ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN (EMMP) FOR A PROPOSED TUNA PROCESSING PLANT MAROBE BAY, PORT VILA VANUATU

SUBMISSION BY

THE DEPARTMENT OF FISHERIES

MINISTRY OF AGRICULTURE, QUARANTINE, FORESTRY & FISHERIES

TO

THE VANUATU ENVIRONMENT UNIT

MINISTRY OF LANDS & NATURAL RESOURCES

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The report was prepared by Vanuatu Fisheries Department in partial fulfillment of the recommendations specified under the preliminary environmental assessment study of the Marobe Bay Fish Processing Plant conducted in February 2007 as required under the Vanuatu's Environmental Management and Conservation Act 2002.

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ACCRONYMS

DG	Director General
EMMP	Environmental Monitoring & Management Plan
FD	Forestry Department
PA	Political Advisor
PEA	Preliminary Environmental Assessment
PES	Project Engineering Supervisor
SC	Steering Committee
TRMC	Tagabe River Management Committee
TWG	Technical Working Group
VEU	Vanuatu Environment Unit
VFD	Vanuatu Fisheries Department
VLL	Vanuatu Livestock Limited
VMA	Vanuatu Maritime Authority
VQIS	Vanuatu Quarantine & Inspection Services

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BACKGROUND

An important objective of environmental assessment is to develop procedures and plans to ensure that the mitigation measures and monitoring requirements approved and that environmental compliance review will be carried out in subsequent stages of the project. As a result, strong emphasis is placed on the preparation of environ mental monitoring and management plans (EMMP) during project processing and on setting out conditions and targets to be met during project implementation.

Typical operation of the fish processing plant will cover two major processes, a primary process involving unloading and freezing and a secondary process involving sorting and packaging (Fig 1).

Vessel Unloading
Frozen whole fish will be offloaded out of the vessels' holds into water sealed cooler truck, similar to what is used by the abattoirs and transported to the fish processing plant's grading stations where the fish are manually sorted according to their species and then kept in the freezer until they can be further processed.

Dressing fish
Dressing of fish (or some times referred to as "butchering") for freezing depending on the requirement of the market generally involves the removal of the head and gutting of the fish. The tails, fins and the collar bone immediately behind the head are not cut off. Dressing is done manually or sometimes with semiautomatic dressing lines. Depending on market preferences, for high quality tuna species dressing involves gutting and removal of viscera without removal of fish head. The manual dressing lines consists of a large table and fish cleaning station where will be responsible for specific tasks, such as:

- Head removal
- Belly slitting
- Removal of viscera and separation of milt and/or roe
- Removal of kidney
- Cleaning of fish

Water is used to flush out remaining viscera and blood away

Offal from the fish dressing may be dropped in the floor, into collection bins which is discharged into a dedicated offal storage bin which is adequately sealed for further disposal. It is likely that for the proposed processing plant, only a small amount of dressing will be taking place as whole frozen fish will be exported to the overseas market.

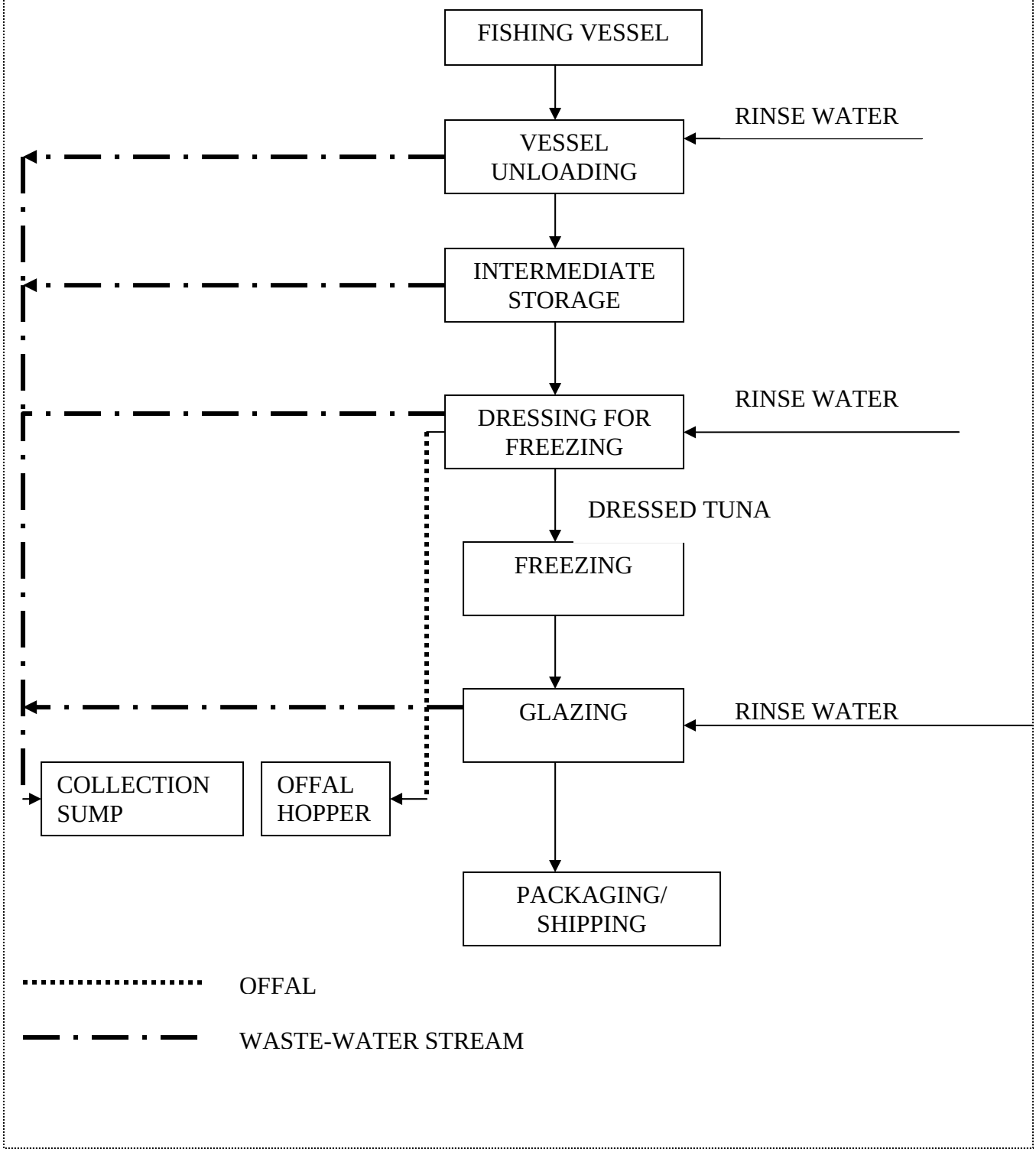
Glazing

Frozen fish generally receives a smooth coating of clear ice glace prior to final packing and shipping. This is accomplished by either spraying already frozen fish with a fine water spray or by dipping the frozen fish into chilled water. After glazing the frozen fish are packed in plastic bags and placed in boxes for shipment.

The industry is water intensive and like any other industry is capable of producing large amount of both solid and liquid waste. Having a sound water resource management and effluent disposal system in place are crucial to ensure a sound environmental and profitable operation of a fish processing plant.

The following outline a number of issues that requires monitoring during construction and operational phase of the fish processing facility based on outcome of the preliminary assessment report (PEA). Major significant factors to consider would be waste management during construction and operational phase of the project. This document is in partial fulfillment of the recommendations of the PEA report (Kaly, et al, 2007) and in compliance with the requirements of the Vanuatu Environmental Management Act 2002, for the development of the Marobe Bay Fishing Processing Plant in Port Vila. The document is subject to review during the course of operation of the fishplant.

FIGURE 1 TYPICAL TUNA PROCESSING FLOW CHART



1. SUMMARY OF IMPACTS

The plant site is very close to, and its land lease abuts the Tagabe River which is a major resource for the area and particularly the people living in Blacksands who have no municipal utility supply. The plant is located 800m upstream from the river mouth and therefore downstream from most of the high use areas. There are, however, some parts of the Blacksands community that use the river for washing between the plant and sea, and undergrounds wells are common in the area. There is a potential for impacts through contamination of the river or ground waters through sewage or liquid wastes and through overuse of water if ground water from the plant site is to be heavily dependent on. However for hygienic and food safety reasons, the fish plant will only be using the public water supplied through UNELCO for its food processing items.

1.1 ENVIRONMENTAL/BIOPHYSICAL IMPACTS

1.1.1 Location of the Plant

There are no significant effects expected on the land area surrounding the site which is already highly modified and used for agricultural purposes. There are similarly no significant effects expected in Mele Bay as long as no waste disposal occurs there. However, there will be a need to have waste management and minimization practices in place to ensure that wastes and effluents are adequately treated to ensure that the proposed plant poses no major significant threats within its given location.

1.1.2 Water Resource Management & Effluent Disposal

Water Supply

This industry is a water intensive industry and would require large quantities of high quality water that is used for washing fish, cleaning of processing areas, cooling as well as for other production processes. It is estimated that the operation of the proposed plant would consume a maximum of 60 tonnes of water per day. Although there is a good underground water supply in the area of the fishplant that water supply would not be a problem, the proposed plant will only use the public water provided by UNELCO.

Consideration on use of water should be given to:

- The efficient use of this resource;
- Consumption of water during periods of water shortage;
- Effects of releases of waste water and nutrients contained on the ecosystem of the receiving body of water e.g. toxicity to fish and other aquatic organisms.

Waste Water Discharge and Effluent Treatment

Waste water in the fish processing plant will be generated by the following activities: fish unloading, equipment sprays, offal transportation, and facility cleaning (Fig 2).

Offal Transport

A flow diagram of a typical waste treatment scenario is shown in Figure 2. Generally, fish processing facilities make use of water not only for fish cleaning but also to flush offal and blood from equipment and floors and to flush offals to collection drains. Apart from high water consumption, this method of equipment cleaning and offal transport leads to the problem of any soluble biological oxygen demand (BOD) components (e.g. blood) to be dissolved in the water which cannot be removed by physical treatment such as screening and is discharged unchanged by such treatment. Hence, the application of a biological treatment is crucial for such treatment.

Pre-treatment before discharge of effluent is necessary and this will be covered in the mitigation issues. However, application of screening in processing facilities is a physical treatment process and removes solids which cannot pass through openings of the screen. Solids of organic origin contribute to BOD of a wastewater.

Most of the impacts anticipated for the natural environment are concerned with pollution effects on the Tagabe River and proper disposal of solid and liquid wastes generated at the fishplant. Other form of effluent discharge such as sewage which will require additional treatment. At present, the plan for the fishplant includes a septic system for sewage disposal, the washing down of processing rooms and the disposal of fish liquid wastes. Unfortunately, septic tanks are well-known as sources of contamination for ground and river waters and are not specifically designed to ensure biosafety.

As is recommended in the PEA report, this document further emphasized the need to have the current traditional septic system planned replaced by a biological treatment (an aerobic system) which would be effective in treating both sewage and effluents (liquid fish washings).

The biological systems can be “temperamental” in operation as they require “start up” periods of several weeks before working efficiently and then require controlled “feeding” to maintain optimum conditions. Keeping the reactor “alive” in periods of short fish supply may be difficult. In addition, biological systems can be made to operate on either freshwater or seawater based effluent using different types of bacteria, but will not effectively switch between the two. The sludge produced will have to be disposed of preferably at the Municipal Land Fill Site

while the liquid treated effluent would be allowed into a settlement pond. A full time operator is likely to be required for the entire treatment system.

Other solid & liquid wastes

Other forms of waste will be generated at the plant. This will include disinfectants (foot baths etc), other cleaning agents, fuel and oil residues from the generator, refrigerants from the freezing units, equipment parts, waste paints, and frames, and domestic wastes such as plastics, cans and other items. These need to be fully identified and arrangements for offsite and safe disposal made. It is important that no wastes find their way into the Tagabe River or out into Mele Bay, either through direct dumping or mobilization through water or wind movements.

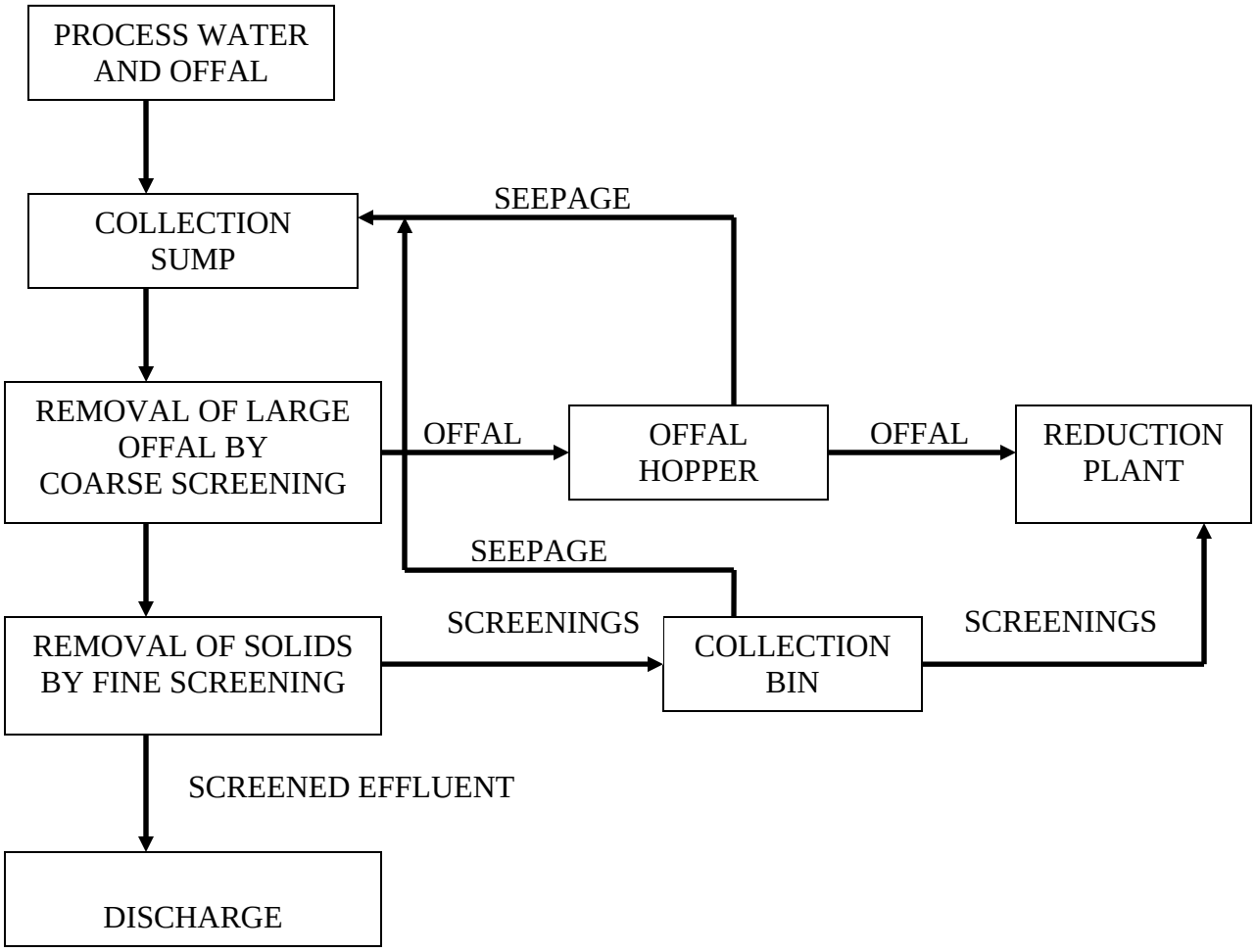
There could also be accidental spills during refueling of boats. If not handled appropriately these present a risk of pollution in Port Vila Harbour and at the wharf area. Proper arrangements are needed to govern how waste is handled for these parts of the project, in association with the Port Authority and Vanuatu Maritime Authority (VMA).

Social Impacts

This project is expected to provide jobs for up to 90 workers when the plant reaches full capacity. There are also expected to be 6 positions per longliner for ni-Vanuatu crew.
There are social risks associated with the construction phase if suitable arrangements are not made for water supply and sanitation for workers. Sanitary working conditions and proper waste disposal facilities need to be established early in the construction phase. The public in the area surrounding the development are in some cases concerned about impacts that are not likely to occur with this project (e.g. shark attacks increasing where children swim because blood is dumped in the bay and smell).

It appears that those who have gardens in the area to be developed were informed of the need to move out (about a year ago). Some people felt that they should be compensated for their gardens. These issues represent social impacts that need to be addressed as part of the project. Concern for prostitution and mixed-race pregnancies resulting from the project and eventually affecting customs are also among social concerns.

FIGURE 2 FLOW DIAGRAM OF A TYPICAL WASTE TREATMENT SCENARIO



2. MITIGATION MEASURES

The Following tasks needed to be conducted to ensure that monitoring guidelines are in place based on the recommendations of the Preliminary Environmental Assessment (PEA) study that has been conducted on the development.

2.1. Appointment of a Steering Committee and a Technical Working Group.

There is a need for an immediate appointment of a Steering Committee (SC) and a Technical Working Group that would oversee the full implementation of the EMMP.

2.1.1 Steering Committee (SC)

The function of the SC shall be to:

- Maintain an overall advisory role on the implementation of the EMMP during construction and operational phase of the project;
- Provide update reporting to the government and private sector on the progress of the project;
- Be the focal point for liaising with the Marobe Bay Project Counterpart, in this case the Chinese Government;
- Source extra funding where necessary on implementation of EMMP
- Attend to any Media concerns arising from time to time
- SC shall comprise Director General of Lands & Environment, DG MAQFF, First PA MAQFF, a senior Officer of Ministry of Finance, Director of Fisheries, Head of Environment Unit, Director of VQIS, Director of Public Works, a senior representative of Chinese Embassy and an Engineer of the Plant.

2.1.2 Technical Working Group (TWG)

The function of the TWG shall be to:

- Execute the technical requirements outlined in the EMMP as endorsed by the SC;
- Oversee the daily/weekly/monthly activities of the project that has been outlined by the EMMP;
- Conduct field assessment surveys in collaboration with external counterparts as part of the EMMP requirements;
- Identify and inform SC on costs of implementing technical components of EMMP where appropriate;
- Provide update quarterly reporting to SC on progress of the project and identify areas of concerns for consideration;

The following tasks needed to be executed to enable functioning of the SC and the TWG overseeing the implementation of the EMMP.

Action

- Director General (DG) of Ministry of Agriculture and Fisheries to liaise with DG Ministry of Lands and Environment for an immediate appointment of a Steering Committee (SC) responsible for implementation of the EMMP of Marobe Project;
- SC to review and adopt the current draft EMMP document prepared for consideration and for it to become official;
- SC to appoint a TWG responsible for the technical component of the EMMP document.

3. MITIGATION DURING CONSTRUCTION PHASE

3.1 Community & Public Consultation

The purpose is to conduct community consultation and public awareness on the nature and scope of the project, what to expect and to dispel any concerns based on misunderstanding (e.g. fish blood being released into bay that may attract shark attacks) is to be conducted during the early phases of the project. Already part of this activity has been implemented, such as awareness activity conducted in Mele Village in October 2007 as well as media interviews through television talk show, radio and articles submitted on the project.

Action

The following activities are to be implemented by the SC:

- Update Mele Village Community on progress of the project;
- Consultation on Ifira Island Community;
- Public Consultation on Media (Television and news papers);
- Have a sign post constructed on entrance to project site clearly marked “danger” and prohibiting general public from entrance to the site for safety reasons OR seal off construction site from public access. This must be clearly marked and be visible both at day and during night;
- Inform general public living in Salili, Blacksands and surrounding area through media on the movement of heavy equipments and materials through the road to avoid potential road accidents.
- Conduct Public Forum where necessary.

3.2 Consultation with People Currently Gardening on Project Land

People, namely squatter settlers currently living on the Project Land have been issued with a notice from the Director General (DG) MAQFF more than a year ago to vacate the area they are currently living on.

***Action*:**

- SC to seek advice from State Law Office on previous notice that has been issued to settlers on project land and what necessary measures to be undertaken next as well as discuss issues of compensation if required.
- Upon approval of the State Law Office, SC on behalf government of Vanuatu to issue another notice to the settlers and provide 3months notice to evacuate from the Project Land or face eviction from Vanuatu Police Force.

3.3 Vegetation Flanking Tagabe River not to be disturbed

The Plant will be located 800m upstream from the river mouth. A buffer system will be created along the river bank to ensure that vegetation along the river system must not be disturbed or destroyed

Action

- TWG to liaise with Tagabe River Management Committee (TRMC) to establish a 10m buffer zone along the river system. Within the buffer zone, the vegetation within this zone must not be disturbed during the construction phase. It would be recommended that TWG entrust TRMC with this activity;
- TWG to review the costs highlighted in the EMMP for establishment and maintenance of the buffer zone and report to SC for further action;

3.4 Water Supply

Large quantity of water will be required for use during construction phase and it is important that the development does not become dependent on the groundwater source in the area but rather to utilize the public water supply system. Since August 2007, water pipeline provided by UNELCO now services the area of the fishplant. The building contract may now be able to utilize the water supply system.

3.5 Waste Management

Identification and categorizing different forms of wastes is crucial to the early stages of project development. Burial of wastes at the site, or discharge into the soil may lead to contamination of the ground or river waters and should not be permitted.

The following wastes are anticipated during the construction phase:

- ✓ Sewage;
- ✓ solid wastes including plastics, metals, cans, paper bags, bottles, kitchen wastes (food scraps from kitchen and garden wastes);
- ✓ Non-organic wastes;
- ✓ Chemicals such as un-used cleaning detergents,
- ✓ Petroleum wastes

Actions

- ➢ Project Engineering Supervisor (PES) to install Portable toilets (i.e. mobile toilets) on site during the construction phase. The Pacific Suppliers have portable toilets that are for sale and could be purchased and used on site.
- ➢ PES to ensure that suitable sanitation facility on site: Have sealed bins as rubbish bins installed for proper disposal of solid waste and will be safely concealed and transported to the Municipal waste refuge area.
- ➢ PES to ensure that rubbish should be emptied at least once per week.
- ➢ PES to ensure that solid wastes are not to be left piled on the soil directly but in rubbish containers
- ➢ PES to ensure that wastes such as oil, benzene, diesel etc should be stored in proper containers and transported to fuel depots such as Mobil, Shell and BP for proper disposal;
- ➢ TWG to conduct regular monitoring (minimum once per week visit) of the site to ensure that the above activities are conducted and maintained.

3.5.1 Sewage System to be replaced by Aerobic System

Given the sensitivity of the project particularly with regards to potential effluent spill-off to both the freshwater and marine environment, it is crucial that organic matters are adequately treated.

Its been planned that the proposed plant will use a sewage and rainwater separation system where drainage from office and processing room will be treated by a grease interceptor and septic tank (all made of concrete) and drainage from defrosting of refrigeration machine to flow directly to the southern river which is Tagabe river.

This system will have to be changed. The use of septic tank system originally proposed in the plan has to be either replaced or supplemented by an aerobic biological treatment system. In addition, there is a need to construct a settlement pond on site which would allow for tertiary treatments of effluents after the secondary phase (biological treatment).

Action

- The SC to instruct the PES to install a biological treatment system for the plant during the construction phase either to replace the septic system as a separate unit or to supplement the traditional septic system as a build in unit;
- SC to instruct PES on construction of a settlement pond as tertiary treatment of effluent;
- TWG to liaise with VFD and PES on design and construction of the settlement pond. Basically pond bottom should be plastic lined to prevent any seepage. Such plastic is available in the market;
- The settlement pond to be used for tertiary treatment of effluent is to be constructed at the "Reserve Construction Land" (recommendation 13, PEA report) to the south of the fishplant buildings which will be allocated as a green area to act as a buffer zone between the fishplant and the river;
- The additional cost of this system has to be covered under the project fund.

3.5.2 Sediment Load

It is important for the contractors to ensure that "best practice" at work is adopted at all times. Where sand and gravels are transported by trucks, it is the duty of the Contractors to ensure that employees understand the risks of the environments within which they work in.

Action

- PES to ensure that lose soil and sand are concealed and should not be left unattended for long period of time;
- PES to ensure that un-used soil and sand are removed from site for safe disposal.

3.5.3 Equipment

Equipment to use particularly for excavation work and trucks which may be required to transport sand and gravel to the site may contain noxious weeds and or pests that could cause an introduction of unwanted weeds or pests to the

area. This may not be such an issue since the area has long been use as agricultural land for decades.

Action

- It is the duty of the Contractor or Sub contractor to ensure a safe operation and transport of construction equipments and materials at all times.

3.5.4 Rehabilitation

During the construction phase, major clearing work would be carried out which would result in removal of some of the vital plants and trees of the island. It is important that the contractor conceal as much of the exposed area as possible at the end of the construction period

Action:

- PES to ensure that landscaping of the area are carried out and replant exposed affected areas with native plants, trees and grass to prevent any exposure to soil erosion.
- PES to establish a 10m buffer area adjacent to the main road side where necessary to maintain its vegetated state and/or additional replanting needs to be undertaken to minimize further run-off into the adjacent coastline.

3.6 Baseline Monitoring

It has been proposed in the PEA that baseline monitoring of the Tagabe River should begin early during the construction phase. This will be expanded to include baseline monitoring of the marine environment of the nearby coastal area by establishing sampling points (Appendix).

Action:

- The Steering Committee to consult and liaise with the Tagabe River Catchment Area Committee and possibly in collaboration with VFD on monitoring of the river system on possible environmental impacts;
- It is recommended that monitoring of the river system to be conducted twice a year (one sampling during wet season and another during dry season), criteria for the monitoring to be discussed by TRCA, VEU and VFD, and TWG to identify costs and request to SC to source funding to implement this activity;
- TWG in collaboration with VFD's Research Division to establish sampling points of the adjacent marine environment and sampling will be conducted

twice per year either during wet and dry seasons or at six monthly intervals (refer Appendix). First sampling is scheduled to commence in February 2008;

4. MITIGATION DURING OPERATIONAL PHASE

4.1 Buffer Zone leading to Tagabe River

Maintaining 10m buffer area leading to Tagabe River during the operational phase of the project is important to sustaining the Tagabe River catchment area. In addition, consultation needed to be conducted to maintain the "Reserve Construction Land" to the south of the fishplant buildings as a green area and to act as a buffer zone between the fishplant and the river.

Action

- The TRMC to maintain the buffer zone to maintain the vegetative state of the river bank and where necessary consult with the Forestry Department (FD) on appropriate trees or plants necessary for planting;
- The SC to consult with the PES for the need to maintain the "reserve construction land" to the south of the fishplant as a green area which will act as a buffer between the fishplant and the river;
- The TWG to be assigned the task of liaising with FD on appropriate native plants that could be planted in the reserve area. The reserve area should be clearly marked and signposted;
- The SC to identify funding to support TRMC and FD for the additional tasks required;

4.2 Waste Management at Fish Plant

During the operation of the fishplant both organic and inorganic wastes in both liquid and solid forms will be produced which require appropriate treatment and disposal procedures. Since a fish plant process is water intensive, organic effluents having high BOD will play a crucial factor in the daily husbandry practices of such plant.

4.2.1 Organic Waste

As highlighted in the mitigation measures in the construction phase, the emphasis is placed on the installation of a biological treatment system as a secondary treatment process for treating liquid organic wastes (organic effluents such as fish washing and sewage). Appendix 3 highlighted some of the basic principles in minimizing effluents which will provide a guide to the Management of the fishplant, the Vanuatu Livestock LTD (VLL) during the operational phase.

Action

- SC to advice VLL that fish discards (such as fish head) or by-catch which may not be fit for export market are by all means not to be given out for free to the general public.
- VLL to conduct specific training for a wastewater technical personnel (WTP) and assign such personnel to be familiar of the effluent treatment system of the plant and to be specifically in-charge of the effluent treatment system;
- VLL to conduct monthly monitoring of pH, dissolved oxygen (DO) and pH of the treated effluent after secondary (at end of biological treatment system), refer Appendix 4. It is recommended that VLL conduct sampling during processing only;
- VLL is liable to make such monitoring data available to TWG, VFD, VEU for routine check;
- VLL to ensure that offal from the screen is collected in a container which is emptied in the main offal container when full. The main offal container must be stored in a hygienic storage area which is well ventilated and the floor is sealed to ensure no seepage into the ground. The main offal container must then be emptied in the Municipal Land Fill area when full.
- VLL to ensure that no solid organic wastes are buried on site but landfilled at the Municipal Land-Fill Site (MLFS);
- TWG to conduct routine check to ensure that solid effluents are to be stored in leak-proof sealed bags or bins and taken to a hygienic storage area of the plant ready to be disposed off at the Municipal Land Fill Site.

4.2.2 Other solids and liquid wastes (non-organic)

Action

- VLL to ensure that normal household non-organic wastes such as cans, plastic bottles etc are to be safely deposited in the bins and landfilled at MLFS;
- Petroleum wastes such as oil, grease should be stored in a safe area with a cement base and transported to the petroleum depots for safe deposits;
- Unused chemicals purchased locally should be returned to the local chemical suppliers for safe deposits;
- VLL to avoid storing large quantities of unused chemicals and petroleum wastes on site;
- TWG to conduct regular checks to ensure that above practice waste storage is adhered to by the Management of the Fish Plant.

4.3 Waste Management during Fish Unloading

There is likely to be accumulation of waste at the main Star Wharf during the operation of the plant when fishing vessels frequent the harbour to off-load catches. At the present, there is no proper facility available at the main Wharf that could be accessed to when vessels dock in. It is often the case that crews/passengers etc tend to use toilet facilities within vessels when vessels dock in as there are no adequate facilities ashore. In addition, there are no proper disposal bins available at the wharfs for use.

Given the sensitivity of the waste being paramount in this development, it is crucial that several infrastructures have to put in place that could be accessed to by crews and passengers not only for foreign vessels docking in but also inter-island vessels.

Action

- SC to conduct consultation with several stakeholders such as VMA, Ports Authorities, Municipal Council, Ifira Stevedoring to have in place basic facilities such as toilets, showers and garbage bins installed for use at the Wharfs
- Once in place, SC to consult with Ports Authorities and VMA to enforce the requirement for vessels not to use toilet facilities on vessels when at the wharf.

5. Field and Analytical Monitoring

The following monitoring requirements are needs during the operational phase of the fishplant on site and within the vicinity of the plant.

Action

- The TWG to conduct quarterly field monitoring on the abiotic parameters (dissolved oxygen, pH, temperature) at the effluent discharge area after secondary process, at the settlement pond (tertiary treatment), at the Tagabe River, preferably area adjacent or nearest to the fishplant, and at the sea, preferably area closest to the fishplant. Refer Appendix 5 for further details;
- The TWG to conduct sampling for laboratory analysis on a six monthly basis for the following parameters highlighted in Appendix 5.2 at the effluent discharge area and the groundwater within the fishplant site. On this occasion, toxicity test is also to be conducted on cultured tilapia fish which are placed in the settlement pond as part of the effluent's tertiary treatment system.

6. Fish Plant Safety Systems

6.1 Power Supply

The factory will install 800KVA box to change electricity supplied by UNELCO (20KVA) and is estimated that the total power to consume will be Ps=928KW, Pjs=650KW. A 410/360KVA diesel generator is on stand-by in case of power cut by the main Power Sypplier, UNELCO. Plant Management is to ensure that regular monitoring and maintenance is conducted on the back up generator to ensure its efficiency.

6.2 Fire Protection System

The outdoor fire protection pipes at the north of the Office and northwest of the factory and will have strength of 30 L/s (liters/sec). It is important that only running water are to be used for fire protection.

6.3 Noise

Noise affecting general public can come from various sources such as from the facility itself and through frequenting of vehicles at nights. The engine room which houses the ammonia compressor will be load producing about 85 decibels from within. However, the engine room will be well sealed thus the noise influence on the surroundings will be very minimal.

Action

- Fish Plant Management to ensure to keep engine room door closed at all times;
- Fish Plant Management to reduce working at night as much as possible.

7. CONCLUDING REMARKS

There is an immediate need to set up a Steering Committee (SC) and Technical Working Group (TWG) taking into consideration a number of different government Stakeholders to be appointed by the government through guidance of both Director Generals of Lands & Environment and Agriculture & Fisheries to oversee implementation of this development.

A budget needs to be identified by the government to enable the SC and TWG to conduct its monitoring activities particularly during the construction phase. However, during the operational phase, as is expected from any industrial developments that, the industry itself meets the environmental monitoring costs of any such future activities as the SC or TWG sees crucial to the development of the fishplant.

The most crucial element to alter in the current proposed plan of the processing facility is having a biological treatment system in place either to supplement the planned traditional septic system originally proposed or having a biological treatment system as a separate and sole unit for organic effluent treatment system for the operational phase. The underlying principal is that nothing flows directly to the marine environment nor the Tagabe River system treated nor untreated.

An immediate action during the construction phase is setting up of portable toilet facility on site for the construction workers.

This current document has been prepared as a basis for an EMMP and will be subject to review and editing from time to time depending on the nature and scope of the proposed project as well as its operation.

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APPENDIX 1: THE BASICS OF EFFLUENT TERMINOLOGY AND TREATMENT

The following terms are used to describe the nature and strength of effluent in a fish processing facility.

Biological Oxygen Demand (BOD)
This is a measure of the amount of oxygen consumed whilst the effluent is broken down by bacteria and is normally expressed in milligrams per liter (mg/l). It is a measure of strength of the effluent in relation to the loading it creates for biological sewage treatment

Chemical Oxygen Demand (COD)
This is a measure of the amount of oxygen consumed when the effluent is broken down by a strong chemical agent, and is normally expressed in mg/l. It is similar to BOD but faster and cheaper to carryout and hence more widely used. Generally COD value will be somewhat higher than the BOD.

Suspended Solids and Settleable Solids (SS)
These are simply measures of the amounts of solid matter in the effluent which can be removed by fine filtration (suspended solids) or settlement (settleable solids), and normally expressed in mg/l

Settled COD (sCOD)
This is a variation of the COD measure. The effluent is left to stand for a period of time, usually one hour, for solids to settle out and then the COD of the liquid is taken.

Oil/Grease
This term is sometimes used as high levels of oils/grease can cause blockages in sewers and harm the environment. It is a measure of the quantity of oils/grease present in the effluent, again normally expressed in mg/l

APPENDIX 2: THE PRINCIPLES OF WATER MINIMISATION

Minimising water use at source is recommended as the most environmentally considerate and effective way of reducing costs.

The main focus of minimizing water use includes:

- Turning off the water when it is not needed
- Using water efficiently where it is needed
- And considering alternative "dry" processes instead of the usual "wet" processes
- Ensure that hygiene standards are maintained at all times.

Most fish processes consume more water than is necessary for effective operation of the process, in many cases this is considerably more than is necessary.

Possibility to:

- Set valves on the supply lines using fitting of inexpensive flow restrictors;
- Do not over flood processes with water but apply sprays from well designed nozzles. Use of tubs for fish-washing is ineffective whilst using large quantities of water. Use of purpose designed fish washer which employs rotation or agitation and water jets or sprays effectively clean the fish with minimum use of water;
- Brief active washing of fish is preferable to a long soak;
- Large quantities of water are wasted simply through leakage or leaving taps on and hosepipes running when not serving any useful purpose;
- Management to be able to train, instruct and supervise staff to be able to find and fix leaks to prevent wastage;
- Minimise wet processes use and alternate to dry processes such as using air thawing techniques on frozen raw materials rather than using running water on frozen products;
- Avoid using hoses all the time to "chase" wastes around the floor but use squeegees instead;
- Hoses can be fitted with adjustable trigger action spray nozzles to conserve water;
- Transporting wastes in dry containers rather than in water;
- For best hygiene control, frequent washing is necessary but can be improved using trigger controlled nozzles instead of open ended hoses;
- Staff training, instruction and supervision are crucial.

APPENDIX 3: THE PRINCIPLES EFFLUENT MINIMISATION AT SOURCE

Minimising effluent contamination at source is recommended as the most environmentally considerate and effective way of reducing costs.

The main focus of minimizing effluent strength includes:

- Separating the solid waste from the water as close as possible to its source;
- Avoid unnecessary cutting up or mashing of the waste;
- Avoid soaking the waste in water or passing running water through the waste;
- Where possible keeping waste off the floor;
- Keep waste out of the drain if it falls on the floor;
- Insert wedge wire screens or some form of wire screens into the exit chutes from fish processing equipments to retain fish processing waste from flowing directly into the drains;
- Where possible recover materials such as livers and gut contents from processing equipments rather than being mashed up and emulsified. Such materials are readily broken up and very rapidly bind with water to produce high strength effluent. The longer the waste remains in water and the more finely it is cut or mashed up, the higher will be the effluent strength.
- Ensure to separate any solids from the effluent in the drains as much as possible;
- Ensure to have well designed screens and catch baskets that would not only separate the solid waste from the water but also keep the separated waste out of the water;
- Ensure that solid waste are not accumulated in processing areas but retained are sealed in proper sealed bags and deposited into leak-proof waste containers and taken into a hygienic storage area to be land-filled at the Municipal Land Fill Site.

APPENDIX 4: EFFLUENT TREATMENT

The principle of the effluent treatment can be categorized according to the following stages:

Preliminary Treatment
This will be the initial separation of the large solids by screening. Various types of static and mechanical screens are used. Unfortunately screens are prone to binding or blockage by the effluent over a period of time and will be subject to cleaning as part of a regular husbandry activity of the plant once it becomes operational.

Primary Treatment
This is the removal of oil/grease and small suspended solids by settlement or flotation and can include the use of settlement tanks, a clarifier or fat traps. This can be assisted by adding chemicals to the effluent to improve separation.

Secondary Treatment
This is the biological treatment stage using “friendly” bacteria to remove organic materials not taken out by earlier treatments, including substances dissolved in the water. Treatment is aerobic (with air) and is usually available in large tanks. The biological treatment is a slow and sensitive process requiring controlled conditions of operations and a regular supply of effluent.

Tertiary Treatment
This is the final cleansing stage and will be used to remove any remaining traces of contamination. Treatment processes can include fine filtration or disinfection (use of chemical for final treatment). The treatment can further pass through UV sterilization as an option.

APPENDIX 5: ANALYTICAL PARAMETERS AND TESTS

5.1 Field Measurements

The following measurements are recommended to be conducted in the field:

- Effluent temperature
- Dissolved oxygen
- pH
- total residual chlorine concentration

5.2 Laboratory analyses

Water samples from the effluent would need to be collected and send to a laboratory for analyses of the following parameters. The University of the South Pacific Laboratory in Fiji can undertake the following tests:

- Alkalinity
- Ammonia
- Biochemical oxygen demand
- Chemical Oxygen Demand
- Conductivity
- Dissolved Organic Carbon
- Metals, dissolved
- Metals, total
- Nitrate and Nitrite
- Oil and Grease
- pH
- Total Solids
- Total Suspended Solids
- Fecal Coliform Enumeration

5.3 Toxicity Test

This is to be performed on cultured tilapia fish that will be held in the outdoor settlement pond as part of a tertiary treatment process of the treated effluent.