Public Environmental Report for the Development of a Biodiesel Plant at the East Arm Precinct

Prepared for: Natural Fuel Limited

Prepared by: EcOz Environmental Services

August 2004

NATURAL FUEL LIMITED

Natural Fuel Limited

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EcOz Environmental Services has prepared this Public Environmental Report (PER) for the Development of a Biodiesel Plant at the East Arm Precinct. The PER has been prepared in accordance with Guidelines issued by the Northern Territory Office of Environment and Heritage, and in accordance with accepted professional standards. The PER has been prepared on the basis of information provided and available at the time of preparation, and the validity of the findings and recommendations is dependent on this information. Much of the information was provided by other parties, and was therefore beyond the control and verification of the consultants.

No warranty is made with respect to the findings, observations and conclusions in the PER.

Natural Fuel Limited Biodiesel Plant

Public Environmental Report

INVITATION FOR PUBLIC COMMENT

Natural Fuel Limited proposes to construct and operate a biodiesel plant in the industrial East Arm Precinct of Darwin, Northern Territory. The project will be situated on 1 ha of land that will be sub-leased from Vopak who are currently constructing the Darwin Industry Fuel Terminal.

In accordance with the provisions of the Northern Territory *Environmental Assessment Act* a Public Environmental Report (PER) which describes the project and the potential environmental impacts has been prepared by Natural Fuel Limited. The proponent has been directed under the Act to advertise the proposal and make available the PER, for public comment for a period of up to four weeks, from Friday 20th of August to Friday 17th of September 2004.

The PER will be available for public review at the following locations during this period:

- Casuarina Public Library, Bradshaw Terrace, Darwin.
- Palmerston Public Library, Civic Plaza, corner University Avenue and Chung Wah Terrace, Palmerston.
- Litchfield Shire Offices, 7 Bees Creek Road, Bees Creek.
- Northern Territory Library, Parliament House, Darwin.
- Charles Darwin University Library, CDU Casuarina Campus.
- Department of Infrastructure, Planning and Environment, Ground Floor, 38 Cavenagh St Darwin (Corner of Cavenagh Street and Knuckey Street).

The PER will also be available for viewing on the internet at the Department of Infrastructure, Planning and Environment site: http://www.lpe.nt.gov.au/enviro/eiareg/eiareg.htm. The PER can be purchased as CD-ROM copies, at a cost of $10.00 each, or in hard bound for $50.00. Copies of the PER may be purchased from:

EcOz Environmental Services
GPO Box 381
Darwin NT 0801
Phone 08 89811100

Email: ecoz@ecoz.com.au

People and organisations who are interested in making comments on the Public Environment Report are invited to make written submissions by close of business Friday 17th September 2004 to:

Office of Environment & Heritage
Attention: Cymbaline
PO Box 1680
Darwin NT 0801

Fax 08 8924 4053

EXECUTIVE SUMMARY

Natural Fuel Limited proposes to construct and operate a biodiesel processing plant on 1.5 ha of land sub-leased from Vopak in the East Arm Industrial Precinct, Darwin. The site will be bordered by Berrimah Rd, the Northern Cement Works and the Darwin Industry Fuel Terminal, which is currently under construction.

The project proposed by Natural Fuel Limited is the construction and operation of a processing plant to manufacture biodiesel, a biogenic fuel derived from vegetable oils and methanol. Biodiesel can be defined as 'a diesel fuel obtained by the esterification of oil (triglycerides) derived from plants or animals' (Australian Fuel Standard (Biodiesel) Determination 2003). Vegetable oil feedstock will be sourced from South East Asia and the methanol will be mainly sourced from Malaysia.

A Fuel Standard (Biodiesel) Determination 2003 has been developed under the Federal *Fuel Quality Standards Act 2000*. The determination states the maximum allowable levels of certain properties and components in biodiesel from 18 September 2003 and then from 01 February 2006. The biodiesel produced by Natural Fuel Limited must conform with the standards set out in the determination.

Under the current proposal, the processing plant will be located on the Natural Fuel Limited sub-lease along with a small tank farm, administration, control and maintenance buildings. The main storage tanks for feedstock, methanol and the biodiesel and pharma glycerine products will be constructed on the Vopak site and managed by Vopak. Movement of materials between the wharf and the Vopak site will also be managed by Vopak using the pipeline that is being established by the NT Government. The drumming facility that will be required for the pharma grade and lower industrial grade glycerine will also be located on the Vopak site.

All infrastructure will conform with the required legislation and current Australian Standards. Generally, all pipelines will be constructed above ground. However, an underground pipeline will be required for the supply of natural gas to the site to power the boiler.

Construction on the site is planned to begin in March 2005 with initial production of biodiesel occurring in late 2005.

The biodiesel product will be distributed by sea, road and rail overseas and interstate. Approximately 20 % of the biodiesel will be supplied to local distributors. Pharma grade glycerine will also be produced during the process. It will be sold to mainly interstate buyers for use in the food industry. As a result the plant must satisfy the kosher quality standard for the food industry and will be certified as an OU (Orthodox Union) Kosher processing facility by a Rabbinic coordinator and field representative. The Kosher trademark is not only a good indicator of a safe product to vegetarians and lactose intolerant persons but has come to represent an independent verification of quality, integrity and purity in a product.

Potential impacts on the environment are mainly concerned with the transport, storage and handling of the various hazardous materials used in the production of the biodiesel and pharmagrade glycerine such as hydrochloric acid, methanol, liquid caustic and sodium methylate. Numerous controls will be in place to ensure that the risks associated with these potential impacts are kept to an absolute minimum.

Various construction wastes will be produced during the construction phase. What is unable to be separated for re-use or recycling will be collected by a licensed waste disposal company and taken to landfill. Waste oils and lubricants will be separated from construction waste and disposed of appropriately by a licensed waste company.

As the plant will be producing pharmagrade glycerine, approximately 72 m^3 of residual process water will be produced by the plant daily. This water can be separated into streams based on COD content. Negotiations will be required with the relevant authority for its appropriate disposal, whether via the

local sewerage system or discharge into Darwin Harbour under a Waste Discharge Licence following treatment through a water treatment facility.

Natural Fuel Limited will produce a construction EMP prior to earthworks and construction taking place on-site, and an operation EMP prior to operating the production plant. The site will operate under an Environmental Management System (EMS) compliant with the International Standard ISO14001. Emergency protocols will be developed as part of this EMS in order to deal with emergency situations involving hazardous substances and natural, external events.

All risks assessed were found to have a low risk. The main risks associated with the project involved the spillage of hazardous substances or products. Due to the location of the site, spillages would pose little threat to the marine environment and any impacts to groundwater would be minor and temporary. The main impacts associated with these risks would be to human health and safety. Personnel will be trained in the transport, storage and handling of all chemicals on-site and will undergo drills to test emergency response on a regular basis. As the plant is largely automated, there will be little need for personnel to come into contact with hazardous substances unless spills or leaks occur.

The following commitments have been made in order to minimise the impacts to the environment on the various aspects of the project identified in the established guidelines for this report.

Aspect	Commitment
Landform	Natural Fuel Limited commit to the development of a construction erosion and sedimentation management plan as part of the construction EMP. Sediment control fencing will be established where required.
Water	Negotiate disposal options for residual process water and concentrated water with relevant authorities and obtain appropriate licences for disposal or discharge prior to operation commencing. Design and construct underground and above ground stormwater system based on a 10 year ARI (Australian Rainfall Intensity) and a 50 year ARI respectively. Drain water from all bunded areas to the waste water buffer tank. Direct all clean stormwater to offsite stormwater drains. Hourly, routine inspections will be conducted of the site to ensure that no pipelines or other infrastructure are leaking. Where deemed necessary, waste water will be removed by a licensed waste contractor. Tanks, bunds and pipelines will be constructed according to industry best practice and current Australian Standards and regulations. Spill response procedures and emergency protocols will be established for all chemicals on-site. These will be developed according to the MSDS and in consultation with the NTFRS. Personnel will be trained in the use of spill clean-up materials and in the spill response procedures. All spilt material will be removed by a licensed waste contractor (this will include materials used in the clean-up process).

Aspect	Commitment
Air Quality and Noise - Construction	Dust levels will be visually monitored by the site supervisor and dust suppression strategies implemented as required. Earthworks and construction activities will be restricted primarily to day-light hours. Noise levels will comply with *AS2436-1981 – Guide to noise control on construction, maintenance and demolition sites.*
Air Quality and Noise - Operation	Air emissions will be minimal at all times. Air emissions leaving the plant will have been passed through a scrubbing system as a minimal level of treatment. Procedures and protocols will be in place to prevent unplanned fugitive emissions. Where required, emergency protocols will be established. The Package Boiler System will be fitted with a relief safety valve. This will undergo an annual test. Noise generation will be negligible during operation.
Greenhouse Management	Natural Fuel Limited will subscribe to the Greenhouse Challenge. There will be no sulfur emissions from the plant or resulting biodiesel product. The processing plant and associated infrastructure will be designed and constructed according to the most relevant Australian and International Standards. As part of the induction process, personnel will be informed of the climatic conditions to be expected in the Top End and how best to combat these in the work environment. Emergency procedures will exist for personnel to abide by during emergency situations such as cyclones and fire. Drills will be conducted on these scenarios on a regular basis no less than annually.
Waste Management - Construction	All clean rock or rubble remaining from excavation activities will be removed for use elsewhere. Any waste that cannot be separated for recycling or re-use will be transported to an approved landfill facility for disposal. Waste oil will be collected in marked empty drums and will be removed from site by a licensed waste contractor to be disposed of at an approved facility. Portable toilets will be used on-site until the permanent facilities are made available.
Waste Management - Operation	Waste materials from the process will be temporarily stored in dedicated vessels for subsequent collection and disposal by a licensed waste contractor. Domestic waste will be removed regularly by a licensed waste contractor and

Aspect	Commitment
	taken to an approved landfill facility. Domestic waters and sewage will be treated via an on-site septic system.
Transport	Transport of all hazardous substances during construction and operation will comply with the NT *Dangerous Goods Act 1996* and the Australian Dangerous Goods Code 1998. All offloading and uploading of feedstock, methanol and products will comply with the established protocols of the Harbour Master. The biodiesel product will comply with the Australian Fuel (Biodiesel) Determination under the *Fuel Quality Standards Act 2000*.

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GLOSSARY

AHD	Australian height datum.
ARI	Australian rainfall intensity.
AS	Australian Standard.
COD	Chemical Oxygen Demand, a surrogate measure of organic substances dissolved in water.
CSIRO	Centre for Scientific and Industrial Research.
DIFT	Darwin Industry Fuel Terminal.
DIPE	Department of Infrastructure, Planning and Environment.
EGR	Exhaust Gas Reticulation.
EMP	Environmental Management Plan.
EMS	Environmental Management System.
ha	Hectares.
HCl	Hydrochloric acid.
LC 50 rate	A measure of dosage or concentration which kills half the sample population.
MCC	Master Control Centre.
NOx	Nitrogen oxides
NTFRS	Northern Territory Fire and Rescue Service.
PER	Public Environmental Report
Pharmagrade	Pharmaceutical Grade (applying to the product glycerine).
ppm	Parts per million.
RBD	Refined, bleached and deodorised (applying to the palm oil feedstock).
TDS	Total dissolved solids.
US EPA	United States Environmental Protection Agency.

1. INTRODUCTION

EcOz Environmental Services has been commissioned by Natural Fuel Limited to develop the Public Environmental Report (PER) for the construction and operation of the proposed Biodiesel manufacturing plant at the East Arm Port, Darwin.

This PER is required to facilitate the environmental approval for the proposed development by the Northern Territory Government in accordance with Clause 8 of the *Environmental Assessment Act 1994.* This report corresponds, where relevant, to the Guidelines for Preparation of a Public Environmental Report prepared by the Office of Environment and Heritage.

1.1 Name and Address of Proponent

Natural Fuel Limited
Level 1/387 Hay St
Subiaco WA 6008
Ph: 08 9388 8788
Fax: 08 9388 8787
Director: Mr Roger Stroud

1.2 Background to the Project

The project proposed by Natural Fuel Limited is the construction and operation of a processing plant to manufacture biodiesel, a biogenic fuel derived from vegetable oils and methanol. Biodiesel can be defined as 'a diesel fuel obtained by the esterification of oil (triglycerides) derived from plants or animals' (Australian Fuel Standard (Biodiesel) Determination 2003). Esterification is the conversion of a compound into an ester by a reaction between an acid and an alcohol with the elimination of a molecule of water. In the production of biodiesel, triglycerides (organic fatty acids) are mixed with alcohol in the presence of a catalyst (potassium or sodium hydroxide) to produce biodiesel and glycerine. The term 'biodiesel' has become the generic name for mono-alkyl esters of long chain fatty acids derived from renewable lipid sources via transesterification (Beer *et al.* 2000).

An ester is the organic equivalent of an inorganic salt. Vegetable oil or tallow belong to the same generic series of esters called triglycerides. They are the combination of glycerine (a three carbon molecule with an alcohol or an '-OH' group attached to each carbon) and three corresponding long chain fatty acids. In the biodiesel process of trans-esterification, the glycerine in the triglyceride molecule is displaced by the methanol in the presence of a catalyst to produce the methyl ester 'biodiesel' and a separate glycerine by-product. Ethanol can also be used to produce an ethyl ester, which has similar biodiesel properties.

Biodiesel can be used as a replacement for, or in a blended-combination with, mineral diesel fuel (eg. B5 is a blend of 5% biodiesel, 95% mineral diesel). Although a relatively new alternative fuel in Australia, biodiesel is a globally recognised and established fuel, especially amongst countries of the European Union and in the United States. Between 1996-2002 the production capacity of biodiesel in the European Union rose 4-fold to two million tonnes with manufacturing occurring in Germany, France, Italy, Czech Republic, Denmark, Austria and Sweden (Environment Australia 2003, Paper 6, National Standard for Biodiesel – Discussion Paper).

An Australian Standard for biodiesel has been developed under the Federal *Fuel Quality Standards Act 2000,* which provides the legislative framework for setting national fuel quality standards. The main objective is to regulate the quality of fuel supplied in Australia, over a specified time period, in order to:

- Reduce the level of pollutants and emissions arising from the use of fuel that may cause environmental and health problems;
- Facilitate the adoption of better engine technology and emission control technology; and

- Allow the more effective operation of engines (Environment Australia 2003).

The biodiesel produced by Natural Fuel Limited must conform with the Fuel Standard (Biodiesel) Determination 2003, established under the *Fuel Quality Standards Act*. The determination states the maximum allowable levels of certain properties and components in biodiesel from 18 September 2003 and then from 01 February 2006.

1.3 Biodiesel

Transport has been identified as the most significant contributor to urban ambient air pollution in Australia. Road vehicles are the dominant source of pollutants, with emissions of carbon monoxide, hydrocarbons, oxides of nitrogen and air toxics (Environment Australia 2003). Diesel fuel vehicles are a major source of certain oxides of nitrogen (NOx). Under particular conditions, NOx may combine with low molecular weight hydrocarbons to form a precursor for photochemical smog (Environment Australia 2003).

Biodiesel contains almost no sulfur and no aromatic compounds (Beer *et al.* 2000). Biodiesel is recognised as a renewable bio-based fuel with lower life cycle CO_2 emissions than mineral oil diesel (Beer *et al* 2000). As it is a simple, straight carbon chain with two oxygen atoms at one end, biodiesel is more readily broken down by bacteria and is biodegradable. Petroleum diesel hydrocarbons are more complex and lack oxygen and are therefore more difficult to degrade (Biodiesel Handbook 1999). Being derived from essentially edible oils and fats, biodiesel can be deemed non-toxic. Biodiesel is also recognised to be a safer fuel due to its high flashpoint (twice that of mineral diesel) (Environment Australia 2003).

Numerous studies have been conducted that demonstrate the environmental advantages of biodiesel to conventional mineral sourced diesel. Von Wedel (1999) found that biodiesel had low solubility and high biodegradation rates. This study investigated the harmful effects of biodiesel on larval fish and shrimp. Larval fish were found to have a LC 50 rate (a measure of dosage which kills half the sample population) of 578 ppm for biodiesel compared with 27 ppm for the reference fuel oil. Larval shrimp were found to have a LC 50 rate of 122 ppm compared with 2.9 ppm for mineral fuel. Death was attributed to the formation of droplets that formed on the gills of the larvae, resulting in suffocation rather than any toxic effects.

Diesel is not considered to be biologically active. It has very few components with oxygen attached and consists of a complex array of hydrocarbons, many of which biodegrade slowly or are non-biodegradable (Environment Australia 2003). Biodiesel by comparison is highly biologically active and being an organic ester, each hydrocarbon chain has at least two oxygen atoms attached. Studies have shown that biodiesel fuels are readily biodegradable (Zhang *et al.* Year Unknown). In 28 days, the biodegradability of rape seed methyl esters was 88.49% compared with 26.24% for diesel (Zhang, Tyson, from Environment Australia 2003). Further studies have shown that blending biodiesel with diesel can accelerate the biodegradation of mineral diesel (Zhang *et al.* Year Unknown). Biodiesel has also been shown to degrade under both aerobic and anaerobic conditions in freshwater and soil, whereas diesel is only degradable under aerobic conditions (Stolz from Environment Australia 2003).

1.4 Australian biodiesel standard

A biodiesel standard exists in Australia under the *Fuel Quality Standards Act 2000*. Table 1 shows the comparable properties between biodiesel and diesel under their respective determinations. Appendix 1 shows the full requirements for biodiesel under the Australian Fuel (Biodiesel) Determination.

Table 1. Allowable limits of certain substances and/or properties in biodiesel as at 18 September 2003 and Diesel as at date specified.

Property	Unit	Biodiesel	Diesel
Sulfur	mg/kg	50	500 (31 December 2002)
Distillation temperature	ºC	360ºC (max)(90% recovered)	<371ºC (95% recovered) (01 January 2002)
Cetane number		51 (minimum)	46 (at least)
Density	kg/m^3	860-890	820-860
Carbon residue (10% distillation residue)	% mass	0.3	0.2 (16 October 2002)
Water and sediment	% vol	0.05	0.05
Flash point	ºC	120 (minimum)	61.5 (minimum)
Polyaromatic hydrocarbons (PAHs)	Mass by mass	na	11% (max)
Viscosity	cSt@40ºC	3.5-5.0	2.0-4.5

1.5 Report Structure

The purpose of this PER is to assess the existing environmental conditions at the proposed plant location and to identify actual and potential environmental impacts of the proposed development during construction and operation. This will assist in the design and development of appropriate environmental management plans that will minimise environmental risks associated with the project.

The report consists of eight sections structured generally in accordance with the guidelines for the preparation of a PER:

Section 1 – Introduction

Section 2 – Describes the proposed development to allow a detailed understanding of infrastructure design and engineering at construction and operation.

Section 3 – Discusses alternative locations and management techniques.

Section 4 – Discusses the existing environment.

Section 5 – Discusses the potential environmental impacts of the development and the commitments to manage these potential impacts.

Section 6 – Risk assessment.

Section 7 – Environmental management.

Section 8 – Health and Safety.

2 THE PROPOSAL

2.1 Location

Natural Fuel Limited proposes to develop and operate a biodiesel plant on the Darwin Industry Fuel Terminal (DIFT) site, within the established industrial area of the East Arm Precinct, Darwin (Figure 1). The 20 ha DIFT site is currently leased from the NT Government by Vopak. The DIFT is situated in the East Arm Precinct industrial area along Berrimah Rd, between the railroad passenger terminal and the Northern Cement Works. The DIFT was originally termed the Darwin Joint Terminal under the management of Shell Australia and was subject of a Public Environment Report in 1999-2000. The lease has since been taken over by Vopak, who submitted an Environmental Assessment Report on the DIFT which was approved in March 2004.

2.2 Land tenure

The East Arm Precinct is zoned for industrial use, and is surrounded by industrial land. It is owned by the NT Government and leased to private organisations. The biodiesel plant site to be sub-leased from Vopak is located at the south-eastern end of the DIFT site and is bounded by the remaining DIFT development, Berrimah Rd and the Northern Cement Works (Figure 2). The closest zoned residential area is the town of Berrimah, which lies approximately 4 km north-east of the Precinct.

2.3 Lease of land proposed for development

A Memorandum of Understanding has been developed between Natural Fuel Limited and Vopak for the sub-lease of 1.5 ha of land from Vopak for the development of the biodiesel processing plant and some associated infrastructure (control room, administration building and small tank farm). Furthermore, Vopak will have a contract with Natural Fuel Limited to construct and operate a number of off-site services for the biodiesel plant on their own lease (on the remaining 18.5 ha), including:

- Construct, operate and maintain the main storage tank facilities for the feed oil, methanol, biodiesel product and glycerine,
- Transport bulk feed oil, methanol and biodiesel between the port and these storage tanks;
- Transport bulk feed oil, methanol, biodiesel and glycerine between the storage tanks and the processing plant; and
- Supply the products (biodiesel and glycerine) for distribution via road, rail or ship.

Negotiations are underway with a second contract company to take charge of the glycerine drumming and storage responsibilities.

2.4 Infrastructure

The required infrastructure that will be constructed in order to successfully construct and operate the biodiesel plant are summarised in Table 2. This table has been separated into two sections – infrastructure that will be located on the biodiesel plant site and infrastructure that will be provided on the Vopak site or come under the management and control of Vopak (eg. pipeline to the wharf).

Table 2. Infrastructure that will be required for the production of biodiesel.

Infrastructure	Area/Volume	Details
Natural Fuel Limited Site		
Biodiesel processing plant	Total area approx. 12×36 m	Unit 10 Transesterification Unit 11 Methylester-Drying Unit 12 Glycerine-water pre-treatment Unit 14 Glycerine-water evaporation Unit 16 Glycerine Distillation
Package boiler system		Will be completely housed in a suitable boiler building.

Infrastructure	Area/Volume	Details
Plant air compressor unit	Duty/Standby instrument air compressor (150 m^3/hr)	Housed in boiler building and also supplies air to the nitrogen unit.
Package nitrogen unit		PSA type that will be housed in the boiler building.
Cooling water system		Closed circuit reticulation system.
Fire suppression system		Underground ring main to fixed hydrants. Skid mounted electric/diesel dual pumps plus jockey pump.
Water break tank	Capacity to be determined following consultation with NTFRS.	Tank will also act as a buffer for water feed to the process and the utilities.
Hydrochloric acid tank (37%)	Approximately 27 m^3	Modified and secured ISO Tank or tanks. Sufficient for a 7 day inventory.
Caustic tank (50% solution)	Approximately 15 m^3	Sufficient for a 31 day inventory.
Sodium Methylate tank (30% solution)	Approximately 200 m^3	Modified and secured ISO Tank. Blanketed with Nitrogen to prevent ingress of water and permanently vented through the plant scrubbing system. Sufficient for a 31 day inventory.
Waste water buffer tank	Approximately 30 m^3	
Residual fatty matter from Unit 12	25 m^3	Sufficient for a 14 day inventory. Fatty matter will be removed by a licensed waste contractor for disposal or for use by others.
Distillation residue from Unit 16	25 m^3	Sufficient for a 5 day inventory. Distillation residue will be removed by a licensed waste contractor for disposal or for use by others.
Administration building	Approximately 10 m × 20 m	Single storey building - Administration offices - Training room - Health and safety room - Toilets and showers
Control building	Approximately 10 m × 14 m	Two-storey building - MCC and Instrument Control - Control Room and crib area - Small test laboratory - Toilets and one office.
Maintenance Building	Approximately 10 m × 15 m	Single storey building - Maintenance facilities - Spare parts storage.
Crude glycerine tank	100m^3	This tank will buffer the transfer of raw glycerine from unit 14 to unit 16 (distillation).

Infrastructure	Area/Volume	Details
Glycerine water tank	100 m^3	This tank will buffer the transfer of glycerine water from unit 10 to unit 12.
Biodiesel 'shift' tanks	2 × 250 m^3	Product is stored here until quality testing is completed (estimated to be 14 hours capacity) prior to being transported to the Vopak site.
Pharma Glycerine 'shift' tank	2 × 40 m^3	Product is stored here until quality testing is completed (estimated to be 26 hours capacity) prior to being transported to the Vopak site.
Industrial Grade Glycerine tank	15 m^3	Industrial glycerine will be stored on-site (estimated to be 7 days capacity); removed by a licensed contractor.
Antioxidant tank	60 m^3	Sufficient for a 31 day inventory for addition to the biodiesel product.
Underground pipeline for supply of natural gas.		Natural Gas to be supplied by NT Gas.
Vopak site or management		
Pipeline/s from wharf to Vopak site	2.5 km	To be constructed by NT Government and handed over to Vopak for operation and management.
Pipeline/s from biodiesel site to Vopak site, together with corresponding pumps, controls and interlocks.	Approximately 200 m	To be constructed by Vopak and Natural Fuel respectively to common fence line.
Vegetable oil feedstock tanks	3 × 5 000 m^3	
Methanol main storage tank	2000 m^3 storage tank (assuming one month's supply)	Sufficient for 31 day inventory. To be fitted with a floating roof to prevent vapour loss to the atmosphere.
Biodiesel product tanks	2 × 6 000 m^3	
Pharma glycerine product tank	250 m^3	To prevent water ingress this tank will be blanketed with nitrogen.
Glycerine drumming facility		1160 drums of pharma grade glycerine per week. 52 drums of industrial glycerine per week. NOTE: road tanker operation may be an alternative to drum filling.
Road tanker filling station		20% of biodiesel will be distributed locally via the bowser system currently being developed on the Vopak site.
Product transport		Product transport to the wharf, via road and rail will be the responsibility of Vopak.

2.4.1 Main storage tanks – Vopak site

As listed in Table 2, the main storage tanks for the feed oil, methanol and products will be built on the Vopak site and shall be in accordance with the required standards for tank construction and bunding requirements detailed in the DIFT Environmental Assessment Report (2003). These tanks will be constructed, operated and maintained by Vopak under a contract with Natural Fuel Limited.

Storage tanks will be required for the vegetable oil feedstock, methanol, biodiesel and pharma grade glycerine on the Vopak site. Currently, two tanks with 5 000 m^3 capacity are proposed for the storage of the vegetable oil feedstock (Refined, Bleached and Deodorised [RBD] Palm Kernel Oil and RBD Palm Olein) with a third spare tank for flexibility in receipt of shipments and in feeding the biodiesel plant. It is anticipated that one month's supply of methanol will be required, thus necessitating a 2 000 m^3 storage tank on the Vopak site.

Two 6 000 m^3 tanks will be built for the storage of the biodiesel product. A single, 250 m^3 tank will be built for the storage of the pharmagrade glycerine. This tank will be required to be blanketed with nitrogen to prevent the ingress of water.

2.4.2 Day tanks and chemical tanks – Natural Fuel site

As listed in Table 2, smaller tanks will be required for chemical storage to service the biodiesel plant operation. Expected tank size in each case has been judged on the expected delivery schedules available and the necessary volumes for continuous safe plant operation. A number of small tanks will be required for the by-products of the process including the industrial grade glycerine, fatty acid residue, distillation residue and waste water.

Tanks will be required for the by-products of the process including the excess process water, fatty acid residue and distillation residue. In addition, there will be a smaller 60m^3 tank required for the storage of antioxidant which is required to be continuously added to the biodiesel product tanks.

All storage tanks will be designed and constructed in accordance with Australian Standards *AS1940: The storage and handling of flammable and combustible liquids* and *AS1692: 1989 Tanks for flammable and combustible liquids* as well as all other required regulations.

A break tank will be installed to buffer the supply of process water, boiler make-up, cooling water make-up, plant water and domestic water. This tank will also serve as the supply tank for the fire suppression system.

Natural gas will be used for powering the boiler in the plant. This will be supplied by NT Gas and piped to the site through an underground pipeline. The greenhouse gas emissions have been calculated for the use of natural gas in section 5.4.2.

2.4.3 Pipeline connection to wharf

The pipeline infrastructure for the connection of the DIFT to the Darwin East Arm Wharf Facilities is currently being constructed by the NT Government and will be handed over to Vopak for operation and management. Consideration is being given to add suitable pipelines to carry feedstock, methanol and biodiesel between the wharf to the main Vopak storage tanks.

2.4.4 Pipeline connection between Vopak and Natural Fuel

Blends of feedstock oils and methanol will be fed from the Vopak tanks directly to the biodiesel plant on a continuous 24 hour operation. An integrated protocol system of process controls and interlock logic will operate between both sites to ensure continuous and safe transfer. Similar considerations will be given to the return transfer of product and pharmagrade glycerine to the Vopak Site. Biodiesel product will be piped to the Vopak site following temporary storage in a 'shift tank' while it undergoes required quality testing. The pharmagrade glycerine will also be stored temporarily in a 'shift tank' on the Natural Fuel Limited site while it is tested prior to transport to the Vopak site.

2.4.5 Processing Plant

The processing plant will consist of five units integrated into the one common plant structure to perform the following processes:

- Unit 10 - Transesterification;
- Unit 11 - Methylester drying;
- Unit 12 - Glycerin water treatment;
- Unit 14 - Glycerin water evaporation; and
- Unit 16 - Glycerin distillation.

The biodiesel production process is described in Figures 3 to 8. The processing plant will occupy an area of 12 m × 36 m. The majority of equipment, fittings and pipes will be stainless steel and operate under low temperatures and pressures (as described below in process description).

Currently, Natural Fuel Limited is investigating constructing the plant in modular form and shipping the modules to East Arm Port. The modules will be transported on multi-wheel trailers to the prepared site.

2.4.6 Additional infrastructure and facilities

Additional infrastructure and facilities will include a control building that will house the control room, master control centre (MCC) and instrumentation control, the laboratory for product quality analysis, a toilet facility and a shift supervisor's office. There will be a separate administration building to contain management and accounting offices, a health and safety room, a training room plus showers and toilets.(Figure 2). The workers' area will include showers, toilets and a crib room facility. Additionally, there will be a purpose built maintenance and storage building. All of these structures will be permanent buildings constructed according to the required Northern Territory building codes and requirements.

2.5 Proposed project schedule

Natural Fuel Limited is currently planning to begin construction of the processing plant and site infrastructure in March 2005 with an estimated completion date of December 2005 at which time operation and production will begin. It is envisaged that the main storage tanks on the Vopak site and the piping infrastructure will also be in place by this time.

2.6 Proposed plant layout

The proposed plant layout and associated infrastructure is provided at Figure 2. The current proposal is for one processing plant (Stage 1). As it is anticipated that demand for the biodiesel product will increase, the drawing shows two processing plants. The second processing plant will be developed during the second stage of development provided there is an increased demand for the product.

2.7 Process description

Natural Fuel Limited plans to engage Lurgi Pacific Pty Ltd to deliver the complete processing plant. The plant will be designed for a continuous 24 hour production of 360 tonnes of biodiesel per day, equating to a total of approximately 120 000 tonnes per year. Approximately 12 200 tonnes of pharmaceutical grade glycerine will also be produced from the process. The production of biodiesel involves the transesterification of a triglyceride oil (vegetable oil feedstock) with alcohol (methanol) in the presence of an alkaline catalyst (sodium methylate). Natural Fuel Limited propose to use a feedstock blend of 25% palm kernel oil and 75% palm olein. The desired properties of the various chemicals used in the process are detailed in Table 3.

Table 3. Properties for chemicals used in production process.

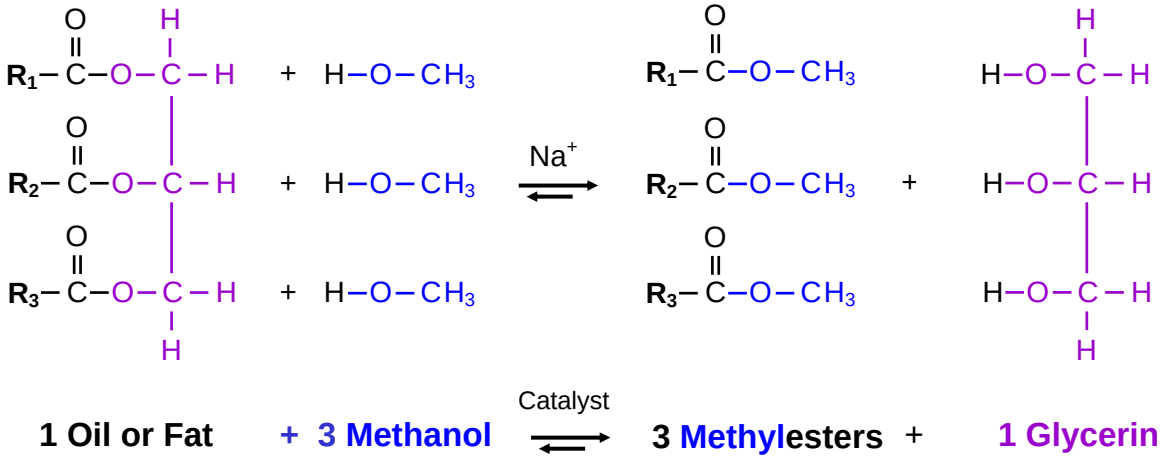
Chemical	Concentration	Form	Water Content	Colour
Methanol	99.85% (min)	liquid	max 0.1%	colourless
Hydrochloric Acid	approx. 37%	liquid	-	colourless
Caustic Solution	approx. 50%	liquid	-	colourless
Sodium Methylate Solution	30% in methanol	liquid	-	colourless

2.7.1 Transesterification and Drying

The transesterification of vegetable oil and methanol into methyl esters and glycerine is achieved in two sequential mixer-settler units. The reaction takes place in the mixers and the settlers are used to allow the two immiscible reaction product phases of methyl ester to adequately separate above the denser glycerine. The process is controlled to a defined temperature profile throughout the mixer-settler arrangement.

Following treatment through the first unit, the lighter 'oily' methyl-ester rich phase may still contain residual un-reacted palm oil and so is transferred to a second unit where fresh methanol and catalyst are added. As the product methyl ester may still contain impurities such as methanol, glycerine, soaps and small amounts of catalyst, it is passed through a simple water wash column. Emulsions are minimised by the addition of small quantities of acid (3.7% HCl) to split soaps that may be present. The washed ester is then vacuum-dried to remove any dissolved water. The biodiesel is buffered in the day shift tank for testing and then exported to the Vopak site.

The reaction can be described by the following chemical equation:



To help force the reaction and maximise conversion, an excess of methanol is used for trans-esterification. That excess is then recovered by distillation and circulated back to the trans-esterification process for re-use. Virtually all the methanol gets converted to methyl ester (>99.9%). All vapour spaces where methanol is present are permanently purged with nitrogen and vented through an in plant scrubbing system to minimise the potential egress of methanol to atmosphere. This approach has the advantage that it also prevents ingress of water into the system where it is not desired, especially as water causes the dissociation of the catalyst to methanol and sodium hydroxide.

2.7.2 Glycerine water treatment and evaporation

The heavier glycerine-rich phase is collected from the base of the first settler system and, together with the wash-water from the methyl ester water wash column, the stream is treated with hydrochloric acid preheated with steam to about 95ºC. The acid releases the fatty matter which then floats to the surface where it is skimmed off for separate disposal. At this stage the glycerine is at a concentration of about 35-40%. It is neutralised with caustic and treated in a 2-stage evaporation system which increases its concentration to approximately 80 - 85%. Steam is used in this process to not only

provide heat for evaporation of the water but also as motive steam in the vacuum ejectors. Temperatures are kept down by running the system under vacuum provided by the ejectors as well as a water ring seal pump. The resultant glycerine is transferred to the Crude Glycerine Tank for further processing into pharmagrade glycerine.

2.7.3 Glycerine distillation

Steam is used in the glycerine distillation unit to fractionate the glycerine into the major fraction Pharmaceutical Grade Glycerine (about 97% of the feed glycerine), and a lesser quality fraction of Industrial Grade Glycerine (3%). A small quantity of residual matter is retained at the base of the distillation column and this is periodically discharged to a separate tank for proper disposal. The main product fraction is bleached with activated carbon to remove final colorants and passed through a polishing filter to catch any remaining carbon residue to achieve the pharmaceutical grade quality. The pharmagrade glycerine is temporarily buffered in the Small Tank area while it is tested and then pumped to the Vopak site for storage, drumming and distribution.

The industrial grade glycerine is formed from condensation of the overhead vapours from the distillation column, and thus provides an outlet for some of the more volatile components which have entered with the crude glycerine feed to the distillation column. This secondary product will have a concentration of approximately 90% and may be used elsewhere for industrial purposes or disposed of by an approved waste disposal company. Finally, the heavier non-distilling components such as salts and soaps which accumulate at the base of the distillation column over time are periodically bled off and stored. This residual matter can be drummed for use by others or will be collected and disposed of by a licensed waste disposal company.

2.8 Design Principles

2.8.1 Construction phase

The site was reclaimed, filled and levelled by the NT Government prior to handover to Vopak for the development of the DIFT. All site works prior to the construction of the DIFT have been the responsibility of the NT Government and are not part of this proposal.

Temporary demountable buildings will be used on site during construction for offices, ablutions and crib rooms. Lay down areas will be fenced and the site will be fenced during construction to comply with the construction regulations.

The processing plant and associated infrastructure will be designed and constructed according to the relevant Australian and International Standards. Natural Fuel Limited will ensure that all statutory regulations and local by-laws are satisfied.

The civil works required for the site will include some earthworks, road and pathway construction, car parking facilities, site drainage, foundations for buildings and tank infrastructure, the biodiesel processing plant, and a small tank farm for chemicals servicing the operating plant. The administration and car park area will be bordered by landscaped gardens and the site will be surrounded by security fencing.

Excavation will be required for the laying of the foundations for the administration building, fresh water tank, waste water tank, fatty matter residue tank and liquid natural gas tank. Excavation will also be necessary for the preparation of the concrete bund that will house the chemical tanks. Trenching will be required for stormwater, potable water, communications, power and sewerage. The plant and tank infrastructure will be secured within concrete bunds. These bunded areas will be furbished with sumps and drain pumps which will transfer collected waters to the Waste Water Buffer Tank for proper disposal. All tanks and bunding will comply with the relevant guidelines and Australian Standards including, but not limited to:

- AS1940: 1993 Storage and handling of flammable and combustible liquids;

- AS1692: 1989 Tanks for flammable and combustible liquids; and
- AS1319: 1994 Safety signs for the occupational environment.

Pipelines for product and utility distribution to, from and around the processing plant will be located above ground in pipe racks. The pipelines to and from the Vopak site that will carry feedstock, methanol, biodiesel and glycerine will also be above ground. Where necessary, these pipelines will be protected by the installation of guard rails. All pipelines will be signed and labelled according to *AS 1345: 1995 Identification of the contents of piping, conduits and ducts*.

Due to the variable weather conditions that commonly occur across the Top End region, the following design conditions will be included in all design plans:

- The wind loading code AS1170.2 for Region C, with a permissible wind speed of 57 m/sec or an ultimate wind speed of 70 m/sec; and
- The earthquake loading code AS1170.4 with a general earthquake design category D for hazardous structures and a category B for other structures.

The *Northern Territory Work Health Act 2004* and accompanying regulations will govern construction standards.

Construction personnel will be sourced locally where possible and will work under the supervision of experienced engineers and the construction supervisor. As the site is not labour intensive (especially if the plant is pre-assembled offsite), the workforce is unlikely to exceed 50 personnel at any one time.

2.8.2 Operational phase

The processing plant will be operated 24 hours a day, every day, consisting of 2 × 12 hour shifts. Access to the site will be controlled by a swipe-card security system. At this stage, approximately 12 personnel will be required to fill four shift rosters with 2 to 3 personnel being on-site at any one time.

The plant will be producing pharmagrade glycerine to be used in the food industry. As a result the plant must satisfy the kosher quality standard for the food industry and will be certified as an OU (Orthodox Union) Kosher processing facility by a Rabbinic coordinator and field representative. The Kosher trademark is not only a good indicator of a safe product to vegetarians and lactose intolerant persons but has come to represent an independent verification of quality, integrity and purity in a product.

For the first six months of operation, feedstock and methanol will be delivered by ship on a monthly basis to the Vopak site. It will increase to approximately a fortnightly basis following this period. Delivery to the wharf will be managed by the Port and Vopak personnel, and stocks will be transported by pipeline to the main storage area on the Vopak site. Feedstock and methanol will be supplied to the processing plant as required. Weekly to monthly supplies of other chemicals such as hydrochloric acid, sodium methylate and liquid caustic will be maintained on-site.

Secondary by-products such as Industrial Grade Glycerine, fatty matter and distillations residue will be removed by a licensed waste contractor on an as-needed basis. Where required, waste water will be removed by a licensed contractor for subsequent proper disposal.

3 ALTERNATIVES

3.1 Not proceeding with the proposal

Not proceeding with the proposal would see the designated land being reclaimed at a later date for an alternative industrial development at the site. Natural Fuel Darwin would source a suitable location elsewhere in the country or overseas for the development of the plant.

3.2 Alternative locations for the proposal

The DIFT location has been selected as the most suitable location in Darwin for the establishment of the biodiesel plant as:

- Darwin would be closer for feedstock arrivals from overseas;
- The site is within a well established industrial area;
- The port facility provides good access to deep water for large vessels;
- The site provides good access to rail facilities for transport of product interstate;
- There is good access to the Trade Development Zone and industrial areas; and
- There is adequate separation from residential areas.

Originally Natural Fuel Limited investigated a site within the East Arm Port facility for the development of the processing plant as well as the storage tanks. This site required reclamation as it is currently being used as a water storage bund. Reclamation of land is not required at the DIFT location. Vopak are required to build all storage infrastructure to the current best industry standards and will implement emergency preparedness system such as fire suppression where required.

It is unlikely that any other area in Darwin would satisfy the above requirements and therefore alternative locations would need to be sourced interstate or overseas.

3.3 Alternative locations for components of the proposal

One alternative considered was to have the plant, day tanks and administration areas located on the reclaimed land within the Port and the main storage tanks at the Vopak site. This would have involved additional pipe work to be established between the plant and storage sites. The current location will minimise the required piping infrastructure.

3.4 Alternative environmental management techniques

Construction of the plant and associated infrastructure will operate under a construction environmental management plan and the operation will run under an operation environmental management plan. Both of these plans will ensure that all identified environmental issues are controlled and monitored. Where additional management plans are required, these will be developed in accordance with current Australian Standards and best practice technology, to ensure compliance with legislative and company requirements.

4 EXISTING ENVIRONMENT

4.1 Regional setting

4.1.1 Climate

The typical climatic regime of the Top End region has two distinct seasons. The 'Dry Season' occurs for approximately five months from May to September. During the dry season, temperatures remain warm to hot during the day usually ranging between the high twenties and low thirties, accompanied by relatively low humidity. Rain is uncommon during the dry season due to the dry south-easterly airstreams that pass over the Top End. Wildfire risk is increased during the dry season and winds are at times quite strong, creating rough seas in coastal waters.

The 'Wet' season consists of a transition period commonly referred to as the 'Build-up' and the 'Monsoon'. The build-up usually occurs from October to December and is the seasonal change between the end of the dry season and the beginning of the monsoon rains. Humidity is greatly increased during this time with daytime temperatures typically in the low to middle thirties in coastal regions with minimum temperatures mostly around the middle twenties. Winds are mainly light and humidity remains high in coastal areas throughout the day. Periods of monsoon activity over the Top End peak in January and February, producing cloudy conditions and frequent rains, which when persistent can produce flooding. Conditions are typically very humid but relatively cool with daytime temperatures often restricted to the high or mid twenties.

4.1.2 Land use

Currently the 1.5 ha site that has been ear-marked within the DIFT for the biodiesel processing plant and associated infrastructure is a cleared area that presently houses portable, demountable offices for GHD, Vopak and the Land Development Corporation. There is a carpark area at the front of these buildings and a car pull-up area to the rear. There are lay-down areas for general construction materials within the 1.5 ha area as well.

Plate 1A. Proposed plant site. Photo from Berrimah Rd.

Plate 1B. Proposed plant site. Photo from back of demountable offices.

The area surrounding the proposed site is an industrial region known as the East Arm Precinct. The plant site will be bounded by the Northern Cement Works, Berrimah Rd and the DIFT. The closest residential development is approximately 4 km from the port area.

4.1.3 Land sensitivities

The surrounding area is an industrial site developed to assist the growth of Darwin's trading ability (Acer Vaughan 1993). The site was prepared by the NT Government prior to being taken over by Vopak for the development of the DIFT. The DIFT site was previously known as Quarantine Island and some low-lying sections of land previously containing mangrove muds (SKM 1999). To make the site suitable for industrial development, the site has been cut and filled to bring it to a common elevation of 5.5 m AHD.

There is little information regarding ground water at the site. Aquifers are low yielding with water quality being typically saline to hypersaline and not suitable for irrigation or human consumption (SKM 1999).

4.1.4 Aboriginal relationships to the land

Two flaked stone points were found near the higher sections of Quarantine Island during the archaeological survey for the Darwin Port Expansion – East Arm Environmental Impact Statement (Acer Vaughan 1993). During the EIS, sites of cultural significance to Aboriginal people were identified on Catalina Island and the associated sandbar. No sites of cultural significance were identified near the proposed location.

5 POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT

5.1 Landform

As noted above, the site has been prepared, filled and graded by the NT Government prior to the construction of the DIFT. All site works prior to the laying of the foundations and the construction of the biodiesel plant are the responsibility of the DIFT and are outside the scope of this report. Civil works for the site will include road construction, car-parking facilities, site drainage, establishment of foundations for infrastructure, the biodiesel processing plant, small storage tanks and utilities.

5.1.1 Erosion and sedimentation control

Construction is planned to begin in March 2005 and to continue through the 2005 dry season. During earthworks and construction, the site supervisor will monitor the site for any potential erosion and implement control measures where required. As the site is bordered by road and industry and is some distance to any water body, sedimentation will not be an issue. However, sediment control fencing will be established where required to minimise any potential material mobilising from the site that may result from late wet season storms.

A construction erosion and sedimentation management plan will be developed as part of the construction EMP prior to construction taking place on site.

5.1.2 Commitments

- Natural Fuel Limited commit to the development of a construction erosion and sedimentation management plan as part of the construction EMP.
- Sediment control fencing will be established where required.

5.2 Water

5.2.1 Water balance

Approximately 14 m^3 of domestic freshwater will be required on an hourly basis in the plant. Water will be initially stored in a break tank which will also serve as the supply tank for the fire system. This water will be used for steam generation, as cooling water make-up and process water in both the biodiesel and glycerine producing processes. The distribution of water input to the plant is detailed in Table 4 and the water output in Table 5.

Table 4. Breakdown of freshwater usage in the processing plant on an hourly basis.

Consumer		Estimated Average Flow	Comments
1	**Process Water**	0.3 m^3/h continuous	Primarily for dilution of chemicals added to control pH.
2	**Cooling Water Make Up**	10.7 m^3/h continuous	To largely compensate for the water evaporation which provides the necessary water cooling.
3	**Boiler Package Unit**	2.5 m^3/h continuous	Steam ejectors are used to generate vacuum and the resultant condensate cannot be recycled to the boiler. The water makes up for the loss.
4	**Plant Water**	1 m^3/d estimated	General purpose use of water around the plant site.
5	**Domestic**	0.75 m^3/d estimated	
6	**Periodic** a) Wash water to bleaching – Back flow in bleaching b) Wash water to still	~ 5 m^3 every 3 months ~ 40 m^3 every 3 months ~ 4 m^3 every 12 hours	Used for discharging activated carbon and replacing with fresh carbon. Used for cleaning the exchanger surfaces.
Average Total Consumption:		13.93 m^3/h **Say 14 m^3/h**	

Table 5. Breakdown of water output from the processing plant.

Consumer			Estimated Average Flow	Comments
1	**Sealing Water (Steam Condensate)**		2.0 m^3/h	COD ~ 4.2 kg/hr
2	**Used Process Water**		0.7 m^3/h	COD ~ 30 kg/hr
3	**Cooling Water System**		10.1 m^3/h	Released as evaporated water vapor to atmosphere.
			0.6 m^3/h	As liquid ~ 1500 ppm Total Dissolved Solids (TDS).
4	**Boiler Package Unit**		0.1 m^3/h	As liquid ~ 1500 ppm TDS.
5	**Used Plant Water**		1 m^3/h estimated	Discharged through normal plant drainage system. NOTE: bunding will apply to all areas where potential leakage from the process or from tanks might occur. The collected waters will be directed to the Waste Water Buffer Tank.
6	**Domestic Water**		0.75 m^3/d estimated	Treated to Standard Specification and discharged from typical Biosolids Treatment Unit.
7	**Periodic**	(a) AC loading/discharge	45 m^3 / 3 months	Released to drain – no COD.

Consumer			Estimated Average Flow	Comments
		(b) Wash Water from still	~ 4 m^3 every 12 hours	Generated on a 12 hour cycle – average COD 17 kg/hr.
Average Total Output:			13.93 m^3/h	Round-up to **14 m^3/h** for worst case scenario.
Average Total residual process water 1 +2+ 7(b)			**3 m^3/h**	**Total COD content - 51.2 kg/hr**
2+ 7(b)			**1 m^3/h**	**47 kg/h of COD**

5.2.2 Residual process water

Outputs of residual process water are documented in Table 5 above. The water containing up to 1500 ppm total dissolved solids (TDS) arising from the cooling water system and boiler package unit will contain the organic and inorganic contents of the freshwater that entered the system. The majority of the initial water would have been released to atmosphere as part of the cooling system process and hence the remaining water will be more concentrated. Approval for the disposal of this water will be sought from the Office of Environment and Heritage under the *NT Water Act 2004.*

Of the 14 m^3 of water generated from the plant hourly, approximately 3 m^3 will contain COD derived from the original vegetable oil fed to the plant. The sealing water derived from the vacuum generating is expected to have a COD level of about 2 kg/h. This volume depends greatly on the ambient temperature, humidity and the amount of steam required to create a vacuum in the glycerine evaporation and glycerine distillation sections of the plant. During winter, it is expected that the volume of sealing water produced hourly would be closer to 1.7 m^3.

The remaining 1 m^3/h of combined used process water and wash water from the still (2+7b) will have an estimated COD content of 47 kg/h (comprised of residual glycerine, methanol and fatty matter). This equates to a concentration of approximately 47000 mg per litre of water per hour (47000 mg/L/hr). The accepted guidelines for COD for trade waste to the NT Power and Water sewerage treatment facilities is 1200 mg/L of water. Waste water will be stored in the waste water buffer tank situated adjacent to the small tank farm on the site.

The disposal of the 3 m^3/h (1+2+7b) waste water has not been resolved at this point due to a number of options being considered including an on-site water treatment plant or municipal waste water treatment plant. Negotiations are required with the relevant authorities for the required water specifications for the various disposal options. Negotiations will be conducted with Power and Water, to determine whether or not disposal of this waste water to sewerage is acceptable and the required specifications for the water. If an agreement can be made, a Trade Waste Agreement will be sought with the Power and Water Corporation. However, if this water is not suitable for treatment at a sewerage treatment facility, negotiations will be held with the Office of Environment and Heritage to decide on the water specifications that are required in order to acquire a Waste Discharge Licence to be issued under the *NT Water Act 2004*.

The appropriate licences to dispose of the waste water generated by the processing plant will be obtained prior to operation occurring on the site.

5.2.3 Stormwater management

The site was elevated during preparation so as not to be susceptible to flooding. Underground and above ground stormwater design will be consistent with the Vopak site and will be based on a 10 year ARI (Australian Rainfall Intensity) and a 50 year ARI respectively.

Clean stormwater run-off from the administration building, car park area, non-bunded areas and pathways will be directed to the offsite stormwater drains.

The bunded tank farm area will drain to the waste water buffer tank in order to minimise the risk of contaminating the stormwater system. The bund drain is to remain closed and water released only after it is deemed appropriate. The contents of the waste water buffer tank will be removed by a licensed waste collector as required.

Routine, hourly site inspections will also be conducted around the plant to ensure that there are no leaks from pipelines or bunds.

Effluent from the on-site septic/biosolids treatment facilities will be discharged to the offsite stormwater drainage system. This water will undergo routine monitoring prior to entering the offsite drainage system.

5.2.4 Potential risks

East Arm Port is situated in Darwin Harbour and therefore there are surrounding marine and estuarine environments that must be protected. The site to be used for the biodiesel plant is bordered by Berrimah Rd, the Northern Cement Works, and the DIFT. If a leak or spill of a chemical or residual process water was to occur on the site, it is highly unlikely that any spilt substance would reach the harbour or influence surrounding groundwater bodies. The following precautionary and response measures will be undertaken to minimise the risk of water contamination resulting from a spill from the processing facility:

- Bulk volumes of process liquids and chemicals will be stored in properly designed tanks and tanks that will be secured in appropriately bunded areas and will be equipped with leak detection mechanisms;
- Spill response procedures will be developed for every chemical stored on the processing site;
- Emergency protocols will ensure that all spills are controlled at source, contained on site and cleaned up according to the requirements of the Material Safety Data Sheet (MSDS) to be provided by the manufacturers;
- Spill containment procedures will include a requirement to block stormwater drains in the case of an incident;
- The NTFRS will be consulted regarding the appropriateness of all emergency procedures and infrastructure; and
- Spill containment and clean-up equipment will be available on site at all times and personnel will be trained in the appropriate use of the equipment.

As mentioned previously, biodiesel is highly biologically active and biodegrades rapidly when compared with mineral diesel (Zhang, Tyson, from Environment Australia 2003). Studies have shown that blending biodiesel with diesel can accelerate the biodegradation of diesel (Zhang, Tyson, from Environment Australia 2003). Biodiesel is not toxic, however, if in significant concentration it may have a short-term impact on larval and sedentary marine life due to suffocation from obstructed gill structures.

The highest risks associated with this site will be spills of hazardous substances such as methanol and hydrochloric acid. All precautionary measures will be taken to minimise the risk of spills and leaks occurring. Personnel will be trained and competent in the handling of all chemicals that are stored on-site. Spill procedures will be developed and will specify requirements for small spills and large spills of every major chemical stored on the area. All spilt material will be removed by an approved waste collector once deemed safe to do so (this will include materials used in the clean-up process).

5.2.5 Commitments

- Negotiate disposal options for residual process water and concentrated water with relevant authorities and obtain appropriate licences for disposal or discharge prior to operation commencing.
- Design and construct underground and above ground stormwater system based on a 10 year ARI (Australian Rainfall Intensity) and a 50 year ARI respectively.
- Drain water from all bunded areas to the waste water buffer tank.
- Direct all clean stormwater to offsite stormwater drains.
- Hourly, routine inspections will be conducted of the site to ensure that no pipelines or other infrastructure are leaking.
- Where deemed necessary, waste water will be removed by a licensed waste contractor.
- Tanks, bunds and pipelines will be constructed according to industry best practice and current Australian Standards and regulations.
- Spill response procedures and emergency protocols will be established for all chemicals on-site. These will be developed according to the MSDS and in consultation with the NTFRS.
- Personnel will be trained in the use of spill clean-up materials and in the spill response procedures.
- All spilt material will be removed by a licensed waste contractor (this will include materials used in the clean-up process).

5.3 Air Quality and Noise

5.3.1 Construction

Currently, the site identified for construction of the biodiesel plant is part of the construction site for the DIFT. As a result there is dust and noise generation that is typical of a construction site situated in an industrial area. Dust suppression is being utilised where required.

Construction of the processing plant and associated infrastructure will not elevate dust levels above what currently exists at the site. Dust generation is anticipated to be localised and minor and will not impact on any residential areas. However, as construction is proposed to occur over the 2005 dry season, dust suppression may be required. Dust levels are to be visually monitored by the site supervisor and suppression implemented using trucks or sprinklers if deemed necessary. Any complaints relating to dust generation will be investigated and suppression strategies instigated if required. This will be further identified in the construction EMP.

Earthworks and construction activities will be restricted primarily to day-light hours and noise levels will comply with *AS2436-1981 – Guide to noise control on construction, maintenance and demolition sites*. Increases in traffic will be minimal and mainly restricted to construction personnel as infrastructure will be delivered primarily by ship and rail. Noise levels during construction will be

minimal for an industrial site and will not impact on any residential areas, the closest of which is over 4 km away.

5.3.2 Operation

Air emissions during operation will be minimal and are tabulated in Table 6. All spaces in the mixer-settlers, the catalyst pump tank and the methanol pump tank will be gently purged with nitrogen. The resultant gases will be directed through a dedicated water scrubbing system which will return water to the process. Any vapours and non-condensable gases that are remaining from the glycerine evaporation and distillation processes will be drawn through steam ejectors, condensers and a final water-ring seal pump which in itself is a very effective scrubbing system.

Table 6. Estimated air emissions from biodiesel and glycerin production (figures supplied by Lurgi Pacific Pty Ltd)

	Biodiesel production	**Glycerine distillation**
Gaseous emission	Exhaust air 12 m^3/h N_2 (max. methanol content: 1 kg/h)	Exhaust air: 8 m^3/h

Fugitive gas emissions may include methanol, natural gas and steam. The 1 kg/h of methanol in Table 6 is a maximum value in case of plant upset and is not a continuous value for long-term plant operation. Procedures and protocols will be in place to prevent unplanned fugitive emissions from the plant. Where deemed to be required, emergency protocols will be established to ensure that any unplanned fugitive emissions are controlled and dealt with in a fast and efficient manner.

Boiler stack gas will be produced resulting from the combustion of Natural Gas in a conventional MP Boiler System. This will be compliant with the usual emission standards for such steam boilers. For plant safety reasons the Package Boiler System will be fitted with a relief safety valve, which will rarely operate and possibly only need to undergo an annual test.

Noise generation will be negligible during operation. Some noise will be generated by the electric drives within the plant. These will be specified with a Noise Specification of <85 dBA at 1 metre.

5.3.3 Commitments

Construction

- Dust levels will be visually monitored by the site supervisor and dust suppression strategies implemented as required.
- Earthworks and construction activities will be restricted primarily to day-light hours.
- Noise levels will comply with *AS2436-1981 – Guide to noise control on construction, maintenance and demolition sites.*

Operation

- Air emissions will be minimal at all times.
- Air emissions leaving the plant will have been passed through a scrubbing system as a minimal level of treatment.
- Procedures and protocols will be in place to prevent unplanned fugitive emissions.
- Where required, emergency protocols will be established.
- The Package Boiler System will be fitted with a relief safety valve. This will undergo an annual test.
- Noise generation will be negligible during operation.

5.4 Greenhouse Management

Emissions studies have been conducted on biodiesel for the past decade. Results from these studies show a large degree of variation due to the type of biodiesel used, the blends used, types of engines, fuel injection methodology and the test methods used (Environment Australia 2003). Beer *et al.* (2000) state that the amount of greenhouse gas emissions arising from the process of biodiesel production depends on the amount of fossil fuel involved in the production of the alcohol (Methanol). Biodiesel requires less fossil energy to make one unit of fuel compared with mineral diesel and the biggest advantage is that its largest component (palm oil) is renewable (Beer *et al.* 2000). There will be no sulfur emissions from the plant or biodiesel product.

5.4.1 Electricity usage

The following greenhouse gas emission results are estimates based on the proposed usage information supplied by the plant manufacturer. Natural Fuel Limited will subscribe to the National Greenhouse Challenge and will re-evaluate consumption data on an annual basis and will supply all relevant information to the Australian Greenhouse Office.

Table 7 details the anticipated amount of electricity consumed by the plant per tonne of biodiesel and per tonne of pharmagrade glycerine produced. The resulting associated greenhouse gas emissions associated with the quantity of electricity used is calculated using the following formula sourced from the Australian Greenhouse Office Factors and Methods Workbook, Version 3 – March 2003:

GHG emissions (t CO_2-e) = Q × EF/1000

Where: **Q** (activity) is the electricity used expressed in KWh; and
EF (emission factor) is the full fuel cycle EF in Kg CO_2-e/kWh for the State or Territory in which the business operates.

Table 7. Anticipated electricity consumption and GHG emissions for biodiesel and glycerine production.

Product	Q (kWh) per tonne of product	EF for the NT (Kg CO_2-e/kWh)	GHG emissions (t CO_2-e) per tonne of product	Annual totals GHG emissions (t CO_2-e)
Biodiesel	11	0.654	0.007	840
Glycerine	37	0.654	0.024	293

5.4.2 Natural gas usage

If used, on average 275 922 GJ of natural gas will be used annually in the processing plant. The greenhouse gas emissions resulting from the usage of this amount of natural gas was calculated using the following formula obtained from the Australian Greenhouse Office Factors and Methods Workbook, Version 3 – March 2003:

GHG emissions (t CO_2-e) = Q × EF/1000

Where: **Q** is the quantity of natural gas consumed and expressed in GJ and sourced from supplier invoices/meters; and

EF (emission factor) is the point-source emission factor kg CO_2-e/GJ coefficient for the state or territory in which the business operates (NT = 51.8).

The resulting greenhouse gas emissions from the use of natural gas are estimated to be 14292.8 t CO_2-e.

5.4.3 Biodiesel emissions comparison

Numerous studies have been conducted comparing the emissions resulting from biodiesel and mineral diesel fuel in vehicles (Beer *et al.* 2000). There is a large degree of variation in the results. Studies in the US show that generally biodiesel use reduces particulate matter, carbon monoxide and sulfur dioxide emissions compared with diesel fuel (Beer *et al.* 2000). Life-cycle analysis of the use of biodiesel showed that the CO_2 emissions are much lower than for petroleum diesel. This is mainly due to the fact that biodiesel production requires only small amounts of fossil fuel and that the largest raw resource is renewable.

Past studies have had variable results in comparing NOx emissions resulting from biodiesel use compared with mineral diesel (Beer *et al.* 2000). A study by the US Environmental Protection Agency found a decrease in all general pollutant emissions with the use of 100% biodiesel but an increase in NOx emissions by 2 % when compared with conventional diesel (US EPA 2002).

This study further investigated the effects of the cetane number of biodiesel on NOx emissions. The cetane number is a measure of the ignition quality of fuel based on ignition delay in an engine. The higher the cetane number the better the ignition quality. The cetane number of biodiesel varies widely and on average is higher than that for mineral diesel. The US EPA found a correlation between the cetane number and level of NOx emissions. This study was based on car models whose engines were not equipped with exhaust gas recirculation (EGR). In engines that were equipped with EGR, the difference between the cetane numbers had a negligible effect on NOx emissions.

The cetane number for palm oil is similar to that of mineral diesel. As it is a triglyceride oil and not a mono-saturated or poly-saturated oil, it is expected to burn in a similar manner to diesel resulting in similar NOx emissions.

5.4.4 Positive energy balance

The amount of energy required to produce fuel compared with the amount of energy released by the fuel when it is burned is termed an 'energy balance'. A low energy balance would indicate that there is merely a transfer of energy from one form to another and that there is no overall increase in the amount of energy available to society. Biodiesel derived from soybeans has been found to have a positive energy balance with 3.23 units of energy gained compared with 0.83 units that are gained for diesel (US Department of Agriculture and Energy from Environment Australia 2003).

5.4.5 Management of potential climatic changes

The CSIRO estimate that sea level rise will be between 9 to 88 cm between 1990-2100 or at a rate of 0.8 to 8 cm per decade (CSIRO 2001). Additional changes may include an increase in flooding due to more intense and sporadic rainfall with more droughts likely in inland areas. Estimated Australian temperatures will be 0.4 to 2 degrees higher in 2030 than what they were in 1990. The regions of origin for tropical cyclones are likely to remain the same, however, maximum wind speeds may increase by 5-10% with precipitation rates increasing by 20-30%. More hot days are to be expected

with fewer cold days. These climatic changes will result in increased evaporation rates, potentially higher fire danger and heat stress on people and materials.

The Top End is particularly susceptible to adverse weather conditions, including severe lightning storms and cyclonic events that generate rough seas, intense wind activity and torrential rains.

The processing plant and associated infrastructure will be designed and constructed according to the most relevant Australian and International Standards. Design and construction will comply with *AS 1170: 2002 Structural Design Actions – General Principles*, which details the structural design requirements to combat various cyclone intensities.

As part of the induction process, personnel will be informed of the climatic conditions to be expected in the Top End and how best to combat these in the work environment. Emergency procedures will exist for personnel to abide by during emergency situations such as cyclones and fire. Drills will be conducted on these scenarios on a regular basis no less than annually.

5.4.6 Commitments

- Natural Fuel Limited will subscribe to the Greenhouse Challenge.
- There will be no sulfur emissions from the plant or resulting biodiesel product.
- The processing plant and associated infrastructure will be designed and constructed according to the most relevant Australian and International Standards.
- As part of the induction process, personnel will be informed of the climatic conditions to be expected in the Top End and how best to combat these in the work environment.
- Emergency procedures will exist for personnel to abide by during emergency situations such as cyclones and fire. Drills will be conducted on these scenarios on a regular basis no less than annually.

5.5 Waste Management

5.5.1 Construction

During construction, it is inevitable that wastes will be generated. General waste may include but not be limited to:

- Plastic, cardboard and scrap steel;
- Domestic rubbish;
- Waste oils and solvents; and
- Excess building and excavation material.

All clean rock or rubble remaining from excavation activities will be removed for use elsewhere. Any waste that cannot be separated for recycling or re-use will be transported to an approved landfill facility for disposal.

Waste oil will be collected in marked empty drums and will be removed from site by a licensed waste contractor to be disposed of at an approved facility.

Portable toilets will be used on-site until the permanent facilities are made available. These wastes will remain in sealed tanks within the portable toilets and will be collected and disposed of by an approved, licensed contractor.

5.5.2 Operation

Operational wastes that will be produced by the plant include waste water, fatty matter and used activated carbon (Table 8). Waste water was detailed under section 5.5 and gaseous emissions under section 5.3.2 and are not repeated here.

Table 8. Waste generated from processing plant during operation.

	Biodiesel processing and glycerine treatment	**Glycerine distillation**
Fatty matter	58 kg/h	-
Distillation residue	-	176 kg/h
Used activated carbon	-	8 tonnes/year

These materials will be temporarily stored in dedicated vessels for subsequent collection and disposal by a licensed waste contractor.

Domestic waste will be removed regularly by a licensed waste contractor and taken to an approved landfill facility.

Domestic waters and sewage will be treated via an on-site septic system.

5.5.3 Commitments

Construction

- All clean rock or rubble remaining from excavation activities will be removed for use elsewhere.
- Any waste that cannot be separated for recycling or re-use will be transported to an approved landfill facility for disposal.
- Waste oil will be collected in marked empty drums and will be removed from site by a licensed waste contractor to be disposed of at an approved facility.
- Portable toilets will be used on-site until the permanent facilities are made available.

Operation

- Waste materials from the process will be temporarily stored in dedicated vessels for subsequent collection and disposal by a licensed waste contractor.
- Domestic waste will be removed regularly by a licensed waste contractor and taken to an approved landfill facility.
- Domestic waters and sewage will be treated via an on-site septic system.

5.6 Transport

5.6.1 Construction

It is envisioned that minimal additional traffic will be generated during the construction of the processing plant and associated infrastructure. This increase in traffic will be temporary and will have a negligible impact on surrounding businesses and no impact on residential areas.

Natural Fuel Limited is currently investigating the possibility of constructing the main plant interstate as one complete module or two sub-modules and transporting them via ship to East Arm Port. Alternatively, if construction is to occur in Darwin, parts will be transported from interstate via rail, road and sea.

5.6.2 Operation

Vehicle entry and exit to the processing plant site will be via Berrimah Rd and will be constructed to the requirements of the Division of Transport and Roads of the DIPE. This entry and exit point will be required to accommodate road tankers that will be required to access the site to deliver fresh catalyst and chemical stocks and to remove wastes.

The raw vegetable oil feedstock will be shipped to Darwin Port facility from South East Asia. Methanol will also be shipped to the Port facility from suppliers in Indonesia and Malaysia. Delivery of fresh feedstock and methanol will occur on a monthly basis for approximately the first six months of operation and will then increase to fortnightly delivery. Both the vegetable oil and methanol will be piped from the docking area to the Vopak site for storage.

The biodiesel product will be stored on the Vopak site to await transportation. The product will be shipped to overseas and interstate clients. The rail may also be required for transport of biodiesel product to interstate clients. In order to minimise the amount of additional ships entering the Port, where appropriate and able, once a ship has delivered feedstock, it will be filled with biodiesel. Approximately 20% of the biodiesel product will be used locally and a filling station will be made available on the Vopak site to accommodate road trains. It is estimated at this stage that there will be, on average, one additional road train entering the Vopak site weekly resulting in a negligible increase in traffic on the site.

Additional required chemicals such as hydrochloric acid, sodium methylate and caustic (liquid) will be transported via road or rail from interstate suppliers on an estimated monthly basis. Transport during both construction and operation will comply with the *NT Dangerous Goods Act 1996* and the *Australian Dangerous Goods Code 1998.* All required uploading and offloading that occurs at the Port will comply with the established protocols of the Harbour Master. Emergency protocols will be developed in consultation with the Darwin Port Corporation, Vopak and Natural Fuel Limited in the case of large spills of feedstock, methanol or biodiesel product during delivery.

As per the *Fuel Quality Standards Act 2000*, documentation will be issued to all customers detailing that the fuel complies with the biodiesel determination and the properties of the fuel as prescribed by the regulations.

5.6.3 Commitments

- Transport of all hazardous substances during construction and operation will comply with the NT Dangerous Goods Act 1996 and the Australian Dangerous Goods Code 1998.
- All offloading and uploading of feedstock, methanol and products will comply with the established protocols of the Harbour Master.
- The biodiesel product will comply with the Australian Fuel (Biodiesel) Determination under the Fuel Quality Standards Act 2000.

6 RISK ASSESSMENT

The scope of the risk assessment was the proposed biodiesel plant and associated infrastructure to be located in the East Arm Precinct, Darwin, Northern Territory. The study relied on information on the project provided by Natural Fuel Limited and Lurgi Engineering as well as expert technical advice from sub-consultants to the project. Any future variations of a substantive nature from the project's design at the stage of the risk assessment may influence the findings of this risk assessment.

The study is an environmental risk assessment, however, it does address risks associated with the occupational health and safety of personnel.

The terms of reference are as defined in the guidelines to the Public Environment Report. The Guidelines suggested that:

> external risks to the project be considered in addition to the on-site risks associated with the project. External risks from natural hazards should be determined on the basis of *AS/NZS 4360:1999 Risk Management*.

6.1 Methods

The methods used for this Environmental Risk Assessment follow those described in the Australian Standard *AS/NZS 4360: 1999 Risk Management*.

Environmental risk assessment and management provide a formal set of processes that help when making decisions affecting the environment, and the project design and development, and assists decision-makers to deal with uncertainty. The risk assessment process is designed to minimise uncertainty associated with potential and actual risks and hazards.

This Risk Assessment aims to assess the risks and identify management practices to mitigate potential impacts with the proposed biodiesel plant project. The objectives for the risk assessment were:

- To identify the hazards and resultant risks to the environment from the project as a whole, and threats from environmental aspects to the project;
- To rank and prioritise risks through a risk assessment process; and
- To identify management measures to mitigate the risks.

Aspects and activities are evaluated against AS4360 by allocating a qualitative measure of likely consequence (Table 9) and likelihood (Table 10). From these a risk ranking has been developed for each aspect. Risks with rankings in the extreme and high categories are considered to be significant and will be addressed in particular, and those in the low and moderate categories addressed by accepted practices for each of the activities.

Table 9. Criteria and consequence of activity occurring.

Consequence		
1	**Insignificant**	No measurable impact on the environment. No injuries. Low-nil financial loss.
2	**Minor**	Minor, temporary environmental impact. No publicity likely and no stakeholder concerns. First aid treatment required. Medium-low financial loss.
3	**Moderate**	Substantial temporary or permanent minor, localised environmental damage. Stakeholder enquires (this may include gov't, unions or public). Medical attention required. High-medium financial loss.
4	**Major**	Substantial or permanent environmental damage. Prosecution possible. Loss of company credibility and high stakeholder interest. Permanent injuries. High financial loss.
5	**Catastrophic**	Widespread severe and permanent Environmental damage. Major stakeholder and media interest. Prosecution likely. Permanent injury or death. Extreme financial loss.

Table 10. Qualitative measures of likelihood.

Probability/Likelihood		
A	**Rare:**	Practically impossible, will only occur in exceptional circumstances. Has never occurred in the industry.
B	**Unlikely:**	Could occur at some time but highly unlikely. Has occurred in the industry previously.
C	**Moderate:**	Might occur at some time. Has occurred in associated companies previously.
D	**Likely:**	Known to occur or will probably occur in most circumstances**.** Has occurred several times/year in associated companies.
E	**Almost Certain:**	Common or repeating occurrence. Is expected to occur several times/year in any associated business.

The likelihood of an event occurring provides a measure of the known or anticipated frequency of occurrences. Combined with the consequences, they provide guidance on risk levels of each aspect and enable ranking of priorities. The risk levels used in this risk assessment are given below in Table 11.

Table 11. Risk rankings used by combining consequence with likelihood levels for each aspect identified.

		Consequence				
Likelihood		1	2	3	4	5
	A	1	3	6	10	15
	B	2	5	9	14	19
	C	4	8	13	18	22
	D	7	12	17	21	24
	E	11	16	20	23	25

Where;

- Red = extreme risk
- Purple = high risk
- Yellow = medium risk
- Green = low risk

6.2 Assessment of risks

A risk assessment was conducted using the above criteria for likelihood and consequence (Appendix 2). The majority of risks associated with potential impacts to the environment or to the health and safety of personnel involved spills or leaks of hazardous and/or flammable substances. All of the risks assessed were determined to be 'low' due to various controls that will be implemented including but not limited to:

- All tanks and bunds will be designed and constructed according to the relevant Australian Standards and regulations;
- All infrastructure will be designed and constructed according to wind loading and earthquake loading requirements;
- A fire suppression system will be installed throughout the site;
- There will be little to no requirement for personnel to come into contact with chemicals being used in the process as the system will be fully automated;
- The site will be manned 24 hours, 7 days a week;
- All personnel will be trained in the storage, transport and handling requirements of all chemicals on-site;
- Hourly site inspections will occur;
- The site must be maintained in pristine condition in order to satisfy the Kosher standards;
- There will be a no smoking and no alcohol policy across the entire site; and
- Emergency response procedures will be developed to deal with spills of all chemicals at various volumes.

7 ENVIRONMENTAL MANAGEMENT

7.1 Environmental Management System (EMS)

It is the intent of Natural Fuel Limited to develop an integrated management system that would encompass quality, environment and safety. This system will be compliant with industry best practice and the following standards:

- ISO 14001, Environmental Management Systems – Specifications with Guidance for Use (1996).
- AS4801, Occupational Health and Safety Management Systems – Specifications with Guidance for Use (2001); and
- AS/NZS ISO 9001 Quality Management Systems – Requirements (2000).

An EMS will be able to provide a structured framework to enable Natural Fuel Limited to support environmental protection and minimise any potential or actual impacts of the operation. A component of the EMS will be to ensure that best available technology and the element of continuous improvement is implemented and maintained. Natural Fuel Limited recognises that environmental management needs to be integrated with all aspects of construction and operation of the biodiesel plant.

Emergency management plans will be developed according to section 4.4.7 of ISO14001. These will include contingency plans to deal with spills of hazardous substances and wastes and will also account for natural disasters and external influences on the processing plant. Where the Harbour Master has established procedures for emergency management (eg. cyclones and fire) Natural Fuel Limited will comply with the requirements of these protocols.

7.2 Personnel

The operation of the plant will be contracted out to an experienced contract company. They will be responsible for the logistics of the site including the operation and maintenance of the plant, small tank farm and administration area. Regular, routine inspections of the plant and associated infrastructure will be required and will be detailed in the operation EMP.

All contractors and employees (personnel) working during the construction and operation phases of the plant will be required to attend an induction session that will highlight the responsibilities of all personnel whilst on the site and all health and safety and environmental obligations. The induction will cover roles and responsibilities for;

- Emergency preparedness and response;
- Monitoring requirements;
- Spill control, containment and clean-up procedures;
- Environmental safeguards; and
- Hazard and Incident reporting.

Occupational Health and Safety requirements will also be addressed at this induction including;

- Personal Protective Equipment requirements;
- Expected safe work practices;
- Evacuation procedures; and
- Hazard and Incident reporting.

Plant operators will be trained by the company responsible for the plant design and development in the operation and maintenance requirements of the plant. Training will be undertaken to ensure that all personnel are aware of their roles and responsibilities and their day-to-day requirements.

7.3 Environmental Management Plans (EMPs)

Objectives will be established and EMPs developed to ensure that any potential or actual environmental risks associated with the activities, products and services of the biodiesel plant are minimised. EMPs will be developed for the construction and operational phases of the project, primarily for those aspects identified in this PER and will include the following;

- Targets and Objectives;
- Potential impacts and risks;
- Management and mitigation strategies;
- Roles and responsibilities; and
- Monitoring requirements.

All environmental commitments made in this PER will be included and indexed in the Construction and Operational EMPs.

7.4 Monitoring and Reporting

Regular, routine inspections will be conducted on an internal basis. If certification of the integrated management system is decided, then the site will undergo regular external inspections as part of the certification process.

8 HEALTH AND SAFETY

Risks to health and safety will be mitigated at all stages of development of the biodiesel project.

8.1 Construction

Lurgi Engineering, the company designing and developing the plant on behalf of Natural Fuel Limited, proposes to appoint a full-time safety officer in the construction team who would have direct access to the corporate Quality and Safety Manager.

A first aid station will be available in one of the demountable buildings and an appointed first aid officer will be on-site at all times during construction. The location of the first aid station and first aid personnel will be incorporated into the site induction. Where injuries are not treatable at the first aid station, personnel will be transported to the nearest medical facility. In the case of serious injury, paramedics will be contacted and personnel transported by ambulance to the Royal Darwin Hospital.

Visitors to the site will be accompanied by an inducted person at all times. They must adhere to the required personal protective equipment (PPE) requirements for the site and be readily identifiable as a visitor. Records of all visitors are to be taken and include time in, time out, company representing, personnel accompanying and a signature of the visitor.

8.2 Operation

Similarly to the construction phase, a first aid station will be available at all times on the site (in the administration building) and at least one person on every shift will be trained in first aid protocol. Emergency contact numbers are to be clearly displayed around the plant. Emergency procedures will be developed in accordance with element 4.4.7 of the International Standard ISO 14001 and will be tested on a regular basis.

The site induction will include health and safety information such as PPE requirements, health and safety policy, safe working expectations, emergency protocols, first aid room location and emergency contact details. The site induction must be completed by all personnel prior to starting work. Inductions will be recorded and records maintained on site.

As per the construction stage, visitors to the site will be accompanied by an inducted person at all times. They must adhere to the required personal protective equipment (PPE) requirements for the site and be readily identifiable as a visitor. Records of all visitors are to be taken and include time in, time out, company representing, personnel accompanying and a signature of the visitor.

Natural Fuel Limited have designated the Darwin biodiesel plant to be a smoke and alcohol free site. There will be a no alcohol and no smoking policy enforced on the site at all times.

Pristine housekeeping will be a mandatory requirement in order to satisfy the Kosher food standards that the site will comply with.

9 REFERENCES

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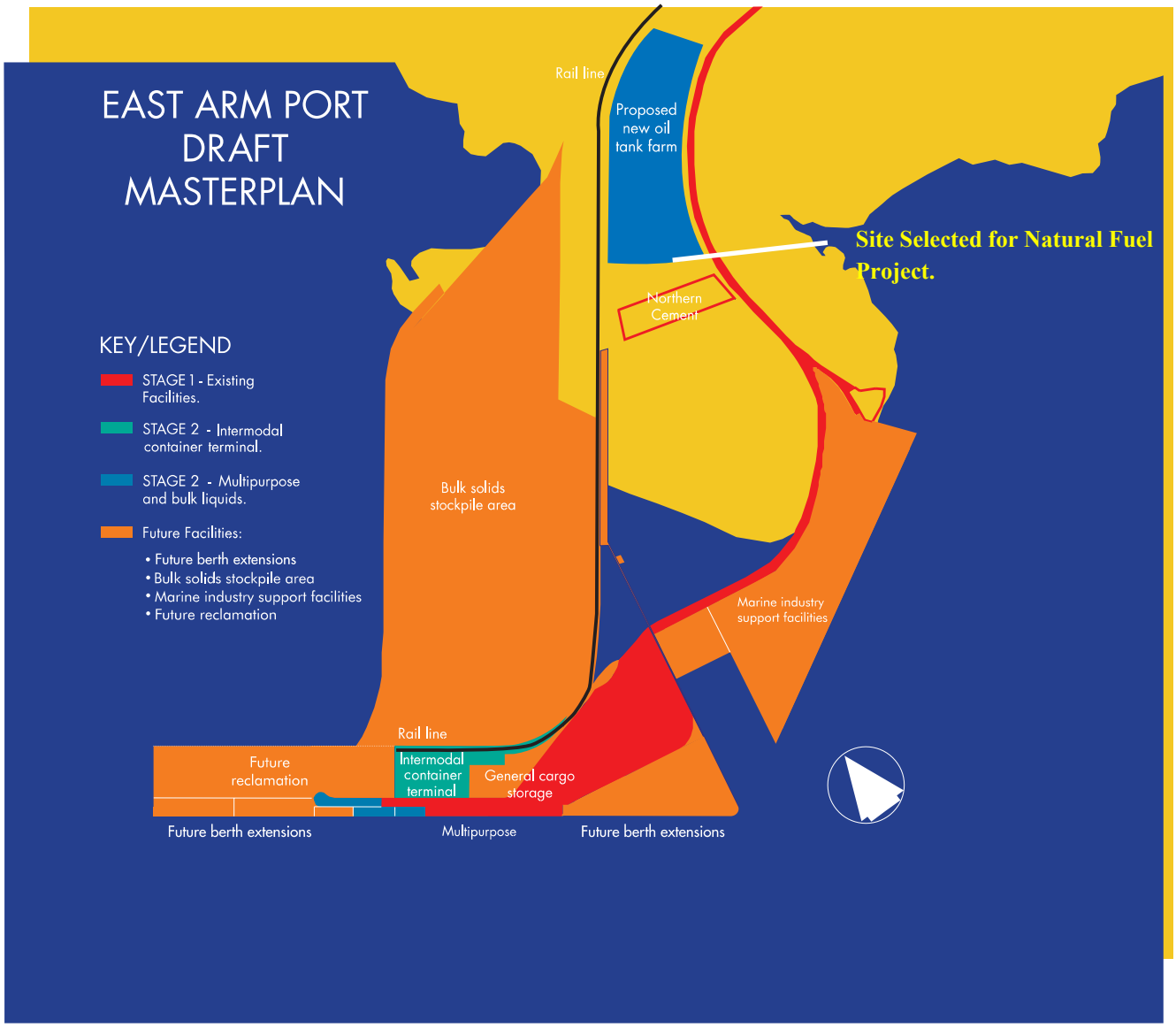
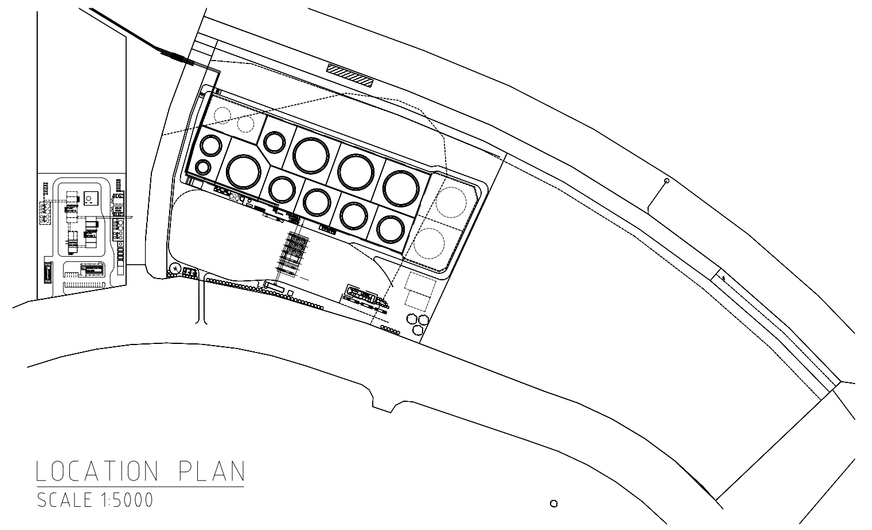


Figure 1. East Arm Port Draft Masterplan showing site selected for Natural Fuel Ltd project. Plan sourced from Port of Darwin Handbook.

Figure 2.
Proposed site layout.

SITE PLAN
SCALE 1:500



LOCATION PLAN
SCALE 1:5000

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		A	ISSUED FOR APPROVAL	L. LOI			03-08-04
DRAWING No.	DESCRIPTION	No.	REVISION DESCRIPTION	DRAWN	CHECKED	APPROVED	DATE

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CLIENT: NATURAL FUEL LIMITED

PROJECT: PROPOSED BIODIESEL PLANT DARWIN

SITE & LOCATION PLAN

PROJECT LEADER:	Jim Van Der Meer
DESIGNER:	Lindsey Glass
DRAFTSPERSON:	L. Loi
DATE:	03-08-04
SCALE:	AS SHOWN
DRAWING SIZE:	A1
JOB No.:	4371
DRAWING No.:	A01
REVISION:	B

Process Description Figures

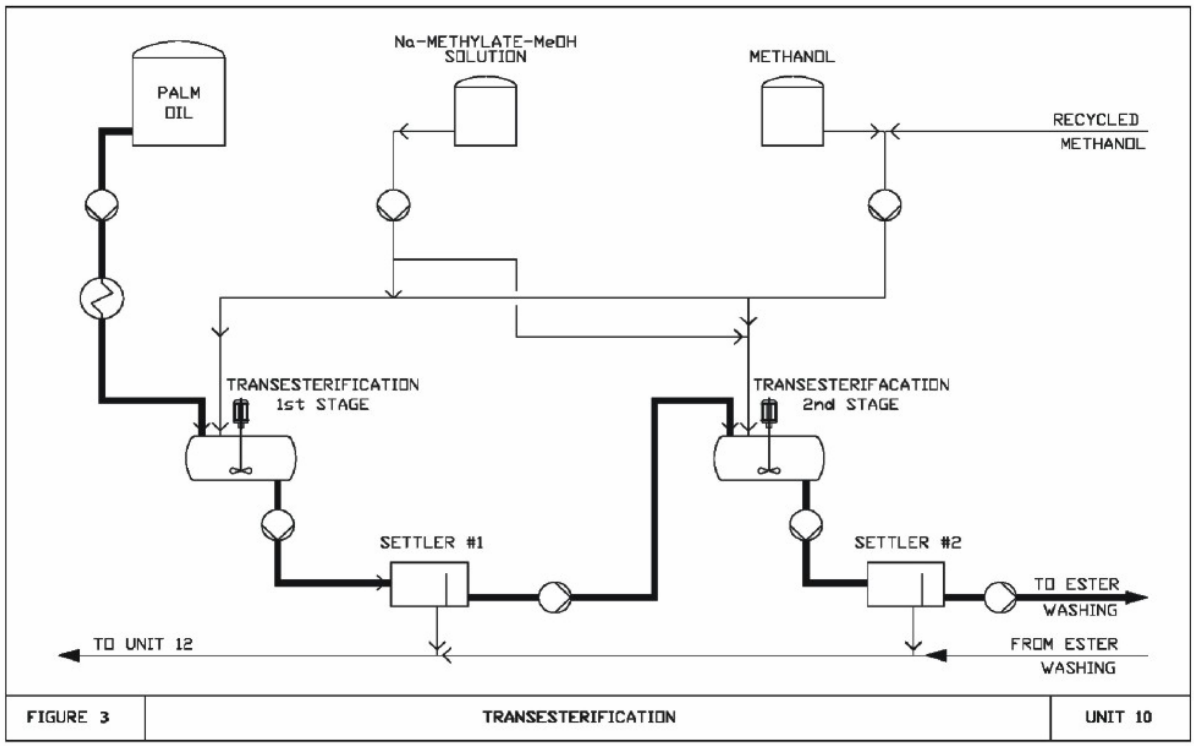

FIGURE 3	TRANSESTERIFICATION	UNIT 10

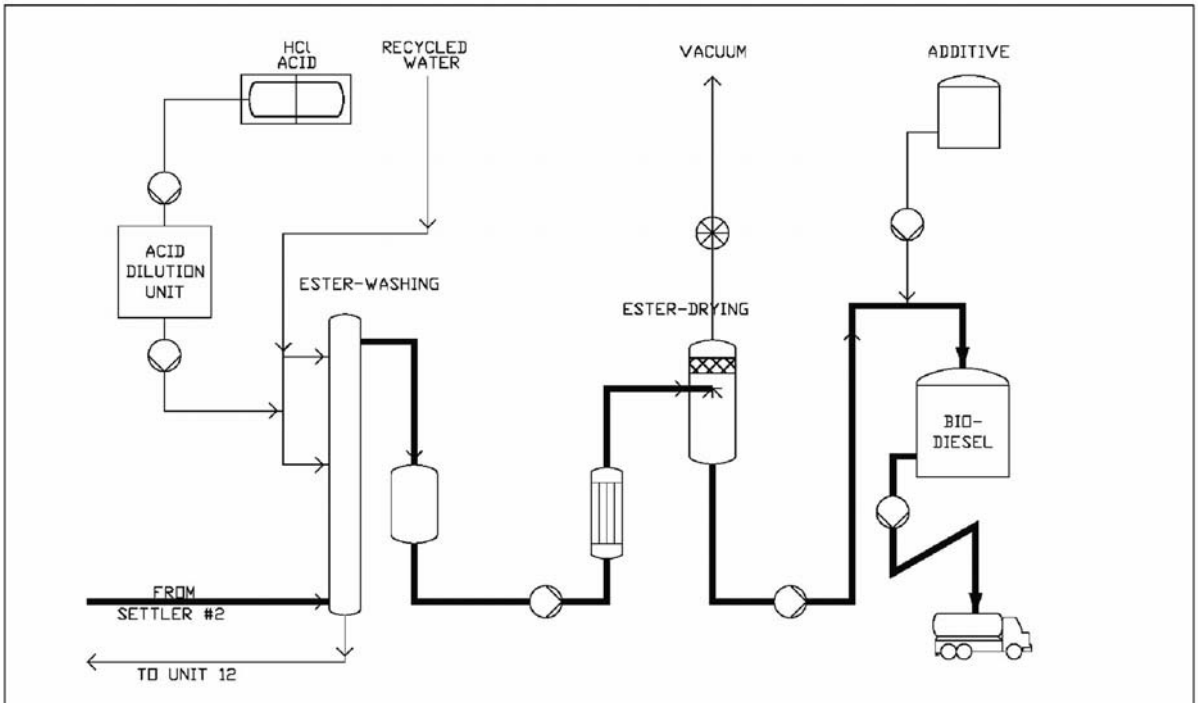

FIGURE 4	BIODIESEL WASHING AND DRYING	UNIT 10 & 11

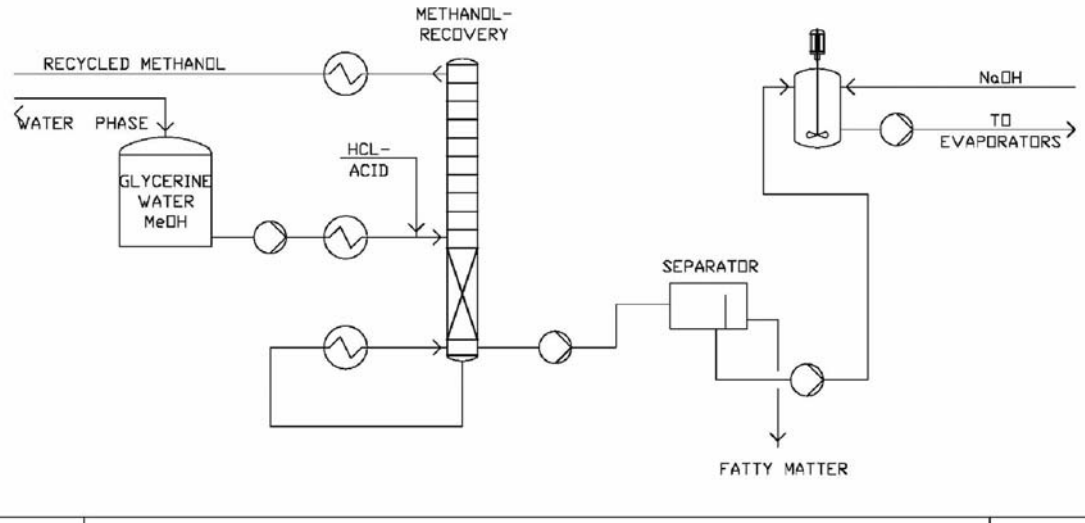

FIGURE 5	METHANOL RECOVERY AND GLYCERINE WATER PRETREATMENT	UNIT 10 & 12

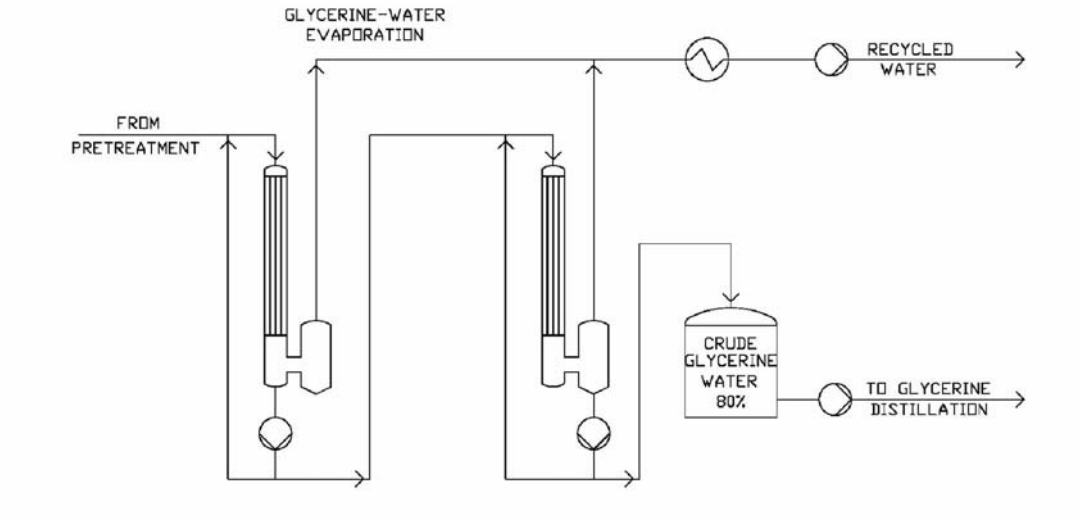

FIGURE 6	GLYCERINE- WATER EVAPORATION	UNIT 14

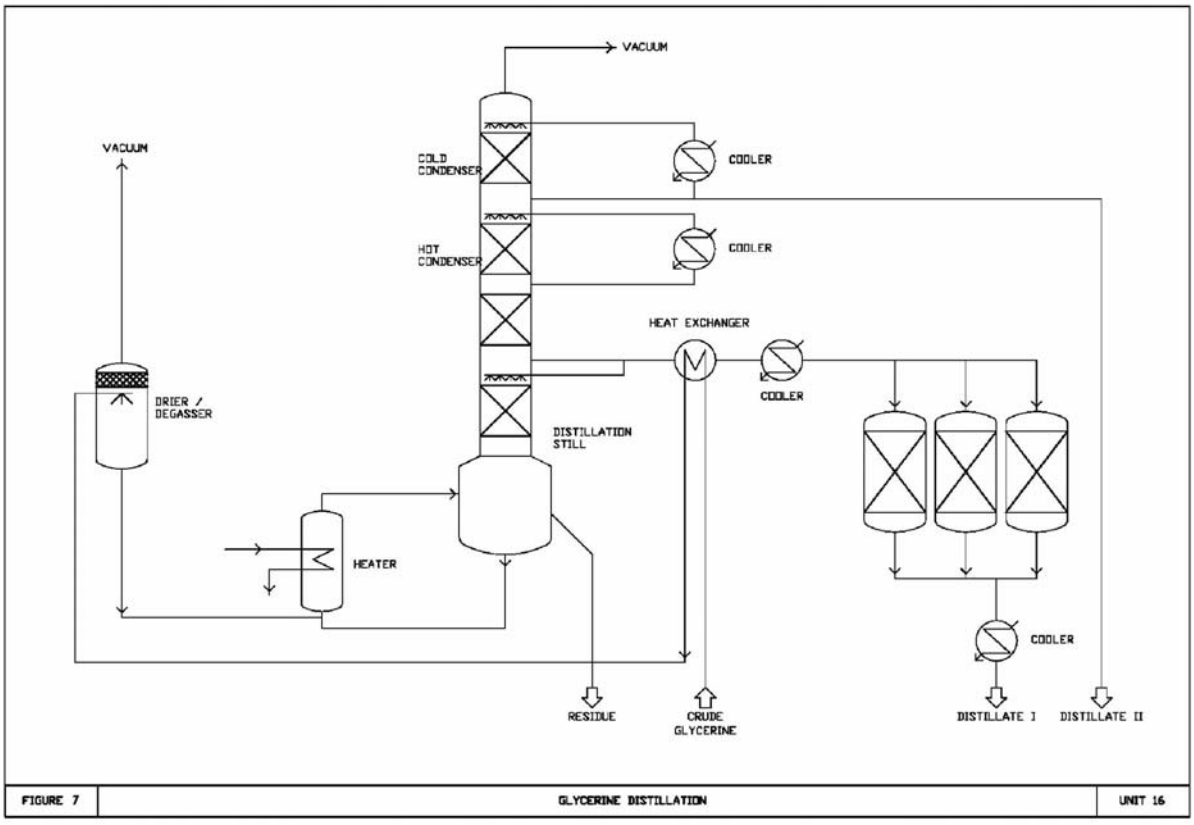

FIGURE 7	GLYCERINE DISTILLATION	UNIT 16

Appendix 1
Fuel Standards Act 2000
Fuel Standard (Biodiesel) Determination 2003

Table 1. Summary of acceptable parameters, the test method and date of effect for biodiesel under the Fuel Standard (Biodiesel) Determination 2003.

Parameter	Standard	Test Method	Date of Effect
Sulfur	50 mg/kg (max) 10 mg/kg (max)	ASTM D5453	18 Sep 2003 1 Feb 2006
Density	860 to 890 kg/m^3	ASTM D1298 or EN ISO 3675	18 Sep 2003
Distillation T90	360ºC (max)	ASTM D1160	18 Sep 2003
Sulfated Ash	0.020 % mass (max)	ASTM D874	18 Sep 2003
Viscosity	3.5 to 5.0 mm^2/S @ 40ºC	ASTM D 445	18 Sep 2003
Flashpoint	120.0ºC	ASTM D93	18 Sep 2003
Carbon Residue (10% distillation residue) (100% distillation residue)	 0.30% mass (max) or 0.050% mass (max)	 EN ISO 10370 ASTM D4530	18 Sep 2003
Water and sediment	0.050% vol (max)	ASTM D2709	18 Sep 2003
Copper strip corrosion (3 hrs @ 50ºC)	No. 3 (max)	ASTM D130	18 Sep 2003
Ester content	96.5% (m/m)(min)	prEN 14103	18 Sep 2003
Phosphorous	10 mg/kg (max)	ASTM D4951	18 Sep 2003
Acid value	0.80 mg KOH/g (max)	ASTM D664	18 Sep 2003
Total contamination	24 mg/kg (max)	EN 12662 ASTM D5452	18 Sep 2004
Free glycerol	0.020% mass (max)	ASTM D6584	18 Sep 2004
Total glycerol	0.250% mass (max)	ASTM D6584	18 Sep 2004
Cetane number	51.0 (min)	EN ISO 5165 ASTM D613	18 Sep 2004
Cold Filter Plugging Point	TBA	EN 116	18 Sep 2004
Oxidation stability	6 hours @ 110ºC (min)	prEN 14112 or ASTM D2274 (as relevant for biodiesel)	18 Sep 2004
Metals	≤ 5 mg/kg Group I (Na, K) ≤ 5 mg/kg Group II (Ca, Mg)	prEN14108, prEN14109 (Group I) prEN 14538 (Group II)	18 Sep 2004
Alcohol content	<0.20% (m/m)	prEN 14110	18 Sep 2004

Appendix 2.
Risk Assessment

Activity	Aspect	Impact	Risk			Severity of Impact Mitigation Measures and Controls
(product or service)			Consequence	Likelihood	Risk Score	
Acquisition of feedstock and methanol and supply of biodiesel						
Ship delivering feedstock.	Equipment damage during delivery and/or offloading resulting in feedstock entering Darwin Harbour.	Potential impact on larval fish and crustaceans. May result in coating of birds and fish resulting in hypothermia or increased susceptibility to predation.	2	B	5	1. Temporary impact as vegetable oil is not toxic and biodegradable. 2. Tanker operations to be carried out by experienced personnel only. 3. Offloading to be carried out by experienced tanker and shore based personnel. Wharf personnel in constant communication with tankers during delivery (UHF ship-shore radios) to shut-down pumping if required. 4. Emergency response plans will be initiated by Harbour Master if required.
Ship delivering methanol.	Equipment damage during delivery and/or offloading resulting in methanol entering Darwin Harbour.	Potential impact on water quality and fauna and flora of Darwin Harbour. Potential impact to harbour personnel health due to toxic nature of methanol.	3	B	9	1. Impact would be temporary as methanol is fully soluble and biodegradable in water and soil (Methanol Institute). Half-life of 1-7 days. 2. Methanol spill response procedure will be developed in consultation with Natural Fuel Limited and Vopak and managed by the Harbour Master. 3. All personnel dealing with the transport and offloading of methanol will be experienced in handling flammable and toxic substances.

Activity	Aspect	Impact	Risk			Severity of Impact Mitigation Measures and Controls
(product or service)			**Consequence**	**Likelihood**	**Risk Score**	
Ship transporting biodiesel.	Equipment damage during delivery and/or uploading resulting in biodiesel entering Darwin Harbour.	Potential impact on larval fish and crustaceans. May result in coating of birds and fish resulting in hypothermia or predation.	2	B	5	1. Temporary impact due to the biodegradability of biodiesel. 2. Tanker operations to be carried out by experienced personnel only. 3. Uploading to be carried out by experienced tanker and shore based personnel. Wharf personnel in constant communication with tankers during delivery (UHF ship-shore radios) to shut-down pumping if required. 4. Emergency response plans will be initiated by Harbour Master if required.
Piping of feedstock and methanol to Vopak site from wharf and biodiesel from Vopak site to the wharf.	Failure of pipeline between wharf and Vopak site.	Soil contamination and potential local water contamination.	2	B	5	1. Pipeline designed so that there is protection against collision with vehicles. 2. Emergency spill response procedures to be developed in consultation with the Darwin Port Corporation, Vopak and Natural Fuel Limited.
Bulk storage of feedstock, methanol and biodiesel on Vopak site.	Failure of tanks.	Potential localised soil contamination. Potential health and safety hazards associated with methanol spillage.	2	B	5	1. Tanks will be constructed according to current best practice and standards. 2. Tanks will be bunded according to AS1940: 1993. 3. Emergency spill response procedures will be developed for both substances.
Piping of feedstock and methanol from Vopak site to processing plant.	Failure of pipeline.	Potentail localised soil contamination. Potential health and safety risks associated with a methanol spill/leak.	2	B	5	1. Pipeline will be designed and constructed to the best current practice and standards. 2. Pipeline will be guarded and signed to protect against collisions with vehicles. 3. Hourly, routine inspections of pipeline to be conducted to detect any leakages. 4. Emergency response procedures to be developed in consultation with Vopak and Natural Fuel Limited. 5. The entire site will be no smoking.

Activity	Aspect	Impact	Risk			Severity of Impact Mitigation Measures and Controls
(product or service)			**Consequence**	**Likelihood**	**Risk Score**	
Processing Plant and Associated Infrastructure						
Storage of various hazardous and/or flammable chemicals at small tank farm on processing plant site.	Failure of chemical storage tank.	Greatest potential hazard would be to the health and safety of personnel in case of fire, smoke and release of hazardous substances. Potential localised soil contamination.	3	B	9	1. Tanks will be designed and constructed to the current best practice and standards. 2. All tanks will be bunded and equipped with fire suppression equipment according to AS1940:1993. 3. Tank farm to be inspected daily. 4. All personnel will be trained in the appropriate handling of the various chemicals to be stored on site. 5. Emergency response procedures to be developed for each chemical. Personnel to be trained in these procedures. 6. The entire site will be no smoking.
Explosion or fire at plant or tank farm.	Damage to plant, tanks and risks to personnel safety.	Greatest potential hazard would be to the health and safety of personnel in case of fire, smoke and release of hazardous substances. Potential localised soil contamination. Hazardous burnt residual material will require disposal.	4	A	10	1. Fire detection and suppression systems to be installed throughout plant and infrastructure. 2. Tanks will be equipped with fire supression systems according to AS1940. 3. Emergency procedures to be developed. 4. Flameproof and spark proof equipment will be used. 5. The entire site will be no smoking.
Release of methanol from the plant during a turn-around or from a faulty gland.	Temporary episode of methanol venting to atmosphere.	Temporary, localised air contamination. Vapours may act as a potential ignition source. Potential illness or injury to personnel from vapours or fire resulting from vapours igniting.	2	B	5	1. All vents where methanol may escape are fitted with a water scrubber. This water is returned to the system for recovery of methanol. 2. Vents will be located at elevated positions and sign-posted accordingly. 3. Emergency protocols will be developed to deal with any unplanned or excessive venting of methanol. Where required, the plant will be shut-down until the release is controlled. 4. The site will be no smoking.

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Supply of Natural Gas to boiler.	Leakage of natural gas.	Temporary, localised soil contamination. Potential health effects to personnel from fumes generated.	4	A	3	1. Underground NT Gas pipeline. Will be adequately signposted. 2. Pipeline to be constructed according to Australian Standards and regulations. 3. Emergency protocols will be developed to deal with gas leaks.
Restocking chemicals at small tank farm.	Tank overfilled or hose leakage resulting in spillage of chemical.	Potential localised soil contamination. Potential health and safety risks associated with a spill/leak of certain chemicals.	3	B	9	1. Tanks will be designed with auto level gauging and high level alarms. 2. Tanks will be bunded according to AS1940:1993. 3. Restocking of chemicals will be conducted by experienced personnel only, under the supervision of plant personnel. 4. Emergency protocols will be developed to deal with response to chemical spills and leaks.
Transport of chemicals around the plant.	Failure of plant equipment or pipeline resulting in spillage.	Potential localised soil contamination. Potential health and safety risks associated with a spill/leak of certain chemicals.	2	A	3	1. Pipelines and plant infrastructure will be designed to the current best standards and practice. 2. The plant does not operate under extremely high temperatures or pressures. 3. Hourly, routine inspections will be conducted of all pipelines and plant infrastructure. 4. Emergency protocols will be developed to deal with leaks and spills. 5. Systems will be fully automated and there will be minimal physical handling of equipment during operation.
Spilled/leaked chemical enters stormwater drain during storm event.	Contaminated water entering stormwater system.	Localised water contamination. Impacts may vary depending on chemical type and volume lost.	2	A	3	1. Pipelines and plant infrastructure will be designed to the current best standards and practice. 2. Emergency protocols will be developed to deal with leaks and spills.

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(product or service)			**Consequence**	**Likelihood**	**Risk Score**	
External risks						
Cyclone hits port facility.	Damage to plant infrastructure resulting in leaks/spills of chemical.	Potential localised soil and water contamination. Personnel safety.	3	B	9	1. Plant and associated infrastructure constructed to account for wind loadings according to AS1170.2 for wind loads. 2. Site levels designed to protect against 1:700 yr storm event (SKM 1999). 3. Emergency response procedures to be developed for the site to include cyclone response.
Cyclone hits port facility.	Damage to tanker.	Water contamination in harbour.	2	A	3	1. No offloading or uploading to occur during a cyclone. 2. All ships to obey the directions of the Harbour Master in the event of a cyclone.
Earthquake.	Damage to plant infrastructure and/or pipelines and bulk storage areas.	Localised soil and water contamination with various chemicals. Personnel safety.	2	A	3	1. Plant and associated infrastructure will be designed and constructed to account for earthquake loads (AS1170.4). 2. All tanks will be bunded according to AS1940:1993. 3. Emergency response procedures to be developed for the site.
Deliberate damage.	Equipment damage. Threat to personnel safety.	Personnel safety. Potential localised soil contamination if damage to pipeline or tank infrastructure.	3	A	6	1. Plant will be manned 24 hrs/day, everyday. 2. Site will be surrounded by security fencing with a swipe-card security access system. 3. Hourly, routine site inspections will be conducted. 4. Visitor entry to be strictly controlled and visitors to be accompanied at all times whilst on site. 5. Fire detection and suppression systems to be installed throughout plant and infrastructure.

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Explosion or fire at neighbouring facility.	Radiant heat or vapours may be a potential ignition source resulting in a fire or explosion at the plant.	Injury to personnel. Damage to plant or infrastructure. Localised contamination of soil due to leaks of chemical from damaged tanks or pipelines.	2	B	5	1. Fire detection and suppression systems to be installed throughout plant and infrastructure where required. 2. Emergency procedures to be developed to cover this scenario.
Lightning strike of tanks or plant.	Lightning strike ignites vapours (eg. methanol) resulting in fire.	Injury to personnel. Damage to plant or infrastructure.	2	B	5	1. Tanks and pads will be designed with earthing cables. Where required (eg. HCl, methanol) internal floating covers will be installed. 2. Tanks will be fitted with fire detection and suppression systems according to AS1940: 1993. 3. Emergency protocols will be developed to cover this scenario.