchment	Upper part of the river	Design stage	EPC/Contractor, MNRE (forest and Water divisions), Agriculture	EPC/MNRE	Included in the EPC budget	A document identifies biotopes to be protected and presents alternatives routes Proposal for reforestation of the catchment	Once	EPC	EPC/ MNRE Forest division Water Resource Division Ministry of Agriculture	Included in EPC and other institutions costs
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (*Dysoxylum* species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										

	Environmental Impact[18]	Mitigative Measures	Mitigation Location	and/or Time Frame	Enhancement Respons ibility: Implementation	Enhancement Respons ibility: Supervision	Costs	Monitoring Plan: Parameter	Frequency	Implementat	Supervising	Cost
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance mechanism implemented Utilise quiet and sound proof equipment	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of working hours	Quarterly	EPC	EPC	Included in project costs
	2.a-2b Dust due to truck circulation	Reduce speed along access road, inform truck drivers, Spray water in dry season Avoid overloading trucks Cover stockpiles and trucks Utilize vehicles with low emission	Residents near the entrance and along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of the access road, intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river developed in the **Erosion and Sedimentation Control Plan**	Intake, head pond, penstock route and powerhouse	Throughout the construction period specifically when dam repairing and penstock burying	Contractor	EPC/PUMA	Included in contracted construction costs	River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.a** construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control**	Site	During intake construction, burying of penstock and construction of powerhouse	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[18]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**					
		Plan									
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation and burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again erosion bare areas	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs
	Social, cultural, H&S										
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of circulation Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity										
Water intake	**6.a- 6.b** reduction of flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control of downstream river flow compared to upstream flow	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[18]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
								Contractor report				
Clearing the land for intake construction	**6.c** Destruction of habitats and endangered species by forest clearing	Preserve valuable trees and biotopes Implement the reforestation plan	Construction site	Throughout the construction period	Contractor	EPC/MNRE	Included in contracted construction costs	Presence of identified valuable trees or sites Plantation of native trees in the catchment	Quarterly	Contractor	EPC/ MNRE Forest division Water Resource Division Ministry of Agriculture	Included in project costs
Construction works	**6.d** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs
	OPERATION	**PERIOD**										
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

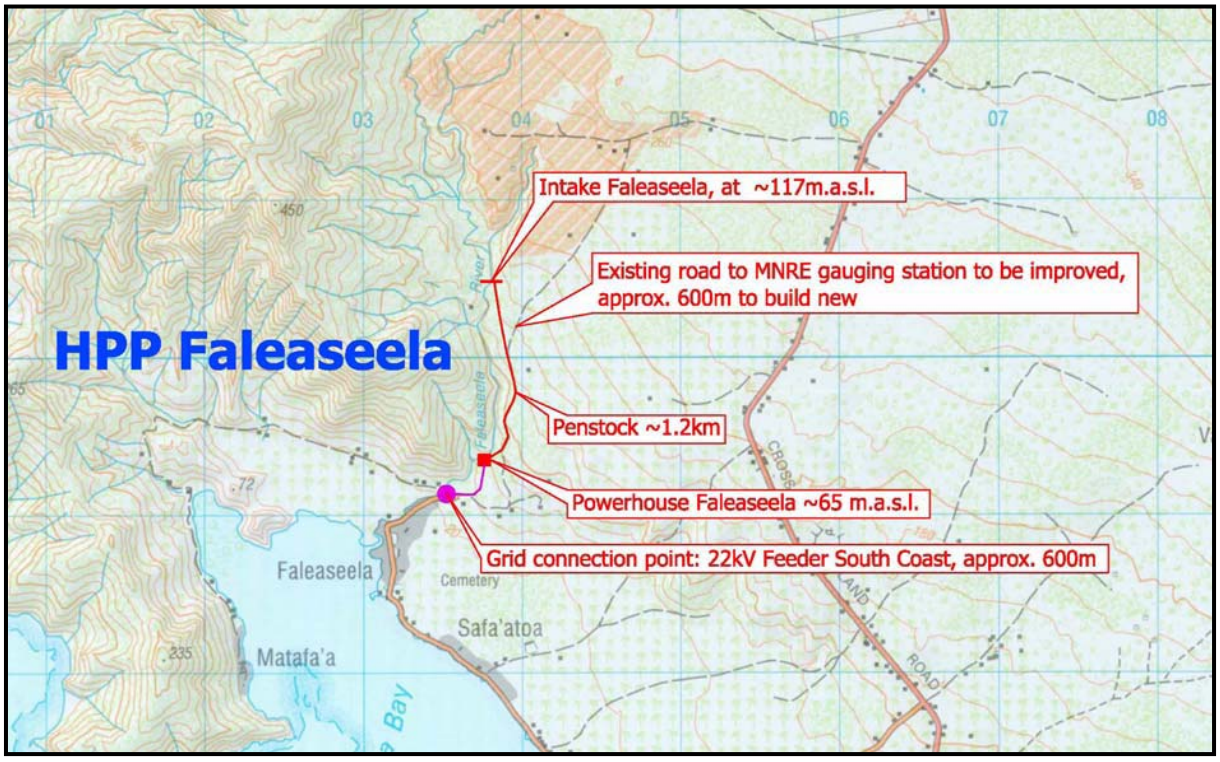
		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[18]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**					
		Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities									

6.8 Faleaseela

6.8.1 Site Description

193. The Faleaseela hydropower scheme is a proposed HPP located 24km southwest of Apia near the southwest coast of Upolu.

Figure 13. Location of Proposed Faleaseela Hydro Power Plant



6.8.2 Geophysical Information

194. The proposed intake of the hydro power scheme is located on the Faleaseela river at approximately 148m asl and with a penstock following the eastern side of the river to a powerhouse at approx. 65m asl. The geology of the catchment is classified as the young Puapua volcanics (3,000 years old), which are lightly weathered (Kear and Wood 1959). On the western side of the catchment on the steeper slopes are much older (up to 2 million years old) and more weathered Fagaloa volcanics (Kear and Wood 1959).

6.8.3 Catchment status and condition

195. The proposed intake, penstock and power house of the Faleaseela HPP are located in the c 982 ha Faleaseela catchment. The Samoa Water Authority (SWA) has in intake approximately 30m upstream from the proposed intake for the HPP.

The headwaters of the Faleaseela catchment are well wooded, however the area around the proposed intake and also the powerplant is highly disturbed with coconuts, grass and around the proposed power plant, grazing cattle.

6.8.3.1 Vegetation types

196. The vegetation of the upper Faleaseela catchment is open native forest but around the proposed intake, penstock and proposed power plant it is a mixed agricultural zone (coconuts, agricultural plantations and cattle) (FAO 2005). The steeper slopes below the intake have remnant Pometia pinnata (tava), Dysoxylum maota (maota) and other native trees.

No rare or endangered plants have been recorded in the project area

Figure 14. Vegetation of the Project Site

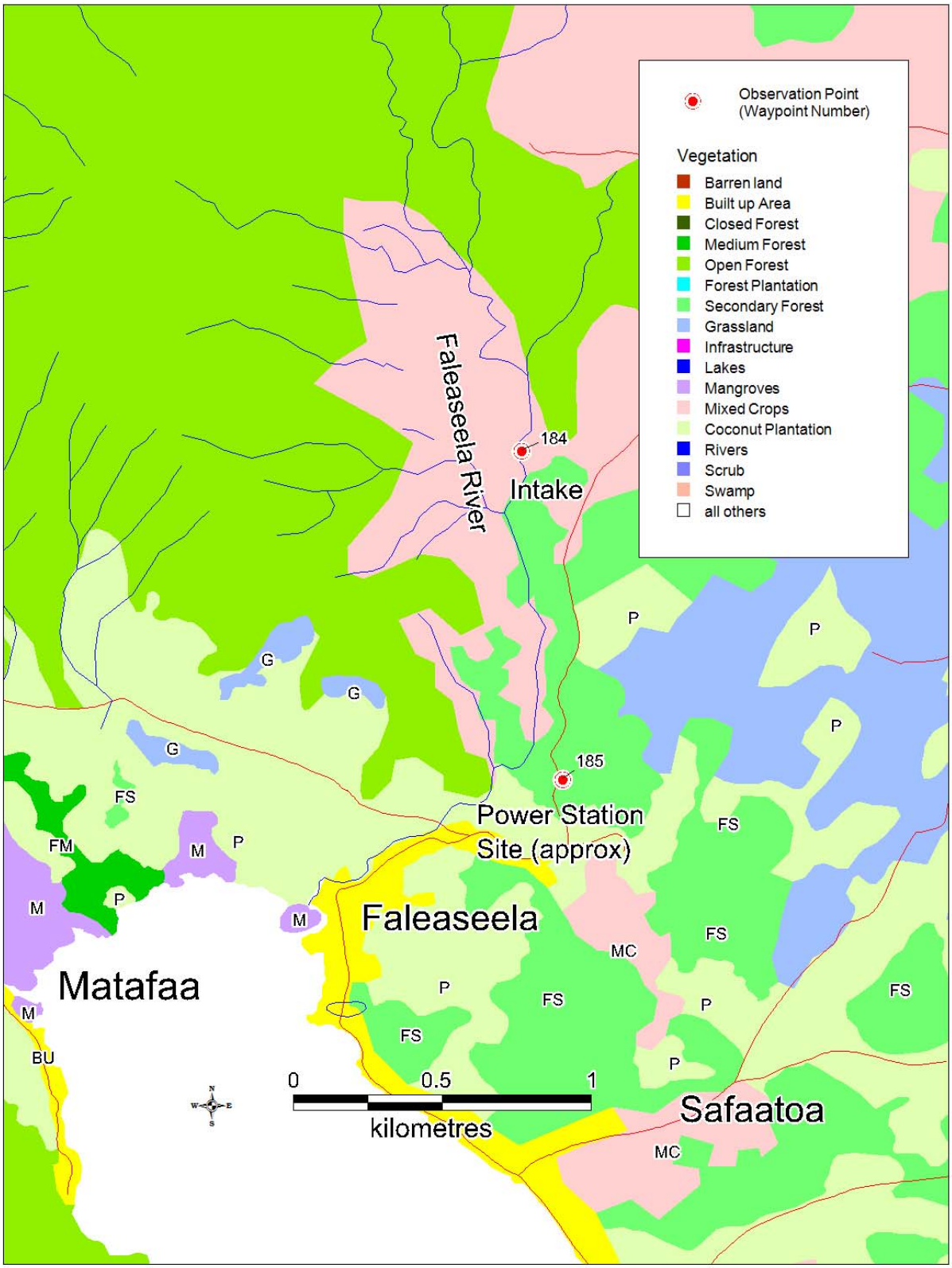


Plate 7. The site of the proposed intake for the Faleaseela at an MNRE gauging station (waypoint number 184). Photo by James Atherton.

Plate 8. The alignment of the proposed Faleaseela HPP penstock along an existing road. Photo by James Atherton.

Plate 9. Looking towards the site of the proposed powerplant for the Faleaseela HPP (waypoint number 185). Photo by James Atherton

6.8.3.2 Freshwater Biodiversity Values

197. The fish biodiversity of both Faleaseela sites visited is medium with three fish species recorded at both the proposed intake and the proposed power plant including one endemic Stiphodon hydoreibatus.

However, the crustacean diversity at both sites is high with five species reported from both the proposed power plant and the intake sites. All the crustacea recorded were common indigenous species. One snail species was recorded at both sites.

6.8.3.3 Birds

198. Eighteen bird species were recorded at the Faleaseela HPP site, with another four species not observed but possibly present. A number of rare and endangered birds were reported in the area including Maomao and the Samoan broadbill and potentially the Manumea which locals say is found in the area. This is high bird diversity.

6.8.3.4 Presence of cultural and recreational heritage assets

199. No cultural heritage sites were observed at the Faleaseela HPP site. However the river is used for waterfall hiking tours, which start near the bridge crossing the Faleaseela River and end at the waterfall immediately below the proposed HPP intake.

6.8.4 Ecological Significance of the HPP Site

200. The Faleaseela HPP project is in a modified catchment and is unlikely to result in significant impacts on native biodiversity as long as forest clearance is kept to a minimum and construction of works is designed to maintain stream flows.

Although the fish diversity in the Faleaseela River is moderate, the crustacean diversity is high. The bird diversity is also high and the site is important for a number of rare and endangered birds such as the Maomao and the Samoan Broadbill. The food trees the Manumea rely on were found along the proposed new access road and in the river down stream of the proposed intake. Local reports also suggest that the Manumea is using this catchment site. Though no Manumea were observed during the survey this does not indicate they are not present, only that they are at extremely low densities. A number of seabirds and more common pigeon species also appeared to be breeding in the area below the proposed intake. Because this site is on the forest edge the development is unlikely to substantially increase predation rates on endangered bird nests by invasive nest predators. However it may impact bird populations in other ways particularly through loss of habitat.

6.8.5 The proposed activities

201. This project is a new HPP scheme. The intake and powerhouse are located on the Faleaseela river upstream of the village.

Intake:

202. A Tyrolean weir with sand trap is proposed, no reservoir

Head race:

203. The headrace consists of a penstock. The upper section runs down a slope to the existing access road, following this road till to the powerhouse location. Forest clearance is required only for the upper section.

Power house:

204. The new powerhouse will be located adjacent to the riverbed. Thus the tailrace water can be released directly into the riverbed. Site and forest clearing is required.

Access road:

205. Short new access roads must be constructed from the existing road up to the intake and down to the powerhouse. The detailed route must be defined during detail design but will be in a forest area, thus forest clearance is required.

Grid connection:

206. The connection point to the grid is in the village to the 22kV South coast feeder.

6.8.6 The Potential impacts and mitigation measures

6.8.6.1 Preconstruction

207.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats and the village close to the entrance access road might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to construct the weir and the penstock.

1.b the national noise standard in the national legal framework[19] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works on advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid

[19] PUMA, Noise Policy October 2011

disturbance too early or at night or on Sundays or public holidays[20]

4- Soil

4.a erosion resulting from works and access road threaten river water quality.
4.b sand needed for construction is dug out in unstable places
4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.
4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency
4_c contractor should develop a Pollution Control Plan

5- Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an Emergency and Preparedness Plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Social aspects

5.d reduction of river flow by water intake upstream at the weir and release of the water at the powerhouse will affect local commercial tourist activities and visits to the spectacular waterfalls

Mitigation measures:

[20] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

5_d discussion and compromise to determine allocation of water for the different uses (hydroelectricity, irrigation and domestic uses, natural river flow to keep scenery)

Working safety

5.e Working conditions are dangerous

Mitigation measures:

5_e the national regulation about Occupational Health and Safety will be applied[21] to ensure workers security mainly for those working above the void

Mitigation measures:

5.e compromise should be sought in the use of water between electricity production, ecological flow and tourist activity

6- Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake

6.b the river is biological life is transformed because of inappropriate ecological flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6_b calculate the appropriate ecological flow according to fish biology

6_c identify and mark large native trees for preservation

6.8.6.2 Construction

208.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Though there is no habitat close to the dam that might be affected by noise, some settlements are situated at the entrance of the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to do the construction works.

1.b the national noise standard in the national legal framework[22] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[23]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable

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[21] Occupational Safety and Health Act 2002

[22] PUMA, Noise Policy October 2011

[23] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

2- Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements close to the entrance of the access road

Mitigation measures:

2_a reduce speed at the entrance of the access road; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the construction of the weir resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when constructing the weir and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion (developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[24], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c construction works mainly during penstock burying along the steep road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and

[24] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have developed a Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised, as the access road is just one lane width. The access road is fairly narrow possibility for a truck to find a safe place to pull over is scarce. The area has many crop fields and engines and trucks may restrict access to the fields during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields
Somebody should be posted at the entrance and another one at the site with cellular phones or a radio to give clearance to use the access road. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.
Unskilled workers will be brought from near-by site and skilled workers will stay in hotels
The national regulation about Occupational Health and Safety will be applied[25] to ensure workers security mainly for those working above the void

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE

[25] Occupational Safety and Health Act 2002

should be implemented in case of discovery during works

Working safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[26] to ensure workers security mainly for those working above the void

6- Environment, Vegetaion and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_ Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c forest clearing, though limited, could destroy valuable tree species or species harbouring endangered animal species

6.d riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_c valuable trees species should identified and preserved whenever possible during the penstock and powerhouse constructions.

6_d Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

209. After completion of in-stream works, all disturbed areas should be:

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

210. Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems

[26] Occupational Safety and Health Act 2002

- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.8.6.3 Operation

211.

5 Social and cultural aspects, health and safety

Safety

5.a The HPP premises are not secured by fencing leading to HPP infrastructure vandalising, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_a HPP premises should be secured including penstock if not buried.
Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,
The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well
Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted
Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)
Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

Most important impacts

- River pollution from poisonous substances and siltation during construction phase

- Clearance of patches of forests where endemic birds live.
- Disappearing of a tourist activity based on waterfalls visits due to the reduction of the river flow during operation phase
  The Faleaseela catchment is the site of an ecotourism venture that involves waterfall hikes up the Faleaseela River to the waterfall immediately downstream from the proposed intake.

Mitigation and Monitoring Table FALEASEELA

		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact**[27]	**Mitigative Measures**	**Location**	**Time Frame**	**Responsibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents near the access road of forthcoming works A **Grievance Redress Mechanism** ready	Residents near the entrance and along the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and wok sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Passing of	**5.b** the main roads are	Gravel the main road whenever	Access road	Prior to the start of	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project

[27] **as listed in IEE**

		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact**[27]	**Mitigative Measures**	**Location**	**Time Frame**	**Responsibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
trucks and engines on access road and main roads	soiled	necessary		construction								costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Diverting all river water	**5.d** destruction of tourist assets	Compromise sought	Between intake and powerhouse	Prior to the start of construction	EPC	EPC	Included in the EPC budget	Agreement between parties	Before start of works	EPC/local authorities	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.e** working conditions are dangerous; accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance mechanism implemented	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of working hours	Quarterly	EPC	EPC	Included in project costs

		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact[27]**	**Mitigative Measures**	**Location**	**Time Frame**	**Responsibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		Utilise quiet and sound proof equipment										
	2.a Dust due to truck circulation	Reduce speed along settlements, inform truck drivers, spray water in dry season Cover stockpiles and trucks Utilize vehicles with low emission	Residents near the entrance and along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river developed in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.a** construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During intake construction, burying of penstock and construction of powerhouse	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation	**4.c** Riverbanks erosion	Schedule	Riverbanks	During rehabilitation	Contractor	EPC/PUMA	Included in contracted	Control in situ for any erosion	Monthly	EPC	EPC	Included in EPC

Source of impact	Environmental Impact[27]	Mitigative Measures	Location	Time Frame	Responsibility: Implementation	Responsibility: Supervision	Costs	Monitoring Plan: Parameter	Frequency	Implementat	Supervising	Cost
and burying of penstock		construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again erosion bare areas		of penstokc			construction costs	signs				costs
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of circulation Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a- 6.b** reduction of flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Clearing the land for intake construction	**6.c** Destruction of habitats and endangered species by forest clearing	Preserve valuable trees	Construction site	Throughout the construction period	Contractor	EPC/MNRE	Included in contracted construction costs	Presence of identified valuable trees or sites	Quarterly	Contractor	EPC/ MNRE forest division	Included in project costs
Construction works	**6.d** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs

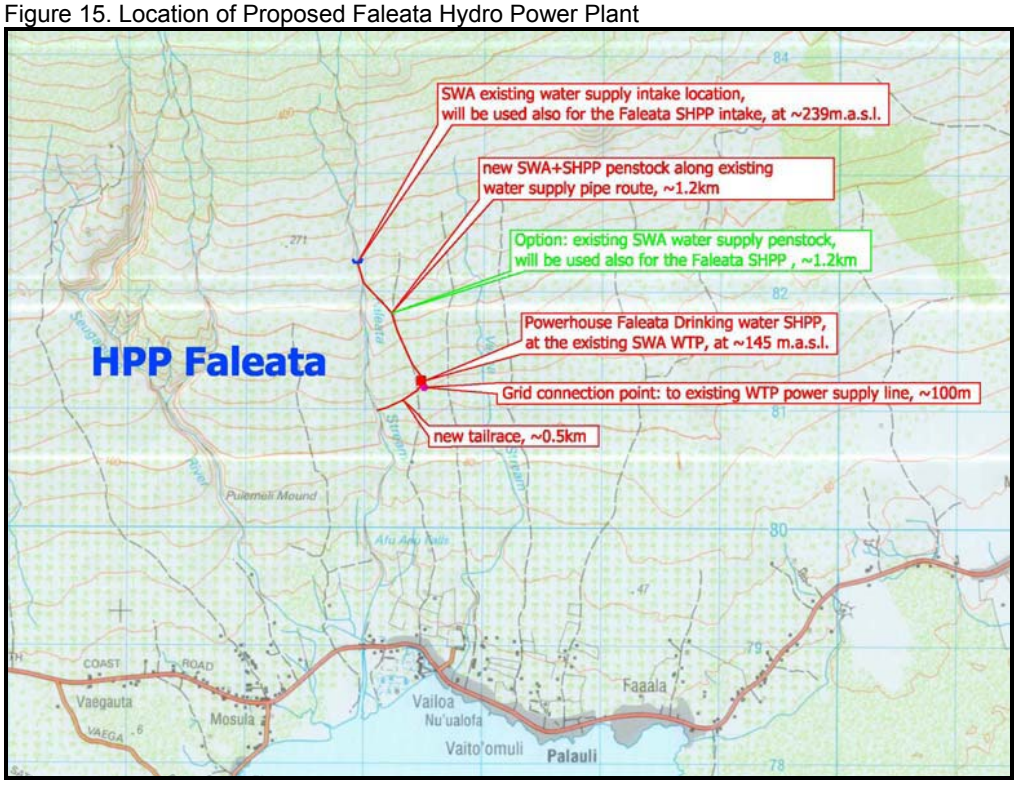
		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact[27]**	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implementat**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks										
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

6.9 Faleata

6.9.1 Site Description

212. The Faleata hydropower scheme is a proposed HPP located 10km west of Salelologa on Savaii.

Figure 15. Location of Proposed Faleata Hydro Power Plant



6.9.2 Geophysical Information

213. The proposed intake of the hydro power scheme is located on the Faleata river at approximately 239 asl and with a penstock following the eastern side of the river to a powerhouse at approx. 145m asl and a tailrace back to the river. The geology of this area is classified as the relatively young Salani volcanics (100,000 to 200,000 years old), which are deeply weathered with deep gorges and valleys (Kear and Wood 1959).

6.9.3 Catchment status and condition

214. The proposed intake, penstock and powerhouse of the Faleata HPP are located in the c 4166 ha Faleata catchment. The Samoa Water Authority (SWA) has in intake at the same site as the proposed intake for the HPP and an existing penstock to a water treatment plant at approx. 145m asl.

The headwaters of the Faleata catchment and the area along the river bank at the proposed intake are well wooded, however the lower area around the power plant and tailrace is disturbed with coconuts, grass and grazing cattle.

6.9.3.1 Vegetation types

215. The vegetation of the upper Faleata catchment is classified as medium dense native forest but around the proposed intake, penstock and proposed power plant it is classified as coconut plantations (coconuts, agricultural plantations and cattle) (FAO 2005). However, within the deeply incised river valley of the Faleata river are good stands of native trees especially Pometia pinnata (tava), Rhus taitensis (tavai), Planchonella garberi (alaa), Dendrocnide harveyi (salato) and other native trees. However, where there have been landslides or forest clearance along the river banks there are large areas covered in invasive vines, especially Merremia peltata.

No rare or endangered plants have been recorded in the project area.

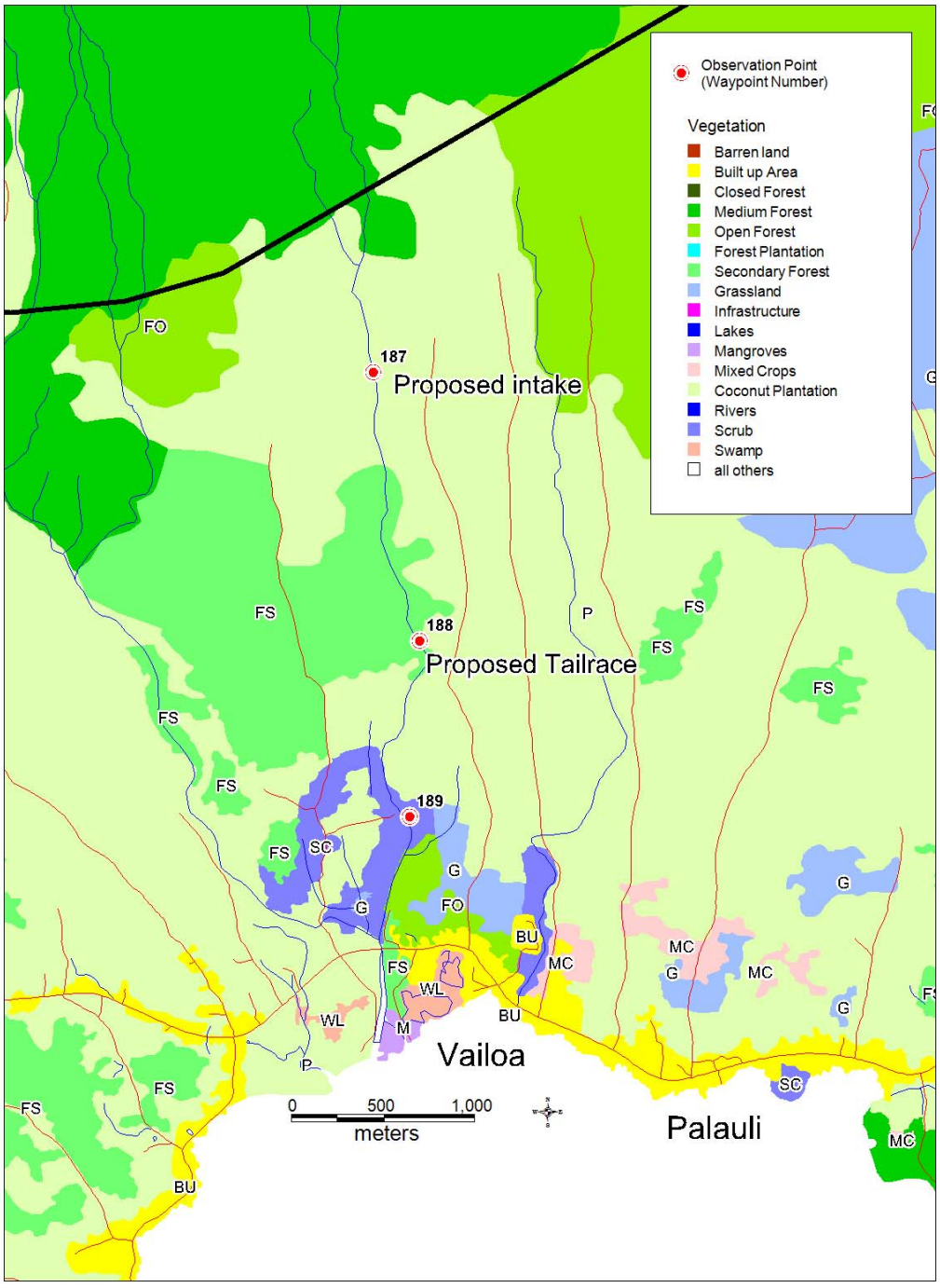


Figure 16. Vegetation of the Project Site

Plate 10. The site of the proposed intake for the Faleata HPP at an existing SWA intake (waypoint number 187). Photo by James Atherton.

Plate 11. The site where the proposed tailrace meets the Faleata river (waypoint number 188). Note the use of the net to catch fish. Photo by James Atherton.

Plate 12. *Smilosicyopus* species. An endemic goby caught at the site of the tailrace on the Faleata river. Photo by Aaron Jenkins.

6.9.3.2 Freshwater Biodiversity Values

216. The fish biodiversity of both Faleata sites visited is medium with two fish species recorded at the proposed intake and four at the tailrace. At least two of the species recorded at the tailrace are endemic including Stiphodon hydoreibatus and a new species of goby (Smilosicyopus sp) which was photographed and collected for later identification (plate 3).

217. The crustacean diversity at both sites is high with five species reported from the proposed intake and four from the tailrace site. All the crustacea recorded were common indigenous species. One snail species was recorded at both sites.

6.9.3.3 Birds

218. Sixteen bird species were recorded at the Faleata HPP site, with another six species not observed but possibly present. Two bird species of conservation interest were recorded- the mao and the Samoan broadbill, although the Samoan parrotfinch and the manumea may be present. Overall the bird diversity of the area is high.

6.9.3.4 Presence of cultural and recreational heritage assets

219. No cultural heritage sites were observed at the Faleata HPP site. However in the lower reaches of the river at approx. 30m elevation is the Afu Aau waterfall- a popular series of waterfalls visited by tourists and locals. Approximately 600m to the west of the proposed tailrace is the Pulemelei mound, one of the most important historical sites in Samoa.

6.9.4 Ecological Significance of the HPP Site

220. The Faleata HPP project is in a modified catchment but with some important biodiversity values. Although the fish diversity in the Faleata River is moderate, there are two endemic fish in the stream and the crustacean diversity is high. The bird diversity is also high and the site is important for a number of rare and endangered birds such as the Mao and the Samoan Broadbill and possibly the Manumea. The upper headwaters of the Faleata River are in the Upland Savaii Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation (CI, MNRE AND SPREP 2010).

The two proposed HPP options will have varying impacts on native biodiversity. Option A (using the current SWA intake and penstock) would have little impact on the native biodiversity since the majority of the infrastructure is already in place, apart from the powerhouse, there would be little or no increase in the current extraction rates from the river and little good quality forest would have to be removed. However, option B (installing a new intake to take more water, constructing a new penstock, powerhouse and tailrace) would require considerably more development with a road proposed along the pipeline thereby reducing habitat for native species and also removing more water from the stream, which will impact on freshwater biodiversity. Because this site is on the forest edge it is unlikely to substantially increase predation rates on birds by invasive nest predators.

6.9.5 The proposed activities

221. This project is a drinking water HPP scheme on Savai'i island. The same water which is used from the SWA water treatment plant for water supply will be used prior for power generation. The technical details must be defined during detail design, dependent on the hydrological data and the SWA requirements. Two options are possible: using only the required water amount for water supply or use all available water of the river and discharge the surplus water after the HPP to the river bed.

Intake:

222. The existing SWA intake or optionally a new Tyrolean weir with sand trap is proposed, no reservoir

Head race:

223. The headrace consists of a penstock, either the existing SWA pipe or a new penstock, replacing the existing one on the same route

Power house:

224. The new powerhouse will be located on the area of the SWA treatment plant. Dependent on the option, a new tailrace must be constructed from the treatment plant to the riverbed to discharge the surplus water amount to the riverbed.

Access road:

225. The existing access road leads close to the intake and has to be extended. For the access to the powerhouse the existing road to the water treatment plant can be used

Grid connection:

226. The connection point to the grid is to the existing power line at the water treatment plant.

6.9.6 The Potential impacts and mitigation measures

6.9.6.1 Preconstruction

227.

1- Noise

There is no dwelling close to the site, only crops fields and cattle breeding but basic information should be placed at the entrance of the access road
The national noise standard in the national legal framework[28] apply here
Legal working hours have to be respected and enforced to avoid disturbance too early or at night or on Sundays or public holidays[29]

4- Soil

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[28] PUMA, Noise Policy October 2011

[29] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

4.a erosion resulting from works and access road threaten river water quality and stability of fertile soil.
4.b sand needed for construction is dug out in unstable places
4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.
4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency
4_c contractor should develop a Pollution Control Plan

5- Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an emergency plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.d Working conditions are dangerous

Mitigation measures:

5_d the national regulation about Occupational Health and Safety will be applied[30] to ensure workers security mainly for those working above the void

6- Environment, Vegetation and Biodiversity

[30] Occupational Safety and Health Act 2002

6.a the river is biological life is transformed because of water intake
6.b the river is biological life is transformed because of inappropriate ecological flow
6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted
6_b calculate the appropriate ecological flow according to fish biology
6_c identify and mark large native trees for preservation

6.9.6.2 Construction

228.

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.
3_b the contractor may be tempted to stop the river flow to facilitate the construction of the weir resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like special nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when constructing the weir and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[31], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)
4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

[31] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

4.c construction works mainly during construction road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. The Erosion and Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have implement the Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised, as the access road is just one lane width. The access road is fairly narrow possibility for a truck to find a safe place to pull over is scarce. The area has many crop fields and engines and trucks may restrict access to the fields during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.
Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

Working Safety

5.b Working conditions are dangerous

Mitigation measures:

5_b the national regulation about Occupational Health and Safety will be applied[32] to ensure workers security mainly for those working above the void

[32] Occupational Safety and Health Act 2002

Cultural aspects

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_c a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

6- Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be developed to assure continuity and surviving of river ecosystems.

6_c Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

229. After completion of in-stream works, all disturbed areas should be:

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

230. Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.9.6.3 Operation

231.

5 Social and cultural aspects, health and safety

Safety

5.a The HPP premises are not secured by fencing leading to HPP infrastructure vandalising, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_a HPP premises should be secured including penstock if not buried. Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,

The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.d destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_b an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well

Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted

Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)

Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

Most important impacts

232. Depending on the option chosen the impacts are different. The most impacting option is the one with a new intake, more water abstraction and a new penstock

- River pollution from poisonous substances and siltation during construction phase.
- Special care should be brought to the SWA intake to avoid water deterioration during construction phase specifically for the option using the actual SWA pipeline

Mitigation and Monitoring Table FALEATA

		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact[33]**	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**					
	PRE- CONSTRUCTION PERIOD										
	General										
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	A **Grievance Redress Mechanism** ready	On the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	Soil Pollution										
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and from works sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S										
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Passing of trucks and engines on access road and main roads	**5.b** the main roads are soiled	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
Removing earth during clearing the	**5.c** destruction of archaeological or cultural	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs

[33] **as listed in IEE**

		Mitigation and/or Enhancement Measures					Monitoring Plan				
Source of impact	**Environmental Impact[33]**	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**					
soil or burying the penstock	remains										
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity										
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION PERIOD:										
	Water/River Pollution										
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river mentioned in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution										
Construction of SHPP's infrastructures	**4.** Construction waste pollution the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During intake construction, burying of penstock and construction of powerhouse	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs

		Mitigation and/or Enhancement Measures						Monitoring Plan				
Source of impact	**Environmental Impact[33]**	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation and burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again erosion bare areas	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of circulation Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a-6.b** reduction or interruption of river flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in the EPC budget	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Construction	**6.c** riverbanks vegetation is	Limit clearing of riverbank vegetation	Riverbanks and wet zones	During rehabilitation	Contractor	EPC/PUMA	Included in contracted	Control of presence of	Monthly	EPC	EPC/MNRE	Included in project

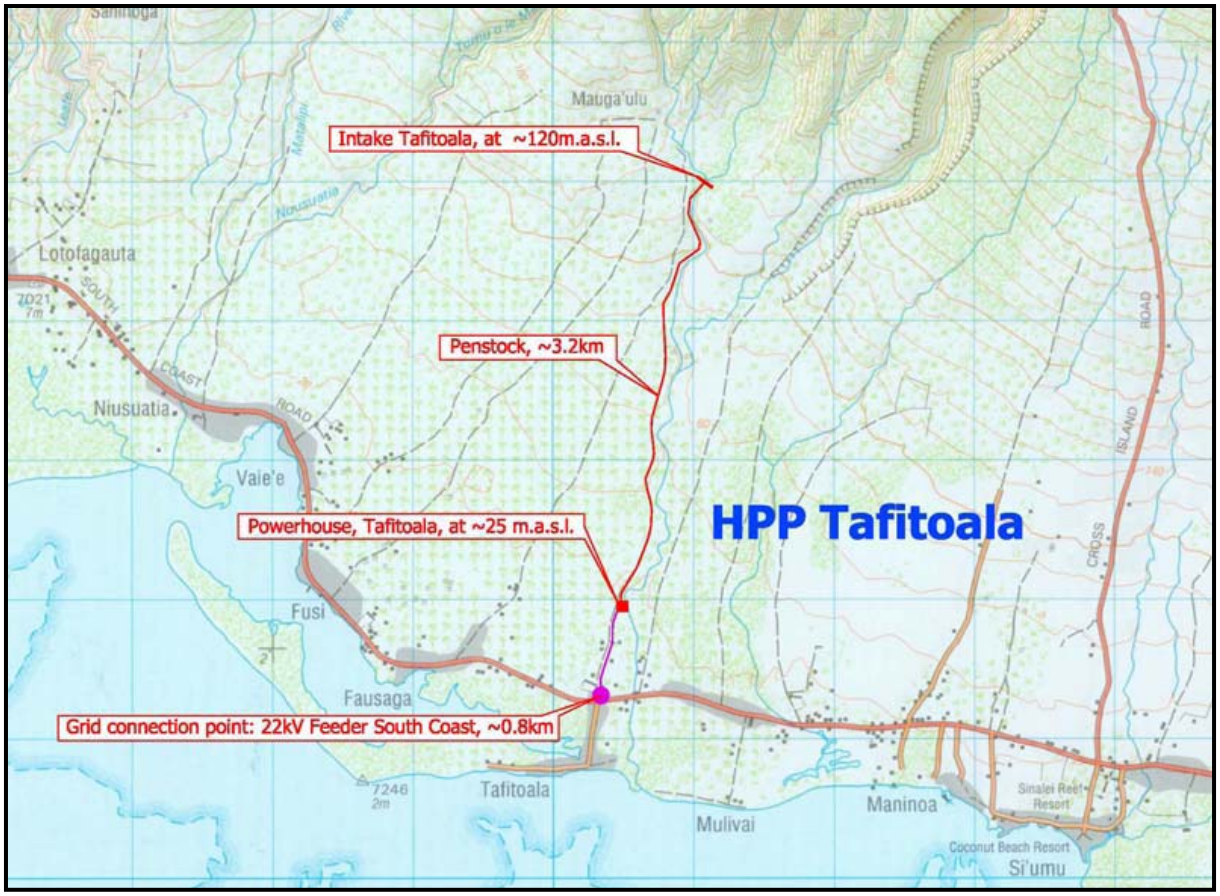
		Mitigation and/or Enhancement Measures						Monitoring Plan				
Source of impact	**Environmental Impact[33]**	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
works	destroyed Some large native trees are destroyed	to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks		of penstock			construction costs	marked trees, revegetation of riverbanks				costs
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

6.10 Tafitoala

6.10.1 Site Description

233. The Tafitoala hydro power scheme is a proposed HPP located 15km south of Apia near the south coast of Upolu.

Figure 17. Location of Proposed Tafitoala Hydro Power Plant



6.10.2 Geophysical Information

234. The proposed intake of the hydro power scheme is located on the Tafitoala river at approximately 120m asl and with a 3.2 km penstock following the western side of the river to a powerhouse at approx. 25m asl and a tailrace back to the river. The geology of this area is classified as the relatively young Salani volcanics (100,000 to 200,000 years old) which are deeply weathered with deep gorges and valleys (Kear and Wood 1959).

6.10.3 Catchment status and condition

235. The proposed intake, penstock and powerhouse of the Tafitoala HPP are located in the c 3,182 ha Tafitoala (Saleseu) catchment which arise in central Upolu in the vicinity of Mount Fiamoe. The headwaters of the Tafitoala catchment and the area along the river bank at the proposed intake are well wooded, however the lower area

around the power plant and tailrace is disturbed with coconuts, grass and grazing cattle.

236. The SWA has an intake and a water treatment plant (WTP) on the eastern branch of the Tafitoala river. However the intake and pipe were destroyed during cyclone Evan in December 2012 and the river has changed it course, now following a different route.

6.10.3.1 Vegetation types

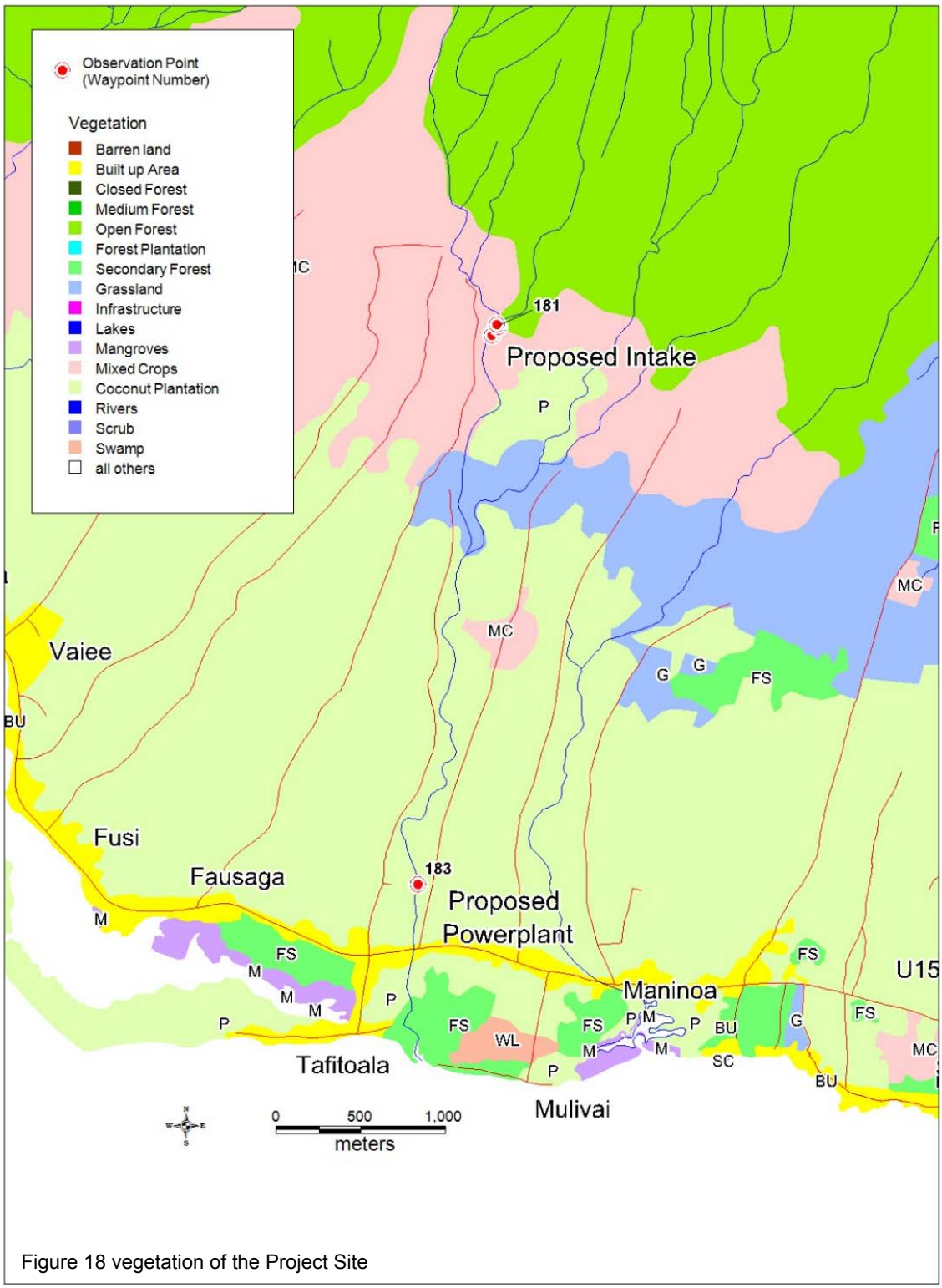


Figure 18 vegetation of the Project Site

237. The vegetation of the upper Tafitoala catchment is classified as open native forest but around the proposed intake, penstock and proposed power plant it is classified as mixed crops or coconut plantations (agricultural plantations of taro, coconuts, and cattle) (FAO 2005). However, within the deeply incised river valley of the western branch of the Tafitoala near the proposed intake are good stands of native trees especially Pometia pinnata (tava) and other native trees.

238. No rare or endangered plants have been recorded in the project area.

Plate 13. The site of the proposed intake for the Tafitatoala HPP near an MNRE river gauge (waypoint number 181). Photo by James Atherton.

Plate 14. The proposed penstock route along a plantation road. Photo by James Atherton.

Plate 15. The site of the proposed tailrace near the proposed power plant on the Tafitoala river. Photo by James Atherton.

6.10.3.2 Freshwater Biodiversity Values

239. The fish biodiversity of both Tafitoala sites visited is high with four fish species recorded at both sites. At least one of the species recorded at each site is endemic including *Stiphodon hydoreibatus* at the intake and *Kuhlia salelea* at the tailrace. Additionally, a species of S*chismatogobius* was recorded at the tailrace.

240. The crustacean diversity at the intake was high with five species recorded but was low at the tailrace with only one species recorded. All the crustacea recorded were common indigenous species. One snail species was recorded at both sites.

6.10.3.3 Birds

241. Only seven bird species were recorded at the Tafitoala HPP site, with another two species not observed but possibly present. No bird species of conservation interest were recorded. Overall the bird diversity of the area is low.

6.10.3.4 Presence of cultural and recreational heritage assets

242. No cultural heritage or recreational sites were observed at the Tafitoala HPP site.

6.10.4 Ecological Significance of the HPP Site

243. The Tafitoala HPP project is in a modified catchment but with some important biodiversity values. The fish diversity in the Tafitoala River is high, with two, possibly three, endemic fish in the stream. The crustacean diversity is also high. There is also a large Tongan flying fox roost near the proposed intake site (*Pteropus tonganus*). The bird diversity is quite low however.

Some forest clearance will be required for this HPP especially at the intake site. Construction works may disturb the flying fox roost and will have impacts on local avifauna. The proposed penstock, powerhouse and tailrace are in already highly modified areas and the impact to the native biodiversity will be minimal. Because this site is on the forest edge it is unlikely to substantially increase predation rates on birds by invasive nest predators.

6.10.5 The proposed activities

244. This project is a new HPP scheme. The intake is located at the western branch of the river and as well as the powerhouse upstream of the village.

Intake:

245. A Tyrolean weir with sand trap is proposed, no reservoir

Head race:

246. The headrace consists of a penstock. The upper section runs down a slope to the existing access road, following this road till to the powerhouse location. Forest clearance is required only for the upper section.

Power house:

247. The new powerhouse will be located adjacent to the riverbed. Thus the tailrace water can be released directly into the riverbed. Only minor site and vegetation clearing is required.

Access road:

248. Short new access roads must be constructed from the existing road up to the intake and down to the powerhouse. The detailed route must be defined during detail design but will be at the upper portion in a forest area, thus forest clearance is required.

Grid connection:

249. The connection point to the grid is in the village to the 22kV South coast feeder.

6.10.6 The Potential impacts and mitigation measures

6.10.6.1 Preconstruction

250.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats and the village close to the entrance access road might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to construct the weir and the penstock.

1.b the national noise standard in the national legal framework[34] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works ion advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid disturbance

[34] PUMA, Noise Policy October 2011

4- Soil

4.a in the upper part of the site, erosion resulting from works and access road threaten river water quality and stability of fertile soil.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

5- Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an emergency plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.d Working conditions are dangerous

Mitigation measures:

5_d the national regulation about Occupational Health and Safety will be applied[35] to ensure workers security mainly for those working above the void

[35] Occupational Safety and Health Act 2002

6- Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake and/or inappropriate ecological flow

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6.b the river is biological life is transformed because of inappropriate ecological flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6_b calculate the appropriate ecological flow according to fish biology

6_c identify and mark large native trees for preservation

6.10.6.2 Construction

251.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. The village at the entrance of the access road and some settlements along the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to do the construction works.

1.b the national noise standard in the national legal framework[36] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[37]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable

2- Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements at the entrance and along the access road

Mitigation measures:

2_a reduce speed along the access road; inform truck drivers, reduce speed at the entrance of the access road; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand

[36] PUMA, Noise Policy October 2011

[37] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the construction of the weir resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like special nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when constructing the weir and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion (developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[38], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c construction works mainly during penstock construction along the steep road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. The Erosion and Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and implement the Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most

[38] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised, as the access road is just one lane width. The access road is fairly narrow possibility for a truck to find a safe place to pull over is scarce. The area has many crop fields and coconut plantations and engines and trucks may restrict access to the fields during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields and private properties Somebody should be posted at the entrance and another one at the site with cellular phones or a radio to give clearance to use the access road or create regularly crossing bays. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.
Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

Working Safety

5.b Working conditions are dangerous

Mitigation measures:

5_b the national regulation about Occupational Health and Safety will be applied[39] to ensure workers security mainly for those working above the void

Cultural aspects

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_c a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

6- Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in

[39] Occupational Safety and Health Act 2002

the various river sections downstream

6.c forest clearing, though limited, could destroy valuable tree species or species harbouring endangered animal species

6.d riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.
The necessity to have a fish pass above the weir should be investigated

6_c valuable trees species should identified and preserved whenever possible during the penstock and powerhouse constructions.

6_d Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

252. After completion of in-stream works, all disturbed areas should be:

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

253. Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.10.6.3 Operation

254.

5 Social and cultural aspects, health and safety

Safety

5.a The HPP premises are not secured by fencing leading to HPP infrastructure vandalising, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution

Mitigation measure:

5_c HPP premises should be secured including penstock if not buried. Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,

The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well

Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted

Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)

Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

Most important impacts

- River pollution from poisonous substances and siltation during construction phase threatening possible new endemic fish species
- Destruction of forest cover in the upper part of the river
- Disturbance of the fauna near the intake during works

Mitigation and Monitoring Table TAFITOALA

			Mitigation	and/or	Enhancement	Measures		Monitoring	Plan		
	Environmental Impact[40]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION	**PERIOD**										
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents near and along the access road of forthcoming works A Grievance Redress Mechanism ready	The entrance and along the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.2 working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and from works sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Passing of trucks and	**5.b** the main roads are	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs

[40] **as listed in IEE**

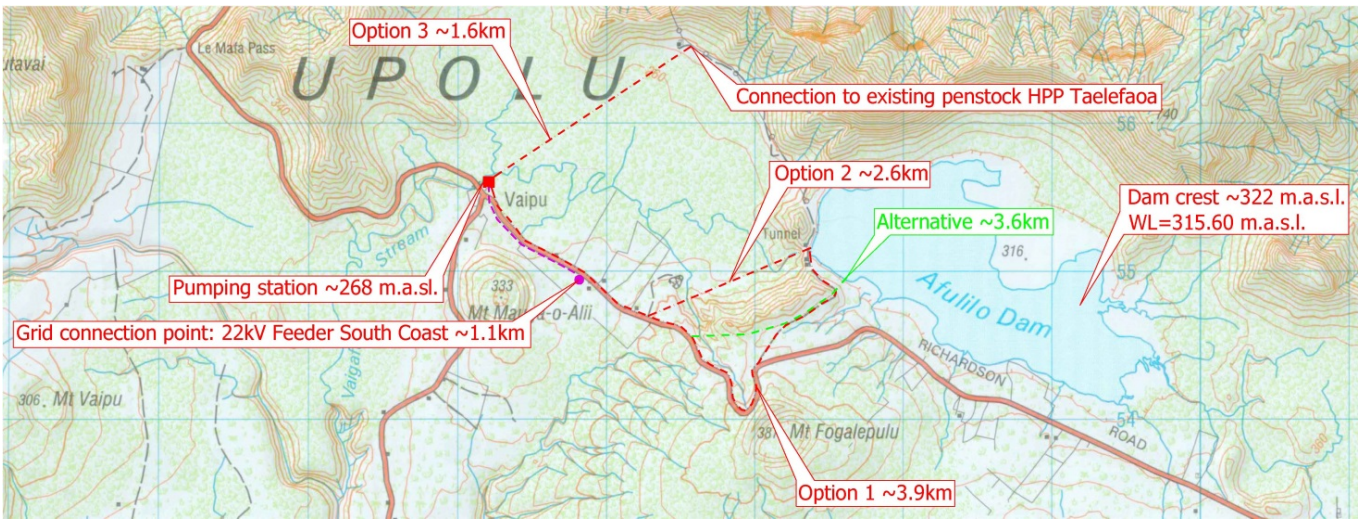
			Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[40]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
engines on access road and main roads	soiled											
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment Assess the necessity to have a fish pass	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance mechanism implemented Utilise quiet and sound proof equipment	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of working hours	Quarterly	EPC	EPC	Included in project costs
	2.a Dust due to truck circulation	Reduce speed along settlements, inform truck drivers, spray	Residents near the entrance and along the	Throughout the construction	Contractor	EPC/PUMA	Included in contracted construction	Number of grievance received and	Quarterly	EPC	EPC	Included in project costs

		Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[40]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		water in dry season Cover stockpiles and trucks Utilize vehicles with low emission	access road	period			costs	number solved				
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river mentioned in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.a** construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During intake construction, burying of penstock and construction of powerhouse	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation and burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs

			Mitigation	and/or	Enhancement	Measures			Monitoring	Plan		
	Environmental Impact[40]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		erosion bare areas										
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of circulation Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.b** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.c** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a-6.b** reduction or interruption of river flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in the EPC budget	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Clearing the land for intake construction	**6.c** Destruction of habitats and endangered species by forest clearing	Preserve valuable trees	Construction site	Throughout the construction period	Contractor	EPC/MNRE	Included in contracted construction costs	Presence of identified valuable trees or sites	Quarterly	Contractor	EPC/ MNRE forest division	Included in project costs
Construction works	**6.d** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop	Secure premises Develop awareness of residents for protection Work with	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs

		Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[40]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	plantations	MNRE/Water resource division to develop watershed management										
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

6.11 Vaipu



6.11.1 The proposed activities

255. A pumping station at the Vaigafa stream near Vaipu to pump water up to the Afulilo reservoir, or directly into the penstock of the Taelefaga HPP:

Intake:

256. Tyrolean weir with sand trap

Headrace:

257. Penstock 1,6 km

258. Three options:

- Option 1: Pumping line along the existing road.
- Option 2: Pumping line half way up the existing road, then cross-country towards the dam and finally by gravity into the reservoir.
- Option 3: Pumping line directly to the power conduit of the Taelefaga HPP and connecting in front of the existing tunnel.

Pumping station

259. This sub-project is still at an initial phase and its feasibility depends on the effect of water intake from the river on two spectacular waterfalls, which are major tourist assets in the area.

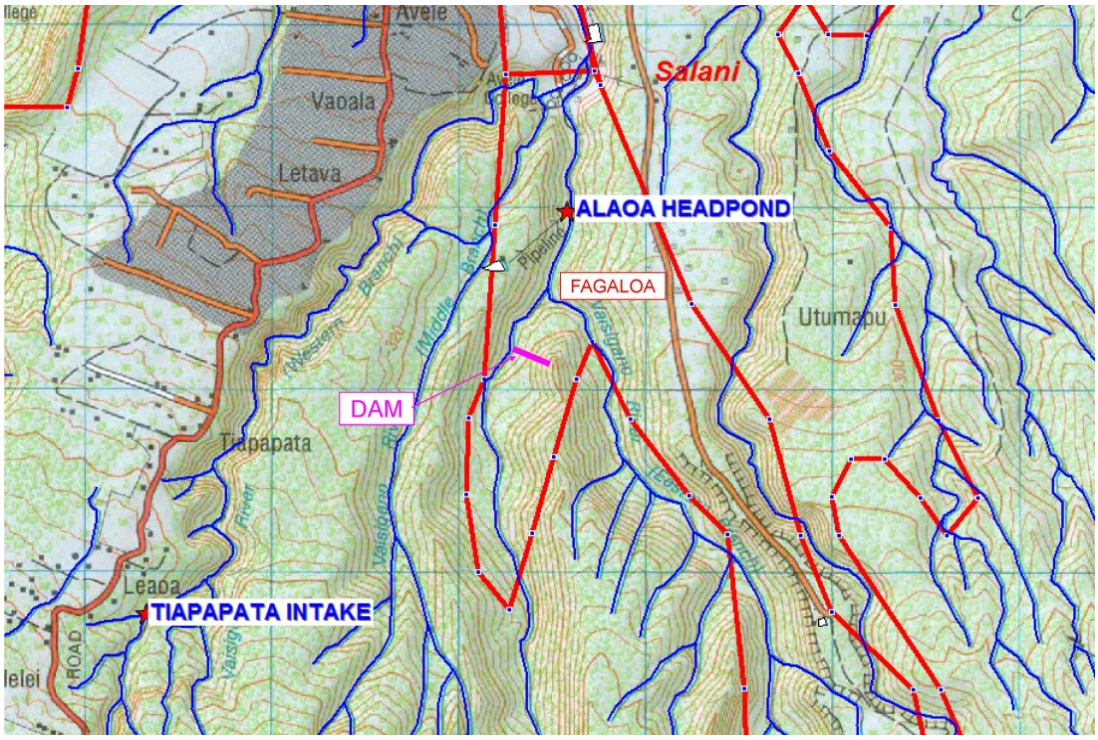
Preliminary measurements should be done at several locations along the Vaigafa River (at the intake site, at the first waterfall Fuipisia, and the second waterfall Sopaoga) to assess the effect of foreseen water abstraction on the cascades.

260. At the time of the preparation of the IEE, no data was available on flow measurement in the river and it is impossible to contemplate any possibility for the development of

this sub-project. All rely on this measurements.

261. In any case Vaipu flat is the last remaining wetland in Samoa and this area should be treated with extreme care to avoid the destruction of habitats with endemic species. The only acceptable and less environmentally damaging option could be the number one with a pipeline running along the road.

6.12 Vaisigano



6.12.1 The proposed activities

262. Construction of a rock fill dam of 80 m height with a storage reservoir of 1 million m3:

263. The realisation of the dam is still vague and depends on several factors.
Since a number of HPPs already exist in the Vaisigano catchment area, it will be necessary to study the consequences of a new dam in the western tributary of the Vaisigano East Branch on the existing HPPs. The Alaoa HPP intake is located several km upstream, in the same valley as the proposed dam. If the dam will be realised, the currently damaged Alaoa intake and long headrace channel would become obsolete.

264. Assessing that a large dam will be created on the Vaisigano River catchment, which is a pristine and sensitive zone and in the middle of a Key Biological and Bird area protection zone, at this stage it is recommended to conduct a full Environmental Assessment

The feasibility and the design of this sub-project depends on the results of the full EIA

7. Grievance Redress Mechanism

265. EPC doesn't have a grievance redress mechanism.
It has enquiry boxes where the public can deposit complains or suggestions.
The EPC public relation officer and the officer in charge of social affairs will extract documents from the inquiry box and distribute them to the relevant EPC persons to be treated.
There is no records of complains and no individual response will be sent to the compliant.
EPC will have to develop a mechanism for complain to be taken into account and instructed and solved.

266. Here is a possible grievance redress mechanism with a step-by-step procedure to receive, register and track all grievances concerning the environment.

A grievance form is presented in Annex E and could be adopted by EPC to address complaints in a more organised way.

1. Members of the public will have rights to make grievances known to the EPC and for them to be addressed, to the extent practicable and reasonable. During project construction, a Supervising Field Engineer, EPC PMU Head, EPC's Public Relations Officer and as required members of Environmental and Social Unit.

2. The affected people will file their complaint through "matai" women's council and village chief to the EPC–PMU Community Liaison team. The name and contact details of these individuals will be presented on a notice board at the village, town of the project area. Complaints can be also filed in person, via email or via a letter to EPC The EPC Liaison team will hear grievances and initiate appropriate remedial action.

3. For complaints over major issues, such as compensation, damage to property, or occupation of land during construction without due agreement, EPC-PMU will respond within 24 hours and arrange a meeting with appropriate personnel including a representative of EPC-PMU to hear the complaint.

4. If a solution, agreeable to all parties, is not reached within a period of seven days, depending on the nature of the grievance (land issue or environmental issue) the complainant may file the grievance with the Secretary of MNRE or Secretary of the Samoa Land Board, who will hear his/her grievance when the Board meets monthly. The complainant also has the right to take his/her grievance to the Magistrate Court for resolution. If the complainant remains dissatisfied with the corrective action proposed, he /she may take his/her complaint to the Magistrate's Court. The Magistrate Court has a complement of over 50 Court staff including five Magistrates. It is not anticipated that the level of complaints from the project will be significantly high such that current resources of the Court will be stretched. However, should this situation arise, the Court will appoint a Magistrate to deal specifically with Project related cases, to avoid lengthy delays.

5. A register of project complaints will be maintained by the EPC–PMU, recording dates, name of complainants (men or women), action taken and personnel involved. The contractor will also be required to keep a register of complaints or issues and how and when they are resolved. These will be incorporated into the contractor's Monthly Reports and be subject to monitoring. A summary on grievances and their status will be reported through regular progress reports and safeguard monitoring reports.

267. The process of documenting the operation of the Grievance Redress mechanism (GRM) will include the following elements:

(i) tracking forms and procedures for gathering information from the contractor/highway section and complainant(s);

(ii) updating the complaints database routinely;

(iii) identifying grievance patterns and causes, promoting transparency and information disclosure, and periodically evaluating effectiveness of the environmental GRM, environmental controls, and their implementation; and,

268. To ensure that the GRM is effective and accessible, the Public will be made aware of the GRM and how to use it. This will need to be done by EPC.

8. CONCLUSIONS AND RECOMMENDATION

8.1 Benefits

269. The proposed project is an environment-friendly project which will result in substantial diesel saving and GHG emission reduction and improve the energy infrastructure of Samoa.

The other benefits generated from this project are:

- Saving diesel consumption and importation
- Reducing the price of electricity
- Increase independency of Samoa for energy production and diversification of its sources
- Increase the part of renewable energy in national energy production

270. The project's benefits in energy savings have been estimated and are shown in Table 2below. In addition to the significant total savings in gallons of fuel per year is the prevention of associated pollutants from combustion of fossil fuels entering the local airshed.

8.2 Conclusion

271. The IEE concludes that the potential negative impacts arising from the construction of new SHPP's, out of Vaipu and Vaisigano sub-projects, will be relatively minor, localised and acceptable, providing that the set of mitigations measures presented in the EMP are incorporated in the design and implemented properly.

- The project is the creation of run-of river hydropower's schemes with a small footprint and it does not involve the creation of new dams (out of Vaisigano sub-project).
- The aquatic habitats won't be impacted if appropriate precautions are taken during construction's phases and that ecological flow is implemented
- The possibility of fish pass structures will be studied during final design stage for some rivers without important waterfalls
- The possible loss of forest habitats due to the project is relatively minor due to the generally disturbed environment of the project areas and it can be further minimize by protecting valuable tree species or habitats. Only the upper part of Tiapapata River intake should have specific attention.
- The potential impact on terrestrial wildlife including rare and endangered species is minor according that specific attention to valuables trees and habitats where endangered bird species nest or feed are identified and protected
- Adaptation of climate change is already included in the design specifically regarding the occurrence of 50years maximum climatic event set to 100 years, protection from flooding of the powerhouse as it happened recently

8.3 Recommendation

272. Flow measurement should be carried out for Vaipu to assess the feasibility of the sub-project Additional impact assessment is considered necessary at this stage for the Vaisigano sub-project.

8.4 Climate change

8.4.1 Reduction of gas emission (global warming)

273. In total, the subprojects will achieve a net reduction of greenhouse gas emissions of around 13,469 tons of CO2 per year will be saved. This corresponds to a fuel savings amount of **5 262 500 l** for electricity generation.

Table 2: Energy Savings and green house gas emission

Subprojects	**Renewable electricity production/year [MWh]**	Equivalent of fossil fuel saving [ltr] [1]	Equivalent of ton of CO2 emission[2] (0,670Ton CO2/MWh)
FULOUASOU	2580	645	1 729
TIAPAPATA	3100	775	2 077
FALEASEELA	1060	265	710
FALEATA	500	125	335
TAFITOALA	1820	455	1 219
FALE O FEE	3340	835	2 238
ALAOA	4780	1 195	3 203
SAMASONI	3870	967	2 593
Total	**20,110 MWh**	**5 262 500 liters**	**13,469 tons of CO2**

8.4.2 Adaptation to climate change

274. There have been several well-documented events that show the increase of extreme weather events such as tropical storms and typhoons in the Pacific. Most climate change modelling shows that tropical typhoon will increase in frequency and severity, and will be a characteristic of the project area in the future. Many of these extreme weather events can be linked to the El Niño/La Niña-Southern Oscillation (ENSO) pattern, but ENSO is predicted to also have an effect in modifying trade winds in the Pacific, strengthening of tropical deep convection, and alteration of monsoon flow.

In April 2009 Typhoon Evan (2009) hit the islands of Samoa. It was the strongest typhoon in 50 years with strong winds and heavy rain. Flooding and tree falling partially destructed the SHPP installations. Climate change modeling has predicted that typhoon frequency will increase due to the increased dominance of the El Niño weather patterns.

275. In order to survive Super Typhoon in the region, HPP installations are designed to cope with extreme conditions, especially to avoid submersion. To avoid any future destruction of penstock from tree falling the option was taken to burry them.

Climate change issues have been addressed by the Project.

Each of the sub subprojects has been designed with climate change adaptation features. The major focus of adaptation in the western Pacific is the increase in frequency of typhoons. The installations and equipments will be protected from flooding and tree falling.

9. Consultation program

9.1 Consultation and Participation, Information Disclosed

276. Since 2011 EPC held several Public consultations with communities to prepare the project.

These consultations mainly focussed on land acquisition, compensations and integration of local communities in the protection of water catchment and EPC infrastructures, where the community locally owned the land.

Interesting communities in the protection of EPC assets was achieved by the mean of sharing a percentage of the benefits generated by the electricity locally produced.

Though a first agreement has been reached between local communities consent by the Cabinet of the Prime Minister has to be obtained.

During these meetings the project was presented to the participants with the support of PowerPoint projections.

277. During the preparation of the Resettlement Plan, complementary meetings were held with the communities or with affected persons.

Minutes of these meetings are to be found in the annexes of the Resettlement Plan Report

The sole social dimension of the project was the predominant aspect during the meetings.

No questions were raised regarding the environment as it was considered as a minor topic compared to land tenure, resettlement and compensation.

More consultations should be organised in the next weeks by EPC with local communities to finish the round of consultations.

To avoid interference and confusion with the actual social consultation process initiated by ECP and conducted also by the independent social specialist, it was decided that already contacted communities should not be contacted again separately by another team to only discuss environmental issues.

These issues, if the have been of a definite importance would have necessary emerged during former discussions of preceding public meetings.

278. During the mission a meeting was held on the 5th of July 2013 with government stakeholders.

Concerned government agencies were invited to the meeting (see annex 2). These stakeholders have already been invited in a previous informative meeting organised by EPC on the EPC SHPP's project.

This meeting aimed at updating the stakeholders on the development of the project and collect their views and concerns about environmental issues as the previous one was focussed on social and land acquisition topics.

MNRE raised questions about the protection of water resources during rehabilitation or construction of new schemes for drinking water supply.

It was also stressed that ecological flow was necessary for all sites.

The effect of sea sedimentation resulting of new schemes was another point raised during the meeting. New project design doesn't involve construction of dams but weirs and the sediment flow will thus not be interrupted.

Recommendation was made to assess the effect on the project, specifically the Faleaseela scheme, on local cultural and socio economic sectors.

Because of the very unique and sensitive environment of Vaipu MNRE was firmly opposed to any development in this area.

General recommendation was made, such as reduce any clearance of native forest, involve the stakeholders (MWCSD and MNRE) in the next round of community's consultations, and carry out a rapid biodiversity survey for the sites project.
The Samoa Conservation Society raised the question about the schemes situated in the Key Biodiversity Areas.
Most of SWA concerns were raised during the previous meeting.

ANNEX 1

Terms of Reference

International Environmental Specialist (7 person-months)
The international environmental specialist (IES) will have at least ten years experience in environmental assessment and management including in project implementation. Experience in the power sector and in Samoa and/or other Pacific countries would be an advantage. At least three-quarters of the time of the IES will be devoted to capacity building of the Environment Officer (EO) located within the project management unit (PMU) as well as wider awareness raising and strengthening of Electric Power Corporation (EPC) staff (including management) in safeguards.

The TOR for the IES includes the specific aspects:

i. In conjunction with the EO and social/resettlement specialists and PMU's Public Relations Officer undertake or participate in consultations as required by the Consultation and Communications Plan (CCP) prepared for the Project;
ii. Based on detailed design, assist the EO to update the initial environmental examinations (IEEs) for the schemes in compliance with ADB Safeguard Policy Statement 2009 (SPS) and the Planning and Urban Management Act (PUMA) 2004 and PUMA Environment Impact Assessment Regulations 2007;
iii. During detailed design of the scheme, prepare draft method statements to be included in the contractor's construction environmental management plan (CEMP) including waste management plan (WMP), materials management plan (MMP), erosion and runoff control plan (ERCP), drainage management plan (DMP), and health and safety plan (HSP);
iv. Assist EPC/PMU, in consultation with the Department of Conservation and Environment (DCE), to ensure that environmental safeguard measures under the Project comply with national safeguard requirements including obtaining requisite permits (environmental and water resources permits) and ADB's SPS;
v. Assist PMU procurement specialists and other PMU members as required to include the draft method statements and updated EMPs and other plans (see item iii above) and relevant provisions and text from the updated IEEs into the tender/contract documentation for the scheme;
vi. Prior to contractor's preparation of the CEMP provide training on environmental management provisions and monitoring. Assist the EO to review the contractor's CEMP (including other plans as required - see item iii), suggest changes or revisions as required, and recommend to PMU Head that approval of the CEMP may be issued;
vii. Assist the EO to establish an environmental monitoring and reporting system within the PMU and contribute to Quarterly Progress Reports - including compilation of relevant items from Monthly Reports prepared by contractors - to be prepared by the PMU for EPC and ADB. The monitoring and reporting system will cover CEMP compliance;
viii. Monitor the contractor's compliance with CEMP (and other plans), and as necessary conduct on-site spot-checks of contractor's mitigations and review contractor's Monthly Reports regular monitoring reports; and
ix. Ensure compliance with all assurances under the Project.

ANNEX 2

Stake holder's meeting, 5th July 2013

HYDRO MINUTES: Government Stakeholders DATE: 5th July 2013

Project Title: Proposed Hydro Projects

Participants from Government Ministries Involved:

- Ministry of Natural Resources and Environment: (MNRE)
  - Planning Urban Management Agency
  - Land Management Division
  - Water Division
- Attorney General's Office (AG)
- Ministry of Women Community and Social Development (MWCSD)
- Samoa Water Authority (SWA)
- Ministry of Commerce, Industry and Labor (MCIL)
- Electric Power Corporation – Project Management Unit (EPC/PMU)
- Porch Consultants
- ADB

Date of Meeting: 5th July 2013

Time: From: 10am To: 11.30am

Location: EPC General Manager's Room, Level 5 TATTE Building - Sogi

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Chairperson: Fonoti Perelini (EPC PMU)

Minute Taker: Moetuasivi S Asiono (EPC PMU)

Agenda	Discussion	Action/Responsible Person
OPENING	Chairman welcomes everyone and introduces the presence of Porch and Partners consultants who will be working on the Due Diligence for all 7 Hydro Projects. Chairman then introduces issues of discussions which mostly on the following: • Proposed Hydro Projects Introduction • Hand over to Porch and Partners with relation to environment concerns • Open Discussions	
Proposed Hydro Project	Chairman introduced the following for participants info given last meeting was with government ministries, although issues were focused mainly on land acquired and the business model, but today consultation will gather concerns, issues and suggestions from environment associated bodies for the environment side of research for the Porch and Partners Due Diligence reports. Chairman once again touched on the following – • Government has signed an MOU with ADB for the development of 7 hydros, an addition to the 5 EPC has	

	currently operating. The seven hydros will be : ○ Fuluasou – rebuilding the old one ○ Tiapapata – utilize the western branch of the Vaisigano River ○ Faleseela ○ Vaipu – Pump scheme ○ Tafitoala ○ Faleata – Vailoa Palauli Savaii ○ Sili – This hydro site is left aside for consultation later • EPC has done all feasibility studies for the above mentioned sites, but as mentioned earlier, these sites require Due Diligence reports and EPC and ADB have agreed for consultant Porch and Partners to carry out • As EPC looks at the best way to approach the development of the proposed project, EPC had to look at the best way to deal with villages as well, as out of the 7 schemes, probably only Fuluasou will not require dealings with villages • This is a real challenge for government, and due to this thought, EPC came up with the idea of a BUSINESS MODEL • The idea of the model is as follows: ○ This is where the government and the village and land owners join as a liability company to develop each of these hydro and sell the electricity to EPC, at some negotiated tariff ○ Epc went to cabinet and cabinet approved and instructed EPC to start going out to the villages and start elaborating on this model. Sili was left out by cabinet for later negotiation. ○ Epc did this last year and visited Faleata, Vailoa, Tafitoala and Faleseela. We explained the structure of the model which is just like a business, where partners are involved, put in money and assets and develop the business just like a shop for example elaborated to villages to clearly understand, and as it is develop as such, sell the product ○ One of the good thing about this model government changed EPC Act which allows independent power producers to produce power and sell back to epc. Anyone can sell electricity and not just EPC. The idea and structure of the said business model was further discussed in a consultation with government partners who will be working closely with EPC in determining pros and cons of the proposal for final recommendations. Chairman then handed over to Porch and Partners…	
Concerns from Ministries	The following concerns were voiced by MNRE and SWA during the consultation, which was echoed by members from both ministries who are involved with social and environment issues within their respectful organizations/ministries.	

	MNRE raised the following issues: • Recognized the importance of the projects economically (reduced costs of electricity) and also good impacts on environmentally (in terms of reduced emissions from reduced use of diesel fuels to generate electricity) • Site 1-Fuluasou: the project should recognize the needs of the water supply utility, and should also facilitate for the e-flow at this area. *(EPC comments – hydro dam is below SWA water intake. SWA takes water from dam. EPC gives SWA priority of water from dam during dry season)* • Site 2-Tiapapata: the project should recognize the needs of the water supply utility, and should also facilitate for the e-flow at this area. • There were issues raised by PUMA regarding community awareness at this site as there have been complaints from surrounding land owners that EPC engineers are trespassing. *(EPC response – a SWA staff guided EPC engineers over this family land. EPC and SWA are securing land for another access to site of hydro and water intakes to stop going through this family land)* • Site 3-Faleaseela: we raised concerns over the damming of water and the risks it poses on sediment loading/sediment build up. We do not want another Taelefaga. *(EPC response – Taelefaga case is different from Faleseela. Taelefaga involves water diverted from flow to south of island and discharge into Fagaloa Bay. On Faleseela will continue to discharge to sea now and same when dam or intake for hydro is built. Second is that all vegetation will be moved from dam site in Faleseela, different from Afulilo where vegetation, forest, etc were not removed from dam during construction of dam)* MNRE was told that a weir design will be done so this kinds of alleviates the concerns dramatically. The project will take into consideration the needs of the water supply utility, and will also allow for the environment-flow in design of systems.. Asked for an assessment to be done on the cultural and socio-economic significance of the Liua le Vai o Sina on the Faleaseela community as some recreational activities depend on the river as well as some fishing activities by the village. MNRE were told that the village is very supportive of the development of river for hydro if village will benefit from it under business model. Have also submitted our freshwater survey report to the consultant which had some results from this area.	

	• Site 4-Vaipu: we strongly oppose any developments at this site. • Site 5-Tafitoala: we were concerned with the dam option but reverted when a weir design was brought up MNRE general recommendations voiced at this meeting were: • To ensure minimum clearance of native forests within the watershed areas • To involve all stakeholders (MWCSD/MNRE) as much as practicable during the consultations • To ensure that EIAs as well as research permits/drilling permits/abstraction licenses are all facilitated, to safeguard any impacts on the environment • To look into the cultural and recreational / socioeconomic significances of these water ways on surrounding communities • To carry out rapid biodiversity surveys Concern from the Samoa Conservation Society: • Raised the importance of the above as some of the developed areas fall into Key Biodiversity Areas (KBAs) Concerns raised by SWA: (see minutes later consultations with SWA staff)	

Meeting concluded at: 11.30am

Minutes Prepared by: Moetuasivi (EPC PMU)

Minutes endorsed: Chairman

Initial Environmental Examination for SHPP schemes rehabilitation

October 2013

Samoa Renewable Development and Power Rehabilitation Project Preparation

Technical Assistance – 46044-002

Prepared by STR + P&P for the Asian Development Bank

This Initial Environmental Examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

Abbreviations

ADB	Asian Development Bank
ASL	Above Sea Level
CEAR	Comprehensive Environmental Assessment Report
CEMP	Construction Environmental Management Plan
COEP	Codes of Environmental Practice
DEC	Division of Environment and conservation
EIA	Environmental Impact Assessment
EMP	Environmental management plan
EPC	Electric Power Corporation
FD	Forest Division
GHG	Greenhouse gas
GoS	Government of Samoa
IEA	Initial Environmental Assessment
IEE	Initial environmental examination
KBA s	Key Biodiversity Area
kW	Kilowatt
MAF	Ministry of Agriculture and Fisheries
MFAT	Ministry of Foreign Affairs and Trade
MNRE	Ministry of Natural Resources and Environment
MOF	Ministry of Finances
MW	Megawatt
MWCSD	Ministry of Women, Community and Social Development
MWTI	Ministry of Works, Transport and Infrastructure
NGO	Non-government organisation
NUS	National University of Samoa
PEAR	Preliminary Environmental Assessment Report
PMU	Project management unit
PSEP	ADB Power Sector Expansion Project
PUMA	Planning and Urban Management Act 2004
SPESP	Samoa Power Expansion Project Sector Project
SPREP	South Pacific Regional environmental Program
SROS	Scientific Research Organisation of Samoa
USP	University of South Pacific
WRD	Water Resources Division

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Annex 2

1. Executive Summary

The objective of the proposed project is to assist the government's efforts to reduce the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally sound source of electricity for the consumers, the project proposed to construct and implement 7 small hydropower schemes and to rehabilitate existing 3 hydropower schemes damaged by recent cyclone (Evan 2012).
The following new hydropower plant schemes are prioritized by EPC to be included in the project: (i) Fuluasou; (ii) Faleata; (iii) Tafitoala; (iv) Faleaseela, v) Vaipu, vi) Tiapapata, vii) Vaisigano. The rehabilitation of existing power plants includes: (i) Samosoni Hydropower; (ii) Fale ole Fee hydropower; (iii) Alaoa Hydropower.
Two "Initial Environment Examination Reports" has been prepared: one Report for the rehabilitation and another one for the new schemes sub-projects. The present IEE deals with rehabilitation of existing infrastructures. A Resettlement Plan (RP) has been prepared to assess and address potential resettlement impacts associated with land that may be taken or affected during project implementation for all hydropower plant schemes under this Project.
The three SHPP's have been in activity for many years and their environment modified by human presence and activities, including the SWA infrastructures for drinking water.
However, some of the sites present important biological values including endemic and/or threatened fish and birds, as well as patches of native forest.
Most of the potential impacts generated by the sub-projects constructions or rehabilitation works like forest clearance for the opening of access roads, soil pollution by spill, soil erosion, noise from engines and works, and riverbanks degradation, etc. can be easily reduced or avoided if the mitigation measures contained in the EMP are correctly implemented and monitored.
The potential impact on terrestrial wildlife including rare and endangered species is minor according that specific attention to valuables trees where endangered bird species nest or feed are identified and protected.
The possible loss of forest habitats due to the project is relatively minor because of the generally disturbed environment of the project areas and it can be further minimize by protecting valuable tree species or habitats.
Ecological flow should be developed for all sites specifically for the Alaoa site where all water is taken at the intake.
The possibility of fish pass structures will be studied during final design stage.
A grievance redress mechanism will be developed for any complain issued by near-by residents.
Adaptation of climate change is already included in the design in relation to the protection from flooding of the powerhouse, with the calculation of the occurrence, normally for a 50 years maximum climatic event, set now to 100 years

These subprojects will achieve a net reduction of greenhouse gas emissions of around **8034 tons of CO2** per year. This corresponds to a fuel savings amount of **2 997 litres** for electricity generation.

Falee o le Feh and Alaoa schemes are situated in the Vasigano catchment and within the key Biodiversity Area (KBA), one of Samoa's priority sites for conservation. The Vaisigano catchment is also a designated Important Bird Area (IBA). This IBA/ KBA contains important habitats for a number of threatened species such as the tooth-billed pigeon (manumea), mao (maomao), Samoan broadbill (tolaifatu), and Samoan flying fox (pea vao).
The plan to repair the damage caused by Cyclone Evan will involve rebuilding the roads to the eastern and western intakes and the rehabilitation of both intakes. The work in these sites will reopen the roads and involve the use of heavy machinery. To reduce the impact of

this work on the endangered and native birds it is important that large native trees (especially around the intakes) are not damaged during the rehabilitation work. These trees, such as maota (*Dysoxylum* species), are key food trees for the Manumea and other native pigeons and are important breeding sites for seabirds. Patches of native's forests should be preserved as much as possible and when it is not possible, reforestation with native plants should take place in compensation. Whenever necessary, riverbanks should be reforested to maintain the original biotopes in the riverbeds. Furthermore, reopening access roads may result in future impacts in these areas by improving access for plantation development. Over the last few years the land use of the water catchment area of this site has been increasingly modified with large areas of land, formerly covered with native forest, now being converted to plantations. Such impacts will need to be managed carefully in collaboration with local communities.

When at Fale o le Fehh the aquatic biodiversity is high, the fish diversity of the Alaoa western intake and upstream is very low. This is probably because the entire river flow goes into the western water race essentially stopping recolonisation of fish species which spawn in rivers and have embryos that drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce. This is good evidence of the need to maintain ecological flows in order to retain fish diversity in streams and rivers.

The Samasoni SHPP is an area that has already been highly modified by development. The proposed plan outlined to restore the Samasoni HPP site is likely to have little impact on the native biodiversity. The area is already highly developed and little additional forest clearance appears to be required.

However, there are two endemic fish species in the lower Vaisigano River.

2. Background

1. The proposed project has been included in ADB's Country Operations Business Plan 2012-2014 and country Partnership Strategy (2008-2012). The project will be financed through ADB grants and a Loan from ADB's Asian Development Fund (ADF). The energy sector in Samoa is highly vulnerable to rising international oil prices, characterized by a heavy reliance on imported petroleum rather than on renewable energy sources for power generation. Sixty percent of the electricity is generated by diesel generators, 38.9% by hydropower plants, 1% by biofuel (coconut oil) plants, and 0.1% by solar generators. For the power utility, the Electric Power Corporation (EPC), fossil fuel is by far the single largest expense item representing 74% of total generation costs and 51% of overall costs. The utilities power asset management is still under development, hence power distribution system has about 20% losses, and the average tariff of electricity fluctuates between $0.40 - $0.55 per kilowatt hour (kWh). Developing indigenous and renewable energy sources is a viable solution for achieving energy sector priorities, as it will deliver socially acceptable, technically feasible, and affordable electricity services.

2. Samoa comprises two main islands; Savai'i and Upolu, where the capital city Apia is situated, and two isolated outer islands. EPC's power system in Savai'i and Upolu, each has independent grids, while small stand-alone solar and diesel generation schemes operate on the two isolated outer islands. The total installed power generation capacity mix of EPC in 2011 was 42 megawatt (MW), composed of 30 MW diesel generators, 11 MW run of river hydropower plants, 1 MW biofuel power plants, and small distributed solar generators in the few kilowatt (kW) range, generating about 121.4 gigawatt-hour (GWh) of electricity. About 95% of the population has access to grid electricity, while the remaining 5% is connected to small diesel generators or solar systems.

3. The objective of the proposed project is to assist the government's efforts to reduce the country's heavy reliance on imported fossil fuels for power generation. By providing a secure, sustainable and environmentally sound source of electricity for the consumers, the project proposed to construct and implement 4 small hydropower schemes and to rehabilitate existing 3 hydropower schemes damaged by recent cyclone.

4. Under the Loan - Power Sector Expansion Project, technical feasibility and environmental studies for small hydropower schemes of four rivers in Upolu and one river in Savaii was undertaken. No Resettlement Plan (RP) was prepared for the sub-projects. The four rivers studies for the feasibility study are in Upolu: Faleseela, Tafitoala, Fuluasou and Vaisigano West Branch (Tiapapata), and two in Savaii are Faleata and Sili/Vaitai. However, Electric Power Company (EPC) has prioritized 4 new hydropower schemes and rehabilitation of three existing schemes for this proposed Renewable Energy Development and Rehabilitation Project. The proposed project is located in the island of Upolu. The project include 2 components: (i) component one comprises the implementation of new hydropower schemes; (ii) component two includes the rehabilitation and invest plan for existing power plants damaged by cyclone.

5. The following new hydropower plant schemes are prioritized by EPC to be included in the project: (i) Fuluasou; (ii) Faleata; (iii) Tafitoala; (iv) Faleaseela, v) Vaipu, vi) Tiapapata, Vaisigano. The rehabilitation of existing power plants includes: (i) Samosoni Hydropower; (ii) Fale ole Fee hydropower; (iii) Alaoa Hydropower.

6. Two "Initial Environment Examination Reports" has been prepared: one Report for the rehabilitation and another one for the new schemes sub-projects. The present IEE deals

with rehabilitation of existing infrastructures. A Resettlement Plan (RP) has been prepared to assess and address potential resettlement impacts associated with land that may be taken or affected during project implementation for all hydropower plant schemes under this Project.

7. . The present IEE, deals with rehabilitation of existing infrastructures, has been prepared in accordance with applicable laws and regulations of GOS and safeguard policies of ADB on Environmental Impact Assessment. Given that the detailed technical design of the hydropower schemes will be done during implementation of the project, an actualisation of these IEE and a full EIA whenever deemed necessary will be prepared. The Ministry of Finance (MOF) is the project executing agency and the EPC is the project implementing agency.

8. The Project will have the following Outcomes and Outputs – The Output and the 3 main Outcomes of this project are:

- Outputs of Outcome (i): Development of a renewable source of energy
- Output 1 – Increase hydro generation and hence reduce diesel fuel consumption
- Output 2 – Reduce cost of electricity or minimize fluctuations due to diesel fuel price increases
- Output 3 -Sustainable development

3. Project description

9. Samoa is an oceanic, volcanic archipelago with a land area of 2,820km2. It is composed of two main islands, Upolu (1,115km2) and Savai'i (1,700km2) (refer Map in Figure 1) and seven small islands.

The capital of Samoa is Apia, which is located on the island of Upolu. Samoa's economy is reliant on foreign imports (20-25 per cent of GDP), remittances (25 per cent of GDP), and foreign aid.

Fisheries, construction and, agriculture and small-scale manufacturing also contribute to GDP.

Figure 1 Map of Samoa (source: http://www.lib.utexas.edu/maps/islands_oceans_poles/western_samoa.jpg)

10. The hydropower plant schemes under this project are located in the island of Upulo and the island of Savai'

3.1 Component 2: Rehabilitation program of cyclone damages

3.1.1 Fale ole Fee

11. This HPP is out of operation because the damages by the cyclone. Required rehabilitation works:

12. key data: 1,740 kW 3,340 MWh/a 1.4 MUSD

Intake:

Rehabilitation and refurbishment of the 2 existing Tyrolean weirs

Headrace:

Repair of the existing steel penstock on several locations

Powerhouse:

Refurbishment of the powerhouse and installation of additional measures to make the powerhouse flood proof; replacement of the damaged alternator, electrical and mechanical control systems, governor; rehabilitation of the turbine; checking and required rehabilitation of all electrical installations;

3.1.2 Alaoa

13. key data: 1,050 kW 4,780 MWh/a 1.0 MUSD

This HPP is in operation, however only with 1/3 of the capacity, because the eastern intake is damaged. Required rehabilitation works for the eastern intake:

Intake:

New construction of the intake in form of a Tyrolean weir with sand trap

Headrace:

Cleaning and repair of the damaged sections of the open head race channel over the full length; replacement of the completely destroyed channel sections by pipe sections;

3.1.3 Samasoni

14. key data: 1,900 kW 3,870 MWh/a 7.7 MUSD

Intake:

Rehabilitation and refurbishment of the existing concrete intake

Headrace:

Replacement of the completely damaged over-ground penstock by a new buried penstock

Powerhouse:

Refurbishment of the powerhouse and installation of additional measures to make the powerhouse flood proof; replacement of 2 damaged alternators, electrical and mechanical control systems, governors; rehabilitation of the turbines; checking and required rehabilitation of all electrical installations;

Figure 2: Map of the project Area

4. Institutional, Regulatory frameworks and Policies

4.1 Institutional framework

15. This project will be developed under the Ministry of Finance (MOF).
    - **The implementing agency is EPC.**

16. As the sole provider of electricity in Samoa, the Electric Power Corporation (EPC) continually reforms itself to fulfill its core function, which is to generate, transmit, distribute and sell electricity. Currently, the Corporation with the exception of the Upolu streetlights installation implements also non-core functions:
    - Design of power system,
    - Installation and maintenance of generation equipment,
    - Installation of some distribution and utilization equipment,
    - Repair of motor vehicles,
    - Perform Government Community Service Obligations (CSOs),

17. Initially under the Ministry of Works Transport and Infrastructure it became independent (Corporate body) in 2011 but with strong links with its former Ministry.

4.1.1 The other relevant institutions directly concerned by the project are:

- **Ministry of Natural Resources and Environment (MNRE)**

18. The ministry of Environment has several principal divisions covering all aspects of the environment: i) Disaster Management, ii) Environment and Conservation, iii) Forest Division, iv) Global Environment Facility, v) Land management, vi) Meteorology, vii) PUMA, viii) Renewable Energy, ix) Water Resources.

MNRE is the Implementing Agency for the IWRM (GEF) and the Hycos project (EU) through its WRD, and for the SSDP (ADB) through PUMA, in particular for the capacity building component.

19. The main divisions concerned by the project are:
    - The PUMA (Planning and Urban Management Act 2004)

The Agency reviews and assesses the EIA being submitted by the proponent. This process ensures that all the relevant information is included to ensure that an informed decision is easily made about the proposed development. The EIA must be in accordance with the EIA Regulations 2007. The review of EIA reports for major developments is usually submitted to the Board for a decision while sometimes the Agency may process and make its decision on the approval of EIAs for minor developments.

    - Division of Environment Conservation
    - Division of Water Resources

Controls the water resources or the watershed under the Water Resources Management Act 2008-2011

20. The domain of the sector includes the regulation, development and use of all fresh water resources as well as the receiving coastal waters in Samoa. Over the years, sanitation has evolved as a priority issue in the sector. It is responsible for water resource management and includes policy and regulation, watershed management, hydrological and hydro-geological investigation, and water quantity monitoring. This Division has the appropriate equipment for water management and monitoring.

- Division of Forestry is in charge of delivering permits to harvest trees (Forestry harvesting Permit)
-

- **Ministry of Works, Transport and Infrastructure (MWTI)**

21. It regulates the construction of buildings and issue building permits, to construct, maintain and manage the public assets, in the project case, the construction of access roads.

Each Government Department or agency is responsible for the construction and maintenance of its buildings

The Ministry of Works, Transport and Infrastructure (MWTI) is responsible for drainage and storm water management, especially in relation to the development of road infrastructure and power lines.

- **Ministry of Finances (MOF)**

22. This project has been placed under this Ministry because it is financed by external aid.

- **Ministry of Women, Community and Social Development (MWCSD)**

23. Any land acquisition needed under this project will have social implications and transformations and each case will have to refer to this Ministry.

The Ministry of Women, Culture and Social Development (MWCSD) through its Internal Affairs Division, is facilitating in the provision and improvement of water supply and sanitation services in Village Managed Schemes (VMS), and assisting MNREM in water resources management at community level.

- **Ministry of Commerce, Industry and Labour (MCIL)**

24. It regulates labour conditions and the contractors and its manpower will have to comply with Samoan Legislation.

- **The Samoa Water Authority**

25. The Samoa Water Authority (SWA) is the national service provider of water supply and more recently for sanitation, sewerage and wastewater treatment. The SWA also monitor their own water supplies and have a water quality laboratory to support these activities. Because the drinking water is collected in the same river where SHPP will be or are installed it requires good coordination between EPC and SWA.

- **The Ministry of Agriculture and Fisheries MAF**

26. The Ministry of Agriculture, Forestry and Fisheries (MAFF) is responsible for the promotion, and sustainable development and management of irrigation services, and assists MNREM/WRD in the prevention and monitoring of uncontrolled clearance of forests for agriculture in watershed areas.

It is related to the project for the conservation of the watershed through the control of the crop field's development

- **The Ministry of Health**

27. The Ministry of Health (MOH) is responsible for water quality monitoring, inspection and investigation of water safety issues.

- **Indirectly the other institutions concerned are:**
- the SROS (Research institution)
- the Samoa University

These institutions may be called on for specific analysis if needed during the monitoring phase.

4.2 Legal framework

28. The relevant regulatory framework for this project is the following:

4.2.1Lands, Surveys and Environment Act 1989

29. Section 95 of the Act outlines the principal functions of the Ministry of Natural Resources and Environment (MNRE) which include:

- Advising the Minister on all aspects of environmental management and conservation including:
    - the potential environmental impact of a public or private development proposal; and
    - to act as the advocate of environmental conservation at Government, its agencies, and other public authorities with advice on procedures for the assessment and monitoring of environmental impacts.

30. Relevant to the PEDAP is Section 23, which covers the purchase of private land or Government interest in land. Under this section, the Government may, with the approval of the Minister, purchase any freehold land, or the interest of a lessee in any Government land for a Government purpose.

4.2.2Planning and Urban Management Act 2004

31. The Planning and Urban Management Act 2004 (PUMA) sets out the framework for the planning, use, development, management and protection of land in Samoa. It describes the process where an environmental impact assessment will be required as follows:

Section 42: Environmental Impact Assessment –

(1) The Agency may require an applicant under Section 37 to provide an environmental impact assessment in relation to the proposed development to which the development application relates.

(2) Where the Agency decides that an environmental impact assessment shall be prepared, the format, structure, subject matter of any such assessment and any other related matter, shall be specified in writing by the Agency to the applicant and the applicant shall comply with the Agencies requirements under this section

The Act also outlines the process of notification of applications and also the submissions on development applications.

4.2.3Environmental Impact Assessment Regulations 2007

32. EIA's in Samoa are regulated by the Environmental Impact Assessment Regulations 2007 (Regulations). The Planning and Urban Management Agency (PUMA) administer the EIA process, establishing what level of EIA is required, the aspects that need to be included and the process for review and approval.

When an EIA is required under Section 42 of the PUMA Act, it must be prepared and provided in the manner prescribed under these regulations.

Section 4 of the regulations prescribes the two forms of EIA:

1) A Preliminary Environmental Assessment Report (PEAR) and;
2) 2) A Comprehensive Environmental Assessment Report (CEAR).

A PEAR is required when the Agency considers an activity requiring consent is not likely to have a significant adverse impact on the environment. A CEAR is required when a development is likely to have a significant adverse impact on the environment.

Under Section 34 of the PUMA Act, all development needs consent, unless a sustainable management plan or regulations provides otherwise.

33. The Regulations also outline:

- Baseline and compliance monitoring (Section 8);
- Reviews of the environmental assessment (Section 9 and 10); and

Public Consultation (Section 11).
Schedules attached to the Regulations detail the content of the PEAR and CEAR.

34. From MFAT Environmental and Social Impacts Guideline (30August 2012 Document ID: 6111649)
The following categories reflecting the level of impact or risk and the type of impact assessment required development

Category	Description	Assessment
A	The Activity has the potential to cause significant adverse impacts considered irreversible or unprecedented, and which extend beyond the physical footprint of the Activity	Comprehensive impact assessment covering the full range of environment and/or social impacts, and impact management plan
P (A)	Same as for 'A' but where Activity is being implemented by a Partner agency	Impact assessment and management procedures by the Partner will be evaluated and, if required, supplementary work requested to ensure conformity with the requirements of this policy
B	The Activity has the potential to cause adverse site-specific impacts, which are potentially reversible or more easily mitigated than for category 'A'. As part of the design phase an impact assessment is to be conducted covering adverse impacts only, along with an impact management plan demonstrating how these will be addressed	Impact assessment and impact management plan covering adverse impacts only
P(B)	Same as for 'B' but where Activity is being implemented by a Partner agency	Impact assessment and management procedures by the Partner will be evaluated and, if required, supplementary work requested to ensure conformity with the requirements of this policy
C	Minimal or no adverse impacts	None – no further action needed

35. Examples of category A
• New airstrips, ports, and related transport infrastructure
•Activities taken place within or immediately adjacent to nationally or internationally designated area of conservation or heritage
• Large-scale industrial or agricultural Activity
• Large-scale land reclamation or coastal development
• Large-scale commercial fishing and logging
• Large-scale forestation/reforestation, including logging operations
• Large-scale aquaculture/marine culture
• Use of mangroves or wetlands
• Dams or other large-scale water impoundments
• Water drainage, abstraction, or irrigation schemes of medium- or large-scale

36. Example Activities: Category B
• Maintenance or rehabilitation of roads, airstrips and other infrastructure
• Construction of new minor roads and medium-scale infrastructure such as public utilities
• Agro-industry projects of small and medium-scale
• Small-scale coastal developments
• Small-scale dams and water impoundment, irrigation and drainage schemes
• Small and medium-scale aquaculture and marine aquaculture
• Small and medium-scale wind and solar farms
• Small-scale bio-energy development
• Small and medium-scale commercial fishing and logging

37. Example Activities: Category C

• Scholarships
• Technical assistance
• Workshops and meetings
• Research and extension in natural resources
• Replacement small-scale infrastructure (e.g. new electricity pylons) and maintenance of existing installations
• Capacity and institutional strengthening
• Health and education programs that do not include infrastructure
• Business mentoring

38. PEAR shall contain the following particulars:

(a) a brief description of the development proposal;

(b) a brief description of the area to be affected and the nature of the proposed change to the area (including a location map and site plan);

(c) a brief justification for the development proposal;

(d) a summary of the stakeholder consultation undertaken, the general issues raised, and responses to those issues;

(e) an assessment of all reasonably foreseeable adverse and positive environmental impacts, including long-term and short-term, primary and secondary consequences;

(f) an indication of possible alternatives to mitigate any identified adverse environmental impacts; and

(g) an indication of measures that the proponent intends to take to mitigate or avoid identified adverse environmental impacts.

4.2.4 Water permit and water management Act

39. This project will need to apply for a Water permit as it directly deals with waters resources and also have to comply with the Water Management Act related to the protection of watershed.

4.2.5 Forest act

40. Some sub-projects will have to log trees to open access roads, and thus should apply for a tree-harvesting permit.

4.2.6 Samoa Codes of Environmental Practice 2006

41. The Samoa Codes of Environmental Practice (COEP) have been prepared (2006) to define methods and/or procedures to be followed by consultants, designers and contractors. They seek to avoid or mitigate adverse environmental effects that may arise out of infrastructure development projects or maintenance work. The COEP is to be implemented for the planning, design and construction of all development works where development consent is required under PUMA.

Though these Codes refers essentially to road construction, guidance on public consultation, land acquisition and slope and soil protection, campsites, archaeological discovery, drainage, Earthworks Plan, Erosion and Sedimentation Measures, etc.

42. There are three implementation mechanisms for the COEP:

1. Use of the COEP is specified in the Terms of Reference for the design of works. The relevant design directives stated in the COEP should also be incorporated in the Terms of Reference;

2. Use of the COEP is specified in the specifications for the construction of physical works. The relevant suggested specifications stated in the COEP should also be incorporated in the specifications.
3. Environmental approvals are granted with the condition that works proceed under the provisions of the COEP.

43. There are 14 COEP which were prepared under the PUMA which include:

- COEP 1 – Administrative Procedures;
- COEP 2 – Road Planning, Design and Construction;
- COEP 3 – Consultation;
- COEP 4 – Land Acquisition and Compensation;
- COEP 5 – Construction Camps;
- COEP 6 – Road Construction Erosion Control;
- COEP 7 – Slope Stability;
- COEP 8 – Quarry Development and Operations;
- COEP 9 – Gravel Extraction;
- COEP 10 – Coastal Protection;
- COEP 11 – Drainage;
- COEP 12 – Traffic Control During Construction;
- COEP 13 – Earthworks; and
- COEP 14 – Cellular Telecommunications Facilities.

Of these, COEP 2, 3, 4, 6, 7, 9,11, 12 and 13 are particularly relevant to the project.

4.2.7 Security and Emergency

44. Disaster and Emergency Management Act 2007

This act gives guidance of the role, responsibility and actions to be taken after a disaster like typhoons or tsunamis.
There is no regulation related to anticipation of these disasters.
The Fire and Emergency Service Act 2007 is specifically related to fire.
EPC has not prepared an early warning and emergency preparedness Plan.
Though it is not internationally required to have a Early Warning and Emergency Preparedness Plan for Small HPP or HPP without reservoirs, EPC should nevertheless develop such a Plan in the future mainly to be prepared to face extreme situations.

4.2.8 Obtaining permit for new HPP

45. To build new HPP two consent should be obtained by:

- An application for a water permit should be lodge to the Water Resources Division of the MNRE and
- An application delivered by PUMA (MNRE)

When a project belongs to the competency of several Authorities (Agencies) and could have potentially significant environmental effects, the section 44 of the PUMA Act 2004 states that PUMA will consult appropriate Authorities by sending a referral to the relevant Authorities requesting comments. The answer of the Authority will be made within 10 days, unless the Agency will needs more information.
The timeframe to obtain a permit for a project depends on its complexity and the number of Agencies involved.

ANNEX 1:

Figure 1: Referral requirements and procedures

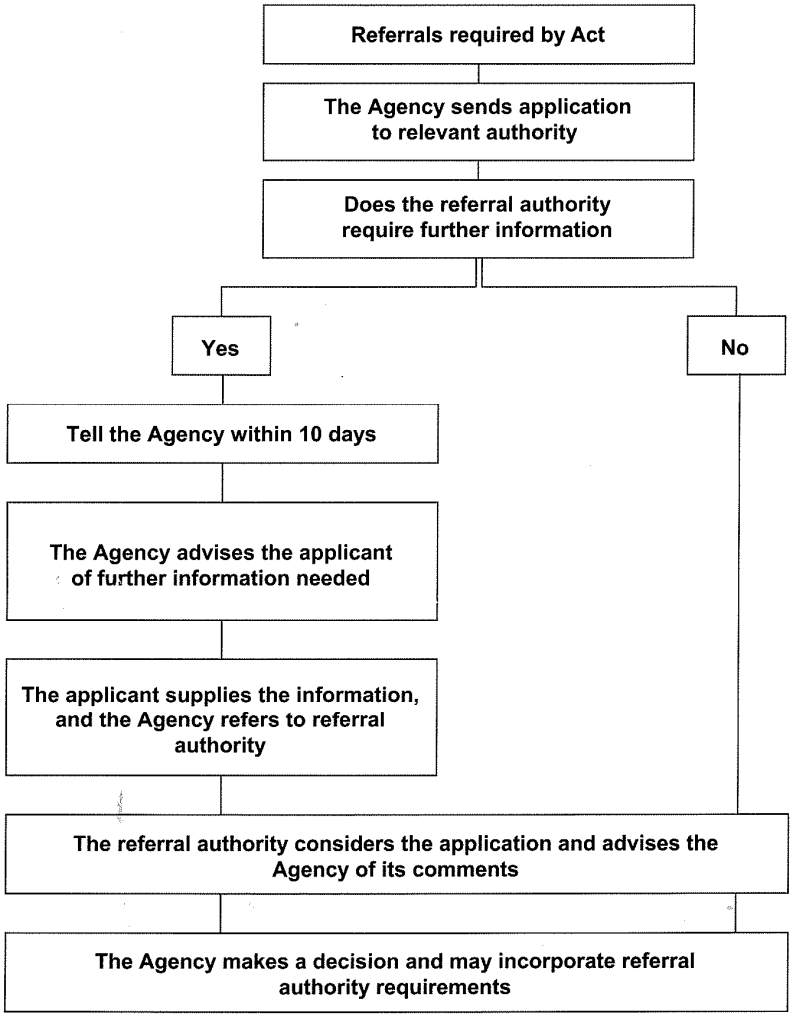


Figure 3:Referral chart Sources: PUMA Info sheet Referrals - Oct 2008

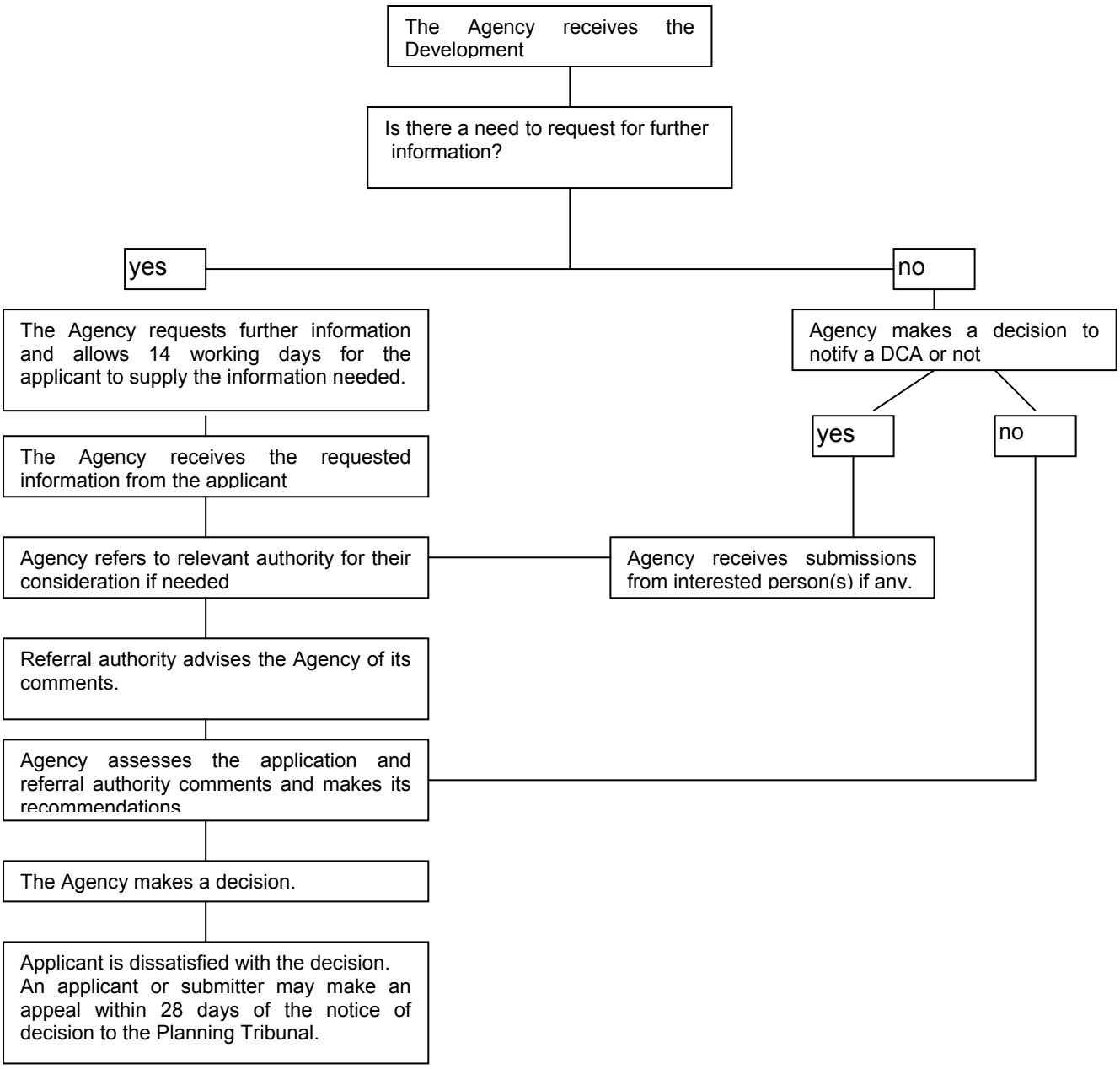


Figure 4: Development Consent Application chart, May 2009

4.2.9 Protection of Wildlife Regulations 2004

46. These regulations deal solely with the protection of flying endemic species. Under these regulations no person is allowed to harm flying species endemic to Samoa unless approval is granted by the Minister of Natural Resource and Environment. Flying endemic species are defined as any of the following:

- Flying fox;
- Pigeon;
- Crimson crown fruit dove;
- Wattle honeyeater; and
- Cardinal honeyeater.

Harm is defined as trap, shoot, kill or otherwise destroy.

4.3 Policies

4.3.1 Cultural and Natural Heritage Conservation Policy 2004

47. This policy provides the framework for the conservation, preservation, use, allocation and sustainable management of heritage resources. It also seeks to improve approaches to heritage planning by ensuring that the preservation of natural and cultural heritage are fully recognized and taken into account in the formulation and implementation of development programs.

4.3.2 Planning for Climate Change Policy

48. This policy addresses national responses to Climate Change as identified in the National Environment Management Strategy (NEMS) 1993. The local risks from greenhouse warming are defined as: coastal inundation; shoreline retreat; more severe and frequent storms and wave condition; enhance coastal sedimentation and threat to infrastructure and services.

4.3.3 Policy Statement on Biological Diversity

49. This policy statement provides the framework for the conservation, sustainable use and management of Samoa's terrestrial and marine biodiversity including the protection of endemic and native species and the control of invasive species.

4.3.4 Statement of Economic Strategy (SES) 2000 – 2001

50. Samoa's Economic Strategy seeks to encourage private sector led, and broader based growth in outputs and employment, as well as facilitating social development. The education and health sectors are a high priority in order to provide people with greater opportunities to advance themselves. Significant support is also given to rural development programmes to improve power distribution, transport infrastructure, and communications to create more opportunities for those in Savai'i and the rural areas of Upolu, where lowest income levels tend to occur.

4.3.5 Strategy for the Development of Samoa (SDS) 2008 -2012

51. The Vision for the 2008-2012 Strategy for the Development of Samoa is for 'Improved Quality of Life for All'.

The achievement of the vision relies on implementing the seven national development goals of SDS 2008–2012, which in turn requires effective implementation of development strategies in the three priority areas of economic policies, social policies and public sector management and environmental sustainability. The goals included:

- Sustained Macroeconomic Stability;
- Private Sector Led Economic Growth and Employment Creation;
- Improved Education Outcomes;
- Improved Health Outcomes;
- Community Development: Improved Economic and Social Well-being and Improved Village Governance;
- Improved Governance; and
- Environmental Sustainability and Disaster Risk Reduction.

4.3.6 Energy Sector Plan 2012 - 2016

52. The key guiding document for all energy projects in Samoa is the Energy Sector Plan, published by the Samoa Ministry of Finance in December 2012. This plan supersedes the National Energy Policy (2007) and the Strategic Action Plan (2008). Samoa has a "Carbon Neutral by 2020" goal approved by Cabinet in 2010, with the Energy Sector Plan as the guiding document for this goal.

As part of the PEDAP a 100% Renewable Energy Roadmap for Samoa is being developed by ITP separately.

4.4 Relevant International Agreements

53. According to the Samoan Ministry of Foreign Affairs and Trade, Samoa is a party to the following
Environment Conventions and Treaties[1]1.

- Agreement establishing the South Pacific Regional Environment Program (SPREP), 1993;
- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, 1986;
- Protocol for the Prevention of Pollution of the South Pacific Region by Dumping, 1990;
- Convention on the Conservation of Nature in the South Pacific, 1976;
- United Nations Framework Convention on Climate Change, 1992;
- Kyoto Protocol to the Framework Convention on Climate Change, 2005;
- Convention on Biological Diversity, 1992;
- Vienna Convention for the Protection of the Ozone Layer, 1985;
- Montreal Protocol on Substances that Deplete the Ozone Layer, 1987;
- United Nations Convention to Combat Desertification, 1994;
- Convention concerning the Protection of the World Cultural and Natural Heritage, 1972;
- Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, 1998;
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and
  their Disposal, 1989;
- Convention on Persistent Organic Pollutants, 2001;
- Convention on Wetlands of International Importance, 1971;
- Convention on International Trade in Endangered Species of Wild Fauna, 1973;
- Convention of Migratory Species, 1979;
- Protocol concerning Cooperation in combating Pollution Emergencies in the South Pacific
  Region, 1990;
- Carthagena Protocol on Biosafety to the convention of Biological Diversity, 2003;
- International Plant Protection, 1951;
- International Treaty on Plant and Genetic Resources for Food and Agriculture, 2001;
- Plant Protection Agreement for the South East Asia & Pacific Region, 1956;
- Strategic Approach to International Chemicals Management, 2007.

4.5 Relevance of Legal, Policy, and Administrative Frameworks

54. The Samoan policies and frameworks assessed above support the development of new small Hydro Power Plants. This includes the Strategy for the Development of Samoa, which seeks to improve the overall quality of life for Samoan.

Key, policy or administrative frameworks that support the project are:

- Statement of Economic Strategy (SES) which supports development program to improve power distribution, transport infrastructure, and communications, in order to create more opportunities for those in Savai'i and the rural areas of Upolu, where lowest income levels tend to occur.
- Energy Sector Plan. This is the key guiding document for all energy projects in Samoa.

Samoa has a "Carbon Neutral by 2020" goal approved by Cabinet in 2010, with the Energy Sector Plan as the guiding document for this goal.

[1] 1 http://www.mfat.gov.ws/Convention treaties.html

4.6 ADB requirements

4.6.1 Environmental Requirements

55. ADB uses a classification system to reflect the significance of a project's potential environmental impacts. A project's category is determined by the category of its most environmentally sensitive component, including direct, indirect, cumulative, and induced impacts in the project's area of influence. **Samoa Renewable Development and Power Rehabilitation Project** has been assigned Category B. A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects.

56. For this Project an Initial Environmental Examination (IEE) is required. This IEE has been prepared under the provisions of the ADB's safeguard policy document[2], which requires a number of considerations not normally included in the Samoan EIA such as:

(i) project level grievance redress mechanism;
(ii) climate change mitigation and adaptation;
(iii) occupational and community health and safety requirements, including emergency preparedness and response);
(iv) economic displacement that is not part of land acquisition;.

57. It has been determined by the PPTA team that a Project IEE prepared under the provisions of the ADB's safeguard policy would fully satisfy all the requirements for a PEAR under the **PUMA Environmental Impact Assessment Regulations 2007***.*

58. The ADB's climate change efforts are guided by five strategic priorities:

- expanding the use of clean and renewable energy;
- encouraging sustainable transport and urban development;
- promoting climate-resilient development;
- strengthening policies, governance, and capacities; and
- managing land use and forests for carbon sequestration..

The proposed renewable energy project is in line with these priorities.

4.6.2 Environmental, Health, and Safety Guidelines 2002

59. ADB's SPS applies pollution prevention and control technologies and practices consistent with international best practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. The Guidelines provide the context of international best practice and contribute to establishing targets for environmental performance. The air and noise standards in the EHS guidelines will be used in parallel with local standards (where they exist) throughout this document.

Occupational and community health and safety, as laid out in the EHS Guidelines, will be a crosscutting assessment for all subprojects.

[2] ADB. 2009. Safeguard Policy Statement.

5. Description of the environment

60. This section borrows heavily from the 'State of the Environment Report, Ministry of Natural Resources and Environment, 2013'.

5.1 Biophysical

5.1.1 Climate

61. Samoa has a wet tropical climate with temperatures ranging between 17°C and 34°C and an average temperature of 26.5°C. Average humidity for the capital Apia is 83 %. The average annual rainfall is about 2,000 mm with about 75 per cent of the precipitation occurring during November- March.

Due to the predominance of moisture-bearing southeasterly trade winds, the northwest parts of the main islands, as well as the southeast side of Savai'i, are rain shadow areas, receiving about half the rainfall of the highland areas.

Samoa is affected by tropical cyclone patterns with the cyclone season in November to March.

Cyclone Evan struck Upolu in December 2012. A weather monitoring mast at Mt. Fiamoe measured wind at a peak of 46m/s at 28m above ground, in a ten-minute average, with a maximum 3-second gust of 59m/s being recorded in the same 10-minute interval. Cyclone Evan was thought to be the worst to hit Samoa in over two decades.

5.1.2 Geography

62. The topography of Samoa is rugged and mountainous with about 40 per cent of Upolu and 50 per cent of Savai'i characterized by steep slopes descending from volcanic ridges. The interior of both main islands is still covered with mountain forests and, in the case of the highest peaks on Savai'i, covered in cloud forest. These areas also contain volcanic peaks with the Upolu crestal ridge rising to 1,100m. Savai'i has more and younger volcanic cones with the highest peak reaching 1,848m at Mt. Silisili. Western Savaii and northwest Upolu are almost devoid of surface streams, corresponding to the rain shadow and sub-surface drainage.

5.1.3 Geology

63. The Samoan islands are composed almost wholly of basic volcanic rocks such as olivine basalt, picrite basalt and olivine dolerite. Most of the soils are formed from weathered basaltic volcanic flows, including pahoehoe and aa lava types, scoria and volcanic ash. Soils are generally clay in texture, free draining, porous and relatively shallow.

A coral reef surrounds the islands for nearly half of the coastline, except where there are steep cliffs and where young lava flows have filled the lagoon. Coral sand is found along most of the coastline, up to 5 m from sea level. Alluvium is not common, but forms the parent material for the most versatile soils.

Earth tremors continue on a frequent basis in Samoa (as measured by the MNRE Meteorology Division at Mulinuu, Apia) and Samoa remains vulnerable to future volcanic activity. The last recorded eruptions were all on Savai'i in 1902 and 1905-1911.

Samoa islands are subject of violent earthquakes. The last one occurred in 2009. The epicenter was far away in the Pacific so few damages were noted on structures in villages and in Apia. The Tsunami resulting from this earthquake has affected the southwestern part of Upulu and destroyed many habitats where 115 persons perished.

5.1.4 Ecology

64. It is estimated that Samoa supports 775 native vascular plant species of which approximately 30% of the angiosperms are endemic. There are about 280 genera of native angiosperms. In addition, there are about 250 introduced plant species and 47 threatened plants. Samoa's fauna consists of 21 butterfly species, 11 species of reptiles, 43 resident bird species eight of which are endemic, and three flying fox species (Samoa NBSAP 2001).

Samoa's unique biodiversity is a result of its geographic isolation, which has led to the evolution of unique species and communities of plants and animals, many of which are indigenous to only one island or island group within the Pacific region. These species usually have small population sizes, making them particularly vulnerable to loss from over-exploitation and habitat degradation. 11 terrestrial and 65 marine species found in Samoa are listed as globally threatened on the 2009 IUCN Red List of Threatened Species. It is thought that the true number of threatened species in Samoa is significantly higher than this.

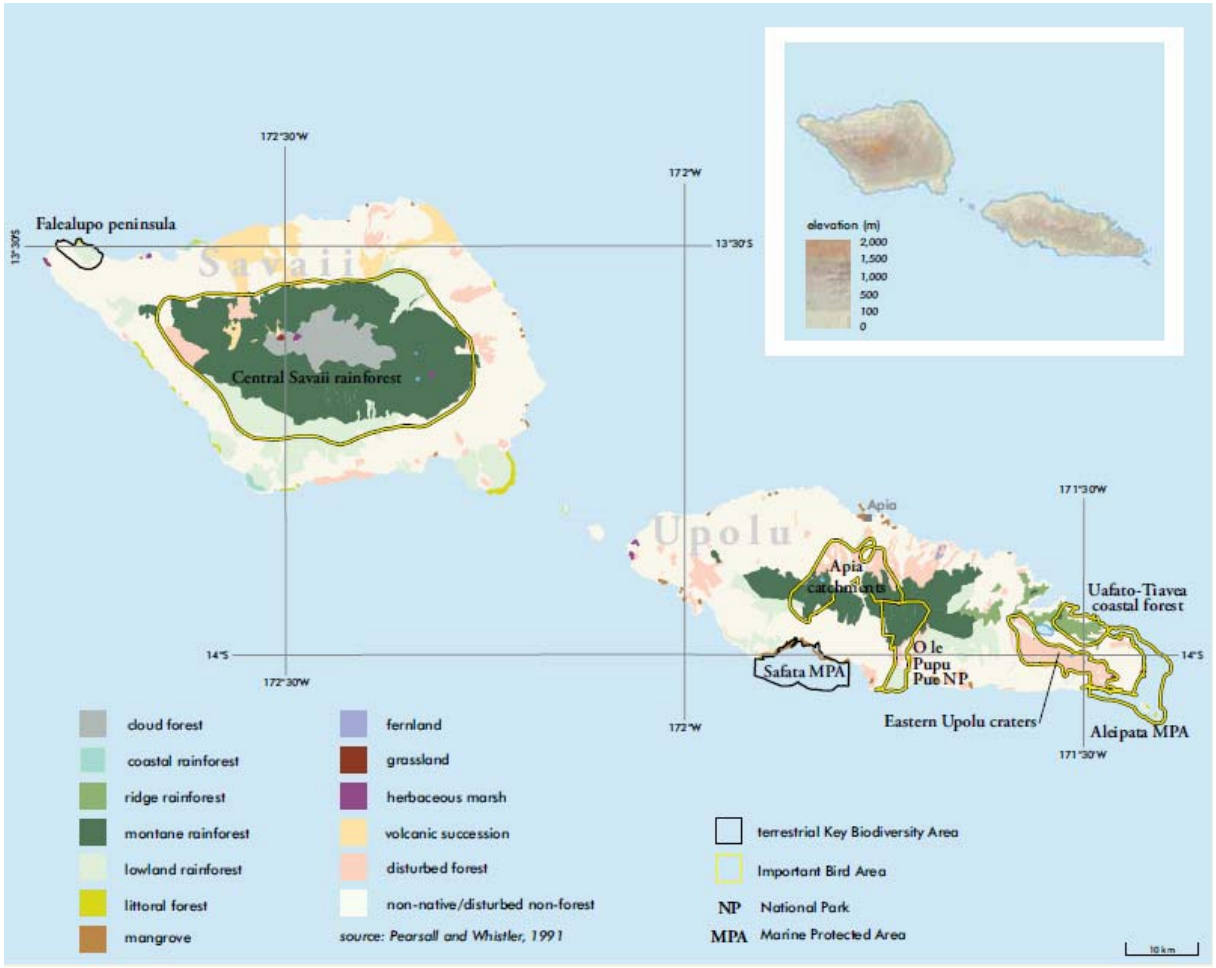


Figure 5: Terrestrial Key Biodiversity Areas and Native Vegetation for Upolu and Savai'i. (Source: Priority Sites for Conservation in Samoa: Key Biodiversity Areas)

5.1.5 Flora

65. A 1992 survey classified Samoa's vegetation into 19 plant communities within five broad categories, as follows:

- Littoral vegetation: Four communities of vegetation situated on the seashore were recognised: herbaceous strand or beach; littoral shrub-land; Pandanus scrub; and littoral forest whereby much of these types have been lost or degraded. The best remaining examples are at Aleipata Islands, O Le Pupu-Pue National Park and sites on the South (central) coast of Savai'i.
- Wetland vegetation: Four communities are recognised: coastal marsh; montane marsh; mangrove scrub/forest; and swamp forest. There has been a very serious loss

of wetlands, particularly in the lowlands, and only a few intact areas of each type remain.

Rainforest: Four communities are recognised on an altitudinal gradient: coastal; lowland; montane; and cloud forest. Cloud forests are restricted to Savai'i with the summit reaching over 1800 m. The few remaining significant areas of coastal forest are at the Aleipata Islands, Apolima and possibly Tafua Crater. The montane habitat is considered to have the richest flora of any forest community in the country. On Upolu, no montane sites were found that had good forest or were recovering (from cyclone damage) and there was substantial impact from several weeds. On Savai'i, the forests are recovering faster at higher elevations where there is little human activity, whereas the process is much slower at lower areas where forest cutting has added to the problem.

Volcanic vegetation: Two communities, lowland volcanic scrub and upland volcanic scrub, are recognised and these occur only on recent lava flows on Savai'i.

Disturbed vegetation: Four communities derived from a combination of human activities and weather are recognised: managed land; secondary scrub; secondary forest; and fernlands.

66. About 25% of the plants found in Samoa are endemic and 32% are endemic to the Samoan archipelago. A further 500 or so species of plants have been introduced to the islands since the first

Samoans brought the coconut, taro and other species for cultivation about 3,000 years ago. Currently about half the plants in Samoa are exotic. While some of these plants are beneficial for agriculture, others are considered destructive weeds.

5.1.6 Avifauna

67. Bird Life International records 81 bird species in Samoa. This includes 31 breeding native land birds, one possibly extinct native land bird (the Samoan Moorhen), 4 breeding introduced birds, approximately 10 breeding seabirds and 35 migrants or vagrants. Nine of the land birds are endemic to Samoa and another seven are regional endemics or near endemics.

Twelve species are globally considered to be Restricted Range species, but not classed as of immediate conservation risk. Six species are considered to be of national conservation concern as determined through the National Biodiversity Strategy and Action Plan.

Sea/shore birds

68. There is a gap in the knowledge of population numbers and breeding status of seabirds in Samoa making it difficult to review and update the existing list of seabird species of conservation concern.

Based on the available literature, approximately 12 seabird and shorebird species that are of global or national conservation concern have been recorded in Samoa.

Several seabird species of global concern are either passage migrants, visitors or status unknown in Samoa. These include the Phoenix Petrel (*Pterodroma alba*); Tahiti Petrel (*Pseudobulweria rostrata*); Collared Petrel (*Pterodroma brevipes*) and Polynesian Storm Petrel (*Nesofregetta fuliginosa*). The globally threatened Bristle-thighed Curlew (*Numenius tahitiensis*) is a regular northern winter migrant in small numbers.

5.1.7 Fauna

Terrestrial Mammals

69. Bats:

There are 13 species of terrestrial mammal now present in Samoa. Of these, only three are native, two flying foxes (or fruit bats), the Samoan Flying-fox (*Pteropus s. samoensis*) and the Tongan or White-necked Flying-fox (*P. tonganus*). A small insectivorous bat, the Sheath-tailed Cave Bat (*Emballonura semicaudata*) is now believed to be extinct in Samoa. The flying foxes are important for the long-term survival of the forests as they pollinate the flowers

of many species and also disperse the seeds of the fruits that they eat throughout the forest. It has been estimated that almost one in three Samoan forest trees depend on flying foxes in some way.

5.2 Protected Area and Key Biological Areas

70. Key Biodiversity Areas (KBA) support the regular occurrence of one or more globally threatened species assessed as Critically Endangered, Endangered, or Vulnerable according to the IUCN Red List.

Terrestrial KBAs cover a total of 940 km2 or approximately 33% of the total land area of Samoa, including representation of 12 of the 13 native terrestrial vegetation communities in the country.

The seven marine KBAs cover approximately 173 km2 or 23% of the inshore reef area of Samoa.

Currently, six of the eight terrestrial KBAs and three of the seven marine KBAs have been completely or partially established as conservation areas by the Government of Samoa or by local village communities and two additional KBAs have small community based fisheries sites within their boundaries.

The first National Park established in Samoa was the O Le Pupu-Pue National Park in Togitogiga, in 1978. Two new national parks have since been established, including Mauga o Salafai, the first to be located on Savai'i, and Lake Lanoto'o which is the first Ramsar Convention Wetland site in Samoa at the center of the volcanic ridge on Upolu.

Protected forest area consists of existing and proposed national parks and nature reserves, community conservation areas. All forest area outside protected forest is by definition considered production forest.

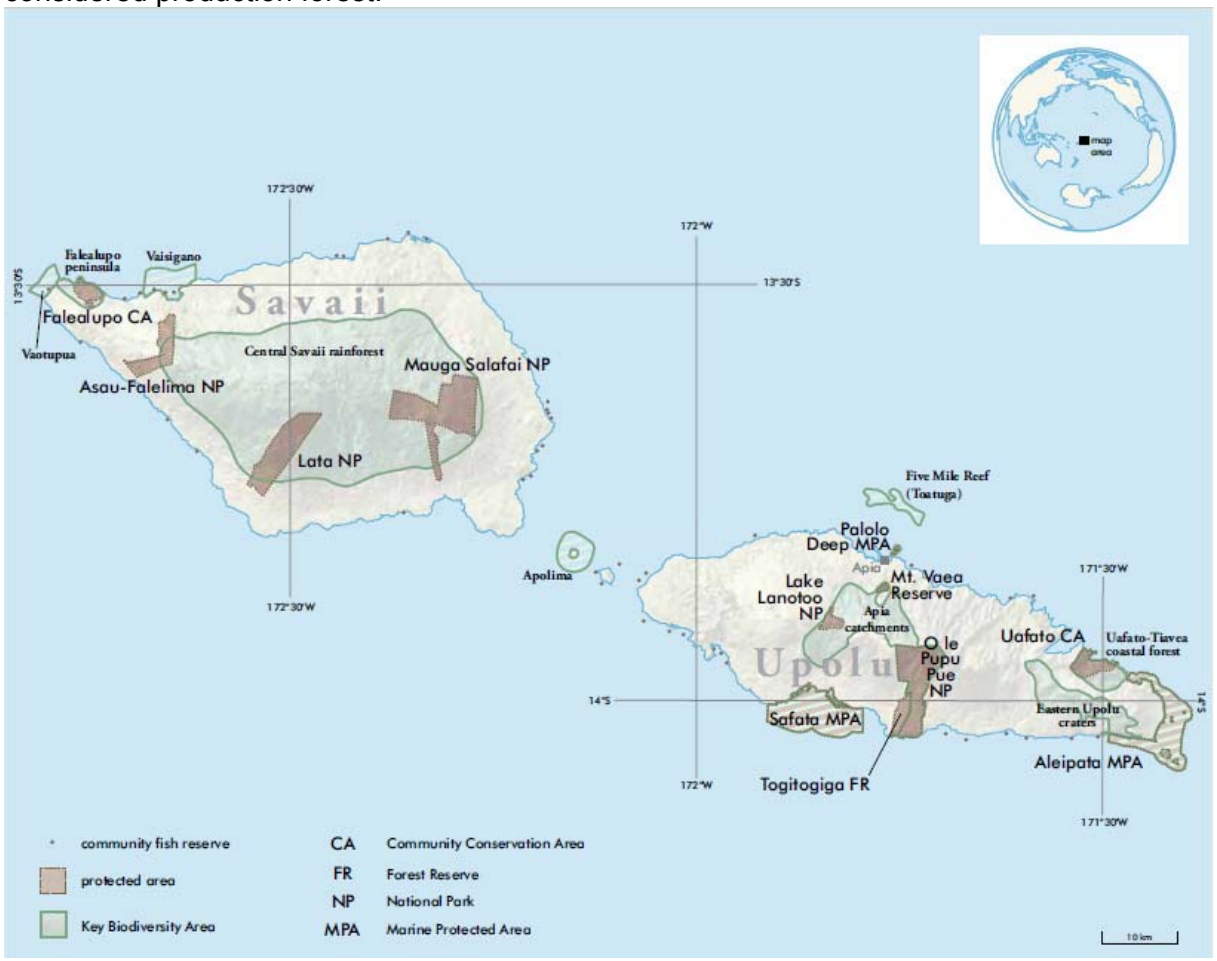


Figure 6: Terrestrial Key Biodiversity Areas and Native Vegetation (source: Priority Sites for Conservation in Samoa: Key Biodiversity Areas)

5.3 Socio-economic

71. Further consideration on socio-economic and land tenure issues are developed in a stand alone document related to the Resettlement Plan

5.3.1Economy

72. Samoa's economy is dominated by subsistence agriculture and related activities, which support around 75 per cent of the total population, including almost the entire rural population. The economy is also dominated by external aid and by remittances from Samoans residing and working abroad.

Samoa's economy has suffered from tropical cyclones. The destruction of tree crops, forests and infrastructure by cyclones has affected economic performance, especially primary production, and these impacts on the environment and the people could be felt for over three years after each cyclone. More recently, Cyclone Evan struck in December 2012. Its economic impact is still unknown but could be as significant as that which resulted from the 2009 Tsunami.

5.3.2Transport

73. The two main islands are well served by coastal ring roads and Upolu has three cross-island roads.

The completion of the current road improvement program should see all the main roads upgraded and tar-sealed. The main international port is Apia, with an inter-island ferry service operating between Mulifanua at northwest Upolu and Salelologa at southeast Savai'i. The islands were once linked by air service between Faleolo near Mulifanua on Upolu and Maota near Salelologa on Savai'i, but this air service was discontinued in 2006. Another airport is located in North-West Savai'i at Asau. The main international airport is Faleolo Airport in northwest Upolu.

5.3.3Water Sources

74. Historically, community water supplies from groundwater have been derived from coastal springs commonly found around the coastal villages. Groundwater is most readily available from freshwater lenses, but aquifer yields are constrained by the risk of inducing saline intrusion. With the high rainfall and virtually no drought period, the flows of such springs are sustained throughout the year. There are minor perched aquifers, held up by less permeable strata, which may be of local significance for inland springs.

Despite high rainfall occurring between October and March, many parts of Samoa are devoid of perennial streams and rivers due to the high permeability of the underlying volcanics. The driest areas are found in northwest Upolu and northwest Savai'i. Rainwater is harvested and widely practiced in dryer areas of the country such as in western Savai'i.

Surface water is abstracted from catchment areas of the central highlands of Upolu and south-east of Savai'i. There are 28 surface water intakes on Upolu producing an average of 42.5 million m_3 of water per year and two on Savai'i (Patamea and Sili).

5.3.4Energy

75. The EPC operates 22kV transmission networks on Upolu and Savai'i and is in the process of completing staged upgrades to transmission and generation infrastructure through the ADB's Power Sector Expansion Project. While the bulk of Samoa's existing transmission network is via overhead cable, newer sections of the network include underground cabling.

Upolu currently has a combination of hydro-generation and diesel generation as the primary source of electricity. The main Upolu power station, located at Tanugamanono, has been in operation since the mid-1970s.

EPC operates four run-of-river and one dam-based hydroelectric power stations with a total capacity of around 12MW. Hydro generators on Upolu generated a total of 35.248 GWh in 2010/11, representing 36% of Samoa's total electricity. This was slightly less than typical due to the prevailing drought conditions at the time.

Station	Type	Year Commissioned	No	Capacity (kW)	Derated Capacity
Taelefaga	Dam-Reservoir	1992	1	2,000	2,000
			2	2,000	2,000
Lalomauga	Run of River	1984	1	1,850	1,700
			2	1,850	1,600
Samasoni	Run of River	1981	1	950	640
			2	950	720
Fale-ole-Fee	Run of River	1985	1	1,600	1,400
Alaoa	Run of River	1959		1,000	1,000
Total				**12,200**	**11,060**

Table1 outlines the existing hydro generators in Upolu.

76. Under the EPC Expansion Plan, a new diesel power station has been constructed at Fiaga, in the area of Aleisa, and replace the existing Tanugamanono power station in the EPC expansion plan. The

Fiaga power station consists of four new diesel engines (5.78MW each) all-generating at 11kV.

Also, three existing diesel units will be relocated from Tanugamanono to Fiaga generating at 6.6kV.

New transmission lines of 33kV connect Fiaga Power Station to the new Fuluasou Substation, which supplies 22kV feeders. Tanugamanono will continue to operate as a substation serving distribution feeders and terminating transmission line from five existing hydro projects. A new underground transmission cable will connect Fuluasou to Tanugamanono. There will be a total of 10 feeders fed from three major substations supplying on Upolu.

The overwhelming majority of Upolu's load is located in the Apia area, with the remainder spread out around the coastal ring and the cross-island road. Some sections of the network experience poor power quality. Upolu had a peak demand of 13.5 MW in 2000.

Savai'i's loads are somewhat higher in the Salelologa area, but are generally distributed around the island along the coastal road. Power quality problems are common at the northern end of the island near Asau, due to the distance from the power station. Savai'i load profiles are predominantly residential, with a steady daytime load of 800kW – 1MW and an evening peak of up to 3MW.

All electric generation on Savai'i is currently diesel generation located at the Salelologa Power Station, which has six diesel engines, all generating at 400/415 volts. Two 22kV feeders transits and distribute electricity out to the consumers namely the Puapua Feeder that goes along the north coast and the Asau Feeder on the south coast. The peak load in Savai'i is about 2.8MW. Figure 4.4 and Figure 4.5 shows the grid system on Savai'i and Upolu.

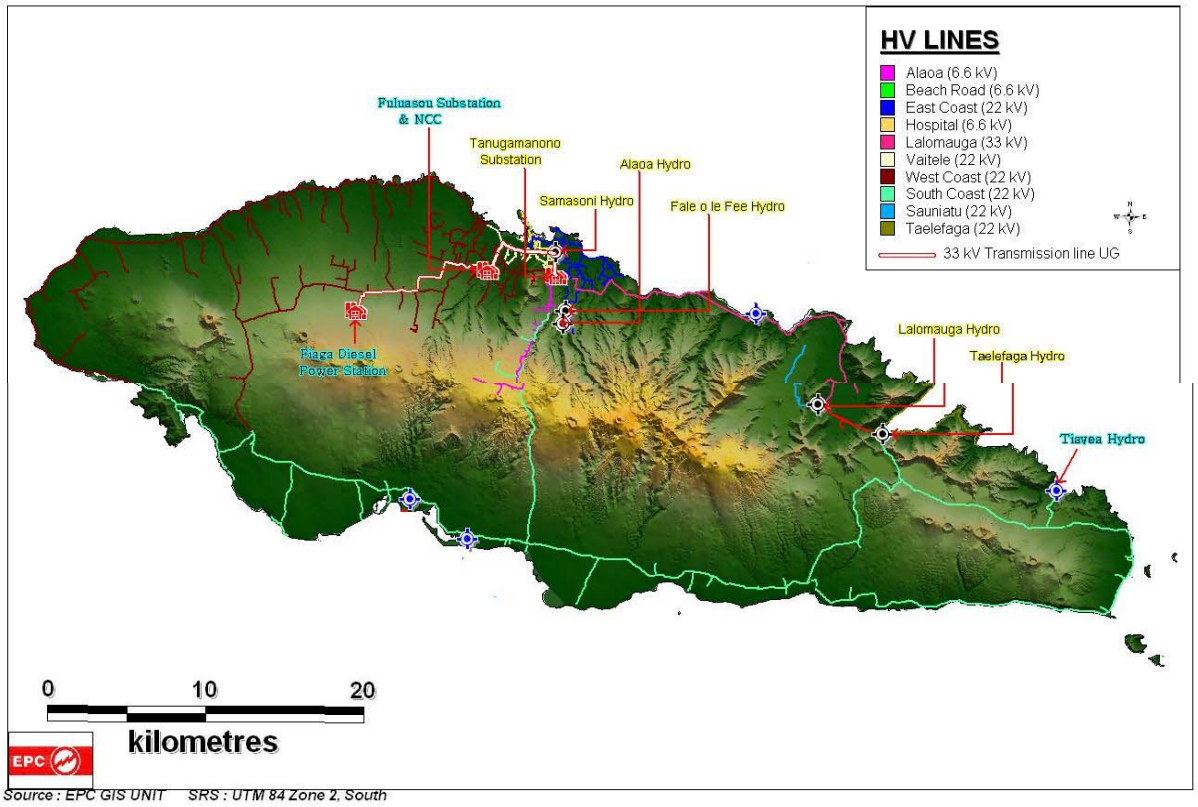


Figure 7: EPC's grid network on Savai'i (Source: EPC)

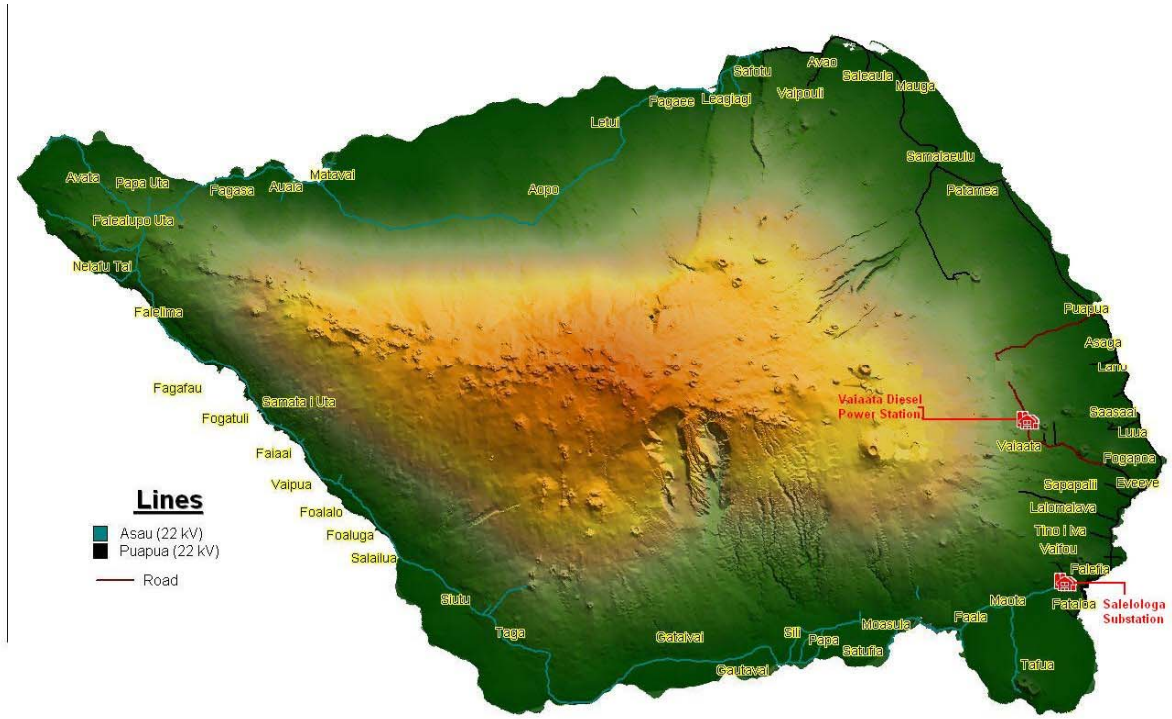


Figure 8: EPC's grid network on Upolu (Source: EPC)

Renewable Energy Projects

77. There are a number of different renewable energy projects underway and planned for both Upolu and Savai'i. These include:

1. 550kW of grid-connected solar PV (150kW on Savai'i and 400kW on Upolu) installed through the Pacific Environment Community (PEC) fund. This project is led by EPC and is expected to be completed in end-2013. Installation is to be on EPC-owned sites.
2. 2. 4MW by 7.2 million KWh per year of grid-connected solar PV to be installed and operated by Solar Samoa Ltd, an independent power producer (IPP), under a Power Purchase Agreement (PPA) with EPC. Since signing of the PPA no site development or construction has commenced.
3. 4MW by 31 MKWh per year of grid-connected biogas generation to be installed and operated by a Biogen3, an IPP, under a PPA with EPC. This project is pending environmental and financial approval.
4. EPC are currently running an Expression of Interest for up to 2 by 2 MW of grid connected solar under an IPP arrangement. Request for Proposal is scheduled to be advertised in August 2013.
5. New Zeeland government grant funded 1.2 MW grid connected solar system on Upolu to be commissioned by September 2014. Owned and operated by EPC.
6. Proposals for reducing diesel by Biodiesel produced locally from coconut oil are being evaluated in July 2013 for implementation at end of the year. Private investor financed. (12 Ml/y, EPC; transportation consumption uses the double) it will reduce 10% of national diesel consumption
7. 6. Feasibility studies have been completed for five new hydro power schemes, 3 on Upolu and 1 Savai' through the ADB's Power Sector Expansion Project (PSEP) and are expected to be installed in the next future.
8. The 13.5kva Apolima Island mini-grid solar PV system, now in its sixth year of operation, is owned and managed by EPC and has experienced no major maintenance issues to date.
9. Wind data collection is continuing to develop a wind farm on Opolu and Savai'. IPP to develop a private project.

5.3.5Landuse

78. The landscape on Upolu and Savai'i generally consists of a narrow coastal plain, with rocky, rugged, volcanic terrains making up the inner parts of the islands[5]. The vegetation in these areas is primarily composed of lowland and montane rain forests, with small areas of riverine, swamp, mangrove, and beach forest. The islands have undergone extensive deforestation, as a consequence of timber operations and clearance of land for agriculture. A large proportion of the lowland forest on Savai'i and Upolu has been cleared or highly modified, but the montane forests are less disturbed and have a rich variety of endemic flora and fauna[6].

In the rural communities, land remains primarily under customary ownership and a large proportion of it is currently under cultivation.

Land use capability assessments in 1990 categorised Samoa's land into four main classes:

1. Land with few limitations for agricultural use (39,600 ha);
2. Land with moderate limitations for agricultural use and few limitations for forestry use
3. Land with severe limitations for agricultural use and moderate to severe limitations for forestry use (59,400 ha); and
4. Land unsuitable for agricultural or forestry use (69,000 ha).

The predominant land use, apart from indigenous forests, is agriculture. A common land use pattern in most villages consists of a residential area with a village common ground or malae on about a kilometre-wide strip of land along the coastline. Immediately inland is a mixed

cropping zone of fruit trees, bananas and coconuts, and further inland is a zone of primary food crops of taro, taamu and yams.

5.3.6Land ownership

79. There are four types of land ownership in Samoa with over 80 per cent of total land under customary ownership. The rest is divided between freehold, Government, and land vested in Samoa Trust Estates Corporation (STEC) and Samoa Land Corporation (SLC).

About 15% of land in Samoa is publicly owned and is generally known and recognized as Government land. Under statutory law, access to Government land is through lease or exchange of either freehold land or customary land. Freehold land takes up 4% of the total land area.

Landowners independently manage their own lands. These can be alienated in any manner desired by the owner, be it through sale, gifting, leasing, licensing or exchange. However, alienation to no citizens or overseas residents is prohibited under the Alienation of Freehold Land Act 1972 unless granted consent by the Head of State.

Customary land vested in accordance with Samoan custom and usage, are primarily managed by the matai who is the head of an extended family. As trustee for his/her family, the matai is responsible for the management and allocation of the land for various uses by family members.

These lands are protected from alienation by sale by the Constitution of the Independent State of Samoa 1960, except by way of lease or license in accordance with the Alienation of Customary Land Act 1965.

An emerging form of land tenure is leased land, which is land under lease arrangements between the leasor (landowner) and the leasee (applicant). All types of land, whether Government, freehold or customary, can be leased out to individuals, corporations and community or to private investors. In this regard, leasing can provide a viable option to access the land necessary for private sector growth. Ideally, leasing allows the use of land without alienating it from traditional landowners.

The Government closely controls the leasing of customary land. The Minister of MNRE, as the trustee of customary lands, is vested with the power to manage and administer lease arrangements between the leasor and the leasee. The Minister's involvement in land leasing is designed to ensure that landowners are protected from entering into inappropriate land deals or making unwise decisions, and to prevent alienation of customary land or ownership from the landowner.

5.3.7Cultural heritage

80. For the moment MNRE is in charge for the implementation of the Cultural Heritage law. This law has not been revised as the Samoan Law Reform proposed to create a separate body, the Samoan Heritage Authority.

Some sites show evidence of very early of human presence. For Fale o Le Feh to allow construction of infrastructures archaeological remains had to be removed and transplanted away from HPP site.

81. The Samoan Code of Environmental Practices (2006) states that" Should any archaeological sites be discovered during any stage of gravel extraction works such work shall cease immediately and MNREM notified forthwith. On no account shall extraction work continue until authorised by MNREM.

MNREM shall arrange an evaluation of the site in association with archaeologists before making any decision as to whether or not extraction works may proceed. A suggested specification is:

If the contractor locates any archaeological site or suspected archaeological site he shall immediately cease operations and notify the engineer forthwith. On no account shall extraction work continue until authorised by the PUMA"

6. Environmental impacts and mitigation measures

6.1 Introduction

82. The environmental management plan covers all phases of subproject implementation from preparation through commissioning and operation. It aims to ensure the monitoring of environmental impacts and implementation of mitigation measures. The EMP will be incorporated into the construction, operation and management of each sub component.

83. Environmental protection measures will i) mitigate environmental impacts, ii) achieve compliance with national environmental regulations and ADB safeguard standards, iii) provide compensation or offsets for lost environmental resources, and iv) when possible enhance environmental resources.

84. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures or compliance with regulations

To ensure that mitigation measures contained in the EMP are successfully implemented appropriate steps have to be taken to ensure that:

- The present EMP is included in the tender documents
- The contractor prepare its own EMP (contractor EMP)
- The tender document specify that the contractor will engage experienced staff to care for the environment management and monitor the effectiveness of the mitigation measures
- The contractor submit to EPC and PUMA its contractor management plan for approval (site clearance, site drainage, waste and material management, pollution control, traffic, noise and dust management)
- Contractor recruit qualified and experienced staff to oversee implementation of environmental and safety measures specified in the EMP
- Project documents are disclosed and made available to public
- There is a redress grievance mechanism made known to the public prior the start of the project
- EPC has manpower to oversee EMP implementation in all project sites and have regular support of international expertise

6.2 Environmental impacts

85. Considering that there will be a tender for each site and not a tender for each type of activity, the EPM is organised in such way that each contractor winning a bid will find all information relevant to the pre construction, construction phase for a definite site.

Each of the 8 sites has been treated separately as the activities planned for each site differ from one site to the other and affect the environment in a different way. Existing sites will only have some reconstruction activities when new sites will see the development of a complete range of construction and equipment: opening for access road, installation of intake and headrace, construction of a powerhouse.

For each site, potential impacts have been assessed according to the type or sequence of activity planned as they may affect differently the environment and are situated at different geographic locations of the site.

The EMP presents mitigative measures and associate monitoring actions. These have identical number so can be easy referenced and crosschecked.

The EMP provide details on the monitoring requirement

If unexpected impacts occur during project construction phase and operation phase, EPC and the contractor will update the EMP.

The IEE and EMP will be updated following detailed design.

The environmental management plan covers all phases of subproject implementation from preparation through commissioning and operation. It aims to ensure the monitoring of environmental impacts and implementation of mitigation measures. The EMP will be incorporated into the construction, operation and management of each sub component.

86. Environmental protection measures will i) mitigate environmental impacts, ii) achieve compliance with national environmental regulations and ADB safeguard standards, iii) provide compensation or offsets for lost environmental resources, and iv) when possible enhance environmental resources.

87. Environmental monitoring programs will be carried out and the results will be used to evaluate the extent and severity of actual environmental impacts against the predicted impacts and the performance of the environmental protection measures or compliance with regulations

88. The receiving environmental factors selected are:

1. noise
2. air pollution
3. aquifers and river pollution
4. soil pollution
5. social, cultural, health and safety issues
6. environment and biodiversity

The impacting factors or/and mitigation measures occur during the three phase

- pre construction
- construction
- operation

Not all environment factors are concerned or impacted for each phase, only those concerned are appearing in the text.

6.3 Mitigation measures

89. The mitigation measures will be incorporated into tender document-s, construction contracts, and operational management procedures. Contractors and the implementing agencies will implement these measures. The effectiveness of these measures will be controlled by the monitoring plan. The monitoring plan will assess the need to reinforce or change the mitigation measures.

Ecological flow

90. The Government of Samoa has not developed minimum ecological flow requirements for rivers and streams within Samoa. The actual ecological flow proposed by MNRE is not a national standard but this institution is currently working to transform the actual recommendation of 95% of flow duration curve into a national standard.

Determining precise minimum ecological flow guidelines for permanent streams within Samoa will require long term monitoring of fauna over several seasons to determine precise timings and magnitude of migrations for feeding and breeding requirements. However, several general suggestions can be made based on knowledge of the fauna.

Firstly, the majority of indigenous fauna species are adapted to the temporal impermanence of island waterways and have diadrom[3]ous life history strategies (A, FC, COB) that allow

[3] Truly migratory fishes which migrate between the sea and fresh water.

population persistence through recolonization of newly available freshwater habitats. So, in most cases, even if a stream dries up entirely the fauna will be able to recolonize. In addition, most species have prodigious climbing ability and will be able to surmount natural waterfalls. However some manmade structures, particularly hanging culverts and long, enclosed pipes may hinder re-colonization. Where the entire flow is channeled through a long pipe or into a headpond, as is the case in some sites (eg Alaoa west intake), recolonization of upper waterways is hindered for fishes in particular. In this case, part of the natural low-flow should be diverted around the manmade structures and allowed a natural flow to the lower courses.
An ideal fish-way for a culvert crossing a stream (Kapitzke, 2010) should allow for:

Slope: as flat as possible; should not exceed 1:100.
Water depth: minimum 0.2-0.5 m.
Velocity: maximum 1 m/s preferred 0.3 m/s.
Length: maximum 6 m without resting areas.
Width: to width of stream.
Bottom roughness should simulate natural streambed morphology.

91. To determine a rough minimum ecological flow the biologist of the Biological Rapid Assessment recommend calculating a 7-day Mean Annual Low Flow (MALF) to give an indication of the low flows experienced by each catchment. In order to maintain steady populations of fishes in upper catchment areas the rapid Assessment Scientists Team recommend *at least 80% of this MALF value for each catchment be available external to manmade structures for migration purposes*

6.4 Environmental monitoring

6.4.1 Monitoring program

92. The Project monitoring program will focus on the environment within the project's area of influence. The program considers the scope of monitoring and frequency

6.4.2 Monitoring parameters

93. The monitoring program will focus on parameters, which can be monitored visually by appropriate local specialists and equipment.

6.4.3 Monitoring management

94. During construction, the EPC will make appropriate arrangements for monitoring according to the progress of implementation. Monitoring reports will be made available to the EPC and PUMA (MNRE) as required, on a monthly basis during construction. When complaints are received from the public (either directly or via the formal grievance redress mechanism), monitoring staff will conduct additional inspections immediately.

6.4.4 Monitoring costs

95. The continuing activities of the EPC monitoring during construction will be funded from the construction budget. EPC ongoing monitoring costs will be covered by their operational budget

6.5 Implementation responsibilities

96. <u>The Implementing Agency</u>

The implementing agency for this project is the EPC with its technical department to supervise these aspects and the social and environmental unit to supervise the social and environmental aspects.

At this stage it is not clear under which form the project will be implemented.

It depends of the type of sub-projects and the sites.

Some sub-project may be implemented under an Engineer Procure and Construction Contract, when other sub-projects may be implemented under more simplified form where the contractor will only implement plans and arrangements designed by EPC.

Implementation of mitigation measures and monitoring of these measures during the construction and operational phases will be the responsibility of EPC and of the MNRE, specifically the PUMA division.

Incidentally, if specific needs arise, the help of the research institution (Scientific Research Organisation of Samoa) may be sought.

The construction and rehabilitation impact mitigation measures contained in this EMP will be included as necessary activities in the contract documents

97. Capacity building requirements

The EPC has a unit dedicated to social and environmental matters. The environment officer will be in charge of supervising the implementation of the EMP and its monitoring. The environmental officer is alone to cover all EPC activities and do their monitoring. It is advisable to temporary reinforce the EPC environmental capacity by seeking the assistance of an international expertise to ensure the proper integration of the EMP measures into the contractor work plan and the preparation of the Contractor EMP.

International expertise will be contracted and paid from the grant budget and will provide intermittent assistance to the EPC environment division helping it to fulfil its supervision and monitoring responsibilities. The expertise will also provide monitoring reports for the ADB (see terms of reference in Annex 1)

The EPC environment Officer with the guidance of the international expertise will undertake the incorporation of EMP provisions into the contract documents

98. The Contractor

The contractors will be engaged by EPC for construction and rehabilitation activities.

Each contractor will be responsible for the implementation of construction and rehabilitation activities for one site.

The contractors will have the responsibility for implementing the impact mitigation measures in the construction phase and the EPC Environment Officer will supervise their performance.

The EPC contractor will include staff to be specifically responsible for preparation and implementation of the CEMP. Based on the detailed design of the Project, the contractor will be required to prepare the CEMP, which describes the contactor's construction methodology and measures and plans for implementing the EMP as specified in the tender contract. This includes maintaining a site diary and a grievance registry. The CEMP shall be approved by the EPC prior to the contractor's mobilization to the site. The contractor will be required to report on the implementation status of the EMP to EPC.

99. The MNRE

It is a large minister with competency over several matters, ranging from forest, water resources, to biodiversity, land management. With its PUMA division, it ensures compliance with environmental legislation. It has the appropriate equipment to perform the necessary measures needed in the monitoring program.

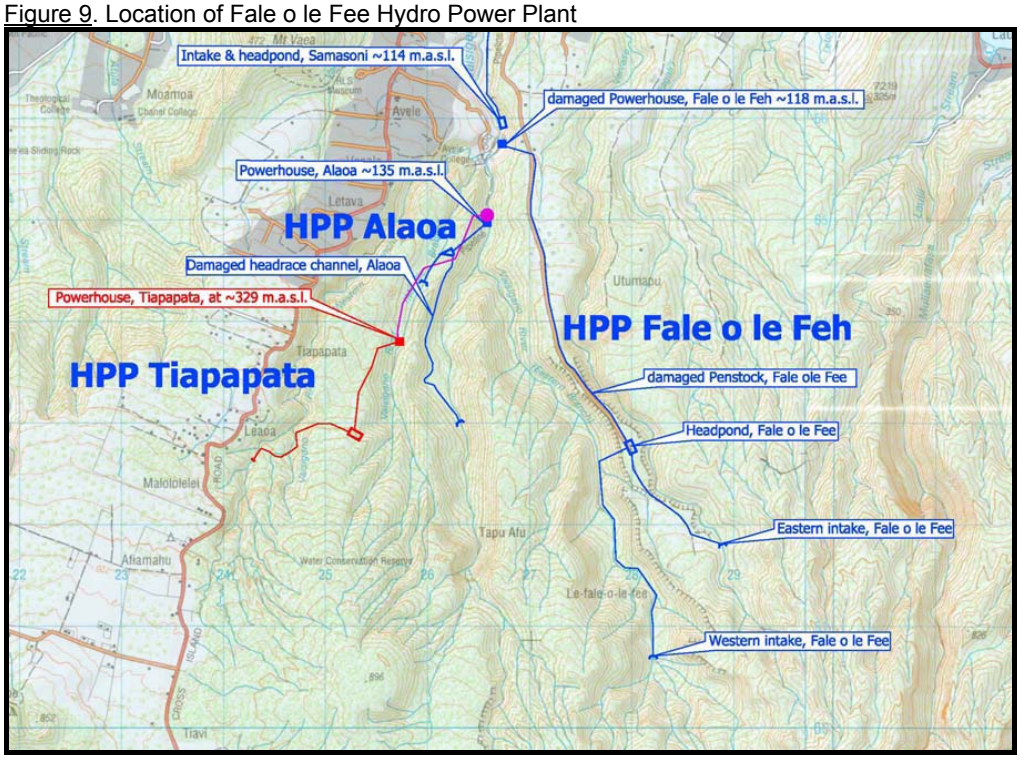
EPC will cooperate with MNRE for the monitoring of the EMP mitigation measures.

6.6 Fale o le Fee

6.6.1Site Description

100. The Fale o le Fee hydropower scheme is located 8km south of central Apia in the inland parts of Magiagi village. This is rehabilitation project to repair damages to infrastructure from cyclone Evan (December 2012).

Figure 9. Location of Fale o le Fee Hydro Power Plant



101. Geophysical Information

The hydro power plant is located in two adjacent catchments (the Vaivase stream and the Vaisigano river). The valley bottoms are geologically the oldest rocks in Samoa dating from the Fagaloa volcanics (up to 2 million years old), while the upper slopes are the more recent Salani volcanics (100,000 to 200,000 years old) (Kear and Wood 1959).

102. Catchment status and condition

The eastern intake of the Fale o le Fee HPP is located in the c 1000 ha Vaivase catchment, while the western intake and powerhouse are located in the c 3,300 ha Vaisigano catchment. The Vaisigano catchment is the most critical catchment for Apia providing much of the water supply for the town. The Samoa Water Authority (SWA) has a number of water supply intakes in the Vaisigano river and a main treatment works at Alaoa upstream from the damaged Fale o le Fee powerhouse.

103. The headwaters of both the Vaivase and the Vaisigano catchments are in the forested central mountains of Upolu around Mount Le Pue and Mt Fito. The Vaisigano catchment has three main river branches (eastern, middle and western), which meet at Alaoa, very close to the Fale o le Fee powerhouse and then flow northwards and eventually into Apia harbour.

104. While the headwaters of both catchment are well wooded, the lower portions of the

catchments below 100 m asl are highly disturbed with agricultural plantations and towards Apia are built-up with housing, roads and other infrastructure (refer figures 1 and 2). The main ridge between the Vaivase catchment and the Vaisigano catchment is intensively farmed with crops and cattle, as are some of the valley bottoms, especially in the eastern branch of the Vaisigano River. The vegetation of the upper catchments is mostly secondary forest dominated by invasive weedy trees such as Albizzia chinensis (Tamaligi), A. falcataria (Tamaligi) and Castilla elastic (Pulu Mamoe) but with pockets of native trees, especially Pometia pinnata (Tava). Many landslides in the catchments occurred during and after cyclone Evan and significant debris was washed downstream contributing to flooding in parts of Apia.

6.6.1.1 Vegetation types

105. The vegetation of both the Vaivase stream and the Vaisigano catchments is described as secondary forest, but with the areas inland of the two intakes classified as open native forest (FAO 2005) with small pockets of native forest on steep slopes. The pockets of native forest remaining in the upper parts of both catchments are dominated by tava (Pometia pinnata) especially on the steepest slopes.

106. Along both the Vaivase and the Vaisigano rivers are many small plantation areas with taro, bananas and other crops and some small areas of livestock. No rare or endangered plants have been recorded in the project area.

6.6.1.2 Freshwater Biodiversity Values

107. The freshwater biodiversity of both Fale o le Fee sites visited is moderate with four fish species and two crustacea recorded at the eastern intake and one fish species and four crustacea at the western intake. No snail species were recorded. The one fish species recorded at both sites is an endemic (Stiphodon hydoreibatus), while another fish recorded at the eastern intake only is a potential endemic (Schismatogobius sp). All the crustacea recorded were common indigenous species.

No rare or threatened fish species were recorded in the Fale o le Fee HPP site.

6.6.1.3 Birds

108. Twenty-eight bird species were recorded at the Fale o le Fee site, including a number of species of conservation interest including the tooth- billed pigeon (manumea), the samoan broadbill (tolai fatu), the Samoan parrotfinch (sega ula) and the maomao. Twenty-two bird species are thought to breed at the site.

This is very high bird diversity.

6.6.1.4 Presence of cultural and recreational heritage assets

109. The Fale o le Fee or “house of the octopus” is a site of cultural heritage value and is made of ancient basalt columns. It is located approximately 200m inland (to the south) from the Fale o le Fee Western Intake. Currently the site is overgrown with weeds but should be maintained, as it is one of the few remaining ancient temple sites in Samoa and has significant ecotourism potential.

110. The Vaisigano eastern branch to the water intake is a lovely nature walk and has recreational potential for adventurous hikers and bird watchers. It is currently listed on bird watching web sites as an accessible and good area for bird watching in Samoa.

Figure10. Vegetation of the Project Site

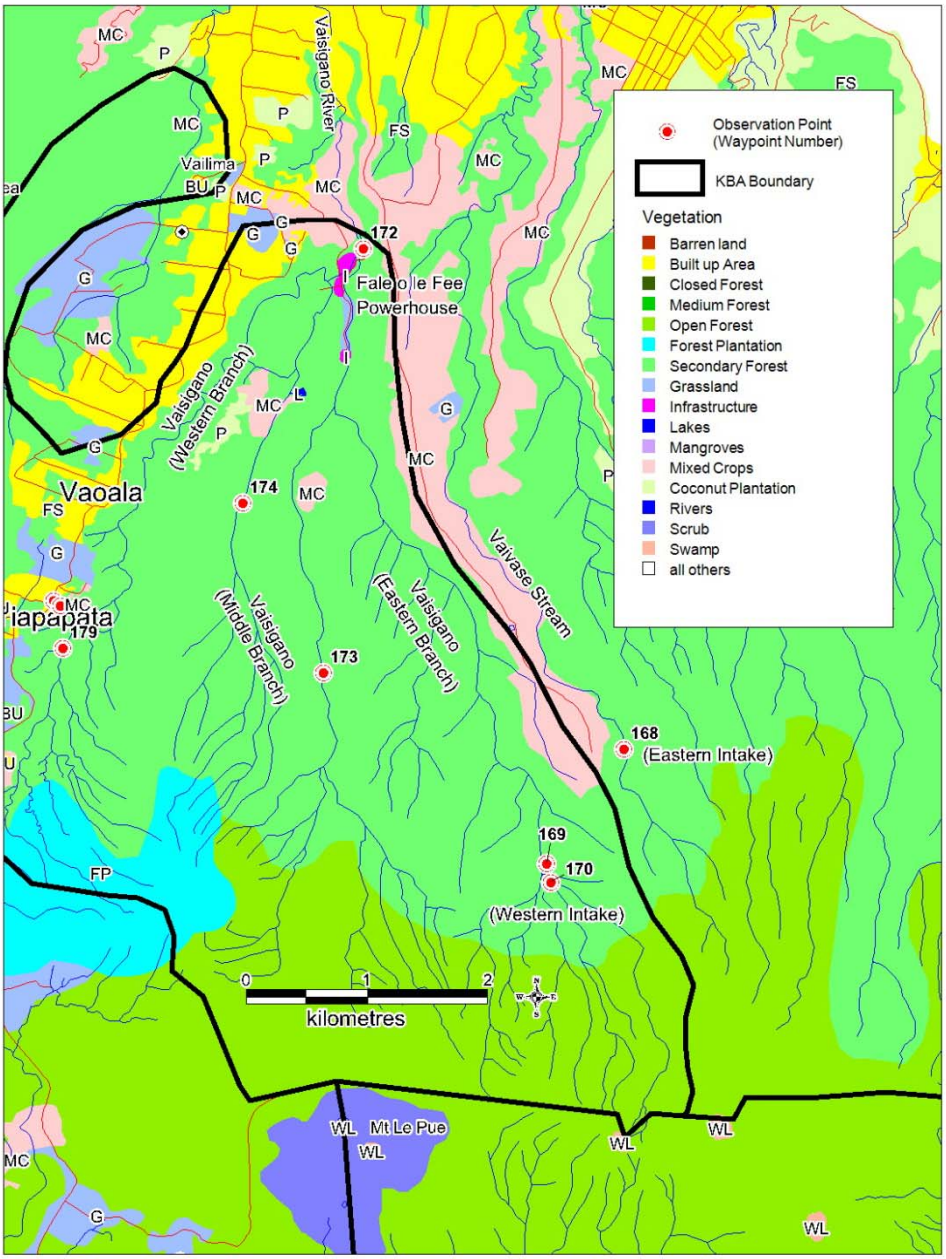


Plate 1. The Fale o le Fee Eastern Intake on the Vaivase Stream (waypoint number 168). Photo by James Atherton

Plate 2. The damaged penstock from the western intake to the head pond in the upper Vaisigano river valley approaching the Fale o le Fee Western Intake. Photo by James Atherton

Plate 3. The Fale o le Fee Western Intake (waypoint number 170). Photo by James Atherton

6.6.2Ecological Significance of the HPP Site

111. The Fale o le Fee HPP project is an existing HPP and is an area that has already been modified by development. However, there are important biological values in the site including endemic and/or threatened fish and birds, as well as patches of native forest that should be protected.

Most of the Vaisigano catchment is located within the Apia Catchments Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation (see figure 2). The Vaisigano catchment is also a designated Important Bird Area (IBA). This IBA/ KBA contains important habitat for a number of threatened species such as the tooth-billed pigeon (manumea), mao (maomao), Samoan broadbill (tolaifatu), and Samoan flying fox (pea vao) (CI, MNRE AND SPREP 2010). The Vaisigano catchment is also a critical watershed area for Apia and as such needs to be managed carefully in order to retain, or ideally enhance, its provision of clean water and other ecosystem services.

The plan to repair the damage caused by Cyclone Evan will involve rebuilding the roads to the eastern and western intakes and the rehabilitation of both intakes. The work in this site will reopen the roads and involve the use of heavy machinery. To reduce the impact of this work on the endangered and native birds it is important that large native trees (especially around the intakes) are not damaged during the rehabilitation work. These trees, such as maota (Dysoxylum species), are key food trees for the Manumea and other native pigeons and are important breeding sites for seabirds.

Furthermore, reopening access roads may result in future impacts in these areas by improving access for plantation development. Over the last few years the land use of the water catchment area of this site has been increasingly modified with large areas of land, formerly covered with native forest, now being converted to plantations. Such impacts will need to be managed carefully in collaboration with local communities.

6.6.3The proposed activities

112. This HPP is out of operation because the damages by the cyclone. Required rehabilitation works:

Intake:

Rehabilitation and refurbishment of the 2 existing Tyrolean weirs

Head race:

Repair of the existing steel penstock on several locations

Power house:

Refurbishment of the powerhouse and installation of additional measures to make the powerhouse flood proof;
Replacement of the damaged alternator, electrical and mechanical control systems, governor;
Rehabilitation of the turbine;
Checking and required rehabilitation of all electrical installations;

6.6.4The Potential impacts and mitigation measures

6.6.4.1 Preconstruction

113.

1 Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats close to the entrance and along the access road situated in the suburbs of Apia might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to repair the weirs and the penstock and powerhouse.

. The national noise standard in the national legal framework[4] apply here

1.b the national noise standard in the national legal framework[5] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works on advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid disturbance too early or at night or on Sundays or public holidays[6]

4 Soil

4.a erosion resulting from works and access road threaten rivers water quality.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

[4] PUMA, Noise Policy October 2011
[5] PUMA, Noise Policy October 2011
[6] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

5 Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an Emergency and Preparedness Plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use.

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during rehabilitation when digging out soil, mainly for penstock burying along the river.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.e Working conditions are dangerous

Mitigation measures:

5_e the national regulation about Occupational Health and Safety will be applied[7] to ensure workers security mainly for those working above the void

6 Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake

6.b the river is biological life is transformed because of inappropriate ecological flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

[7] Occupational Safety and Health Act 2002

6_b calculate the appropriate ecological flow according to fish biology
6_c identify and mark large native trees for preservation

6.6.4.2 Construction

114.

1 Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. The habitats situated along the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to do the construction works.

1.b the national noise standard in the national legal framework[8] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[9]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable.

2 Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements close to the entrance of the access road

Mitigation measures:

2_a reduce speed at the entrance of the access road; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks.

3 Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the rehabilitation of the weir resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when rehabilitating the weir and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion (developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the

[8] PUMA, Noise Policy October 2011

[9] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[10], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all "clean water" runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage

4 Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c construction works mainly during penstock burying along road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and Sedimentation Control Plan will be produced. The sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtain material from the Samoa Quarry Agency

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have developed a Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather. Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5 Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised. The area has many private property entrances and engines and trucks may restrict access to the properties during construction phase

Mitigation measures:

[10] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.
Unskilled workers will be brought from near-by site and skilled workers will stay in hotels
The national regulation about Occupational Health and Safety will be applied[11] to ensure workers security mainly for those working above the void

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

Working safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[12] to ensure workers security mainly for those working above the void

6 Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_ Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_c Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with

[11] Occupational Safety and Health Act 2002
[12] Occupational Safety and Health Act 2002

invasive species

After completion of in-stream works, all disturbed areas should be:

a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

Additionally:

- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.6.4.3 Operation

115.

5 Social and cultural aspects, health and safety

Safety

5.a the HPP premises are not secured by fencing. The HPP premises are not secured by fencing opening to HPP infrastructure vandalised, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_a HPP premises should be secured including penstock if not buried. Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,
The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness

should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well

Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted

Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)

Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

6.6.5 Most important impacts

116.

- River pollution from poisonous substances and siltation during construction phase mainly burying the penstock along the river
- Destruction of patches of native forest harbouring native and/or endemic fauna
- Riverbanks erosion and depletion of vegetation

117. Mitigation and Monitoring Table FALE O LE FEH

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[13]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents along the access road of forthcoming works A **Grievance Redress Mechanism** ready	the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and from works sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	**Pollution control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor and EPC	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs

[13] **as listed in IEE**

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[13]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**	**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**					
Passing of trucks and engines on access road and main roads	**5.b** the main roads are soiled	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance mechanism implemented Utilise quiet and sound proof equipment	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of working hours	Quarterly	EPC	EPC	Included in project costs

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[13]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	2.a Dust due to truck circulation	Reduce speed along settlements, inform truck drivers, spray water in dry season Cover stockpiles and trucks Utilize vehicles with low emission	Residents near the entrance and along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river mentioned in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4 a.** Construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During construction works	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site, stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation or burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[13]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		slopes Stabilise again erosion bare areas										
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit restriction to private properties access and accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ Residents grievance Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a-6.b** reduction or interruption of river flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in the EPC budget	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards Control of any illegal activities	No limit in time Quarterly	EPC	EPC	Included in project costs

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[13]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implement**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		resource division to develop watershed management										
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

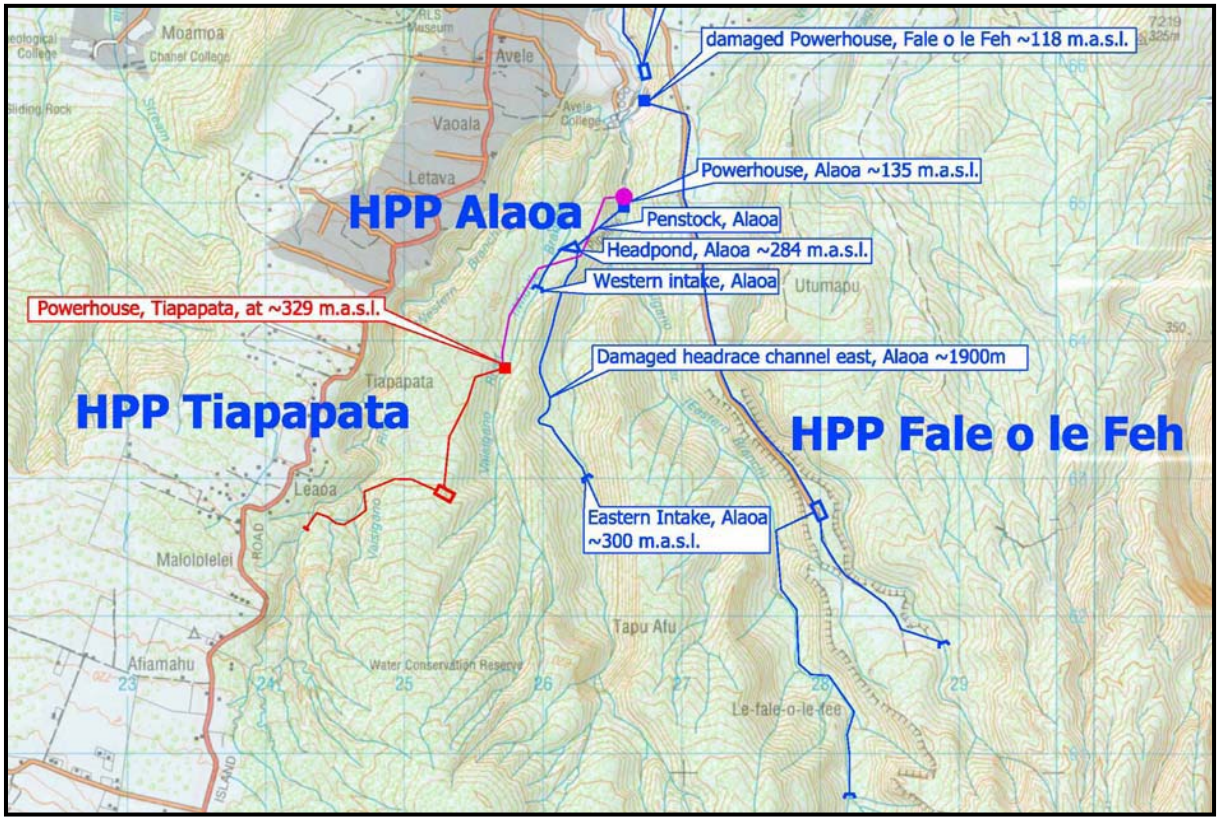
6.7 Alaoa

6.7.1Site Description

118. The Alaoa hydro power scheme is located 6km south of central Apia in the vicinity of Alaoa. This is rehabilitation project to repair damages to infrastructure from cyclone Evan (December 2012).

119. The eastern intake and powerhouse of the Alaoa HPP are located on the eastern branch of the Vaisigano River, while the western intake is located on the western branch of the Vaisigano River. The Alaoa headpond is located on a ridge between the eastern and middle branches of the Vaisigano River.

Figure 11. Location of Alaoa Hydro Power Plant



Geophysical Information

120. The Alaoa hydro power plant is located in the Vaisigano catchment. The valley bottoms are geologically the oldest rocks in Samoa dating from the Fagaloa volcanics (up to 2 million years old), while the upper slopes of the catchment are the more recent Salani volcanics (100,000 to 200,000 years old) (Kear and Wood 1959).

Catchment status and condition

121. The c 3,300 ha Vaisigano catchment has three main river branches (eastern, middle and western), which meet just downstream from the Alaoa powerhouse and then flow northwards and eventually into Apia harbour (see figure 1). The headwaters of the Vaisigano catchment are in the forested central mountains of Upolu around Mount Le Pue and Mt Fito.

122. The Vaisigano catchment is the most critical catchment for Apia providing much of the water supply for the town. The Samoa Water Authority (SWA) has a number of water supply intakes on the Vaisigano river and a main treatment works at Alaoa downstream from the Alaoa powerhouse.

123. While the headwaters of the Vaisigano catchment are well wooded, the lower portions of the catchment below 100 m asl are highly disturbed with agricultural plantations and towards Apia is built-up with housing, roads and other infrastructure (refer figures 1 and 2). The vegetation of the upper catchments is mostly secondary forest dominated by invasive weedy trees such as Albizzia chinensis, A. falcataria and Castilla elastica, but with pockets of native trees, especially Pometia pinnata. Many landslides in the catchment occurred during and after cyclone Evan and significant debris was washed downstream contributing to flooding in parts of Apia.

6.7.1.1 Vegetation types

Figure 12. Vegetation of the Project Site

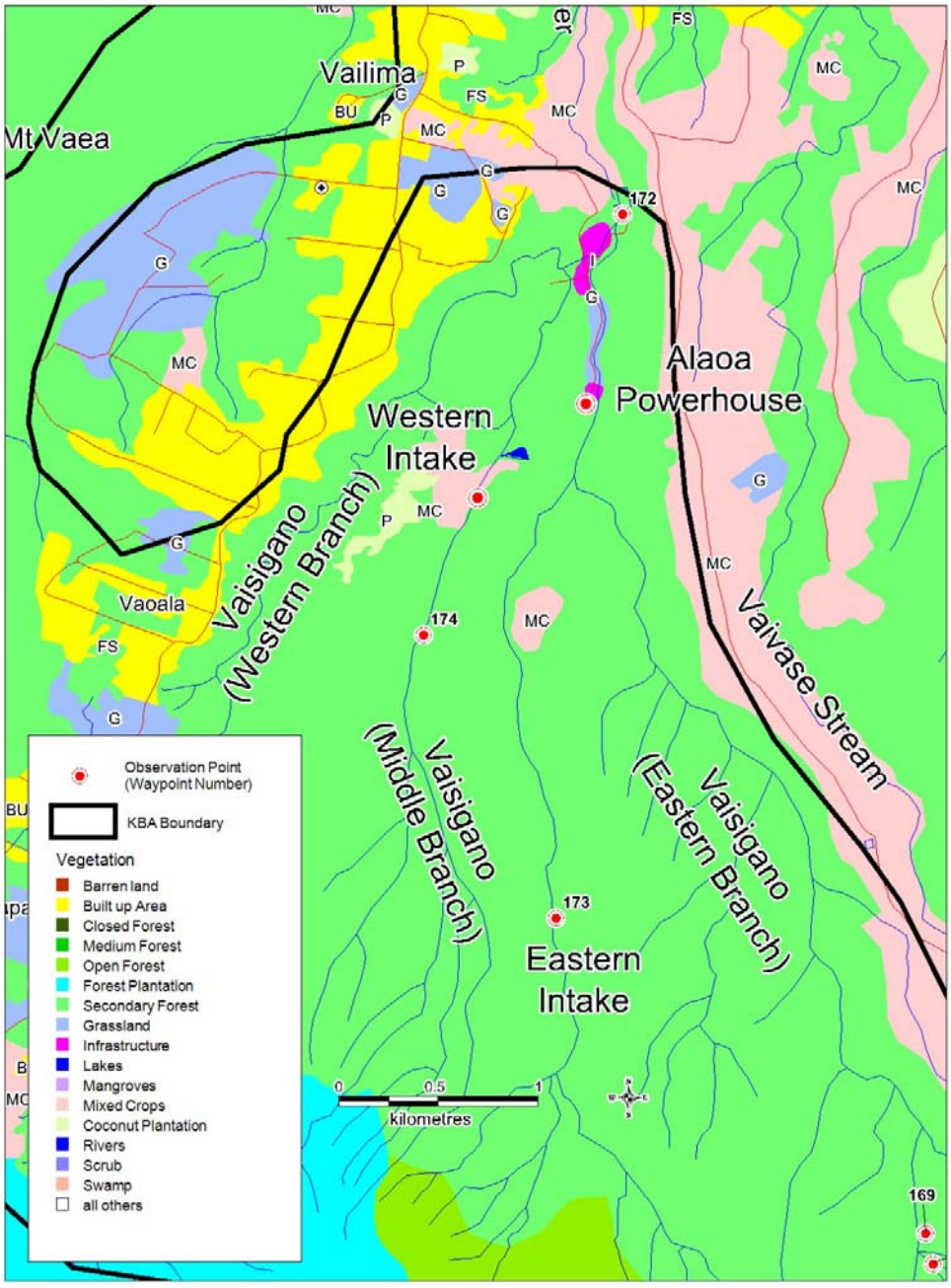


Plate 4. The middle branch of the Vaisigano river adjacent to the damaged headrace. Note debris in river from numerous landslides that damaged or destroyed the headrace. Photo by James Atherton

Plate 5. The site of the eastern intake for the Alaoa HPP (waypoint number 173). Note destroyed intake on the right of the photo. Photo by James Atherton

Plate 6. The Alaoa HPP Western Intake. Note the whole river flow going into the headrace. Photo by James Atherton

124. The vegetation of most of the Vaisigano catchments is described as secondary forest, (FAO 2005). However there are small pockets of native forest on steep slopes dominated by tava (Pometia pinnata) especially on the steepest slopes.

125. Along the lower Vaisigano river (all branches) are many small plantation areas with taro, bananas and other crops. This is especially the case around the Alaoa western intake. No rare or endangered plants have been recorded in the project area.

6.7.1.2 Freshwater Biodiversity Values

126. The freshwater biodiversity of the Alaoa eastern intake is moderate with three fish species and five crustacea recorded. However, it is very low at the western intake with no fish recorded and only three crustacea observed. This is probably because the whole river flow goes into the western intake and water race (see plate 3). No snail species were recorded at either site. One fish species recorded the eastern intake is an endemic (Stiphodon hydoreibatus). All the crustacea recorded were common indigenous species. No rare or threatened fish species were recorded in the HPP site.

6.7.1.3 Birds

127. Twenty-one bird species were recorded at the Alaoa HPP site, including a number of species of conservation interest including the Samoan broadbill (Tolai fatu), the Samoan parrotfinch (Sega ula) and the Mao (maomao). The Manumea is potentially present. At least one bird breeds at the site. This is high bird diversity.

6.7.1.4 Presence of cultural and recreational heritage assets

128. No sites of cultural heritage value were observed. However, the Alaoa eastern water race and intake is a lovely nature walk and has recreational potential for fit and adventurous hikers and bird watchers.

6.7.2Ecological Significance of the HPP Site

129. The Alaoa project is an existing HPP and is an area that has already been modified by development. However, there are important biological values in the site including endemic and/or threatened birds, as well as patches of native forest that should be protected.

Interestingly, the fish diversity of the Alaoa western intake and upstream is very low. This is probably because the entire river flow goes into the western water race essentially stopping recolonisation of fish species which spawn in rivers and have embryos that drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce. This is good evidence of the need to maintain ecological flows in order to retain fish diversity in streams and rivers.

Most of the Vaisigano catchment is located within the Apia Catchments Key Biodiversity Area (KBA), one of Samoa's priority sites for conservation (see figure 2). This site is also a designated Important Bird Area (IBA). This IBA/KBA contains important habitat for a number of threatened species such as the tooth-billed pigeon (Manumea), Mao (Maomao), Samoan broadbill (Tolaifatu), and Samoan flying fox (Pea Vao) (CI, MNRE AND SPREP 2010). The Vaisigano catchment is also a critical watershed area for Apia and as such needs to be managed carefully in order to retain, or ideally enhance, its provision of clean water and other ecosystem services.

The plan to repair the damage caused by Cyclone Evan will involve rebuilding the road from the Alaoa headpond towards the eastern intake and the rehabilitation of the entire 1.9km long concrete water race and intake, which will inevitably involve the use of heavy machinery. To reduce the impact of this work on the endangered and native birds and other wildlife it is important that large native trees (especially around the intakes and along the

water race) are not damaged during the rehabilitation work. These trees, such as Maota (Dysoxylum species), are key food trees for the Manumea and other native pigeons and are important breeding sites for seabirds.
Furthermore, reopening the access road may result in future impacts in these areas by improving access for plantation development. Such impacts will need to be managed carefully in collaboration with local communities.

6.7.3The proposed activities

130. This HPP is in operation, however only with 1/3 of the capacity, because the eastern intake is damaged. Required rehabilitation works for the eastern intake:

Intake:

New construction of the intake in form of a Tyrolean weir with sand trap

Head race:

Cleaning and repair of the damaged sections of the open head race channel over the full length;
Replacement of the completely destroyed channel sections by pipe sections;

6.7.4The Potential impacts and mitigation measures

6.7.4.1 Preconstruction

131.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats close to the entrance and along the access road situated in the suburbs of Apia might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to repair the weir and the penstock.

1.b the national noise standard in the national legal framework[14] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works on advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid disturbance too early or at night or on Sundays or public holidays[15]

4 Soil

4.a erosion resulting from works and access road threaten rivers water quality.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

[14] PUMA, Noise Policy October 2011

[15] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

5. Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an Emergency and Preparedness Plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use.

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during rehabilitation when digging out soil.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.e Working conditions are dangerous

Mitigation measures:

5_e the national regulation about Occupational Health and Safety will be applied[16] to ensure workers security mainly for those working above the void

6 Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake

6.b the river is biological life is transformed because of inappropriate ecological flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6_b calculate the appropriate ecological flow according to fish biology

6_c identify and mark large native trees for preservation

6.7.4.2 Construction

132.

1- Noise

[16] Occupational Safety and Health Act 2002

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. The habitats situated along the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to do the construction works.

1.b the national noise standard in the national legal framework[17] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[18]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable.

2- Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements along the access road

Mitigation measures:

2_a reduce speed on the access road; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks.

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the reconstruction of the weir and channels resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when reconstructing the weir and rehabilitating the channel to avoid spilling into the river waters chemical substances, construction material, sand or erosion (developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[19], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised

[17] PUMA, Noise Policy October 2011

[18] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

[19] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage.

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c construction works mainly during penstock repair along road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have developed a Pollution Control Plan. Ensure that any spilled materials, or any waste containing oil or other chemicals is disposed of in authorised and adequate waste disposal facilities. Prohibit the fuelling or maintenance of equipment and vehicles near or on the water or residential areas. Store fuel and other chemicals in designated areas way from the water and residential areas, and with adequate ground seal and secondary containment.

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised. The area has many private property entrances and engines and trucks may restrict access to the properties during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads.

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.

Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

The national regulation about Occupational Health and Safety will be applied[20] to ensure workers security mainly for those working above the void

[20] Occupational Safety and Health Act 2002

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

Working safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[21] to ensure workers security mainly for those working above the void

6- Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_ Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_c Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

133. After completion of in-stream works, all disturbed areas should be:
a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

134. Additionally:
- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration

[21] Occupational Safety and Health Act 2002

- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded
- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.7.4.3 Operation

135.

5 Social and cultural aspects, health and safety

Safety

5.a the HPP premises are not secured by fencing. The HPP premises are not secured by fencing opening to HPP infrastructure vandalised, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_a HPP premises should be secured including penstock if not buried.
Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,
The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well
Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted
Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)
Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc).

136. Most important impacts

- River pollution from poisonous substances and siltation during construction phase mainly the reconstruction of the weir and the rehabilitation of channel sections.
- Destruction of patches of native forest harbouring native and/or endemic fauna
- Riverbanks erosion and depletion of vegetation

137. Mitigation and Monitoring Table ALOA

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[22]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents along the access road of forthcoming works A **Grievance Redress Mechanism** ready	the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and from works sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected events.	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs

[22] **as listed in IEE**

		Mitigation and/or Enhancement Measures						Monitoring Plan				
	Environmental Impact[22]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
Passing of trucks and engines on access road and main roads	**5.b** the main roads are soiled	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	6.c destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[22]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
access road		mechanism implemented Utilise quiet and sound proof equipment						Control of working hours				
	2.a Dust due to truck circulation	Reduce speed along settlements, inform truck drivers, spray water in dry season Cover stockpiles and trucks Utilize vehicles with low emission	Residents along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake construction, penstock burying	Develop specific protection and care to avoid spilling into the river mentioned in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.a** Construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During construction works	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site, stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation or burying of	**4.c** Riverbanks erosion	Schedule construction at low	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs

	Environmental Impact[22]	Mitigative Measures	Location	Time Frame	Responsibility: Implementation	Responsibility: Supervision	Costs	Monitoring Plan: Parameter	Frequency	Implment	Supervising	Cost
		Mitigation and/or Enhancement Measures										
penstock		flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep slopes Stabilise again erosion bare areas					costs					
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit restriction to private properties access and accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ Residents grievance Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a-6.b** reduction or interruption of river flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in the EPC budget	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs

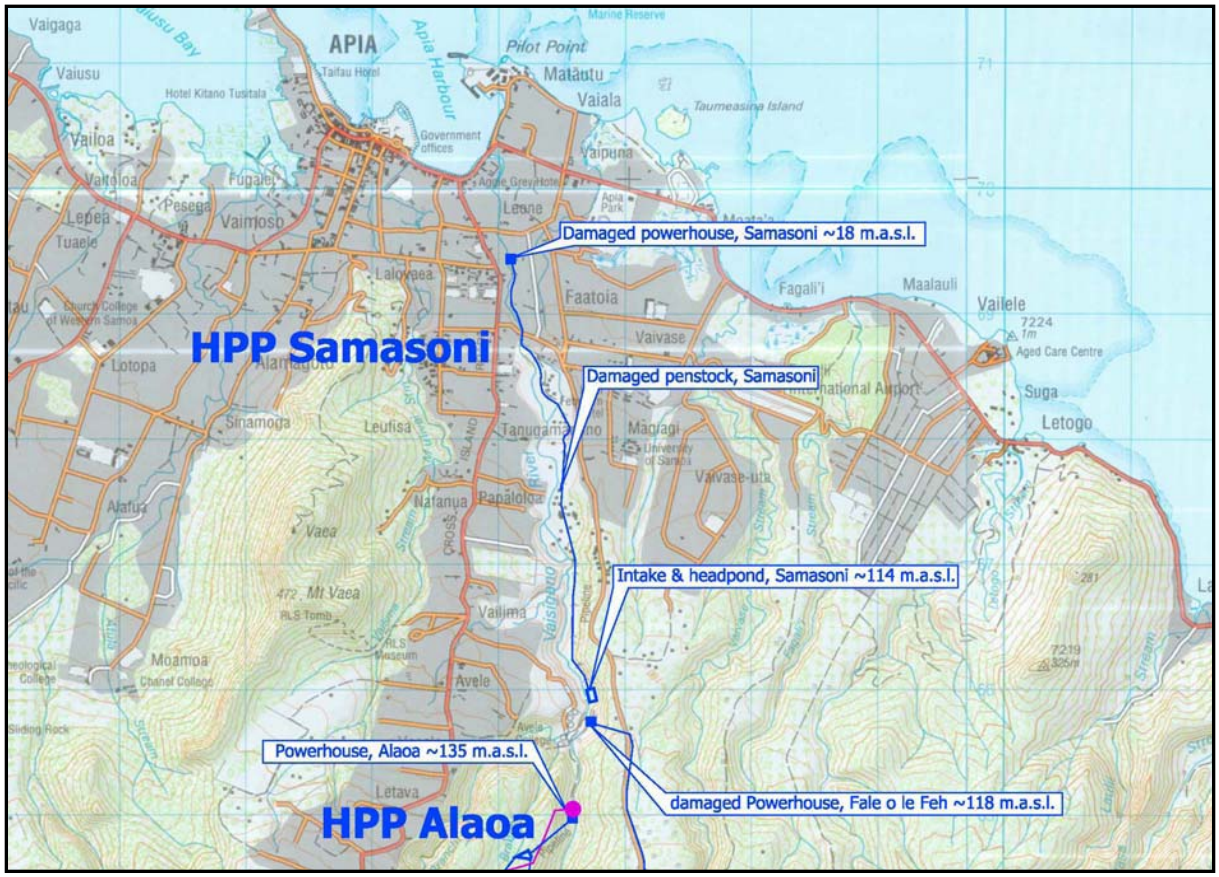
	Mitigation and/or Enhancement Measures						Monitoring Plan				
	Environmental Impact[22]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

6.8 Samasoni

6.8.1Site Description

138. The Samasoni hydropower scheme is located 1km southeast of central Apia. This is rehabilitation project to repair damages to infrastructure from cyclone Evan (December 2012).

Figure 13. Location of Samasoni Hydro Power Plant



Geophysical Information

139. The Samasoni hydropower scheme is located in the lower part of the Vaisigano catchment, below 120m asl. The geology of this area is recent alluvial (river) sediments (Kear and Wood 1959).

Catchment status and condition

140. The intake, penstock and powerhouse of the Samasoni HPP are located in the lowest (northerly) part of the c 3,300 ha Vaisigano catchment. The Vaisigano catchment is the most critical catchment for Apia providing much of the water supply for the town. The Samoa Water Authority (SWA) has a number of water supply intakes in the Vaisigano river and a main treatment works at Alaoa upstream from the intake and headpond for the Samasoni HPP.

The headwaters of the Vaisigano catchment are in the forested central mountains of Upolu around Mount Le Pue and Mt Fito. The Vaisigano catchment has three main river branches (eastern, middle and western), which meet at Alaoa, (see figure 1).

141. While the headwaters of the Vaisigano catchment is well wooded, the lower portions of the catchment below 100 m asl where the Samasoni HPP is located is highly disturbed

with agricultural plantations, housing, roads and other infrastructure and with trash and evidence of pollution in the river (filamentous algae) near the powerhouse site (refer photographs).

6.8.1.1 Vegetation types

Figure 14. Vegetation of the Project Site

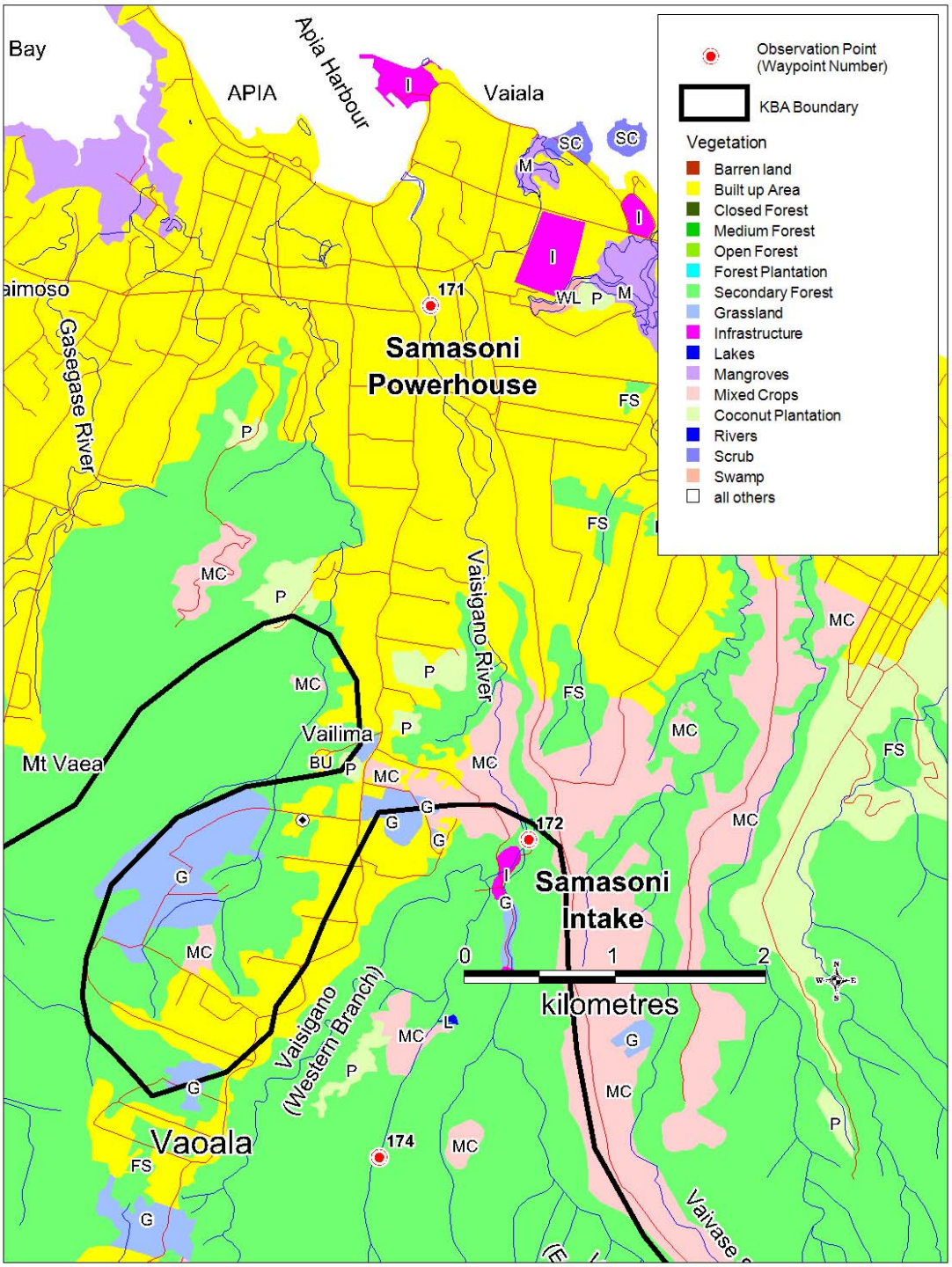


Plate 7. The site of the outfall from the Samasoni HPP- adjacent to the power house (waypoint number 171). Photo by Moetuasivi F Asiono.

Plate 8. The site of the outfall from the Samasoni HPP- adjacent to the power house. Note the green and brown algae indicating signs of river eutrophication. Photo by Moetuasivi F Asiono.

Plate 9. The damaged headpond and intake on the Samasoni HPP in the lower Vaisigano river valley. Photo by Moetuasivi F Asiono.

142. A map of the vegetation of the HPP site is shown in figure 2. The vegetation of the lower Vaisigano catchment is highly disturbed and built-up with housing, roads, and small plantation areas of bananas, taro, breadfruit and fruit trees (FAO 2005). The riparian strip is composed of weedy invasive trees such as Albizzia (Tamaligi) species, Castilla elastica (Pulu mamoe) and grasses. More intact forest cover is found on the steeper valley slopes near the intake and headpond but is still mostly invasive secondary tree species (*Albizzia falcataria* and *Albizzia chinensis* predominantly). No rare or endangered plants have been recorded in the project area.

6.8.1.2 Freshwater Biodiversity Values

143. The freshwater biodiversity of both Samasoni sites visited is moderate with seven fish species and one crustacea recorded at the Samasoni powerhouse and three fish species and three crustacea at the Samasoni intake. No snail species were recorded. One fish species recorded at each site is endemic (*Stiphodon hydoreibatus* at the intake and *Kuhlia salelea* at the powerhouse). All the crustacea recorded were common indigenous species.

6.8.1.3 Birds

144. Only eight bird species were recorded at the Samasoni HPP site, with another two species not observed but possibly present. No rare or threatened birds or breeding species were observed. This is low bird diversity reflecting the disturbed nature of the Samasoni HPP in a built-up area.

6.8.1.4 Presence of cultural and recreational heritage assets

145. No cultural heritage sites were observed at the Samasoni HPP site. However, adjacent to the site of the power station is a popular swimming hole for local residents.

6.8.2 Ecological Significance of the HPP Site

146. The Samasoni HPP project is an existing HPP and is an area that has already been highly modified by development. The proposed plan outlined to restore the Samasoni HPP site is likely to have little impact on the native biodiversity. The area is already highly developed and little additional forest clearance appears to be required.

However, there are two endemic fish species in the lower Vaisigano river and as a critical watershed area for Apia, the Vaisigano catchment needs to be managed carefully in order to retain, or ideally enhance, its provision of clean water and other ecosystem services.

6.8.3The proposed activities

147. This HPP is out of operation because the damages by the cyclone. Required rehabilitation works:

Intake:

Rehabilitation and refurbishment of the existing concrete intake

Head race:

Replacement of the completely damaged over-ground penstock by a new buried penstock

Power house:

Refurbishment of the powerhouse and installation of additional measures to make the powerhouse flood proof;
Replacement of 2 damaged alternators, electrical and mechanical control systems, and governors;
Rehabilitation of the turbines;
Checking and required rehabilitation of all electrical installations;

6.8.4The Potential impacts and mitigation measures

6.8.4.1 Preconstruction

148.

1 Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. Habitats close to the entrance and along the access road situated in the suburbs of Apia might be affected by noise and will have to endure the circulation of trucks carrying material (sand, gravel and cement) and equipment to repair the intake, the penstock and powerhouse.

1.b the national noise standard in the national legal framework[23] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works on advance by putting a road sign close to the entrance of the access road, make announcements in papers and distributing of leaflet information related to the HPP works or contacting them individually

1_b legal working hours have to be respected and enforced to avoid disturbance too early or at night or on Sundays or public holidays[24]

4 Soil

4.a erosion resulting from works and access road threaten rivers water quality.

4.b sand needed for construction is dug out in unstable places

4.c soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

Mitigation measure:

4_a An Erosion and Sedimentation Control Plan will be produced.

4_b sand needed for concrete should come from organised quarry

[23] PUMA, Noise Policy October 2011

[24] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

according to Ministry of works (MWTI) recommendations and obtained material from the Samoa Quarry Agency

4_c contractor should develop a Pollution Control Plan

5. Social and cultural aspects, health and safety

Safety

5.a there is no emergency preparedness plan for fire, chemical spill or flooding

Mitigation measures:

5_a an Emergency and Preparedness Plan should be prepared by EPC for any hazardous spill or sudden flooding with the appropriate equipment and training. The contractor should compile a spill response plan, highlighting the sizes and types of spills that may occur, and the resources (onsite and / or offsite) that will be required to address these issues. Ensure an adequate spill kit is provided and that certain key staff is trained in its use.

Safety and Circulation

5.b the trucks may transport mud soiling the main road in rainy conditions

Mitigation measures:

5_b the access road should be gravelled wherever necessary to avoid deep ruts and sludge

Cultural heritage

5.c remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage, there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during rehabilitation when digging out soil, mainly for penstock burying along the river.

Mitigation measures:

5_c a coordination mechanism between the contractor and the MNRE should be developed in a Cultural Heritage Safeguard Plan in case of discovery during works

Working safety

5.e Working conditions are dangerous

Mitigation measures:

5_e the national regulation about Occupational Health and Safety will be applied[25] to ensure workers security mainly for those working above the void

6 Environment, Vegetation and Biodiversity

6.a the river is biological life is transformed because of water intake

6.b the river is biological life is transformed because of inappropriate ecological flow

6.c native trees essential for endemic birds are logged during construction

Mitigation measures:

6_a to monitor the effect of proposed ecological flow an initial biological and chemical assessment of the river should be conducted

6_b calculate the appropriate ecological flow according to fish biology

6_c identify and mark large native trees for preservation

6.8.4.2 Construction

[25] Occupational Safety and Health Act 2002

149.

1- Noise

1.a noise nuisance resulting from the engines and heavy machinery movements from and to the site. The settlements situated along the access road will have to endure the circulation of trucks carrying sediments and material (sand, gravel and cement) and equipment to do the construction works.

1.b the national noise standard in the national legal framework[26] apply here

Mitigation measures:

1_a Close-by residents have to be informed of the works in advance on a regularly basis

1_b legal working hours have to be respected to avoid disturbance too early or at night or on Sundays or public holidays[27]. Contractor has to organise its activity accordingly. Utilize quiet and / or sound proofed equipment and vehicles as far as practicable.

2- Air pollution:

2.a Circulation of trucks on the access road will generate dust during the dry season and could affect local settlements along the access road

Mitigation measures:

2_a reduce speed on the access road; inform truck drivers, spray water in dry season. Utilize equipment and vehicles with low emissions as far as practicable. Cover stockpiles and trucks.

3- Aquifers and River pollution

3_a the river may be affected by involuntary spill of constructing material like sand or cement resulting in heavy silting of the river waters and in the worse case of spilling concrete resulting in poisoning the biotic river life.

3_b the contractor may be tempted to stop the river flow to facilitate the rehabilitation of the intake resulting in loss of aquatic life

Mitigation measure:

3_a develop special care (like nets) or other sediment control devices in areas of steep gradients and areas of high disturbance where possible when rehabilitating the intake and the penstock and during construction of new powerhouse to avoid spilling into the river waters chemical substances, construction material, sand or erosion (developed in the Erosion and Sedimentation Control Plan). If the waterway has continuous flow, other control measures, such as flotation sediment curtains, should be used to minimise the effects of sediment downstream. It may be necessary to sample and analyse water quality before, during and after instream works.

3_b diversion of water to leave a flow untouched is necessary. Whenever possible, instream work should be scheduled for the driest time of the year to minimise erosion. This will also minimize conflict with the majority of fish migration patterns. As most species are amphidromous[28], upstream migration is thought to be triggered in part by high freshwater pulses into adjacent marine systems during heavy

[26] PUMA, Noise Policy October 2011

[27] Day period is defined as 0700 to 1800, evening period is defined as 1800 to 2200 and night period is defined as 2200 to 0700. Construction activities conducted at times not specified in the table above will require special approval from relevant authorities. These may include the Night period, Sundays and all other times within Residential and Tertiary Educational compounds.

[28] Species that spawn in freshwater, the free embryos drift downstream to the sea where they undergo a planktonic phase, before returning to the rivers to grow and reproduce.

rainfall (Jenkins et al. 2010). Furthermore, instream construction should be completed as quickly as possible to lessen the impact on fish and habitats. Ensure that all “clean water” runoff from stabilised surfaces including catchment areas above the site is diverted away from earthwork area through the use of bunds and trenches. Minimizing restrictions of fish passage.

4- Soil pollution

4.a waste from the construction is left on the site (earth, gravel, etc.)

4.b soil and the site may be polluted by oil change/spill of engines and loose parts of engines or leftover of construction material (cement, sand brought to the site)

4.c construction works mainly during penstock burying along the steep road may induce riverbank erosion

Mitigation measure:

4_a any waste should be carried out of the site if it not possible to reuse it and brought to a disposal or to the landfill site. An Erosion and Sedimentation Control Plan will be implemented.

4_b contractor should have the appropriate containers to recuperate any oil or chemical or unused material and have developed a Pollution Control Plan

4_c implement the Erosion and Sedimentation Control Plan. Silt is most effectively controlled at the work site by working at times of low flow. Working in the dry season eliminates conflict with downstream water users and fisheries. Use of heavy machinery along the riverbanks and steep slopes should be kept to a minimum. Avoid works in wet weather Cover and provide secondary containment for stockpile areas. Ensure that any bare areas are stabilised against erosion as soon as practicable and in a progressive manner as earthworks are finished over various areas.

5- Social and cultural aspects, health and safety

Safety and Circulation

5.a Traffic circulation could be dangerous if it is not properly organised. The area has many private property entrances and engines and trucks may restrict access to the properties during construction phase

Mitigation measures:

5_a the contractor will have to organise its vehicles passing and limit circulation restriction and access to the fields. Provide safe access for pedestrians, vehicles and other road users around works areas. Keep stockpile areas and auxiliary construction facilities away from main roads.

Social aspects

There will be no campsite. The average number of workers is evaluated about a maximum of 50 out of it 30 will be unskilled and around 20 skilled.

Unskilled workers will be brought from near-by site and skilled workers will stay in hotels

The national regulation about Occupational Health and Safety will be applied[29] to ensure workers security mainly for those working above the void

Cultural aspects

5.b remains of early human settlement dating back up to 3000 years old could be found on the islands. Though the MNRE is in charge for cultural heritage,

[29] Occupational Safety and Health Act 2002

there is no provision to safeguard archaeological remains. Valuable cultural heritage could be destroyed during construction phase when digging out soil.

Mitigation measure:

5_b a coordination mechanism between the contractor and the MNRE should be implemented in case of discovery during works

Working safety

5.c Working conditions are dangerous

Mitigation measures:

5_c the national regulation about Occupational Health and Safety will be applied[30] to ensure workers security mainly for those working above the void

6- Environment, Vegetation and Biodiversity

6.a River biodiversity may be weakened by pollution or flow interruption (see 3_ Aquifers and River pollution)

6.b total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.c riverbanks vegetation is destroyed during construction

Mitigation measure:

6_b) an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_c Keep the removal of stream bank vegetation and disturbance to the natural banks and bed of the stream to an absolute minimum. Streamside vegetation shades the stream, preventing the water from becoming too warm for fish and provides cover from predators
Hand clearing of bank slopes at the site minimises erosion, siltation and the need for rehabilitation. A vegetated buffer zone of indigenous vegetation (at a density and structure similar to neighbouring undisturbed areas) should fringe all banks, waterways and wetlands. In all cases minimize the removal of vegetation, especially of large trees, which play a current role in reducing riverbank erosion. In some cases, realigning penstocks or other infrastructure can reduce removal of vegetation. Where some vegetation has to be removed ensure that replanting with native species naturally found in the area, occurs promptly and proper landscaping is performed. Do not revegetate with invasive species

150. After completion of in-stream works, all disturbed areas should be:
a) returned to their original condition (i.e stream slope and profile, and instream snags should be replaced);
b) stabilised to resist erosion;
c) replanted with native vegetation where cover has been removed or damaged.

151. Additionally:
- prevent adverse flow turbulence through structure and ensure water surface drops are not excessive
- ensure fish are not obstructed from downstream migration
- maintain natural flow and sediment processes in the waterway
- protect riparian and instream habitat, terrestrial and aquatic ecosystems
- ensure stream water quality is not degraded

[30] Occupational Safety and Health Act 2002

- ensure development and operation of facility does not present public safety problem
- avoid public health problems associated with facility
- minimise adverse effects on recreational amenity in adjoining streams

6.8.4.3 Operation

152.

5 Social and cultural aspects, health and safety

Safety

5.a the HPP premises are not secured by fencing. The HPP premises are not secured by fencing opening to HPP infrastructure vandalised, further forest clearance for agriculture or timber or for the illegal hunting of native birds and flying foxes, and water supplies pollution.

Mitigation measure:

5_a HPP premises should be secured including penstock if not buried. Rebuilding access roads or constructing new access roads for HPP infrastructure may allow easier access to HPP sites and to remote areas of forest by a range of people including local residents and visitors and may be beneficial from an ecotourism or recreational perspective,

The most appropriate and sustainable way to manage potential future threats to HPP sites from increased access is for EPC to work closely with MNRE, SWA, local communities and other stakeholders on developing and implementing watershed management plans that recognise the multiple use/multiple benefits concept of holistic watershed management.

6 Environment, Vegetation and Biodiversity

6.a total water intake without ecological flow would destroy river biological life in the various river sections downstream

6.b destruction of watershed resulting from the extension of plantations coupled with lack of anti erosive practices

Mitigation measure:

6_a an ecological flow should be implemented and monitored to assure continuity and surviving of river ecosystems.

6_b water catchment area should be protected and supervised by the Ministry of Agriculture and/or Forestry division of MRNE. Awareness should be raised amongst local communities on the values of the water catchments and their multiple benefits if managed well

Tree planting programmes and watershed restoration activities especially along riverbanks and on steep slopes should be promoted

Allow limited access to specific areas for recreational purposes and provide appropriate infrastructure for controlled recreation (eg trails, resting areas etc)

Install information signage at access points in Samoan and English covering the rules or restrictions on access, and on development activities such as agricultural activities and the harvest of natural resources (eg hunting, fishing, logging etc)

153. Most important impacts

River pollution from poisonous substances and siltation during construction phase mainly when burying the penstock along the river.

154. Mitigation and Monitoring Table SAMASONI

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[31]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	PRE- CONSTRUCTION PERIOD											
	Noise											
Passing through of trucks and engines on access road	**1.a** grievance from neighbourhood	Inform residents along the access road of forthcoming works A **Grievance Redress Mechanism** ready	the access road	Prior to start of works	EPC/contractor	EPC/PUMA	Included in contracted construction costs	Road Boards, leaflets	Before start of works and regularly	Contractor	EPC	Included in project costs
	1.b working hours not respected	The **national noise standard in the national legal framework** apply here Inform the contractor of the PUMA noise Policy	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Grievance from local residents, control in situ	Quarterly	Contractor	EPC/Puma	Included in project costs
	Soil Pollution											
Passing of trucks on access road and construction of SHPP's infrastructures	**4.a** erosion of the access road and from works sites	**Erosion and Sedimentation Control Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
Material for the construction of the SHPP's infrastructures	**4.b** uncontrolled sand quarry	Contact the Ministry of Works and the Samoa Quarry Agency	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Delivery of authorisation	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP infrastructures	**4.c** waste and pollution of the site	Pollution control Plan	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs
	Social, cultural, H&S											
Flooding, explosions, unexpected	**5.a** control of hazardous events	**Emergency preparedness Plan**	All over the construction site	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Document	Before start of works	Contractor	EPC	Included in project costs

[31] **as listed in IEE**

			Mitigation	and/or	Enhancement	Measures		Monitoring	Plan			
	Environmental Impact[31]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
events.												
Passing of trucks and engines on access road and main roads	**5.b** the main roads are soiled	Gravel the main road whenever necessary	Access road	Prior to the start of construction	Contractor	EPC/PUMA	Included in the EPC budget	Road conditions report	Quarterly	Contractor	EPC	Included in project costs
Removing earth during clearing the soil or burying the penstock	**5.c** destruction of archaeological or cultural remains	Preparation of a **Cultural Heritage Safeguard Plan**	Site where earth will be removed	Prior to the start of construction	Contractor and MNRE	EPC/PUMA/ MNRE	Included in contracted construction costs	Document Clear coordination mechanism	Before start of works	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.d** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Information signs on public works fences	Before start of works	Contractor	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a** transformation of river biological life	Initial biological and chemical assessment of river	River between intake and release	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Analysis results	Before start of works	EPC/MNRE	EPC/MNRE	Included in project costs (around $US 5,000)
	6.b destruction of river biological life	Calculate the appropriate ecological flow requirement according to fish biology assessment	River	Design stage	EPC	EPC/PUMA	Included in the EPC budget	Document based on biological assessment	Before start of works	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** destruction of patches of native forest	Identify the large natives trees such as maota (Dysoxylum species)and mark them for protection	River banks	Prior to the start of construction	Contractor with MNRE	EPC/MNRE	Included in contracted construction costs	Number of native trees preserved	Before start of works and monthly	EPC/MNRE	EPC/MNRE	Included in project costs
	CONSTRUCTION	**PERIOD:**										
	Air Quality and Noise											
Passing through of trucks and engines on access road	**1.a and 1.b** Grievance from neighbourhood	Regular Information of residents of works developments Grievance mechanism implemented Utilise quiet and sound proof equipment	Residents near the entrance and along the access road	Throughout the construction period	Contractor/EPC	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved Control of working hours	Quarterly	EPC	EPC	Included in project costs

	Mitigation and/or Enhancement Measures							Monitoring Plan				
	Environmental Impact[31]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
	2.a Dust due to truck circulation	Reduce speed along settlements, inform truck drivers, spray water in dry season Cover stockpiles and trucks Utilize vehicles with low emission	Residents along the access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Number of grievance received and number solved	Quarterly	EPC	EPC	Included in project costs
	Water/River Pollution											
Construction of SHPP's infrastructures	**3.a** river polluted by spill during construction of intake, penstock burying and powerhouse construction	Develop specific protection and care to avoid spilling into the river mentioned in the **Erosion and Sedimentation Control Plan**	Intake, penstock route and powerhouse	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Appropriate equipment River water quality (turbidity control)	Monthly during instream construction	EPC/ MNRE for the equipment	EPC/MNRE	Included in project costs
	3.b loss of aquatic life if river is stopped	Water diversion leaves a clean flow in the river. Schedule instream works during dry season	Between intake and release	Throughout the works period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of existing clean water flow	Monthly	EPC	EPC	Included in project costs
	Soil Pollution											
Construction of SHPP's infrastructures	**4.** Construction waste polluting the site	Dispose waste according to regulation or reuse it Implement **an Pollution control Plan**	Site	During construction works	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of waste on site) Water turbidity control Contractor report	Monthly	Contractor EPC/ MNRE for the equipment	EPC	Included in project costs
	4.b soil pollution by oil or unused parts	Containers to recuperate oil and used parts Don't manipulates fuel or chemicals near river Implement **an Pollution control Plan**	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ (presence of pollution on site, stocking of chemical and fuel) Contractor report	Monthly	Contractor	EPC	Included in project costs
Rehabilitation or burying of penstock	**4.c** Riverbanks erosion	Schedule construction at low flow in dry season Don't work in wet weather Avoid heavy machinery along riverbanks and steep	Riverbanks	During rehabilitation of penstokc	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ for any erosion signs	Monthly	EPC	EPC	Included in EPC costs

		Mitigation and/or Enhancement Measures					Monitoring Plan				
	Environmental Impact[31]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons ibility**		**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
					Implementation	**Supervision**						
		slopes Stabilise again erosion bare areas										
	Social, cultural, H&S											
Passing through of trucks and engines on access road	**5.a** accidents due to trucks and engine circulation on access road	Organise circulation to limit restriction to private properties access and accidents Provide safe access to pedestrians Don't obstruct roads with stockpiles	Access road	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ Residents grievance Mechanism to regulate circulation Number and time length of access restrictions	Monthly	Contractor	EPC	Included in project costs
Removal of earth during construction of infrastructures	**5.b** safeguard of cultural remains	Implementation of the **Cultural Heritage Safeguard Plan**	All over the construction site	Throughout the construction period	Contractor	EPC/ MNRE	Included in contracted construction costs	Contractor Reports	Monthly	Contractor	EPC	Included in project costs
Construction of SHPP's infrastructures	**5.c** working conditions are dangerous, accidents and workers injured	**Occupational Health and Safety** national regulations will apply here	All work sites	Throughout the construction period	Contractor	EPC/PUMA	Included in contracted construction costs	Control in situ of regulation respect	Quarterly	EPC	EPC	Included in project costs
	Environment Biodiversity											
Water intake	**6.a-6.b** reduction or interruption of river flow during construction endangers river ecology	Leave enough ecological flow during construction	Between intake and water release	Throughout the construction period	Contractor	EPC/PUMA	Included in the EPC budget	Control of downstream river flow compared to upstream flow Contractor report	Monthly	Contractor MNRE for the equipment	EPC/MNRE	Included in project costs
Construction works	**6.c** riverbanks vegetation is destroyed Some large native trees are destroyed	Limit clearing of riverbank vegetation to a minimum Hand clean bank slopes Replant with native vegetation found in the area Revegetate fringe of riverbanks	Riverbanks and wet zones	During rehabilitation of penstock	Contractor	EPC/PUMA	Included in contracted construction costs	Control of presence of marked trees, revegetation of riverbanks	Monthly	EPC	EPC/MNRE	Included in project costs
	OPERATION PERIOD											
	Social, cultural, H&S											
Trespassing in the premises	**5.a** HPP not secured, risks of accidents, pollution, illegal hunting, forest clearing and crop plantations	Secure premises Develop awareness of residents for protection Work with MNRE/Water	Intake, penstock, powerhouse	No limit	EPC	EPC	Included in EPC costs	Presence of fences, gates and boards	No limit	EPC	EPC	Included in project costs

		Mitigation	and/or	Enhancement	Measures		Monitoring	Plan		
	Environmental Impact[31]	**Mitigative Measures**	**Location**	**Time Frame**	**Respons**	**ibility**	**Costs**	**Parameter**	**Frequency**	**Implment**	**Supervising**	**Cost**
				Implementation	**Supervision**							
		resource division to develop watershed management										
	Environment Biodiversity											
Water intake	**6.a** destruction of river biological life	Monitor the river ecology	River downstream	Regularly	EPC/MNRE	EPC/MNRE	Included in the EPC budget	Biological and chemical factors	Each month over 3 years	EPC MNRE for the equipment	EPC MNRE	Included in EPC costs
Destruction of forest cover of the site watershed due to expansion of agriculture	**6.b** reduction of water flow	Protect watershed Develop awareness of residents for protection Work with MNRE/Water resource division to develop watershed management Develop controlled infrastructures for recreation Install signage Samoan and English covering the rules or restrictions on access, and on development activities	Watershed	No limit	MNRE Forest division, Water Resources Division Ministry of Agriculture	MNRE Forest division, Resources Division Ministry of Agriculture	Included in the agencies costs	Assessment of vegetation cover on watershed Existing of signage Cooperation of local communities	Yearly	MNRE/PUMA	MNRE/PUMA	Included in the agencies costs

7. Grievance Redress Mechanism

155. EPC doesn't have a grievance redress mechanism.
It has enquiry boxes where the public can deposit complains or suggestions.
The EPC public relation officer and the officer in charge of social affairs will extract documents from the inquiry box and distribute them to the relevant EPC persons to be treated.
There is no records of complains and no individual response will be sent to the compliant.
EPC will have to develop a mechanism for complain to be taken into account and instructed and solved.
Here is a possible grievance redress mechanism with a step-by-step procedure to receive, register and track all grievances concerning the environment.
A grievance form is presented in Annex E and could be adopted by EPC to address complaints in a more organised way.

1. Members of the public will have rights to make grievances known to the EPC and for them to be addressed, to the extent practicable and reasonable. During project construction, a Supervising Field Engineer, EPC PMU Head, EPC's Public Relations Officer and as required members of Environmental and Social Unit.

2. The affected people will file their complaint through "matai" women's council and village chief to the EPC–PMU Community Liaison team. The name and contact details of these individuals will be presented on a notice board at the village, town of the project area. Complaints can be also filed in person, via email or via a letter to EPC The EPC Liaison team will hear grievances and initiate appropriate remedial action.

3. For complaints over major issues, such as compensation, damage to property, or occupation of land during construction without due agreement, EPC-PMU will respond within 24 hours and arrange a meeting with appropriate personnel including a representative of EPC-PMU to hear the complaint.

4. If a solution, agreeable to all parties, is not reached within a period of seven days, depending on the nature of the grievance (land issue or environmental issue) the complainant may file the grievance with the Secretary of MNRE or Secretary of the Samoa Land Board, who will hear his/her grievance when the Board meets monthly. The complainant also has the right to take his/her grievance to the Magistrate Court for resolution. If the complainant remains dissatisfied with the corrective action proposed, he /she may take his/her complaint to the Magistrate's Court. The Magistrate Court has a complement of over 50 Court staff including five Magistrates. It is not anticipated that the level of complaints from the project will be significantly high such that current resources of the Court will be stretched. However, should this situation arise, the Court will appoint a Magistrate to deal specifically with Project related cases, to avoid lengthy delays.

5. A register of project complaints will be maintained by the EPC–PMU, recording dates, name of complainants (men or women), action taken and personnel involved. The contractor will also be required to keep a register of complaints or issues and how and when they are resolved. These will be incorporated into the contractor's Monthly Reports and be subject to monitoring. A summary on grievances and their status will be reported through regular progress reports and safeguard monitoring reports.

156. The process of documenting the operation of the Grievance Redress mechanism (GRM) will include the following elements:

(i) tracking forms and procedures for gathering information from the contractor/highway section and complainant(s);

(ii) updating the complaints database routinely;

(iii) identifying grievance patterns and causes, promoting transparency and information disclosure, and periodically evaluating effectiveness of the environmental GRM, environmental controls, and their implementation; and,

To ensure that the GRM is effective and accessible, the Public will be made aware of the GRM and how to use it. This will need to be done by EPC.

8. Conclusions and Recommendation

8.1 Benefits

157. The proposed project is an environment-friendly project which will result in substantial diesel saving and GHG emission reduction and improve the energy infrastructure of Samoa.

The other benefits generated from this project are:

- Saving diesel consumption and importation
- Reducing the price of electricity
- Increase independency of Samoa for energy production and diversification of its sources
- Increase the part of renewable energy in national energy production

158. The project's benefits in energy savings have been estimated and are shown in Table 2 below. In addition to the significant total savings in gallons of fuel per year is the prevention of associated pollutants from combustion of fossil fuels entering the local airshed.

8.2 Conclusion

159. The IEE concludes that the potential negative impacts arising from the rehabilitation of old SHPP will be relatively minor, localised and acceptable, providing that the set of mitigations measures set out in the EMP are incorporated in the design and implemented properly.

- The project is a rehabilitation run-of river hydropower's schemes and it does not involve the creation of new dams.
- The aquatic habitats won't be impacted and can be improved if the appropriate ecological flow is set to restore the River biodiversity to its originate states
- The possibility of fish pass structures will be studied during final design stage for some rivers without important waterfalls
- The possible loss of forest habitats due to the project is relatively minor because of the generally disturbed environment of the project areas and it can be further minimize by protecting valuable tree species or habitats
- The potential impact on terrestrial wildlife including rare and endangered species is minor according that specific attention to valuables tress where endangered bird species nest or feed are identified and protected
- Adaptation of climate change is already included in the design in relation to the protection from flooding of the powerhouse, with the calculation of the occurrence, normally for a 50 years maximum climatic event, set now to 100 years,

8.3 Recommendation

160. No further or additional impact assessment is considered necessary at this stage.

8.4 Climate change

8.4.1 Reduction of gas emission (global warming)

161. These subprojects will achieve a net reduction of greenhouse gas emissions of around **8034 tons of CO2** per year. This corresponds to a fuel savings amount of **2 997 liters** for

electricity generation.

Subprojects	Renewable electricity production/year [MWh]	Equivalent of fossil fuel saving [ltr] [1]	Equivalent of ton of CO2 emission[2] (0,670Ton CO2/MWh)
FULOUASOU	2580	645	1 729
TIAPAPATA	3100	775	2 077
FALEASEELA	1060	265	710
FALEATA	500	125	335
TAFITOALA	1820	455	1 219
FALE O FEE	**3340**	**835**	**2 238**
ALAOA	**4780**	**1 195**	**3 203**
SAMASONI	**3870**	**967**	**2 593**
Total	**20,110 MWh**	**5 262 500 liters**	**13,469 tons of CO2**

Table 2: Energy Savings and green house gas emission

8.4.2 Adaptation to climate change

162. There have been several well-documented events that show the increase of extreme weather events such as tropical storms and typhoons in the Pacific. Most climate change modelling shows that tropical typhoon will increase in frequency and severity, and will be a characteristic of the project area in the future. Many of these extreme weather events can be linked to the El Niño/La Niña-Southern Oscillation (ENSO) pattern, but ENSO is predicted to also have an effect in modifying trade winds in the Pacific, strengthening of tropical deep convection, and alteration of monsoon flow.

In April 2009 Typhoon Evan hit the islands of Samoa. It was the strongest typhoon in 50 years with strong winds and heavy rain. Flooding and tree falling partially destructed the SHPP installations. Climate change modeling has predicted that typhoon frequency will increase due to the increased dominance of the El Niño weather patterns.

163. In order to survive Super Typhoon in the region, HPP installations are designed to cope with extreme conditions, especially to avoid submersion. To avoid any future destruction of penstock from tree falling the option was taken to burry them.

Climate change issues have been addressed by the Project.
Each of the sub subprojects has been designed with climate change adaptation features. The major focus of adaptation in the western Pacific is the increase in frequency of typhoons. The installations and equipments will be protected from flooding and tree falling.

9. Consultation program

9.1 Consultation and Participation, Information Disclosed

164. Since 2011 EPC held several Public consultations with communities to prepare the project.
These consultations mainly focussed on land acquisition, compensations and integration of local communities in the protection of water catchment and EPC infrastructures, where the community locally owned the land.
Interesting communities in the protection of EPC assets was achieved by the mean of sharing a percentage of the benefits generated by the electricity locally produced.
Though a first agreement has been reached between local communities consent by the Cabinet of the Prime Minister has to be obtained.
During these meetings the project was presented to the participants with the support of PowerPoint projections.

165. During the preparation of the Resettlement Plan, complementary meetings were held with the communities or with affected persons.
Minutes of these meetings are to be found in the annexes of the Resettlement Plan Report
The sole social dimension of the project was the predominant aspect during the meetings.
No questions were raised regarding the environment as it was considered as a minor topic compared to land tenure, resettlement and compensation.
More consultations should be organised in the next weeks by EPC with local communities to finish the round of consultations.
To avoid interference and confusion with the actual social consultation process initiated by ECP and conducted also by the independent social specialist, it was decided that already contacted communities should not be contacted again separately by another team to only discuss environmental issues.
These issues, if the have been of a definite importance would have necessary emerged during former discussions of preceding public meetings.

166. During the mission a meeting was held on the 5th of July 2013 with government stakeholders.
Concerned government agencies were invited to the meeting (see annex 2). These stakeholders have already been invited in a previous informative meeting organised by EPC on the EPC SHPP's project.
This meeting aimed at updating the stakeholders on the development of the project and collect their views and concerns about environmental issues as the previous one was focussed on social and land acquisition topics.
MNRE raised questions about the protection of water resources during rehabilitation or construction of new schemes for drinking water supply.
It was also stressed that ecological flow was necessary for all sites.
The effect of sea sedimentation resulting of new schemes was another point raised during the meeting. New project design doesn't involve construction of dams but weirs and the sediment flow will thus not be interrupted.
Recommendation was made to assess the effect on the project, specifically the Faleaseela scheme, on local cultural and socio economic sectors.
Because of the very unique and sensitive environment of Vaipu MNRE was firmly opposed to any development in this area.
General recommendation was made, such as reduce any clearance of native forest, involve the stakeholders (MWCSD and MNRE) in the next round of community's consultations, and carry out a rapid biodiversity survey for the sites project.

The Samoa Conservation Society raised the question about the schemes situated in the Key Biodiversity Areas.
Most of SWA concerns were raised during the previous meeting.

ANNEX 1

Terms of Reference

International Environmental Specialist (7 person-months)
The international environmental specialist (IES) will have at least ten years experience in environmental assessment and management including in project implementation. Experience in the power sector and in Samoa and/or other Pacific countries would be an advantage. At least three-quarters of the time of the IES will be devoted to capacity building of the Environment Officer (EO) located within the project management unit (PMU) as well as wider awareness raising and strengthening of Electric Power Corporation (EPC) staff (including management) in safeguards.

The TOR for the IES includes the specific aspects:

i. In conjunction with the EO and social/resettlement specialists and PMU's Public Relations Officer undertake or participate in consultations as required by the Consultation and Communications Plan (CCP) prepared for the Project;
ii. Based on detailed design, assist the EO to update the initial environmental examinations (IEEs) for the schemes in compliance with ADB Safeguard Policy Statement 2009 (SPS) and the Planning and Urban Management Act (PUMA) 2004 and PUMA Environment Impact Assessment Regulations 2007;
iii. During detailed design of the scheme, prepare draft method statements to be included in the contractor's construction environmental management plan (CEMP) including waste management plan (WMP), materials management plan (MMP), erosion and runoff control plan (ERCP), drainage management plan (DMP), and health and safety plan (HSP);
iv. Assist EPC/PMU, in consultation with the Department of Conservation and Environment (DCE), to ensure that environmental safeguard measures under the Project comply with national safeguard requirements including obtaining requisite permits (environmental and water resources permits) and ADB's SPS;
v. Assist PMU procurement specialists and other PMU members as required to include the draft method statements and updated EMPs and other plans (see item iii above) and relevant provisions and text from the updated IEEs into the tender/contract documentation for the scheme;
vi. Prior to contractor's preparation of the CEMP provide training on environmental management provisions and monitoring. Assist the EO to review the contractor's CEMP (including other plans as required - see item iii), suggest changes or revisions as required, and recommend to PMU Head that approval of the CEMP may be issued;
vii. Assist the EO to establish an environmental monitoring and reporting system within the PMU and contribute to Quarterly Progress Reports - including compilation of relevant items from Monthly Reports prepared by contractors - to be prepared by the PMU for EPC and ADB. The monitoring and reporting system will cover CEMP compliance;
viii. Monitor the contractor's compliance with CEMP (and other plans), and as necessary conduct on-site spot-checks of contractor's mitigations and review contractor's Monthly Reports regular monitoring reports; and
ix. Ensure compliance with all assurances under the Project.

ANNEX 2

Stake holder's meeting, 5th July 2013

HYDRO MINUTES: Government Stakeholders DATE: 5th July 2013

Project Title: Proposed Hydro Projects

Participants from Government Ministries Involved:

- Ministry of Natural Resources and Environment: (MNRE)
  - Planning Urban Management Agency
  - Land Management Division
  - Water Division
- Attorney General's Office (AG)
- Ministry of Women Community and Social Development (MWCSD)
- Samoa Water Authority (SWA)
- Ministry of Commerce, Industry and Labor (MCIL)
- Electric Power Corporation – Project Management Unit (EPC/PMU)
- Porch Consultants
- ADB

Date of Meeting: 5th July 2013

Time: From: 10am To: 11.30am

Location: EPC General Manager's Room, Level 5 TATTE Building - Sogi

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Chairperson: Fonoti Perelini (EPC PMU)

Minute Taker: Moetuasivi S Asiono (EPC PMU)

Agenda	Discussion	Action/Responsible Person
OPENING	Chairman welcomes everyone and introduces the presence of Porch and Partners consultants who will be working on the Due Diligence for all 7 Hydro Projects. Chairman then introduces issues of discussions which mostly on the following: • Proposed Hydro Projects Introduction • Hand over to Porch and Partners with relation to environment concerns • Open Discussions	
Proposed Hydro Project	Chairman introduced the following for participants info given last meeting was with government ministries, although issues were focused mainly on land acquired and the business model, but today consultation will gather concerns, issues and suggestions from environment associated bodies for the environment side of research for the Porch and Partners Due Diligence reports. Chairman once again touched on the following – • Government has signed an MOU with ADB for the development of 7 hydros, an addition to the 5 EPC has	

	currently operating. The seven hydros will be : ○ Fuluasou – rebuilding the old one ○ Tiapapata – utilize the western branch of the Vaisigano River ○ Faleseela ○ Vaipu – Pump scheme ○ Tafitoala ○ Faleata – Vailoa Palauli Savaii ○ Sili – This hydro site is left aside for consultation later • EPC has done all feasibility studies for the above mentioned sites, but as mentioned earlier, these sites require Due Diligence reports and EPC and ADB have agreed for consultant Porch and Partners to carry out • As EPC looks at the best way to approach the development of the proposed project, EPC had to look at the best way to deal with villages as well, as out of the 7 schemes, probably only Fuluasou will not require dealings with villages • This is a real challenge for government, and due to this thought, EPC came up with the idea of a BUSINESS MODEL • The idea of the model is as follows: ○ This is where the government and the village and land owners join as a liability company to develop each of these hydro and sell the electricity to EPC, at some negotiated tariff ○ Epc went to cabinet and cabinet approved and instructed EPC to start going out to the villages and start elaborating on this model. Sili was left out by cabinet for later negotiation. ○ Epc did this last year and visited Faleata, Vailoa, Tafitoala and Faleseela. We explained the structure of the model which is just like a business, where partners are involved, put in money and assets and develop the business just like a shop for example elaborated to villages to clearly understand, and as it is develop as such, sell the product ○ One of the good thing about this model government changed EPC Act which allows independent power producers to produce power and sell back to epc. Anyone can sell electricity and not just EPC. The idea and structure of the said business model was further discussed in a consultation with government partners who will be working closely with EPC in determining pros and cons of the proposal for final recommendations. Chairman then handed over to Porch and Partners…	
Concerns from Ministries	The following concerns were voiced by MNRE and SWA during the consultation, which was echoed by members from both ministries who are involved with social and environment issues within their respectful organizations/ministries.	

	MNRE raised the following issues: • Recognized the importance of the projects economically (reduced costs of electricity) and also good impacts on environmentally (in terms of reduced emissions from reduced use of diesel fuels to generate electricity) • Site 1-Fuluasou: the project should recognize the needs of the water supply utility, and should also facilitate for the e-flow at this area. *(EPC comments – hydro dam is below SWA water intake. SWA takes water from dam. EPC gives SWA priority of water from dam during dry season)* • Site 2-Tiapapata: the project should recognize the needs of the water supply utility, and should also facilitate for the e-flow at this area. • There were issues raised by PUMA regarding community awareness at this site as there have been complaints from surrounding land owners that EPC engineers are trespassing. *(EPC response – a SWA staff guided EPC engineers over this family land. EPC and SWA are securing land for another access to site of hydro and water intakes to stop going through this family land)* • Site 3-Faleaseela: we raised concerns over the damming of water and the risks it poses on sediment loading/sediment build up. We do not want another Taelefaga. *(EPC response – Taelefaga case is different from Faleseela. Taelefaga involves water diverted from flow to south of island and discharge into Fagaloa Bay. On Faleseela will continue to discharge to sea now and same when dam or intake for hydro is built. Second is that all vegetation will be moved from dam site in Faleseela, different from Afulilo where vegetation, forest, etc were not removed from dam during construction of dam)* MNRE was told that a weir design will be done so this kinds of alleviates the concerns dramatically. The project will take into consideration the needs of the water supply utility, and will also allow for the environment-flow in design of systems.. Asked for an assessment to be done on the cultural and socio-economic significance of the Liua le Vai o Sina on the Faleaseela community as some recreational activities depend on the river as well as some fishing activities by the village. MNRE were told that the village is very supportive of the development of river for hydro if village will benefit from it under business model. Have also submitted our freshwater survey report to the consultant which had some results from this area.	

	• Site 4-Vaipu: we strongly oppose any developments at this site. • Site 5-Tafitoala: we were concerned with the dam option but reverted when a weir design was brought up MNRE general recommendations voiced at this meeting were: • To ensure minimum clearance of native forests within the watershed areas • To involve all stakeholders (MWCSD/MNRE) as much as practicable during the consultations • To ensure that EIAs as well as research permits/drilling permits/abstraction licenses are all facilitated, to safeguard any impacts on the environment • To look into the cultural and recreational / socioeconomic significances of these water ways on surrounding communities • To carry out rapid biodiversity surveys Concern from the Samoa Conservation Society: • Raised the importance of the above as some of the developed areas fall into Key Biodiversity Areas (KBAs) Concerns raised by SWA: (see minutes later consultations with SWA staff)	

Meeting concluded at: 11.30am

Minutes Prepared by: Moetuasivi (EPC PMU)

Minutes endorsed: Chairman