

**ASSESSMENT REPORT 42**

**ALCAN GOVE ALUMINA REFINERY  
THIRD STAGE EXPANSION**

**ENVIRONMENTAL ASSESSMENT REPORT  
AND  
RECOMMENDATIONS**

**by the  
OFFICE OF ENVIRONMENT AND HERITAGE  
NORTHERN TERRITORY GOVERNMENT**

**July 2004**



**Northern Territory Government**

Office of Environment and Heritage

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## ABBREVIATIONS

AAPA	Aboriginal Areas Protection Authority
AHC	Australian Heritage Council
AHD	Australian Height Datum (a measurement of height relative to mean sea level)
AMSA	Australian Maritime Safety Authority
AQIS	Australian Quarantine and Inspection Service
ARI	Average Return Interval
CO <sub>2</sub>	carbon dioxide
dB(A)	decibels (a measuring unit for noise)
DBIRD	Northern Territory Department of Business, Industry and Resource Development (formerly DPIF, DME)
DEH	Department of the Environment and Heritage (Commonwealth Department)
DHCS	Northern Territory Department of Health and Community Services (formerly THS)
DIPE	Northern Territory Department of Infrastructure, Planning and Environment (formerly Department of Lands, Planning and Environment; Department of Transport and Works; and Parks and Wildlife Commission)
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPBC	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth Act)
EPCM	Engineering, Procurement and Construction Management
ERP	Emergency Response Plan
FIFO	Fly-in fly-out
GHG	greenhouse gas
HAT	Highest Astronomical Tide
ISO	International Standards Organisation
LFTF	Light Fuel Tank Farm
L/sec	Litres per second
m <sup>3</sup>	cubic metre (a volume 1 m x 1 m x 1 m)
m <sup>3</sup> /hr	cubic metre per hour
m <sup>3</sup> /y	cubic metre per year
Mt/y	million tonnes per annum
Mdt/y	million dry tonnes per year
ML	million litres
ML/y	million litres per year
MMP	Mining Management Plan
MSL	Mean Sea Level
NC	Nhulunbuy Corporation
NEPM	National Environment Protection Measure
NOI	Notice of Intent
NT	Northern Territory
OEH	Office of Environment and Heritage
PAM	Pre-assembly modules
PM10	particulate matter (in air emissions) $\leq 10$ microns in size
PJ	Petajoules
RDA	Residue Disposal Area (Red mud pond)
T/h	Tonnes per hour
RL	Relative Level
RNE	Register of the National Estate
SO <sub>2</sub>	sulfur dioxide

SPS	Steam Power Station
TBT	tributyltin (toxic anti-foulant added to boat paints)
TTP	Trans Territory Pipeline
YBE	Yirrkala Business Enterprises Pty Limited
YNOTS	The YBE and Nabalco Operator Training School

## **EXECUTIVE SUMMARY**

This report assesses the environmental impacts of the proposal by Alcan Gove Pty Limited (the proponent), for the expansion of the Alumina Refinery located on the Gove Peninsula in the north-east of Arnhem Land. The proposal is to install new plant and equipment and improve the efficiency of some existing facilities to enable the refinery's production capacity to increase from its current 2.0 million tonnes per year to 3.5 million tonnes per year with the potential for further optimisation to reach 3.8 million tonnes per year.

The Assessment Report reviews the Environmental Impact Statement (EIS), public comments and the proponent's Supplement to the draft EIS. Information, comments and advice provided by Northern Territory Government agencies and previous studies undertaken in the region have also been used in the preparation of this report.

Environmental Assessment is the process of defining those elements of the environment which may be affected by a development proposal and of determining the significance, risk and consequences of the potential impacts of the proposal. Recommendations arising from the assessment address methods to mitigate these impacts.

### **Major Issues**

The principal environmental issues associated with the proposed expansion are:

- Social impacts, including the ongoing management of potential impacts on nearby populated areas;
- Continued recognition and respect of the cultural heritage of the Yolngu as the traditional owners of this region;
- The generation and management of additional solid and liquid wastes associated with construction, increased throughput and new refinery processes;
- Atmospheric emissions from the combustion of fuel, the emission of gases and fine particles from production processes as well as fugitive emissions;
- Emission of Greenhouse Gases and their offset;
- Water supply from the mine site aquifer;
- Off shore construction of pre-assembly modules (PAMS);
- The management of surface water and refinery discharge;
- Impacts to the marine and estuarine environment;
- Community consultation.

### **Conclusions**

The Office of Environment and Heritage (OEH) considers that the environmental issues associated with the proposed project have been adequately identified. Appropriate environmental management of some of these issues has been resolved through the assessment process, while the remainder will be addressed through monitoring and management actions detailed in a comprehensive Environmental Management Plan (EMP), included as part of the Mining Management Plan.

The final EMPs for construction and operational phases of the expansion will be subject to review and approval by relevant Northern Territory agencies prior to their incorporation into the Mining Management Plan. They will be working documents for the life of the refinery and will require continual review in the light of operational experience and changed circumstances.

Based on its review of the EIS and the proponent's response to submissions from relevant NT Government agencies and the public, the Office of Environment and Heritage considers that the expansion project can be managed in a manner that avoids unacceptable environmental impacts, provided that the environmental commitments, safeguards and recommendations detailed in this Assessment Report and in the final EMPs are implemented, with regular reporting and compliance auditing.

## **LIST OF RECOMMENDATIONS**

### **Recommendation 1**

**Alcan Gove Pty Ltd shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards:**

- **identified in the Alcan Gove Third Stage Expansion Environmental Impact Statement (the draft EIS and Supplement constitute the EIS); and**
- **recommended in this Assessment Report (No. 42).**

**All safeguards and mitigation measures outlined in the EIS are considered to be commitments by Alcan Gove Pty Ltd and are included in Appendix 3 of this report.**

### **Recommendation 2**

**In accordance with clause 14A of the Administrative Procedures of the *Environmental Assessment Act 1982* the proponent shall advise the Minister of any changes to the proposal for determination of whether or not further environmental impact assessment is required.**

### **Recommendation 3**

**Future proposals for expansion of the residue disposal area are to be provided to the Office of Environment and Heritage for consideration under the *Environmental Assessment Act*, in accordance with Recommendation 2 of this Assessment Report.**

### **Recommendation 4**

**The proponent is to undertake further investigation of the aquifer and monitoring of environmental flows in consultation with the Department of Infrastructure Planning and Environment (DIPE) and the north-east Arnhem community.**

**A report on the results of the investigations is to be provided to the Department of Business Industry and Resource Development (DBIRD) and DIPE prior to commissioning to demonstrate that current water extractions are not compromising the values of the aquifer and its adjacent environment (to the satisfaction of the Controller of Waters).**

### **Recommendation 5**

**In the event that an increase in water extraction is required in the future, the proponent is to lodge an application with DIPE and OEH for further assessment under the Environmental Assessment Act (in accordance with recommendation 2 of this Assessment Report). The proponent will be required to provide a detailed inventory of waste water and stormwater on the refinery site in association with containment and storage availability, and refinery freshwater requirements with the application.**

**Further requirements for extraction would have to be approved under the *Mining Management Act* after appropriate consultation with the Controller of Waters.**

### **Recommendation 6**

**The proponent will prepare a monitoring and remediation program for the Residue Disposal Area, which is to include:**

- **Report on baseline conditions for the RDA receiving environment;**
- **Outcomes and data collected from existing monitoring programs;**
- **Proposed continued monitoring, including mangrove parameters;**
- **Identification of physicochemical and ecological triggers for remedial action;**
- **Remedial measures to be implemented in the event that triggers are exceeded.**

**This program should be submitted as part of the integrated monitoring program identified in Recommendation 25 of this Assessment Report.**

### **Recommendation 7**

**The proponent will upgrade the Light Fuel Tank Farm containment and treatment systems to provide adequate capacity to contain and prevent further incidents from occurring. This work is to be completed within 12 months of the completion of the environmental assessment process within the meaning of the *Environmental Assessment Act*.**

### **Recommendation 8**

**The proponent will continue to reduce all possible sources of caustic contamination to groundwater on the refinery site. An auditable program is to be included within the Mining Management Plan to monitor the progress of continuous improvement.**

### **Recommendation 9**

**The proponent will continue with its measures of groundwater recovery and monitoring to ensure reduction of impacts to groundwater and the adjacent marine environment. Treatment options for recovered water will be developed and submitted to DBIRD and OEH within 12 months of completion of the environmental assessment process within the meaning of the *Environmental Assessment Act*.**

### **Recommendation 10**

The proponent is to prepare an improvement program for the existing and expanded refinery to be submitted to DBIRD and OEH indicating proposed improvement strategies and the timeframes in which these improvements will be implemented. The program will include, but not be limited to, consideration of the following:

- management of stormwater on the refinery site;
- the elimination of caustic contaminated cooling water discharge to Melville Bay, particularly from the startup process of the first and second stage evaporators;
- waste water neutralisation plant discharge;
- contamination of surface water from spills; and
- the quality of sewage discharged from the refinery treatment facility.

Additionally, the proponent will prepare and submit a monitoring program to assess the performance of the improvement program. This program is to be implemented as part of the integrated monitoring program identified in Recommendation 25 of this Assessment Report.

### **Recommendation 11**

The proponent shall submit to the Controller of Waters and DBIRD by 31 December 2004, a proposal to effectively monitor operational controls on discharge water quality through the continuous water quality monitoring of the refinery outfall and the discharges contributing to outfall flows. The monitoring system shall be designed to ensure that appropriate water quality indicator data is available to operators at all times, even in the event that equipment breakage occurs or maintenance is required.

### **Recommendation 12**

Upon receipt of information provided by the Bureau of Meteorology regarding the revised storm surge heights for the Gove and Melville Bay areas, the proponent will advise OEH of the potential for storm surge to impact on the residue disposal area, with a view of developing and implementing preventative measures where necessary.

### **Recommendation 13**

The proponent will prepare a report to be submitted to DBIRD and OEH to be included in the Mining Management Plan outlining all strategies that will be implemented to ensure that releases of residue, waste water and embankment material to the environment adjacent to the RDA, controlled or otherwise, do not occur.

### **Recommendation 14**

The proponent will monitor vegetation and soil adjacent to the existing and third stage cooling towers to determine the effectiveness of mist eliminators on caustic mist reduction. Monitoring results shall be included in the Mining Management Plan. Should the eliminators be shown to be effective, the proponent will retrofit eliminators to the first and second stage cooling towers. Alternatively, other control measures will be implemented.

### **Recommendation 15**

The proponent will implement best-practice dust control measures to minimise fugitive dust emissions on the refinery site. These will be documented in the Construction and Operational Environmental Management Plans.

### **Recommendation 16**

The proponent is required to include in their Air Quality Management Plan:

- a comprehensive description of the meteorological conditions under which the predictive fuel-switching strategy will be employed and the procedures for determining those conditions and proactively implementing the strategy.
- A monitoring program to determine the effectiveness of the switching strategy in terms of meeting the Air NEPM Air Quality Goals for Sulfur Dioxide (that is, determining that measured concentrations reflect predicted concentrations).

### **Recommendation 17**

In the event that gas is not secured and the proponent fails to meet the requirements of the NEPM Air Quality Goal for Sulfur Dioxide at any of the receptor points identified in the monitoring program (refer Recommendation 16), the proponent is to use only fuel oil containing no more than 1.5% sulfur content at all times.

### **Recommendation 18**

The proponent is to implement particulate controls on the Steam Power Station emissions in the event that gas is not secured for the refinery.

### **Recommendation 19**

In the event that natural gas is not secured, DBIRD should engage a technical specialist to undertake a review of the air modelling work incorporated in the Draft EIS as well as proposed pollution control technologies to determine appropriate stack concentration limits for critical pollutants, including sulfur dioxide and particulates.

### **Recommendation 20**

The proponent's Environmental Management Plan shall include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions. This shall include, but not be limited to, provisions for regular greenhouse gas audits, a process for continuous review of new technologies to identify opportunities to reduce emissions, and benchmarking against other Alumina Refineries with a view to achieving international best practice in terms of CO<sub>2</sub> emissions per unit of production. Opportunities for offsetting greenhouse gas emissions, including support for relevant research, shall also be addressed.

In developing its greenhouse gas strategy, the proponent shall consult with the Greenhouse Unit of the NT Office of Environment and Heritage, and the strategy shall be provided to the Department of the Environment and Heritage.

### **Recommendation 21**

The proponent will continue to consult with the Galupa community on the implementation of appropriate noise mitigation strategies for Galupa. These strategies will be included in the EMPs for construction and operation of the expanded refinery.

### **Recommendation 22**

The proponent will undertake to ensure through its Engineering, Procurement and Construction Management (EPCM) contractor that all contractors involved in the construction of the refinery expansion, including those involved in off-site construction activities, will conform with relevant local waste management requirements in line with its sustainability strategies and in accordance with the Construction Environmental Management Plan. The relevant waste management requirements will be included in any contracts between the proponent, its EPCM contractor and any said subcontractors.

A comprehensive coverage of the environmental issues and consequent management strategies associated with construction and transshipment of PAMs, including sites offshore, is to be included in the Construction Environmental Management Plan.

The proponent's Environmental Management Plan is to include a complete list of all waste streams with projected quantities and planned disposal sites. The plan will identify in detail the opportunities for recycling, reuse, remediation and minimisation of refinery and mine site wastes.

### **Recommendation 23**

In the event that gas is not secured to power the expanded refinery or is delayed and fuel oil imports increase, the proponent will update GOVE PLAN to reflect the increases in fuel oil shipments that would occur. The proponent will provide OEH with a summary of these GOVE PLAN updates.

### **Recommendation 24**

The proponent will include in its Environmental Management Plan a list of possible ports of origin from which all expansion-related shipping will come, identification of the risks associated with these ports and the formal advice that will be provided to the respective vessels with regard to ballast water treatment prior to entry.

### **Recommendation 25**

The proponent is to develop a monitoring program, to be submitted to DBIRD and OEH for review, which will integrate the existing discrete programs and parameters to effectively monitor the estuarine and marine environments around the proponent's existing and proposed operations. The integrated monitoring program will account for:

- methodologies, outcomes and recommendations from previous targeted studies and existing monitoring programs;
- the development of trigger values for protection of habitats, waters and sediments around the Gove Peninsula;

- the values placed on the estuarine and marine habitats, and associated biota by the Aboriginal people of the region, incorporated into trigger values;
- remedial strategies should the developed triggers be exceeded.

The program should be robust enough to provide baseline data for any future marine incidents that might occur such as an oil spill.

#### **Recommendation 26**

It is recommended that the proponent engage an independent and appropriately qualified person to prepare a social impact and management plan of the proposed Alcan Gove expansion in consultation with the Yolngu People, Nhulunbuy township and relevant government agencies. This Plan will be submitted in two parts:

**PART 1 – A management strategy for the construction phase of the refinery expansion project will be developed and submitted to OEH and DBIRD prior to construction of the Third Stage. The strategy will address issues associated with the provision of services, access to off-site recreation areas, consideration of indigenous persons, values and law in the region, and any other issues specific to the influx of a construction workforce for the expansion project.**

**PART 2 – This social impact and management plan will incorporate the relevant outcomes from Part 1 and will:**

- Provide detailed assessment of historical context for the establishment of the mine and refinery and analyse the background of the ongoing social impacts on Yolngu people.
- Examine existing and develop new management strategies to address and minimise both existing and potential impacts resulting from the refinery and mining operations.
- Examine the effectiveness of current community consultation systems.
- Develop a consultation strategy to enable effective and ongoing communication with the local and regional communities of the Gove area.
- Provide mechanisms to audit and refine the effectiveness of the management and consultation strategies.

The Plan is to be prepared and be provided to DBIRD and the OEH for review prior to commissioning of the expansion, as well as the major Indigenous groups and the NLC for comment.

The final management and consultation strategies from Parts 1 and 2 are to be included in the Construction and Operational EMPs when completed.

#### **Recommendation 27**

The proponent will undertake an archaeological survey program of the existing mining lease to identify archaeological places and with the view to developing management strategies that will mitigate the impact of mining activities on these places. This survey program should be undertaken in two stages:

- Stage 1 - should involve an archaeological survey of those areas that will be impacted upon in the short to medium term and possess some potential to contain prescribed

archaeological places or objects resulting from Aboriginal occupation activities and protected under the *Heritage Conservation Act 1991*. These areas include the Eldo deposit and that part of the refinery construction access road located on Wargarpunda Point. A survey of the existing mining fringe should also be undertaken.

- **Stage 2 - should involve a series of stratified and random archaeological surveys to further define the nature of Aboriginal occupation on the Gove Peninsula. These surveys should also target areas proposed for mining in the medium to long term.**

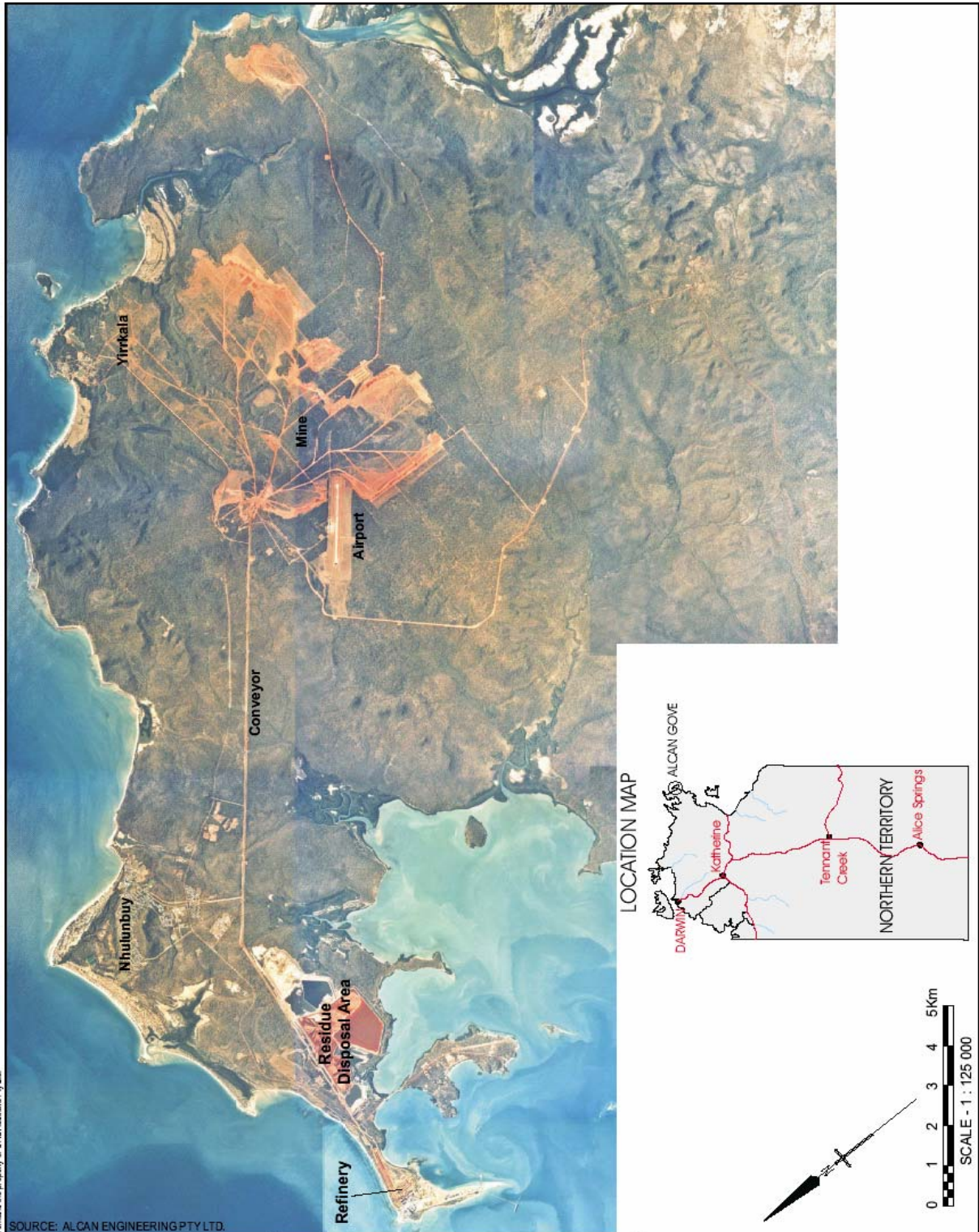
#### **Recommendation 28**



The proponent will ensure that decommissioning is done according to the best environmental standards available at the time.

#### **Recommendation 29**



Revised Environmental Management Plans covering construction and operation of the Third Stage Refinery Expansion are to be submitted to DBIRD and OEHL for approval prior to commencement of construction and operation respectively. The EMPs will be included as an appendix within the Mining Management Plan. The EMPs shall include all proposed improvements and developments associated with the expansion project as well as projects discussed in the EIS that have already commenced as part of the proponent's continuous improvement program (currently referenced in the Mining Management Plan). In this case, the relevant components of the Mining Management Plan shall be incorporated into the appended EMP.

In preparing each Environmental Management Plan, the proponent will include any additional measures for environmental protection and monitoring contained in this Assessment Report and recommendations made by the Northern Territory Government with respect to the proposal. The EMP shall be referred to relevant NT Government agencies for review prior to finalisation, after which it shall become a public document. The EMP shall form the basis for approvals and licences issued under relevant NT legislation.



 	<b>ALCAN GOVE REFINERY EXPANSION          ENVIRONMENTAL IMPACT STUDY</b>		<b>REGIONAL LOCATION</b>	
	Project No. 12373-021-559 CAD File No. -g-015b.cdr	Date 01-08-2003 Rev. B	Figure 1	



 	<b>ALCAN GOVE REFINERY EXPANSION          ENVIRONMENTAL IMPACT STUDY</b>		<b>REFINERY LAYOUT</b>	
	Project No. 12373-021-559 CAD File No. -G-023b.CDR	Date 01-08-2003 Rev. B	A4	Figure 2



**ALCAN GOVE REFINERY EXPANSION  
ENVIRONMENTAL IMPACT STUDY**

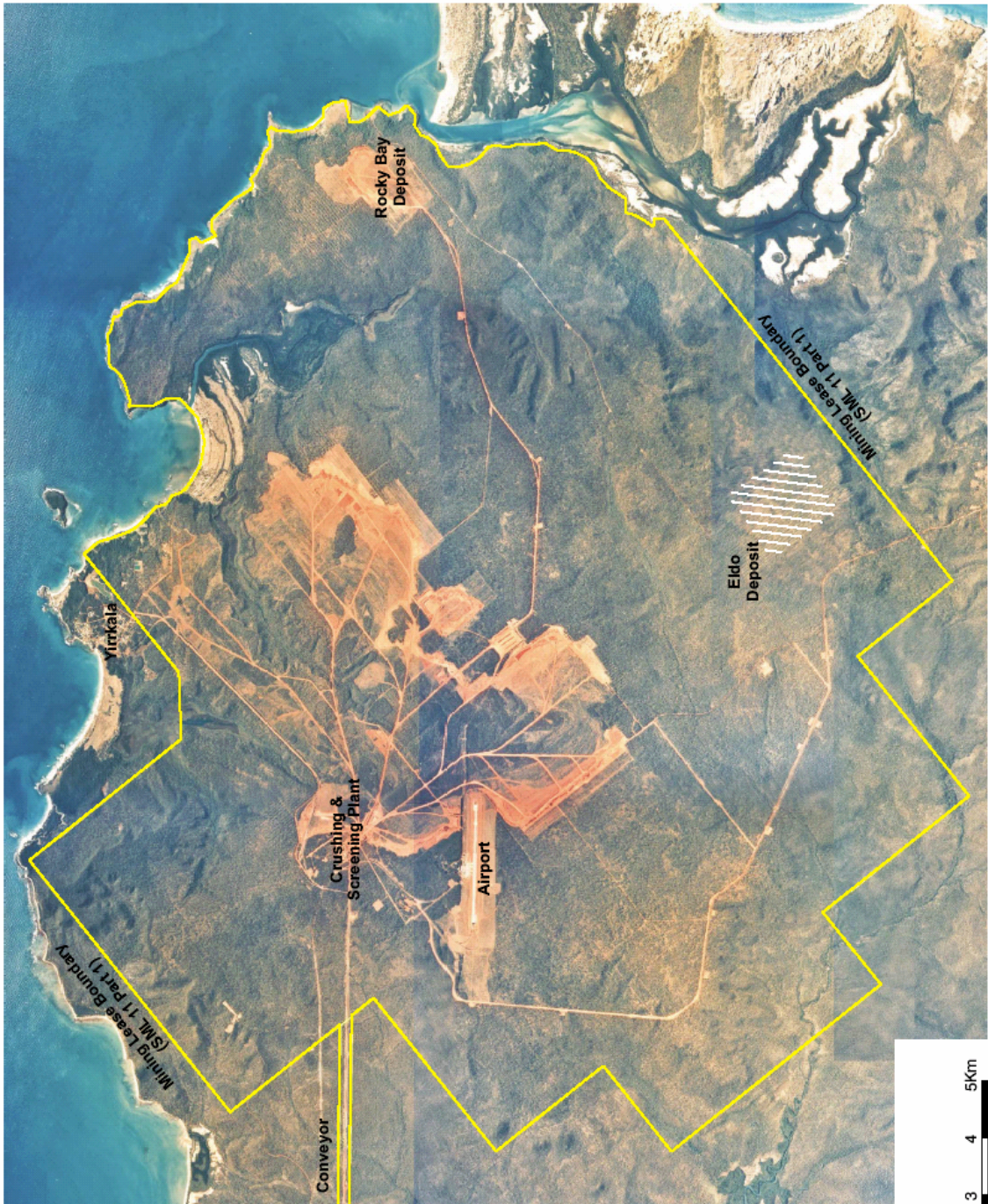
**RESIDUE DISPOSAL AREA**





Project No. 12373-021-559  
CAD File No. -G-020b.CDR

Date 01-08-2003  
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Figure 3

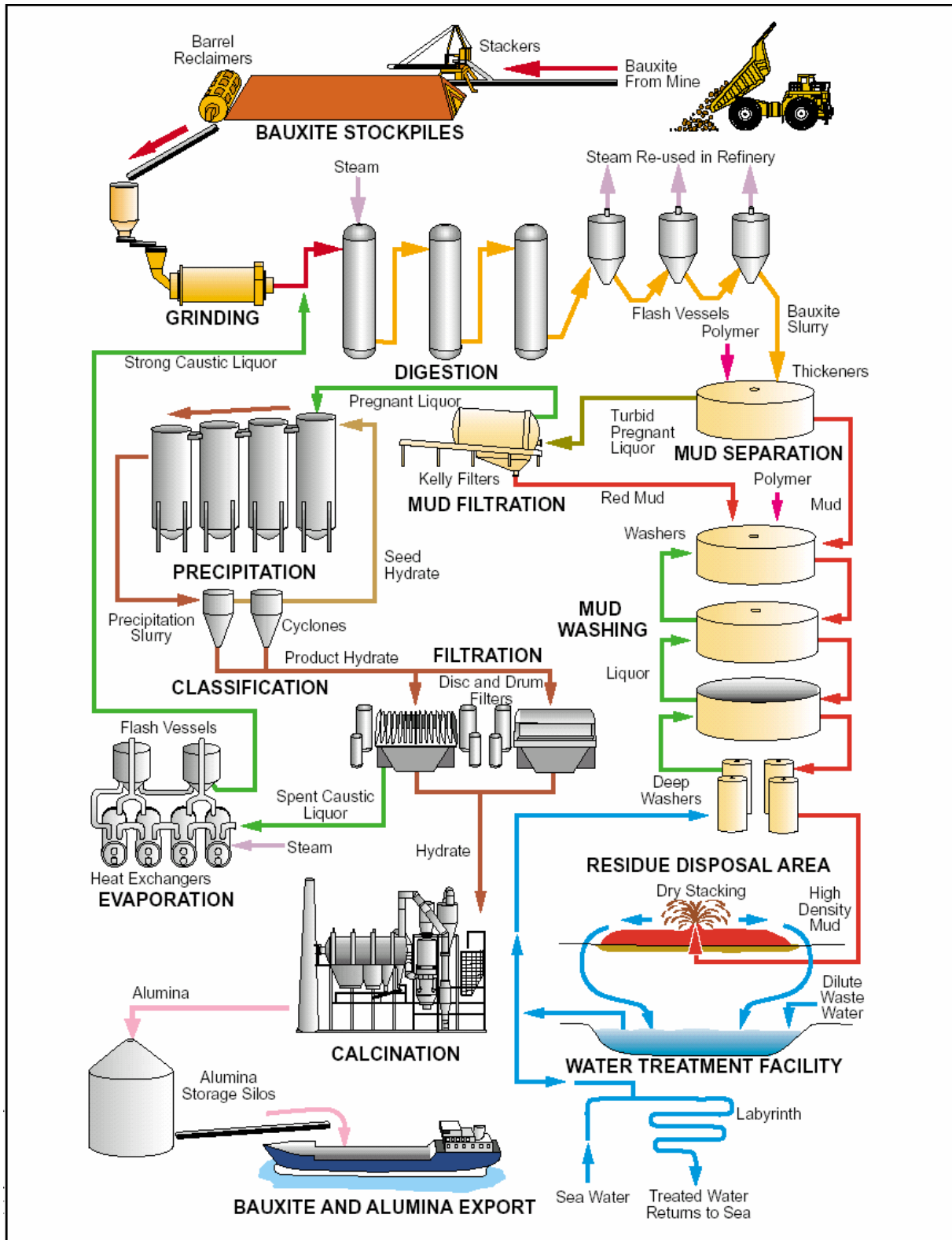


SOURCE: ALCAN ENGINEERING PTY LTD.



	<b>ALCAN GOVE REFINERY EXPANSION ENVIRONMENTAL IMPACT STUDY</b>		<b>MINE AREA</b>	
	Project No. 12373-021-559 CAD File No. -g-016b.cdr	Date 01-08-2003 Rev. B	Figure 4	



 	<b>ALCAN GOVE REFINERY EXPANSION          ENVIRONMENTAL IMPACT STUDY</b>		<b>REFINERY EXPANSION AREAS</b>	
	Project No. <b>12373-021-559</b> CAD File No. -G-027d.CDR	Date 16-01-04 Rev. D	A4	Figure 5



SOURCE: ALCAN ENGINEERING PTY LTD

	<p align="center"><b>ALCAN GOVE REFINERY EXPANSION ENVIRONMENTAL IMPACT STUDY</b></p>	<p align="center"><b>EXISTING REFINERY PROCESS FLOW DIAGRAM</b></p>
		

# **1 INTRODUCTION AND BACKGROUND**

This Report assesses the environmental impact of a proposal by Alcan Gove Pty Ltd to expand their refinery operations on the Gove Peninsula. Figure 1 indicates the location of the current refinery site, Residue Disposal Area and bauxite mine. Figures 2, 3, and 4 show these components respectively in more detail. Figure 5 illustrates the proposed location of various components of the expansion and Figure 6 outlines the current refinery processes.

This Environmental Assessment Report is based on a review of the Draft Environmental Impact Statement (EIS); comments from the public and Northern Territory Government agencies on the Draft EIS; and the Supplement to the Draft EIS in response to these comments (the Draft EIS and the Supplement constitutes the EIS).

A list of respondents to the draft EIS and issues raised in their submissions are provided in Appendix 1 and 2, respectively.

## **1.1 Environmental Impact Assessment Process**

One of the major objectives of environmental impact assessment is to fully define those elements of the environment that may be affected by a proposed development and to determine the significance, risks and consequences of the potential impacts of the proposal. The potential impacts are considered at both local and regional levels.

This report evaluates the adequacy of undertakings and environmental safeguards proposed by Alcan Gove Pty Ltd to avoid or mitigate the potential impacts identified in the assessment process. The safeguards may be implemented at various levels within the planning framework of a project and include (among other approaches):

- Design and layout of buildings and other infrastructure on site;
- Management of construction activities; and
- Management of processes used in operations at the facility (e.g. inputs and outputs).

A list of undertakings made by the proponent in the draft EIS and in the Supplement in response to submissions from the public and NT Government is provided in Appendix 3. Additional safeguards are recommended in this Assessment Report where appropriate.

The contents of this Assessment Report form the basis of advice to the NT Minister for the Environment on the environmental issues associated with the project.

## **1.2 Environmental Impact Assessment History**

Alcan Gove Pty Ltd operate a bauxite mine and alumina refinery on the Gove Peninsula, East-Arnhem Land, Northern Territory. In 2001-2002, a pre-feasibility study was undertaken to examine the potential to expand the refinery.

In March 2003, Alcan Gove submitted a Notice of Intent (NOI) to the NT Department of Infrastructure, Planning and Environment for a proposed expansion of its operations within the existing site. The expansion would increase the plant capacity from 2.0 to 3.5 million tonnes of alumina per annum by mid-2007 with the potential to reach 3.8 million tonnes per annum through further optimisation and improvement.

In April 2003, the Minister for the Environment and Heritage determined that the proposal would be assessed at the level of an Environmental Impact Statement. Draft guidelines covering issues to be addressed in the EIS were subject to public review from 30 April – 13 May 2003.

Subsequent to the public review of the draft Guidelines, Alcan Gove referred the proposed expansion to the Commonwealth for a determination under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In June 2003 the Australian Government determined that assessment was not required under the EPBC Act. Once the Australian Government made its determination, the NT Minister for the Environment and Heritage directed the proponent to prepare the EIS addressing the matters set out in the final guidelines.

The draft EIS was submitted on 11 February 2004 and placed on public review for seven and a half weeks until 2 April 2004. It was also circulated to NT Government advisory bodies for review and comment. Nine public submissions were received within the review period. Comments from NT Government agencies, with the exception of the Office of Environment and Heritage (OEH), were consolidated into one submission and forwarded, with the public submissions, to the proponent at the close of the public review period. OEH provided its comments on the Draft EIS to the proponent separately. The proponent prepared a Supplement to the draft EIS addressing the issues raised by the public and NT Government.

The Supplement was submitted to OEH on 28 May 2004. OEH circulated the Supplement to NT Government advisory bodies for review and comment.

The draft EIS, the Supplement, the public comments and comments from NT Government agencies have been taken into account in the preparation of this Assessment Report.

## **2 THE PROPOSAL**

Detailed descriptions of the major components of the existing operation and proposal are presented in the EIS. The following section gives an overview of the existing operation and the proposed expanded operation. Table 1 provides a summary of the differences between the existing and expanded facilities and processes.

### **2.1 Existing Operation**

Alcan Gove Pty Ltd, wholly owned by Alcan Inc, currently operates a refinery to extract alumina from bauxite mined from their adjacent resource on the Gove Peninsula in the north-east of Arnhem Land.

The major components of the existing operation include the bauxite mine, the refinery, the port and the residue disposal area (RDA). The locations of these components are shown in Figure 1.

Bauxite is mined using conventional open-pit techniques from a laterite deposit that is approximately 3.5m deep and is overlain by up to 2m of topsoil. Vegetation is cleared and topsoil removed and retained for rehabilitation. Bulldozers and front-end loaders are used to remove the bauxite ore and it is trucked to a crushing plant where it is crushed to required size and then transported by conveyor to the refinery. Approximately 130 ha of the lease are mined each year and the current mining rate is approximately 6.5 million dry tonnes per annum (Mdt/y) of bauxite.

Alumina is extracted from bauxite in the refinery using the Bayer process. This involves dissolving the alumina component of the bauxite ore in sodium hydroxide (caustic soda) liquor, removing the undissolved component of the bauxite (residue) by settling and filtering, precipitating alumina trihydrate (hydrate) out of the caustic soda liquor, and then heating (calcining) it to remove bonded water to produce alumina. An overview of this process is illustrated in Figure 6. The refinery's current production of alumina is approximately 1.95 million tonnes per year (Mt/y) with optimisation increasing this figure to 2.0 Mt/y.

The major solid waste from the refinery is the residue (red mud and sand) remaining after alumina is extracted from the bauxite. The residue at this stage has been washed to remove much of the caustic content and is comprised of iron oxide, titanium dioxide, alumina, silica, and sodium aluminosilicate. It is alkaline due to the presence of remnant caustic liquor from the refinery process. Containment areas have been purpose-built to accept the residue using a recently adopted dry-stacking method. The residue disposal area (RDA) is shown in Figure 3. Disposal requires transfer of residue in slurry form, which introduces waste water to the RDA. The inventory of waste water is reduced by neutralising some with seawater in the labyrinth and then discharging via the refinery outfall, returning some to the refinery washing process or through evaporation.

The port supporting the operation includes unloading facilities to receive bulk materials to supply the mine and refinery (fuel and caustic soda), and loading facilities for export of bauxite and alumina from the port. The current export rates of alumina and bauxite are 1.95 Mt/y and 1.8 Mt/y respectively. A quantity of hydrate is also shipped from a separate cargo wharf where limestone is unloaded for the refinery. The port averages 113 ship movements annually.

The existing operation supports 1,100 employees, including contractors. The majority of employees are residents of the town of Nhulunbuy and approximately 60 direct employees fly-in fly-out.

The components and processes of the existing refinery are summarised in Table 1.

## **2.2 Expanded Operation**

The proposed Third Stage Expansion would increase the plant's capacity with the objective of maximising the value of the Gove bauxite resource. It will include the integration of new plant and equipment with the existing refinery, and the augmentation of infrastructure services to meet the demands of the additional refinery capacity. The projects and processes associated with the refinery expansion are outlined in this section. Table 1 provides a summary of the effects of the existing refinery and the proposed expansion.

### **2.2.1 Mine**

The mining rate would increase from 6.5 Mdt/y to 8.0 Mdt/y of bauxite to cater for the expansion demand; however, no significant changes to the mining plan will occur, and procedures, approvals, and the lease area will remain the same. The increased mining rate will require an upgrade to the crushing and screening equipment, and increased conveyor speeds with consequent upgrades to improve capacity.

## 2.2.2 Refinery

Increased production at the refinery will be achieved by installing new process equipment in combination with changes to some existing process and equipment design, generally within the locations indicated in Figure 5. Alumina production is expected to increase from 2.0 Mt/y to 3.5 Mt/y and potentially 3.8 Mt/y with implementation of an optimisation program.

### 2.2.2.1 Bauxite stockpiles and handling

Bauxite will no longer be exported from Gove. All stockpiled bauxite will be directed to the refinery and no changes to the size of existing stockpiles will be necessary. The stacker and feed conveyor systems will be upgraded or replaced to handle additional tonnage and the refinery reclaimer will also be replaced.

### 2.2.2.2 Grinding

Three new grinding mills will be installed, one prior to the expansion, to replace the old rod and ball mills. One new mill slurry tank and pump transfer system together with one train of indirect mill slurry heating equipment will be installed and the heated feed delivered to Stage 3 digesters.

### 2.2.2.3 Digestion

A new high-temperature double-digestion process will be introduced. This will involve installation of a third low-temperature digestion plant with similar though larger capacity facilities to the existing digestion plants of Stages 1 and 2. A deep-cone thickener will be linked to the end of each low-temperature plant to extract residues and new high-pressure pumps will transfer the residues into high-temperature digesters incorporated into the process. The new thickeners will require cleaning with hot caustic cleaning liquor every four months without the need to discharge waste to ground. The mud and liquor will be separated in pressure decanters.

### 2.2.2.4 Residue separation, filtration and washing

Residue from the digestion pressure decanters will be processed through a train of new high-rate washers and a single train of five deep cone thickeners. The existing multi-stage thickeners and red mud washers would become redundant. Some will be demolished to make way for other equipment but the majority will be available for the storage of contaminated waters, fresh caustic, cleaning liquors, pond liquor and spent liquor from the refinery. Some would also be available for the storage of stormwater from within bunded and containment areas during rainfall events. Six new vertical pressure filters will be installed in a new security filtration area to process most of the turbid liquor flow from the thickeners.

### 2.2.2.5 Precipitation

New agglomeration precipitators and growth precipitators will be added to increase capacity and two interstage cooling facilities will be installed on each growth precipitator train with accompanying flash vessels and a barometric condenser using cooling water from new cooling towers.

### 2.2.2.6 Classification and filtration

A new hydrocyclone classification system with three classification stages is included in the Stage 3 design allowing three different-sized hydrate streams to be produced. New filtration equipment will be integrated with existing equipment and new filtration area facilities will be

installed to conduct filtration of various hydrate streams. This will include a requirement for six drum filters, and additional vacuum pumps and air blowers.

#### *2.2.2.7 Calcination*

Three stationary calciners will be installed in conjunction with new hydrate conveyors and upgraded alumina transfer systems. This will be in addition to the existing stationary calciner, with one existing rotary calciner retained for standby operation.

#### *2.2.2.8 Evaporation*

A new evaporation plant with the capacity of approximately 80% of the existing evaporation plant will be included in the expansion to concentrate the spent liquor from Stage 3. Cooling towers will be installed to cool water for vapour removal in the last three flash stages. Makeup water will be required for the cooling towers and this will be sourced from a combination of the western containment pond and the groundwater recovery bores, and the refinery's raw water supply where necessary.

#### *2.2.2.9 Lime plant*

The capacity of the lime plant will be increased from 140 tonnes per hour (t/h) to 200 t/h by installing a new burner system and modifying the kiln's internal geometry. A new burnt lime storage silo will also be installed.

#### *2.2.2.10 Power Station*

The existing power plant has recently been expanded to include a new boiler. It is proposed to convert the power plant from fuel oil to gas (dependent on the outcome of approvals for the Blacktip Gas Project and the Trans Territory Pipeline, which are being assessed separately).

#### *2.2.2.11 Neutralisation Plant*

At this stage the neutralisation plant will consist of a mixing tank to mix waste water and seawater, and two thickeners in a bunded area. It will serve to precipitate out the majority of contaminants from the waste water so that it can be discharged into the refinery outfall discharge channel. The remaining material will be disposed of in the RDA.

#### *2.2.2.12 Liquor Purification Plant*

The proposed liquor purification plant will serve to remove both organic and inorganic impurities from the liquor, which will help maintain liquor productivity, minimise the impact of scale and improve the recovery of soluble caustic. Two separate plants will constitute the liquor purification process. There is a mixing stage where spent liquor is mixed with the aluminium-rich component(s) followed by a drying stage. After that the dry slurry pellets are calcined, cooled and finally dissolved in refinery liquor.

#### *2.2.2.13 Plant infrastructure*

All new process areas will be concrete-bunded with sumps installed. Stormwater drainage and utilities will be extended to all new areas and facilities. The existing on-site sewerage treatment facility will be upgraded by adding separate reticulation and package sewerage plants.

### **2.2.3 Port**

The existing bauxite shipping traffic will cease following the cessation of bauxite exports. Alumina ship movements will increase, as will the imports of lime and caustic soda. Fuel oil imports will increase until natural gas is available. The result of these changes following the expansion will be a net increase in shipping movements from an average of 113 to 143 per year with gas, or 156 if gas is not secured.

### **2.2.4 Residue Disposal Area**

Disposal of residue from the refinery will occur at the existing RDA using the current dry-stacking method. In the short to medium term, there will be no requirement for expansion of the facility beyond the existing lease area. The existing equipment and infrastructure facilities will handle all residue volume increases. There are, however, some improvements proposed in the management of waste water to reduce the waste water inventory and improve the capacity of the existing RDA.

### **2.2.5 Waste Water Inventory Reduction**

Currently the management of the RDA requires a careful balance to regulate rates of residue disposal, water reuse in the refinery and water treatment with rainfall and evaporation rates. The inventory is trending upward.

Alcan Gove aims to reduce the waste water inventory of the RDA. This would be achieved in two ways. The liquor purification process would help to reduce the caustic content of the liquor entrained in the residue slurry thereby maximising the amount of waste water to be recycled back into the refinery. The neutralisation process would enable the disposal of surplus waste water to the marine environment.

### **2.2.6 Workforce and Accommodation**

During the construction phase, the construction workforce is expected to peak at approximately 1500 and will be accommodated in a purpose-built village at Nhulunbuy. New houses and units will be provided in Nhulunbuy and possibly Wallaby Beach for the additional operational workforce, while the remaining workers would work on a FIFO roster and be accommodated in single-person units.

**Table 1**

**Summary of Expansion Components**

<b>Component</b>	<b>Existing Refinery</b>	<b>Expanded Refinery</b>	<b>Effect</b>
<b>Mine</b>			
Production	Bauxite – 6.5 Mt/y, open pit (1.8 Mt/y is exported).	Bauxite – 8 Mt/y, open pit. Additional mobile equipment required and existing crushing and screening equipment upgraded.	No change to existing mining and rehabilitation practices. All bauxite consumed in expanded refinery Bauxite exports cease.
Overland Conveyor	Conveyor from mine to refinery.	Conveyor to remain with slight increase in speed.	No significant change to conveyor operations.
<b>Refinery</b>			
Production	Alumina – 2.0 Mt/y.	Alumina – 3.5 Mt/y increasing to 3.8 Mt/y.	New equipment within existing footprint.
Digestion	Low temperature digestion.	High temperature double digestion (all stages).	10% improvement in alumina extraction and 25% less residue per tonne of alumina.
Mud Separation	Multi-stage thickeners.	New deep cone thickeners and high-rate washers.	Redundant thickeners and washers available for storage of contaminated waters, process liquors and stormwater from bunded areas . Elimination of caustic to ground from thickener descaling.
Evaporation	Multi-stage evaporation plant with seawater cooling.	Additional multi-stage evaporation plant with closed circuit cooling (Stage 3 only).	No seawater discharge from Stage 3 evaporation process.
Precipitation	Multiple precipitation tanks with two-stage cooling and cooling towers.	Additional multiple precipitation tanks and cooling tower.	Extension of existing precipitation operations.
Classification and Filtration	Hydrocyclone classification and vacuum filtration.	Additional hydrocyclone classification and vacuum filtration.	Extension of existing classification and filtration operations.
Calcining	Rotary calciners (4), stationary calciner (1).	Three new stationary calciners plus one existing. One existing rotary calciner on standby and others decommissioned. Stacks for stationary calciners to be 70 m compared to 32 m for rotary calciners.	Improved energy efficiency and dust control.
Alumina Handling	Alumina is stored in four silos and conveyed from silos to ships for export.	Existing alumina storage and shiploading conveyor facilities will remain. Alumina handling systems feeding the silos will be upgraded.	Improved dust control.
Lime Plant	Double shaft lime kiln and two silos.	Kiln capacity to be increased by 40% and additional silo installed.	Increased throughput. Improved stack emission control.
Impurities Removal	Organic impurities purged to residue disposal area.	Liquor purification (all stages).	Organic impurities destroyed in purification process resulting in greater recycling of liquor, 25% less caustic consumption per tonne of alumina, and 75% reduction in soluble caustic concentration in the residue. New source of air emissions and Greenhouse Gases.

Component	Existing Refinery	Expanded Refinery	Effect
Power Station	Three high pressure boilers and turbines with fourth high pressure boiler currently being installed.	Total of five high pressure boiler and turbine units.	Increased power generation capacity. Increased Greenhouse Gas emissions.
Fuel	22 PJ of 3.5% sulfur fuel oil.	43 PJ of natural gas (all stages). Eight days per year (approx) when gas supply may be interrupted and 1% sulfur fuel oil will be used.	Reduced sulfur and particulate emission rates, and reduced greenhouse emissions per tonne of alumina. Increased total Greenhouse Gas emissions.
		If gas supply delayed, continue with 3.5% sulfur fuel oil until gas available with SO <sub>2</sub> control by switching to 1.5% sulfur fuel oil with unfavourable winds.	Switching strategy to minimise emission effects. Increased particulates and SO <sub>2</sub> and increased Greenhouse Gas emissions.
<b>Residue Disposal Area (RDA)</b>			
Residue and Waste Water Storage	Dry stacking of alkaline residue in containment structures.	Dry stacking of residue to continue. Progressive reduction of waste water inventory through operational controls and neutralisation with seawater.	Prior to capacity of the existing RDA being reached, a new containment area will be required. Investigations and separate approvals for new containment pond locations to be sought.
<b>Air Emissions</b>			
Combustion Emissions	Combustion of fuel oil generates SO <sub>2</sub> , NO <sub>x</sub> , particulate and greenhouse emissions.	When natural gas supply is secured, new and existing combustion sources converted to natural gas which will reduce emission rates. Additional emission control equipment to be used.	Reduced sulfur and particulate emission rates and reduced greenhouse emissions per tonne of alumina. Increased total Greenhouse Gas emissions.
		If gas supply delayed, continue with 3.5% sulfur fuel oil until gas available with SO <sub>2</sub> control by switching to 1.5% sulfur fuel oil with unfavourable winds.	Increased emissions of particulates, SO <sub>2</sub> and Greenhouse Gases. Switching strategy to minimise sulfur emission effects.
Fugitive Emissions	Fugitive dust sources include stockpiles, conveyors, roads and shiploader.	No significant additional fugitive dust sources. New dust control measures to be implemented for existing sources.	Overall reduction in fugitive dust emissions.
Liquor Purification	No equivalent technology currently in place.	Emissions from liquor purification plant controlled by scrubber.	No significant air quality effects. Source of Greenhouse Gas emissions.
<b>Water</b>			
Bunding and Containment	Most storage and containment areas compliant with Australian Standards.	All new storage and containment areas to be compliant with Australian Standards and existing areas to be upgraded as necessary.	Compliance with bunding and containment standards.
Caustic to Ground	Thickener cleaning and other practices can result in caustic material placed on ground.	Existing thickeners & washers replaced. no caustic to ground from thickener operations (all stages).	Significantly reduces the potential for caustic contamination of soil and groundwater.

<b>Component</b>	<b>Existing Refinery</b>	<b>Expanded Refinery</b>	<b>Effect</b>
Marine Discharge	Discharge to Melville Bay of cooling water from the evaporation process (with occasional carry-over events forming precipitate on discharge), some neutralised waste water from RDA, stormwater from the refinery and other minor waste streams.	Discharges to Melville Bay to continue. Evaporation cooling water for Stage 3 will be closed circuit to prevent carry-over events and precipitate formation. Progressively all of the waste water from the RDA will be neutralised and discharged. Stormwater and other minor waste streams will be controlled. Opportunities to improve Stages 1 and 2 discharges to be investigated.	Discharge volume estimated to increase by 3000ML/y. Contaminant load not expected to change.
Water Supply	Wellfield extraction rates within existing permit conditions.	No change to existing permit conditions. Water demand management programs to be implemented	Improved efficiency in water use.
<b>Shipping</b>			
Ship Movements	Export of bauxite, alumina and hydrate. Import of fuel oil, limestone and caustic soda.	Bauxite export will cease. Alumina exports will increase. Once gas supply secured, fuel oil imports will cease (apart from occasional delivery of backup supplies). If gas is delayed, fuel oil shipments will increase from 8 to 14 per year.	Ship movements will increase from 113 per year to 143 per year (with gas) or 156 per year (with oil).
<b>Workforce</b>			
Workforce Numbers	Existing workforce is 1,100.	Average construction workforce is 675 and will peak at approximately 1,500. Up to 120 additional positions for ongoing operations.	Construction workers village to be provided in Nhulunbuy. Operational workers to be accommodated in Nhulunbuy.

### **3 REGIONAL SETTING**

The project is located approximately 650km east of Darwin at the western end of the Gove Peninsula in the north-east of Arnhem Land. The Gove Peninsula juts into the southern end of Melville Bay. The regional centre is the township of Nhulunbuy, which is located midway between the refinery and the mine. The township of Yirrkala is located about 15 km to the south-east of Nhulunbuy.

The region has distinct wet and dry seasons with tropical cyclones occurring during the wet season. The coastal zone consists largely of sandy beaches and mangrove lined estuaries. There are two principal inlets in Melville Bay, the Latram and Giddy Rivers, and a number of small islands surround the site, including Strath Island, Granite Islands and West Woody Island. The larger Bremer Island is located about 5 km north of Nhulunbuy.

#### **3.1 Physical**

The refinery is situated on mostly undulating to flat land with elevations in the range of 5 to 10 m AHD. A small portion of the refinery to the north-west near Wargarpunda Point is more elevated (up to 22 m AHD). The majority of the refinery catchment slopes gently to the south and drains into Gove Harbour.

The area in which the refinery is located is comprised of marine sediments, predominantly quartz and calcareous sands, deposited between small outcrops of granitic/gneissic bedrock. On top of the bedrock is a weathered zone, comprising a clayey oxide regolith of variable thickness. Overlying the regolith is generally a layer of sandy marine sediments. In areas to the north of the refinery the bedrock outcrops on the surface and the marine sands are absent.

The Residual Disposal Area (RDA) extends across undulating land with elevations of 3 to 25 m AHD. It is designed to contain all rainwater that falls on the stored residue. The RDA is underlain by low permeability, fresh to weathered granitic bedrock. No major geological structures or faults in the bedrock are believed to be present. The general geology comprises fresh to slightly weathered Archaean Bradshaw Granite bedrock, which is overlain by moderately to completely weathered Bradshaw Granite. The weathered granite is overlain by surficial gravels and laterites up to 1m thick, and/or localised alluvial deposits in stream channels and estuaries.

#### **3.2 Areas with Significant Conservation Values and/or Management Issues**

##### **3.2.1 Biological**

###### *3.2.1.1 Marine/Estuarine (subtidal and intertidal habitats)*

Melville Bay has a diverse assemblage of species. Protected species in the Bay include turtles, dugongs, crocodiles and dolphins which are all listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The Gove area is not considered to be an important area for migratory bird species though a significant seabird breeding site has been identified at Higginson Islet, a series of small rocky islets 8 km north-east of Bremer Island.

The subtidal marine habitats of Melville Bay comprise basin silts, shallow sandy seafloor, seagrass meadows and coral reefs. The soft sediments support a variety of benthic fauna, while the shallower subtidal and low intertidal flats also support seagrass beds which provide feeding grounds for turtles and dugongs. Coral communities occur where the substrate is rocky in the lower intertidal and shallow subtidal zones.

Melville Bay is surrounded by extensive mangrove embayments with associated tidal creek systems. The mangroves support a range of widely distributed fauna typical of tropical mangroves across the Northern Territory. They also provide key habitat for estuarine crocodiles. Other intertidal habitats include small outcrops of rocky shores, protected sandy and muddy bays and wave-dominated sandy shorelines.

### 3.2.1.2 Terrestrial

The terrestrial flora of the Gove Peninsula, inland from the coast, is open forest dominated by *Eucalyptus miniata* Darwin woollybutt and *Eucalyptus tetradonta* Darwin stringybark. Other important vegetation types include *Eucalyptus tetradonta* Darwin stringybark woodlands, *Melaleuca* spp. woodlands and grasslands that occur on coastal floodplains, seasonally inundated creeklines and billabongs and spring swamps, coastal monsoon vine thicket, and intertidal communities of mangrove forests and chenopod salt flats. No threatened or endemic floral species have been recorded in the project area.

Several terrestrial fauna species in the Gove region are listed as threatened under NT or Commonwealth legislation. Of these, the only ones likely to occur in the project area are the red goshawk, the bush stone curlew, the northern hopping mouse and the Gove crow butterfly. Another species of interest is the golden bandicoot, which was historically collected at Yirrkala, but is now considered extinct in the region apart from a population in the Wessel Islands.

Terrestrial habitats occurring within the project area are considered to be of low conservation value because they are small in area, disjunct and disturbed. The narrow fringe of coastal vine thicket present in several areas of the site is habitat for some more specialised species, but the quality and extent of this habitat is poor. Beach dune habitats in the areas may hold populations of the Vulnerable northern hopping mouse, but none have been recorded there. The open forest habitats have a potentially high diversity of species and this habitat is well represented in the coastal Northern Territory.

Feral animals pose a major threat to the natural ecosystems of the Gove Peninsula. Existing feral populations include pigs, buffalo, cattle, horses, cats and yellow crazy ants. Cane toads are also anticipated to move into the area in the next few years.

### 3.2.2 Cultural

The Gove Peninsula in the Nhulunbuy region is located in Arnhem Land in the north-east of the Northern Territory. Arnhem Land is a large area of Aboriginal-owned land and is one of Australia's most significant areas of traditional Aboriginal culture.

East Arnhem Land covers an area of 96,000 km<sup>2</sup> and accommodates a population of approximately 14,000 people, with approximately 3,800 non-Aboriginal people living in Nhulunbuy. The balance live in the surrounding Aboriginal communities and homelands.

The Aboriginal people of North East Arnhem Land call themselves Yolngu and, whilst adopting some elements of western culture, still continue with their traditional practices, including ceremonial activity, art and caring for their country. There are approximately 1,700 indigenous people of numerous clans living in the North-East Arnhem region. The five main clans are Gumatj, Rirratjingu, Djapu, Madarrpa and Dhalwangu. The Gumatj and Rirratjingu are the traditional owners of the land in the area of the Alcan Gove leases.

Prior to European settlement, coastal resources were a major part of the Yolngu economy. The majority of the population was concentrated along the coastline, which also provided one of the major routes for communication and interaction with other clan groups and allowed trade to develop between the Yolngu and the Macassans from Sulawesi (Guse, 1999). The discovery of bauxite during the 1950's initiated development of mining operations by Nabalco. The Yolngu resisted the establishment of the mine but legislation was implemented allowing the mining to commence in 1968.

Previous archaeological research in the Nhulunbuy Region is limited. The Northern Territory Archaeological Site Register revealed some sites in the region mostly associated with Macassan and Aboriginal contact, some of which are recorded on Drimmie Peninsula, but none within the proponent's refinery and mining lease. This will be discussed further in the relevant section of this Report.

### **3.2.3 Socio-economic**

The town of Nhulunbuy began in the early 1970s as a private mining town associated with the refinery and mine at Gove and now has a population of approximately 3,800. The town has a very young population (median age 33) with the largest proportion of people of employable age involved with the Alcan Gove mine and refinery operations and supporting activities. The 2001 census indicated that approximately 7% of Nhulunbuy's population were indigenous.

Nhulunbuy supports the smaller, primarily Aboriginal, settlements of Yirrkala, Gunyangara, and Galupa for essential goods and services.

The events of the last century, culminating in the establishment of mining activities in the Nhulunbuy Region, provide the background to some of the major social issues in Gove. Alcan Gove acknowledges these issues and the company, as well as the indigenous community, has initiated various projects in an attempt to mitigate the negative components of socio-economic effects. As yet, studies of social impact in the region have not been undertaken in a cohesive manner.

## **4 ENVIRONMENTAL IMPACT ASSESSMENT**

### **4.1 Introduction**

The main purpose of this Environmental Assessment Report is to determine if the proposed project can proceed without unacceptable environmental impacts. It does this by identifying all relevant potential environmental impacts and evaluating the feasibility and likely effectiveness of environmental safeguards put forth by the proponent. Where the proposed safeguards were considered incomplete, inadequate or insufficiently clear, or for safeguards that are particularly crucial, this Assessment Report makes recommendations to complete or emphasize the safeguards and commitments made by the proponent.

The environmental acceptability of the project is based on consideration of the following, from the EIS:

- adequacy of information outlining the proposal (particularly which structures or activities are likely to impact the environment);
- adequacy of information on the existing environment (particularly environmental sensitivities);
- adequacy of information on the range and extent of potential impacts; and
- adequacy of the proposed safeguards to avoid or mitigate potential impacts.

Conclusions are then based on comments from review of the Draft EIS by relevant government agencies and the public, and the Supplement to the Draft EIS in response to these comments.

The outcome of the environmental impact assessment for this proposal is that the NT Government believes that the project can be implemented without unacceptable environmental impacts. This outcome is dependent on the proponent implementing the environmental safeguards identified in its EIS in addition to recommended measures for environmental management presented in this Environmental Assessment Report.

Because minor and non-substantial changes may be made to the design and specifications presented in the EIS, some degree of flexibility is desirable and will be necessary for adapting the environmental safeguards defined in the EIS and this Assessment Report. Where it can be shown that such changes are not likely to have a significant impact on the environment, an adequate level of environmental protection may still be achieved by the following recommendations, modifications to these recommendations or by conditions attached to relevant statutory approvals for these modifications.

Each recommendation (in **bold**) is preceded by text that identifies concerns, suggestions and undertakings associated with the project. For this reason, the recommendations should **not** be considered in isolation.

Subject to decisions that permit the project to proceed, the primary recommendation of this assessment is:

### **Recommendation 1**

**Alcan Gove Pty Ltd shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards:**

- **identified in the Alcan Gove Third Stage Expansion Environmental Impact Statement (the draft EIS and Supplement constitute the EIS); and**
- **recommended in this Assessment Report (No. 42).**

**All safeguards and mitigation measures outlined in the EIS are considered to be commitments by Alcan Gove Pty Ltd and are included in Appendix 3 of this report.**

### **Recommendation 2**

**In accordance with clause 14A of the Administrative Procedures of the *Environmental Assessment Act 1982* the proponent shall advise the Minister of any changes to the proposal for determination of whether or not further environmental impact assessment is required.**

## 4.2 Summary of Major Environmental Issues

The principal environmental issues raised by the proponent and through this assessment include:

- Water supply
- Residue Disposal Area
- Stormwater/surface water management
- Groundwater
- Air emissions
- Fuel supply
- Ecological impacts
- Social impacts
- Archaeological survey
- Workforce

The remainder of Section 4 deals with issues raised in the public and government submissions to the EIS and the proponent's commitments to environmental management provided within the draft EIS and the Supplement. In addition, recommendations to complement or strengthen environmental management strategies and safeguards will be presented.

Some issues were adequately addressed in the Supplement and do not require further discussion. The outstanding environmental issues that remain are addressed below.

### 4.2.1 Issues Outside the Scope of this Environmental Impact Assessment

#### 4.2.1.1 Future Expansion of Residue Disposal Area

Plans for residue storage up to 2011 are given in Section ES 9.10 of the EIS Supplement. Plans for the long-term storage of residue are currently under development. Environmental studies and community consultation cannot be undertaken until the preferred options have been developed. The preferred option for residue disposal beyond 2011 will be presented in the 2007 Mining Management Plan to initiate the environmental approval process.

The proponent, however, acknowledges throughout the EIS that any proposed expansion will be subject to further assessment under the NT *Environmental Assessment Act*.

### **Recommendation 3**

**Future proposals for expansion of the residue disposal area are to be provided to the Office of Environment and Heritage for consideration under the Environmental Assessment Act, in accordance with Recommendation 2 of this Assessment Report.**

#### 4.2.1.2 Gas Pipeline

There were a number of submissions pertaining to the gas pipeline including a suggestion that assessment of the refinery expansion could not be undertaken without assessing the impacts of the gas pipeline into Gove, consideration of the impact of the pipeline on Yellow Crazy Ant spread, and the effects of the pipeline on monsoon rainforest.

The current proposal for supplying gas to the refinery involves a pipeline traversing the Northern Territory, known as the Trans Territory Pipeline (TTP), linking the Blacktip gasfield in Joseph Bonaparte Gulf to the proposed expanded refinery in Gove. Both the TTP and Blacktip proposals are being assessed separately from the Third Stage refinery expansion and the drafts of the EIS documents are currently in preparation. The proponent considers that the expansion could proceed without a supply of gas, though gas is the preferred fuel for environmental reasons. The proponent has considered the possibility of not securing gas in the EIS, at least in the short to medium term, and has modelled the potential impacts of this scenario. Although some of the effects of continuing with fuel oil have been accounted for, further discussion of this scenario with respect to Greenhouse Gas and air emissions, and oil spill response appears later in this report.

The potential impacts of upgrading the Katherine to Gove road will be considered in the TTP Environmental Impact Assessment.

#### *4.2.1.3 Perkins Wharf*

The wharf associated with unloading of pre-assembly modules (PAMs) for the refinery expansion is proposed to be extended to improve access for PAM barges and low-loaders. A NOI was submitted to the Office of Environment and Heritage for review and determination of assessment requirements. Although the refinery expansion project construction phase forms the basis of this extension to the wharf, it is considered a separate development to the refinery expansion and outside the scope of this EIS.

### **4.3 Water Supply**

#### *4.3.1 Wellfield Demand Modelling*

The water supply proposal for the expanded refinery has undergone several revisions since the EIS was drafted. The expansion project will generate an increased demand for water, both in the refinery and the steam power station. The demand from Nhulunbuy is also expected to increase. The Draft EIS indicated that the proponent was seeking a revision of their licence limit from 12,000 ML/y to 14,000 ML/y to satisfy the increased demand.

Currently the permit issued by the Controller of Waters allows for a maximum drawdown of 12,000 ML over any 12-month period, a minimum flow of 50L/sec to be maintained in Yirrkala Creek, and regular monitoring and reporting of aquifer performance.

To help facilitate the license revision, a numerical groundwater model was developed in an attempt to provide an understanding of the regional hydrogeology of the Airstrip Plateau catchment area and to determine the following:

- The effect of extracting 14,000 ML/y of groundwater from beneath the Airstrip Plateau on surface flow through Yirrkala Creek/Lagoon or any other surface water system in the region; and
- The most efficient configuration of the expanded wellfield to enable extraction of 14,000 ML/y.

The proposed wellfield expansion derived from the model estimates included seven new bores extending south of the airstrip into a previously mined area (Draft EIS Section 5.1). Several submissions queried the capacity of the wellfield to adequately cope with the extra 2000 ML/y required in the extraction licence application, with particular emphasis on the impact to environmental flows in Yirrkala Creek and lagoon. Some respondents also highlighted limitations within the wellfield modelling that was undertaken on the aquifer, citing

inappropriate representation of the current level of knowledge of the aquifer and the ecosystems it maintains.

In response to these submissions, the proponent engaged in discussions with the Department of Infrastructure Planning and Environment (DIPE) to determine the most viable means of achieving the required supply from the aquifer whilst maintaining adequate environmental flows. Following these discussions, the required capacity of 14,000 ML/y was revised to 13,000 ML/y and the new water supply bores were proposed to be relocated to the west of the airport and closer to the Latram River (EIS Supplement Figure 5).

The proponent has since given further consideration to its use of waste water and stormwater at the refinery site, seeking ways in which this water can be utilised in the process (discussed in Section 4.3.2 below) and minimising the use of potable water. Consequently, the proponent has determined that it will not require an increase in its existing license capacity. However, there are still issues regarding the existing use of the wellfield and the impacts to the aquifer and associated surface water systems of current extraction.

The groundwater model is being modified and retested to take into account DIPE's suggestions regarding the structure of the aquifer. To confirm the aquifer assumptions used in the model, the proponent has committed to undertake an agreed field program of drilling and testing at the location of the proposed new bores. The scope of this field program is being developed in consultation with the Department of Business Industry and Resource Development (DBIRD) and DIPE. It has been further recommended that consultation with the Indigenous Community stakeholders be undertaken to determine their expectation of appropriate environmental flows from the aquifer and the relative importance of places surrounding, and influenced, by the aquifer.

#### **Recommendation 4**

**The proponent is to undertake further investigation of the aquifer and monitoring of environmental flows in consultation with the Department of Infrastructure, Planning and Environment (DIPE) and the north-east Arnhem community.**

**A report on the results of the investigations is to be provided to the Department of Business Industry and Resource Development (DBIRD) and DIPE prior to commissioning to demonstrate that current water extractions are not compromising the values of the aquifer and its adjacent environment (to the satisfaction of the Controller of Waters).**

#### ***4.3.2 Demand Management***

A meeting held with OEH and technical staff for the refinery operation in the proponent's Brisbane offices discussed the expanded refinery's requirement for additional water demand with respect to inefficiencies within the existing refinery operation and water use in the Nhulunbuy community. The discussions highlighted the significant opportunities for the proponent to offset the need for additional license demand with the expansion. In addition to the water demand management strategies included in the Supplement (Section 5.1.7), opportunities for reductions in demand include:

- Crusher de-dust water recycle system as part of the third stage expansion;
- Use of oily water pond underflow for Steam Power Station (SPS) cooling tower makeup;
- Telemetry and remote borehole control to further reduce water storage overflows;

- Reconstitution of SPS regeneration water for SPS cooling tower makeup;
- Improved control of the refinery water balance with particular focus on the inputs to Tank 4 (waste water tank) and Tank 8 (waste condensate tank);
- A Lean Six Sigma (the proponent's Continuous Improvement methodology) project has been initiated to quantify the potential improvements.

Current refinery initiatives to reduce refinery consumption of fresh water as discussed in the meeting include:

- Mill Slurry Heating installation (heat exchangers) reducing direct steam injection;
- Pump gland water restrictor installation;
- Seawater cooling for Ferrosilt positive displacement pumps;
- Use of condensing turbine during major maintenance;
- Flow metres for all major plant areas;
- Ongoing awareness of water conservation issues at the shop floor.

Water efficiency design features in installed components of the third stage expansion include:

- All new pumps will have mechanical seals rather than the water sealing glands in current pumps;
- Pump drive systems will be variable frequency drive to replace all inefficient fluid drive systems (fresh water cooled) of the mud washing plant area;
- Implementing a new filter design in fine mud pressure filtration that eliminates the use of fresh water in this duty and reduces the overall fresh wash water demand;
- Adopt the use of non-fresh water on refinery garden/park areas.

Implementation of these strategies would see a significant improvement in water use efficiency and consequent reductions in the requirement for additional water to that currently demanded. Consequently, the proponent now considers that water demand can be managed within the existing license limit as mentioned in the Draft EIS. Even so, water extraction will still increase from the average of 9,200 ML/y. Implementation of an appropriate monitoring program will be required to assess any impact of this increased extraction rate.

The proponent is no longer proposing to apply for an increase in their water extraction license as previously discussed in this report.

### **Recommendation 5**

**In the event that an increase in water extraction is required in the future, the proponent is to lodge an application with DIPE and OEH for further assessment under the Environmental Assessment Act (in accordance with recommendation 2 of this Assessment Report). The proponent will be required to provide a detailed inventory of waste water and stormwater on the refinery site in association with containment and storage availability, and refinery freshwater requirements with the application.**

**Further requirements for extraction would have to be approved under the *Mining Management Act* after appropriate consultation with the Controller of Waters.**

## 4.4 Groundwater

### 4.4.1 Residue Disposal Area

The Draft EIS identifies groundwater issues relating to the active residue disposal area (RDA) as well as the decommissioned ponds. The proponent considers that these impacts will continue irrespective of the refinery expansion and the waste water reduction project. They are caused by the height (and hence weight) of the residue. The final height of the residue has been established in the long range residue disposal plan (RL 51 m) and this height will not increase as a result of the refinery expansion.

The hydraulic loading of residue and waste water in the RDA has led to some minor seepage of caustic contaminated water from the toe of some RDA embankments. The rate of groundwater seepage appears to be low however, due to the generally low permeability of the embankments and underlying sediments. The Draft EIS acknowledges that increased residue stacking could increase the rate and magnitude of groundwater flows in areas down-gradient from the RDA, particularly where the geology is more permeable. Accordingly, caustic contamination of seepage could rise as the buffering capacity of clays within and under the embankments becomes fully utilised due to continuing and larger amounts of seepage. These effects are currently occurring to some degree at Northern and Taylor's Ponds, and to the north-west, south and east of Pond 5.

Investigations to determine the cause of changes to vegetation communities adjacent to the RDA in the vicinity of Dimbukawuy Rocks and Macassar Creek were undertaken (LDM, 2000a). The study concluded that:

- There was no evidence of widespread seepage of waste water into mangrove communities adjacent to the RDA. Seepage is confined to a localised area within 50m of a groundwater monitoring bore on the western side of Pond 5 (G1006);
- Impacts to mangroves are essentially historical with little or no evidence of current stress, ongoing defoliation of trees or expansion of mortality areas though there is potential for the effect to continue;
- Salinity increases or seawater encroachment was not immediately obvious from groundwater sampling in mangrove areas but could not be discounted in the absence of longer-term data; and
- A persistent elevated water table is the most likely and observable impact that has occurred to the mangroves since the impoundment of the northern arm of Macassar Creek.

While Pond 5 continues to store waste water, the extent and rate of the waste water leakage has the potential to increase. However, the proponent is proposing measures that may alleviate some of these effects.

The Draft EIS indicates that the proposed waste water inventory reduction project (EIS Section 4.5) and liquor purification project (EIS Section 4.6) would result in improvements to the operations at the RDA including:

- A reduction in the volume of waste water stored in Pond 5 and hence a reduction in the risk of contaminated waste water seepage adjacent to this pond;
- A reduction of caustic concentration in residue and waste water (from the liquor purification project); and
- A gradual increase in the disposal of saline solid residue and waste water (from the waste water inventory reduction project).

Discharging of saline residue to the RDA will result in the new saline residue overlying the existing alkaline residue on some of the disposal areas. The hydraulic gradient will continue to increase as residue stacking continues and this will maintain the persistent elevated water table in the vicinity of the Macassar Creek mangrove system.

The proponent continues to monitor pH, total alkalinity and selected trace elements (aluminium, arsenic, and vanadium) in the groundwater adjacent to the RDA embankments on a monthly basis and report the outcomes to DBIRD. Further investigations of the area to the south-west of Pond 5 will be undertaken. The proponent has also indicated that it will develop remedial strategies that may include the installation of an interception and treatment system, and a vegetation replanting program. Details of these strategies will need to be included in the Environmental Management Plan, Mining Management Plan and RDA Closure Plan.

### **Recommendation 6**

**The proponent will prepare a monitoring and remediation program for the Residue Disposal Area, which is to include:**

- **Report on baseline conditions for the RDA receiving environment;**
- **Outcomes and data collected from existing monitoring programs;**
- **Proposed continued monitoring, including mangrove parameters;**
- **Identification of physicochemical and ecological triggers for remedial action;**
- **Remedial measures to be implemented in the event that triggers are exceeded.**

**This program should be submitted as part of the integrated monitoring program identified in Recommendation 25 of this Assessment Report.**

#### ***4.4.2 Refinery***

##### ***4.4.2.1 Hydrocarbons***

Hydrocarbons were detected floating (“free-phase”) on groundwater at the Light Fuel Tank Farm (LFTF) in 1996 following a diesel fuel transfer line leak. Further investigation revealed dissolved phase hydrocarbon in areas separate from the free phase plume considered to be associated with previous spills; however, concentrations were significantly diminished downgradient of the LFTF indicating the tank farm as the likely source. Remediation was undertaken, the fuel line subsequently decommissioned and a free phase recovery program employed to remove the residual hydrocarbon (EIS Section 12.1.4.4). Groundwater monitoring indicated that by 2000, all free phase hydrocarbons had been recovered; however, in 2002, levels of phase separated hydrocarbons were again detected, probably the remains of the original diesel leak. Groundwater recovery was resumed and investigations were reported to be continuing with a more complete analysis and report to be completed as part of the EIS.

The proponent was asked for further detail with regard to the analysis and reporting outcomes of the continued investigations. It appears that investigations were triggered prior to commencement of EIS work when, in January 2003, an incident occurred in which weathered emulsified diesel product was observed along approximately 40m of the shoreline south of the LFTF. The proponent supplied OEHL with a report from a subsequent site inspection (URS, 2003a), which indicated that the source of this pollution was likely to have originated from the LFTF separators and not from groundwater. The capacity of the separators had been exceeded following a build up of diesel product in the flame arrester beds. The consultant recommended that these areas are frequently inspected, the separator is increased in capacity

or the waste water from the separator is pumped to the western pond for treatment. In the interim, the water has been directed to the oily water separator at the Western Pond.

Although the expanded refinery will not require additional storage facilities at the light fuel tankfarm, the increased use of diesel fuel with the expansion will raise the environmental risk at the LFTF. The proponent intends to upgrade the LFTF bunding and treatment system as part of its continuous improvement program.

### **Recommendation 7**

**The proponent will upgrade the Light Fuel Tank Farm containment and treatment systems to provide adequate capacity to contain and prevent further incidents from occurring. This work is to be completed within 12 months of the completion of the environmental assessment process within the meaning of the *Environmental Assessment Act*.**

#### *4.4.2.2 Caustic to Ground*

“Caustic to ground” refers to the discharge of caustic soda and process liquors to the ground outside of containment areas where it can contaminate soil, surface water and groundwater.

One of the main sources of caustic contamination of groundwater is the placement on the ground of caustic scale and sludge from the cleaning of the thickeners.

The previous operational practice of temporarily placing caustic contaminated materials on the ground during thickener descaling has been significantly reduced. A number of operational improvements have been implemented in the existing operation including:

- The use of front-end loaders to directly transfer scale from tanks to trucks; and
- Ongoing improvements to a mechanical device that will return mud and scale from the descaling operation back to the process.

The expanded refinery would reduce the frequency of thickener descaling due to the proposed installation of deep cone thickeners and high-rate washers, which are more efficient in design. Additionally, the continuing practice of direct scale transfer would occur within concrete bunded areas to capture potential spillage. Currently a device used to facilitate the direct scale transfer between the thickener tanks and the front-end loader prevents significant spills. This device would need to be adapted for the new thickener entry ports. Alcan Gove and the construction contractor will have a dedicated “tie in” manager and team to ensure that all connections to existing plant and equipment will have appropriate environment health and safety controls. These controls will include Hazard and Operability Assessments, documented procedures and instructions, and system and compliance audits.

The proponent considers that complete elimination of all other existing operational sources of minor caustic impact on groundwater (eg. Stockpile Creek, Drum Yard and general minor spillages) may not be possible in the short term. Nevertheless, the proponent has committed to eliminate all significant sources of “caustic to ground” and to progressively implement site-wide bunding and containment systems to capture any spills (EIS Sections 11.7.3 and 11.7.4). Construction of the Stockpile Creek containment Pond and redirection of surface flows from the proposed digestion and separation process areas, and the existing thickener/washer area, into this pond should eliminate many of these sources.

## **Recommendation 8**

**The proponent will continue to reduce all possible sources of caustic contamination to groundwater on the refinery site. An auditable program is to be included within the Mining Management Plan to monitor the progress of continuous improvement.**

### *4.4.2.3 Groundwater Recovery Program*

In response to the presence of the contamination that has been identified in the groundwater under the refinery, a number of mitigation strategies have been implemented including a groundwater recovery program to intercept the contaminated groundwater before it flows off site. This program has been operating since 1994.

The current groundwater recovery system comprises recovery bores located in the areas to the north, east and south of the refinery. The quantity of groundwater abstracted from each recovery bore is monitored by recording the number of pump cycles completed over time. The water levels in each recovery bore and the chemistry of the abstracted groundwater is also monitored. Extracted groundwater has traditionally been neutralised with the refinery seawater but undergoes no further treatment prior to discharge to Melville Bay through the refinery outfall channel. This has effectively led to improved groundwater quality beneath the refinery and successful interception of through-flow to the northern and southern beaches, theoretically to the detriment of refinery outfall water quality.

The Supplement indicated that no measurable changes to outfall water quality were detected as a result of groundwater recovery discharge and it is acknowledged that with the elimination of caustic to ground sources, groundwater quality can only improve with time. Nevertheless, it is maintained that continued improvements to overall marine water quality in Melville Bay will necessitate the implementation of every possible preventative measure to reduce contaminant sources. This includes the containment and adequate treatment of recovered groundwater prior to discharge or use in the refinery. The proponent is developing waste water treatment options for this flow. Treatment might include neutralisation in the waste water neutralisation plant.

## **Recommendation 9**

**The proponent will continue with its measures of groundwater recovery and monitoring to ensure reduction of impacts to groundwater and the adjacent marine environment. Treatment options for recovered water will be developed and submitted to DBIRD and OEH within 12 months of completion of the environmental assessment process within the meaning of the *Environmental Assessment Act*.**

## **4.5 Surface Water Management**

### **4.5.1 Refinery**

#### *4.5.1.1 Caustic to ground*

The incidence of caustic to ground has previously been discussed in relation to groundwater impacts at the refinery. Improved caustic scale handling practices within the existing operation, proposed improvements to bunding and containment, and new process infrastructure associated with the third stage expansion should remove the requirement for caustic to be placed on the ground and therefore the major sources of caustic contamination of surface water runoff. The proponent has committed to eliminate all significant sources of

“caustic to ground” and to progressively implement site-wide bunding and containment systems to capture any spills.

#### 4.5.1.2 *Stormwater*

The refinery is divided into various surface water catchments and drainage systems, the details of which are provided in Section 11.2.2.3 of the Draft EIS. Stormwater within each of these catchments is currently managed through process area bunds and a system of secondary containment.

Some shortfalls are evident in the current system of storm water management on the refinery site. These include process areas that are not adequately bunded, the mixing of potentially contaminated with uncontaminated flows directed into containment areas, and a catchment that currently has no containment (Stockpile Creek).

The proposed expansion and a continuous improvement policy has led to a number of planned improvements to stormwater management at the refinery including:

- bunding of previously un-bunded areas with associated sumps and pumps to conform with Australian Standards for storage and handling of flammable and corrosive substances;
- improvements to sub-standard bunds;
- sealing of some refinery roads to facilitate the interception of stormwater to containment areas;
- diversion of “clean” catchment areas around “dirty” areas to the refinery outfall discharge channel to reduce the inventory of potentially-contaminated water;
- establishment of a new containment pond for the Stockpile Creek Catchment; and
- use of redundant tanks as storage vessels for contaminated stormwater.

The Supplement indicates that the entire train of current thickener and washer tanks will be made redundant. Several of these tanks would be converted to operate as storage vessels for refinery contaminated waters, fresh caustic, cleaning liquors (new and used), pond liquor and spent liquor. Some of the redundant thickeners would be available for the storage of stormwater from within bunded and containment areas during rainfall events. This extra storage could prevent or minimise problems associated with overflows of containment ponds that have received contaminants from overflowed bunds. These storm water and other waste water streams would be continuously recycled into the residue washing circuit or could supplement the use of fresh potable water in some refinery processes.

#### 4.5.1.3 *Cooling Water Discharge*

Cooling water used in the existing evaporation circuit is pumped from Gove Harbour and returned via the seawater channel. The quality of the discharged cooling water is affected by heat and by caustic contamination as follows:

- Low level caustic contamination, which occurs on a continuous basis from caustic entrained in steam that condenses during the evaporation process.
- Caustic carry-over events which occur in the low temperature section of the evaporation area when excessive flashing or failure of control valves causes inflow of caustic liquor into the seawater mixing tanks which discharge to the Seawater Channel.

This caustic source is the primary cause of the precipitate that smothers a 60-70 hectare area of substrate within Gove Harbour, a product of seawater neutralisation of the caustic.

Comprehensive operating and maintenance regimes have been implemented to minimise the likelihood of caustic contamination occurring. These include:

- The presence of aerosol condensers within the flash vessels to condense caustic from the steam before it contacts the cooling water;
- Automatic and manual controls to stop the evaporation circuit following excessive pressure changes in the flash vessels and changes in liquor levels; and
- Real-time continuous monitoring of turbidity, pH and video surveillance of cooling water leaving the evaporation process with manual shutdown capability in the event that triggers are exceeded.

However, the proponent has indicated that the risk of caustic contamination is increased during a start up. The act of shutting down the evaporation circuit to prevent a caustic carry-over event could potentially result in increased pollution of refinery discharge. In response to this problem, the proponent has indicated that the seawater required for the waste water neutralisation plant (2100m<sup>3</sup>/hr) will be drawn from the evaporator cooling water discharge.

This would account for approximately half of the cooling water output from the evaporation process that would be redirected through a sedimentation/settling tank in the neutralisation plant rather than discharged directly and has the potential to reduce the concentrations of any caustic from entrainment or carry-over in the cooling water. The benefits of this have not been fully quantified. The remainder of the cooling water would still escape untreated to the outfall. As the elimination of this source is an objective of the proponent, it is recommended that an alternative be found for treatment of this waste water prior to discharge.

The third stage evaporation plant will not have an open circuit cooling system and hence additional caustic contamination of the seawater discharge from this process will not occur. The final design of the cooling water circuit for the new evaporation plant has not been determined. The options include heat exchange with no contact between cooling water and steam, or cooling using direct contact and then purging of contaminants from the cooling water by bleeding the system. The bleed water from the latter would be fed directly into the washer circuit, not discharged into the refinery outfall channel.

#### *4.5.1.4 Refinery Outfall*

Inputs affecting the quality of refinery outfall discharge include cooling water from the existing evaporation circuit, recovered groundwater from parts of the refinery, contaminants in stormwater that are not intercepted, the waste water neutralisation facility at the RDA and treated sewage effluent from the refinery treatment plant. The two latter sources will increase with the third stage expansion resulting in a projected increase in outfall discharge rate of 340 m<sup>3</sup>/hr, an output increase of approximately 3000 ML/y (2978400 m<sup>3</sup>/y). This is a considerable volume of water flowing to Melville Bay annually.

The proponent has committed to the reduction of the impact area in Melville Bay through the following:

- Upgrading of the site's containment system;
- Continuous improvement of operational controls e.g. evaporation barometric levels;
- Review longer-term options to reduce the effects of the highest impact activities;
- Waste water neutralisation.

Although the waste water neutralisation plant will have significant benefits in terms of other impacts from the refinery process, particularly to the long-term environmental risk of the

RDA, there is a concern that precipitate loads will increase in refinery discharge as indicated in the EIS.

The Draft EIS indicates that precipitate and dissolved metal loads from waste water neutralisation will increase following the commissioning of the proposed waste water neutralisation plant. The neutralisation rate of waste water will increase from 50 to 350 m<sup>3</sup>/hr and will include trace amounts of contaminants (metals and caustic) following the settling process. The proponent provides assurances that the extra output of contaminants from this process will be partly compensated for through improved control measures on other waste streams as described in previous sections of this report.

The main improvements that have been proposed to offset discharge water contamination are to be implemented in the Stage 1 and 2 evaporator circuit, principally the cooling water system (Section 4.5.1.3 of this report); however, this partially relies on the neutralisation plant to remove the majority of contaminants as previously discussed.

The proponent is investigating further initiatives to settle precipitate.

### **Recommendation 10**

**The proponent is to prepare an improvement program for the existing and expanded refinery to be submitted to DBIRD and OEH indicating proposed improvement strategies and the timeframes in which these improvements will be implemented. The program will include, but not be limited to, consideration of the following:**

- **management of stormwater on the refinery site;**
- **the elimination of caustic contaminated cooling water discharge to Melville Bay, particularly from the startup process of the first and second stage evaporators;**
- **waste water neutralisation plant discharge;**
- **contamination of surface water from spills; and**
- **the quality of sewage discharged from the refinery treatment facility.**

**Additionally, the proponent will prepare and submit a monitoring program to assess the performance of the improvement program. This program is to be implemented as part of the integrated monitoring program identified in Recommendation 25 of this Assessment Report.**

#### *4.5.1.5 Surface Water quality monitoring*

The EIS indicates that on-line alkalinity monitoring is undertaken at the discharge end of the refinery outfall. The refinery's central control room has alarms set for high alkalinity and prescribed preventative actions are taken in the event of high alkalinity being recorded. In addition the central control room has video monitors to detect any visible discharge.

The Mining Management Plan indicates that the real time monitoring system is often off line. The proponent claims that this is due to the difficulties of maintaining the sensors within a constant flow of discharge water.

The proponent will need to investigate options to provide effective monitoring of the refinery outfall discharge water quality and the sources of discharge to the outfall to ensure that adequate water quality data is always available to process operators.

## **Recommendation 11**

**The proponent shall submit to the Controller of Waters and DBIRD by 31 December 2004, a proposal to effectively monitor operational controls on discharge water quality through the continuous water quality monitoring of the refinery outfall and the discharges contributing to outfall flows. The monitoring system shall be designed to ensure that appropriate water quality indicator data is available to operators at all times, even in the event that equipment breakage occurs or maintenance is required.**

### ***4.5.2 Residue Disposal Area***

#### ***4.5.2.1 Erosion***

A submission to the Draft EIS raised the issue of erosion at the RDA embankments, both internally and externally. The proponent maintains a program of inspections to ensure that erosion is not threatening the stability of the walls. Piezometers are in place to detect any water seepage into the walls by measuring water pressure build up. The banks have been vegetated and remedial earthworks are undertaken to counteract any serious erosion that is detected. In the medium to long term, waste water inventory reduction measures should see a reduced risk of water pressure build up and the potential for erosion of internal walls.

This issue can be adequately addressed by maintaining the current program of monitoring and maintenance.

#### ***4.5.2.2 Storm Surge***

There was a concern that storm surge could reach some pond embankments and erode them. A hydrological report determined that the toe of the lowest dam sits above 5m AHD, or 5m above Mean Sea Level (MSL) since Australian Height Datum (AHD) is a measurement of height relative to mean sea level. The Highest Astronomical Tide (HAT) at Gove is approximately 1.9 m above MSL and the EIS maintains that the 1 in 50 year storm surge calculated for the Gulf of Carpentaria is 2.44m above HAT. Therefore a storm surge of greater than 3m would be required to affect the wall. In the future global sea level rise, and increased intensity of cyclones and consequent storm surge associated with the enhanced greenhouse effect and global warming, could confound this issue. These are currently unknowns.

The proponent is aware that the Bureau of Meteorology (BOM) will be modeling the storm surge effects for the Northern Territory coastline in the near future and will consult the BOM accordingly for information. This information will update current understanding of potential storm surge effects on the RDA including the predicted impact of sea level rise due to global warming.

The proponent has also made a verbal commitment that further preventative measures could be employed should there be a risk of storm surge effects to the RDA, including the use of rock armour at the base of RDA walls most at risk.

## **Recommendation 12**

**Upon receipt of information provided by the Bureau of Meteorology regarding the revised storm surge heights for the Gove and Melville Bay areas, the proponent will advise OEH of the potential for storm surge to impact on the residue disposal area, with a view of developing and implementing preventative measures where necessary.**

#### 4.5.2.3 *Residue Disposal Area Embankment Stability*

In 1999 an exceptionally heavy and sustained period of rain led to the controlled release of caustic contaminated water from the RDA into Drimmie Arm to prevent the breaching of the wall and therefore an uncontrolled spill. This incident led to the pollution of the embayment with relatively short-term impacts including the formation of precipitate on mangroves and substrate, some mortality of organisms including fish and epibenthos, and metals contamination of sediments and some biota (LDM, 2000b).

A submission to the Draft EIS indicated concern that there was a risk of a pollution incident occurring due to pond wall failure. The proponent maintains that they now have adequate dam capacity to store any large unplanned volumes of contaminated runoff. Additionally, with the implementation of the waste water neutralisation process, the volume of water in the RDA will be significantly reduced providing more storage capacity for rainwater and lessening the risk of any further releases. Pond 7 is currently empty and would be used to store freshwater for use in the refinery to minimise the use of potable water from the aquifer.

The Draft EIS indicates that short to medium term management (one to two years) of the waste water inventory at the RDA is based on maintaining sufficient free storage to contain rainfall for a 200 year Average Return Interval (ARI) wet season. Freeboard (additional height allowance above the maximum storage level) is added to the 200 year wet season rainfall volume to allow for waves from winds up to 160 kph.

The structural integrity of the embankments of the RDA ponds in extreme floods is also important to prevent failure and loss of residue that could contaminate the downstream environment. The ponds are designed with spillways to allow safe overtopping for extreme events up to the Probable Maximum Flood. It is expected that every action would be taken to avoid a recurrence of the incident in 1999 and that the spillways have been constructed only to prevent catastrophic environmental damage from a breached embankment. Ponds are designed to internationally accepted standards and routinely monitored and recertified to confirm stability and low risk of overtopping.

#### **Recommendation 13**

**The proponent will prepare a report to be submitted to DBIRD and OEHL outlining all strategies that will be implemented to ensure that releases of residue, waste water and embankment material to the environment adjacent to the RDA, controlled or otherwise, do not occur.**

### **4.6 Atmospheric Emissions**

#### **4.6.1 *Caustic Mist***

There is some evidence of vegetation impact in the form of crown dieback in the immediate vicinity of the existing cooling towers located on the hill in the north-west corner of the refinery site. The proponent indicates that this effect could be caused by low levels of caustic in the cooling tower mist. Much of this vegetation will be removed during the construction of the PAM haul road that will be located in this area. However, the proponent has stipulated that this road will be rehabilitated once it is no longer required, presumably with revegetation. Further, the impacts of caustic mist on the soil environment have not been considered.

As part of the expansion, an additional cooling tower will be located in this area with the potential to increase the level of cooling tower mist effects on the adjacent vegetation and soils. In order to reduce the risk of additional effects, the proponent has committed to fitting

the new cooling tower with mist eliminators. The effectiveness of the eliminators will be determined by monitoring the health of the surrounding vegetation during the first two years following commissioning of the new cooling tower. The Supplement indicates that monitoring and management of caustic mist will be included in the air quality environmental management plan and could form part of the ongoing vegetation monitoring program that the proponent has committed to implementing. It is recommended that monitoring also include soil testing.

#### **Recommendation 14**

**The proponent will monitor vegetation and soil adjacent to the existing and third stage cooling towers to determine the effectiveness of mist eliminators on caustic mist reduction. Monitoring results shall be included in the Mining Management Plan. Should the eliminators be shown to be effective, the proponent will retrofit eliminators to the first and second stage cooling towers. Alternatively, other control measures will be implemented.**

#### ***4.6.2 Fugitive Dust Sources***

##### ***4.6.2.1 Shiploading***

Improvements to reduce dust and spillage from the current shiploading facilities will be undertaken in 2004 and 2005 as part of the continuous improvement initiatives to be implemented through the current strategic plan for Alcan Gove operations. The detailed design of the dust control system, to be implemented following cessation of bauxite exports, is currently being developed by the proponent to achieve a dust reduction target of 95% of existing alumina dust loads and will be included in the Mining Management Plan. The shiploader upgrade will be completed by December 2007.

The general cargo wharf is an additional source of fugitive emissions from stockpiled calcium carbonate and hydrated alumina.

##### ***4.6.2.2 Refinery dust***

Dust sources at the refinery site include stockpiles of alumina, calcium carbonate, and bauxite, transfer plant such as the conveyors, silos, unsealed roads and some process plant including the calciners. Currently, alumina dust from some of these sources drifts westward and settles on the vegetation and ground on the western boundary of the refinery. Though impacts of this dust have not been fully examined and the vegetation is of low habitat value, the proponent should continue to develop and implement measures to minimise these dust emissions.

##### ***4.6.2.3 Mine Dust***

It is considered that dust on the mine site is being adequately addressed through a program of dust suppression on haul roads. Dust is unlikely to be problematic during the wet season. The expansion project will see an upgrade to the crusher on the mine, which should see some reductions in dust from this area.

#### **Recommendation 15**

**The proponent will implement best-practice dust control measures to minimise fugitive dust emissions on the refinery site. These will be documented in the Construction and Operational Environmental Management Plans.**

### 4.6.3 SO<sub>2</sub>

Sulfur Dioxide (SO<sub>2</sub>) is produced from the combustion of heavy fuel oil at the existing refinery; in the power station, the calciners, and the lime kiln. The fuel for the expanded refinery will continue to be fuel oil until supply of natural gas is secured. Currently, the fuel burns with an average sulfur content of 3.5% but will be switched to a lower sulfur fuel oil (approx 1.5% sulfur) as conditions require, most likely during the wet season. The proposed fuel switching strategy is a reflection of the potential for SO<sub>2</sub> contained in stack emissions to directly impact on populated areas.

SO<sub>2</sub> is an irritant when inhaled and high concentrations may cause breathing difficulties in people exposed to it. People suffering from asthma and chronic lung disease may be especially susceptible to the adverse effects of SO<sub>2</sub>.

The proponent has proposed to use a fuel switching strategy when winds are blowing towards populated areas if gas is delayed. The EIS indicates that the fuel switching strategy will be facilitated by the use of software that will enable switching to occur in advance when adverse wind conditions are predicted. It is not clear on how long it takes for the low sulfur fuel to feed the boilers once the fuel has been switched.

With gas, there will be periods when fuel oil is required and in this case the proponent proposes to use a light fuel oil with Sulfur content of 1% or less. The proponent, when queried on the reasons why low sulfur fuel would not be used exclusively under all conditions, gave cost as the significant limitation.

It is noted that the air dispersion modeling work completed for the Draft EIS has been based on three-dimensional models that can calculate the dispersion of plumes within the three-dimensional meteorological field. This accounts for local meteorological conditions that can impact on plume dispersion. Air dispersion modeling provided in the Draft EIS indicates that the NEPM 10 year Air Quality goals for SO<sub>2</sub> will be met at nominated sensitive receptors even if gas is not secured for the expanded refinery and the proponent employs the fuel switching strategy. It is noted however that current operations result in one exceedance of the 1-hour average NEPM goal at a location on West Melville Bay.

Current operations result in SO<sub>2</sub> mass emissions of approximately 29 000 tonnes per annum (as reported for the 2002-2003 National Pollutant Inventory). This makes Alcan Gove currently a large emitter of SO<sub>2</sub> (approximately three times more than total SO<sub>2</sub> emitted by all motor vehicles in the country).

Studies show that sulfur dioxide directly affects vegetation by uptake through parts of the plants that are above the ground. Depending on the amount of SO<sub>2</sub> taken up per unit of time impacts include degradation of chlorophyll, reduced photosynthesis etc. A monitoring program undertaken to determine the presence of SO<sub>2</sub> damage to vegetation as a result of Alcan operations observed no short-term injury signs (Doley 2003).

The switch to natural gas will considerably reduce concentrations of SO<sub>2</sub> in emissions.

#### **Recommendation 16**

**The proponent is required to include in their Air Quality Management Plan:**

- **a comprehensive description of the meteorological conditions under which the predictive fuel-switching strategy will be employed and the procedures for determining those conditions and proactively implementing the strategy.**

- **A monitoring program to determine the effectiveness of the switching strategy in terms of meeting the Air NEPM Air Quality Goals for Sulfur Dioxide (that is, determining that measured concentrations reflect predicted concentrations).**

#### **Recommendation 17**

**In the event that gas is not secured and the proponent fails to meet the requirements of the NEPM Air Quality Goal for Sulfur Dioxide at any of the receptor points identified in the monitoring program (refer Recommendation 16), the proponent is to use only fuel oil containing no more than 1.5% sulfur content at all times.**

#### **4.6.4 Particulate Emissions**

The switch to gas will reduce particulate emissions from the Steam Power Station (SPS) considerably; predicted total point source emissions indicate an approximate 95% reduction in particulate emission rates. In the event that gas is not secured, particulate emissions will be similar to or slightly less than those from the existing refinery due to improved particulate controls on new plant and equipment as well as the replacement of less efficient process equipment in the existing refinery.

Currently there are no existing particulate controls on the SPS stacks. If gas is not secured, there is an expectation that the proponent will undertake all measures possible to achieve a particulate emission rate equivalent to that predicted for the proposed conversion to gas-fired boilers.

#### **Recommendation 18**

**The proponent is to implement particulate controls on the Steam Power Station emissions in the event that gas is not secured for the refinery.**

#### **Recommendation 19**

**In the event that natural gas is not secured, DBIRD should engage a technical specialist to undertake a review of the air modelling work incorporated in the Draft EIS as well as proposed pollution control technologies to determine appropriate stack concentration limits for critical pollutants, including sulfur dioxide and particulates.**

#### **4.7 Greenhouse Gas Emissions**

The expansion of the refinery with conversion to natural gas will see a decrease in greenhouse gas (GHG) emissions of approximately 28% per tonne of alumina produced. The total GHG emissions however, will increase by approximately 595,000 t/y with increased alumina production. Furthermore, if gas is not secured for the expansion and fuel oil continues to be used, the EIS indicates that GHGs will nearly double from existing GHG outputs.

Discussions between the proponent and the Greenhouse Unit of OEH have focussed on the requirement for a greenhouse emissions offset program. The proponent continues to liaise with the Greenhouse Unit in the development of such a program.

## **Recommendation 20**

**The proponent's Environmental Management Plan shall include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions. This shall include, but not be limited to, provisions for regular greenhouse gas audits, a process for continuous review of new technologies to identify opportunities to reduce emissions, and benchmarking against other Alumina Refineries with a view to achieving international best practice in terms of CO<sub>2</sub> emissions per unit of production. Opportunities for offsetting greenhouse gas emissions, including support for relevant research, shall also be addressed.**

**In developing its greenhouse gas strategy, the proponent shall consult with the Greenhouse Unit of the NT Office of Environment and Heritage, and the strategy shall be provided to the Department of the Environment and Heritage.**

### **4.8 Noise**

Several submissions to the Draft EIS expressed concern that noise levels associated with the expansion would increase and consequently the Aboriginal community nearest to the refinery site, Galupa, would be detrimentally impacted. Modelling of refinery noise predicts that noise levels at Galupa will increase by 1dB(A) or less due to the expanded refinery. The World Health Organization's Sleep Disturbance Criteria are already exceeded at this location.

The proponent states that it will not be practicable to reduce noise emissions from the refinery. The reasons for this have not been considered in the EIS. The proponent has committed to provide a 2.5m noise attenuation barrier on the northern and western sides of the community at Galupa and will continue to consult with the Galupa community on this issue. However, this structure would attenuate traffic noise from the road to the north and noise from movement of equipment to the west associated with wharf-related activity during the construction phase; it would not reduce noise emanating from the refinery. The specialist advice on noise provided by a consultant during the development of the EIS indicated that construction noise at the refinery itself would be less obvious to the community than changes in traffic noise. The noise barrier would only be installed in line with wishes of the Galupa community.

Noise modelling has indicated that for noise sources at Perkins Wharf and along Melville Bay Road, the attenuating fence will achieve a noise reduction of approximately 4 dB(A) from the noise predicted to occur from these sources with the expansion.

## **Recommendation 21**

**The proponent will continue to consult with the Galupa community on the implementation of appropriate noise mitigation strategies for Galupa. These strategies will be included in the EMPs for construction and operation of the expanded refinery.**

### **4.9 Waste Management**

#### ***4.9.1 Residue Disposal Area Landfill***

The EIS indicates that the RDA will continue to be used for the disposal of process wastes compatible with the main purpose of the facility. The proponent claims that the impacts of this disposal are very low due to the isolation of the RDA from other activities and the very low permeability and depth of the residue stored at the RDA. Although the RDA has been designed to contain all contaminants within its embankments including possible leachate from

exposure of waste to caustic water, seepage from some of the ponds is occurring and there is some concern that leaching of waste constituents from the RDA landfill is possible.

This is considered unlikely given the reasons provided by the proponent and the central location of the RDA landfill relative to Ponds 4, 5 and 6. The long range residue disposal plan indicates that southern Pond 6, which forms one boundary of the landfill, will be used for the storage of unneutralised red mud liquor until at least 2010. It is essential that the landfill be managed to avoid contact with the caustic water in this Pond.

The proponent should explore the opportunities for remediation of wastes such as the bottom sludge from fuel tanks. This would remove at least one form of contamination within the landfill that could potentially become problematic in the future of the RDA.

#### ***4.9.2 Nhulunbuy Landfill***

The new community landfill at Gove is being used for some non-contaminated waste from Alcan Gove. This includes domestic waste generated during the construction period. Significant quantities of waste from the refinery could lead to a considerably shortened landfill life. Currently there is no project-specific information available in regard to the quantities of waste that will be generated by construction of the expanded refinery. The proponent is currently investigating initiatives for the recycling of glass, paper and plastics to reduce the amounts of domestic waste from the construction period that will be taken to the landfill.

#### ***4.9.3 Pre-assembly Module Construction Site/s***

It is not yet known where the PAMs will be constructed or if a transshipment site will be required. In the Draft EIS, the proponent maintains that the site's environmental management capability will be a criterion for site selection. The Engineering, Procurement and Construction Management (EPCM) contractor will be responsible for the environmental management of the PAM site and is preparing a Construction EMP that includes the offshore component of the project. This EMP will complement the proponent's EMP.

The Supplement indicates that the proponent will fully address any environmental implications associated with construction at sites remote from the refinery if the sites are within the Northern Territory. The relevant NT Government agencies would be consulted on this issue. However, at sites outside the NT, the proponent has not committed to providing an assessment of the impacts but indicates that it will monitor the PAM contractors through its EPCM contractor in accordance with the EMP to ensure that relevant waste management requirements are complied with.

### **Recommendation 22**

**The proponent will undertake to ensure through its Engineering, Procurement and Construction Management (EPCM) contractor that all contractors involved in the construction of the refinery expansion, including those involved in off-site construction activities, will conform with relevant local waste management requirements in line with its sustainability strategies and in accordance with the Construction Environmental Management Plan. The relevant waste management requirements will be included in any contracts between the proponent, its EPCM contractor and any said subcontractors.**

**A comprehensive coverage of the environmental issues and consequent management strategies associated with construction and transshipment of PAMs, including sites offshore, is to be included in the Construction Environmental Management Plan.**

**The proponent's waste management plan is to include a complete list of all waste streams with projected quantities and planned disposal sites. The plan will identify in detail the opportunities for recycling, reuse, remediation and minimisation of refinery and mine site wastes.**

#### **4.10 Risks from Shipping**

According to the EIS, the most significant changes to the existing shipping regime will be the elimination of bauxite exports, an increase in the alumina exports, an increase in caustic soda and lime imports, and a 95% reduction in fuel oil imports if gas is available. Average ship movements will increase by 30 with gas to 43 without gas each year. Only one fuel oil shipment will be required if natural gas is available, otherwise fuel oil ship movements will increase from 8 to 14. Shipments of caustic soda will double with the expansion. Additionally, there will be up to 240 barge movements associated with the transport of construction equipment during the construction phase.

The majority of materials imported or shipped through Gove are relatively inert (e.g. alumina, hydrate, limestone) and will not add considerably to environmental risk. The two major risks to the marine environment from increased shipping will be potential oil spills and the potential for the introduction of marine pests.

If gas is not secured for the refinery or in the interim until gas is supplied, there will be a total of 850,000 t/y in heavy fuel oil for the refinery and 150,000 t/y of fuel oil for transport ship operation. This increased risk will be managed by the proponent's emergency response plan for the port, GOVE PLAN, which is currently being updated to reflect the proposed changes.

#### **Recommendation 23**

**In the event that gas is not secured to power the expanded refinery or is delayed and fuel oil imports increase, the proponent will update GOVE PLAN to reflect the increases in fuel oil shipments that would occur. The proponent will provide OEH with a summary of these GOVE PLAN updates.**

In 2003, a survey was undertaken in Gove Harbour to determine the potential presence of introduced marine species in the harbour. The Draft EIS makes no mention of the presence of introduced species in the harbour but does report that no known or suspected marine pest species were found.

Ballast water discharges will increase by approximately 15% with the expansion. The proponent considers the risk of marine pest introduction to be small due to the marginal increases in ballast discharged and the origin of ports from which ballasted ships will be entering Gove. No information is supplied as to whether the ports of origin for ships and the PAM barges are considered low risk for pests. This has the potential to be a major issue but provided the ballast water is treated correctly prior to port entry as indicated in the Supplement (Section 13.7.2), the risks will be manageable.

#### **Recommendation 24**

**The proponent will include in its Environmental Management Plan a list of possible ports of origin from which all expansion-related shipping will come, identification of the risks associated with these ports and the formal advice that will be provided to the respective vessels with regard to ballast water treatment prior to entry.**

## 4.11 Ecological Impacts

### 4.11.1 Impacts on Marine Habitat

As discussed in Section 12.1.1 of the Draft EIS, groundwater discharges naturally at the saltwater interface with the ocean along the Northern Beach. The EIS documents a narrow band of dark-stained groundwater discharge along 100m of Northern Beach, with an area at the point of discharge exhibiting a crust of stained sand weakly cemented by calcium, aluminium and iron salts. Neither the Draft EIS nor the Supplement clearly indicate whether or not the coloured seepage could be attributed to refinery groundwater contaminant impacts. These documents suggest that the discolouration itself is natural. However, extrapolated data within the refinery groundwater review in 2003 (Draft EIS Appendix H.1) shows an apparent plume of contaminated groundwater in marine sands extending from beneath the thickener/washer area of the refinery to the shoreline at Northern Beach. Investigations have been undertaken to determine whether the seepage has affected macrobiota within the inter-tidal or near-shore sub-tidal communities in the area (URS 2001b; LDM 1995).

A summary of these studies indicated that the impact was localized and visual with some indicative parameters elevated above background levels and no measurable impacts to macrobiota in the near-shore areas; groundwater behind the shoreline, however, contained a suspended precipitate. Once again the Supplement provides no clear indication of the precipitate's possible connection to the refinery, if any. Precipitation within the beach sands and at the beach surface was shown to play a significant part in reducing the concentration of trace elements and organic carbon in the seepage.

The extent of staining is reported in the EIS to have declined since the groundwater recovery bores were commissioned in this area. It is accepted that continued recovery of groundwater and measures to minimise groundwater contamination at the refinery site, if indeed this contributes to the phenomenon, should see a further decline in the effects at Northern Beach (referred to in Sections 4.4.2.2 and 4.4.2.3 of this Report). This will be evidenced by further physicochemical and ecological monitoring in the area in accordance with Recommendation 25 of this Assessment Report.

The occurrence of seepage from the RDA embankments and the incident of waste water release from the RDA to Drimmie Arm in 1999 have been discussed respectively in Sections 4.4.1 and 4.5.2.3 of this Assessment Report. The outcomes of the studies that have been conducted in this area indicate that there is recovery of the adjacent marine environment following the Drimmie release incident. It is considered that measures to prevent future incidents in accordance with Recommendations 6 and 13 will ensure continued recovery and protection of the marine environment adjacent to the RDA and an ongoing program of monitoring will assess the effectiveness of the measures implemented.

The effects of flocculated precipitate from refinery outfall discharge on the marine substrates in Gove Harbour have been well documented (McConchie and Saenger 1993; LDM 1999; URS 2001a; URS 2003c). The proponent's existing and proposed management of outfall discharge water is discussed in Sections 4.5.1.3 and 4.5.1.4 of this Assessment Report and further requirements of the proponent are addressed through Recommendation 10.

Although many of these incidents and persistent contaminant sources relate to the previous operator at Gove and the existing operation, it is considered necessary that monitoring of the marine environment to assess improvement or detect further impact is undertaken, particularly with the increased capacity of the proposed expanded refinery operation.

#### **4.11.2 Marine and Estuarine Monitoring**

Impacts and potential effects of the existing refinery on the marine environment have been studied through routine monitoring programs as part of the proponent's Mining Management Plan requirements and through the commissioning of independent consultants for specific issues. A review of previous studies and a subsequent risk assessment (LDM 1999) highlighted knowledge gaps, assigned investigation priorities and recommended a scope of work for further investigations into the potential and known marine impact sources. Since this review was undertaken, there have been a number of other studies commissioned to inform some of these gaps and to investigate subsequent incidents. Further, a study has been conducted to characterise the marine environment of the Gove Peninsula (URS 2003b), providing valuable information on the habitats likely to be impacted in the event of an environmental incident associated with the refinery.

The information available appears to be comprehensive and provides a substantial baseline for developing triggers for the management and protection of the marine and estuarine environments surrounding the Gove refinery. The proponent has committed within the Supplement to provide a marine health monitoring program to the DIPE in June 2004. This has not yet been provided and no details accompany the EIS references to this program.

The proponent needs to develop an integrated program to effectively monitor the marine and estuarine environments to determine:

- the performance of the existing refinery environment in comparison to non-impacted areas;
- the recovery of previously impacted areas such as Drimmie Arm and Inverell Bay;
- any sub-lethal impacts to biota that could potentially be occurring, such as imposex in gastropods;
- the impacts to marine biota from possible contaminant biomagnification and the synergistic effects of various refinery contaminants;
- ongoing impacts to marine and estuarine ecosystems through the occurrence of historical and continuing pollution; and
- the impacts of any future marine or estuarine incidents associated with the refinery that may occur.

The program should maintain compatibility with historical data collection methods or allow for the calibration of old and new methods over a specified time period. The Traditional Owners need to be consulted to determine their values with respect to the marine habitats and associated biota in the area and triggers will need to be developed to account for these values.

#### **Recommendation 25**

**The proponent is to develop a monitoring program, to be submitted to DBIRD and OEH for review, which will integrate the existing discrete programs and parameters to effectively monitor the estuarine and marine environments around the proponent's existing and proposed operations. The integrated monitoring program will account for:**

- **methodologies, outcomes and recommendations from previous targeted studies and existing monitoring programs;**
- **the development of trigger values for protection of habitats, waters and sediments around the Gove Peninsula;**

- **the values placed on the estuarine and marine habitats, and associated biota by the Aboriginal people of the region, incorporated into trigger values;**
- **remedial strategies should the developed triggers be exceeded.**

**The program should be robust enough to provide baseline data for any future marine incidents that might occur such as an oil spill.**

#### **4.12 Biting Insects**

Government advice was provided with regard to the sources of mosquito-borne disease risk from storage of excess sewerage effluent during construction. In its response to the submission, the proponent advised that the Nhulunbuy Corporation (NC) is responsible for managing the sewerage effluent issue and provided information on the NC's behalf. Despite the proponent not having direct responsibility in this regard, it is advised to work with the NC to resolve issues pertaining to the project's contribution to sewerage effluent and the impact this may have on biting insect populations. The NT Department of Health and Community Services provides the following advice.

With the likely increase in excess treated effluent due to the development, there is the possibility of an increase in effluent being pumped to the evaporation/infiltration/overflow pond located within the coastal sand dunes. Depending on the rate of infiltration/evaporation, ponding of effluent for periods conducive to mosquito breeding may occur (if not already occurring). To prevent mosquito breeding, effluent water should not pond for more than five days. If effluent water is expected to pond for more than five days, mosquito inspections and possible control may be required 3 days after initial flooding occurs, and then every five days afterwards until the area dries. The evaporation/infiltration/overflow pond should always be maintained free of vegetation. Alternatively, the evaporation/infiltration/overflow pond located within the coastal sand dunes could be designed and operated (if not already) to ensure ponding does not occur for a period greater than 5 days at any one time.

#### **4.13 Social and Community Effects**

##### ***4.13.1 Social Impact of the Existing Mine and Refinery***

A number of submissions received in response to the Draft EIS raised concerns that the document failed to examine the social impacts that the presence of the mine and refinery has had on the Aboriginal people. There was also concern that the social impact analysis contained in the EIS document was one-sided.

The Draft EIS provides only a brief summary of what is identified as the social impact of the existing presence of the mine and refinery. This fails to examine the implication or direct impact on the indigenous people of the region that occurred with the establishment of the township and industry.

The proponent has advised that the social impact assessment undertaken for the Draft EIS focussed on the impacts of the refinery expansion rather than what it describes as "complex issues underlying the region's social structure". However it is acknowledged that "the development of the township of Nhulunbuy and the accompanying mining and alumina operations would not only have positive impacts on local Aboriginal people" and that, as with other towns in the Northern Territory, negative social impacts occur.

In this respect, the proponent has committed to continue with support for collaborative efforts to improve social well-being in and around Gove. These include:

- Co-funding the construction and staffing of a substance abuse support centre;
- Financial support to the Dhimurru Land Management Aboriginal Corporation (Dhimurru);
- Support to Dhimurru for the preparation of a Management Strategy for recreational areas;
- Ensuring that all construction personnel receive cross-cultural training;
- Support of and involvement with the YNOTS indigenous training program, indigenous business opportunities and initiatives, the Harmony Djamamirri Mala Group and the establishment of the Community Reference Groups.

While the proponent's support is recognised, it is also considered that undertaking a social impact analysis of the existing township, refinery and mine would be necessary to allow both an understanding of the social and/or cultural impacts that could occur with the expansion and to develop appropriate management strategies.

#### ***4.13.2 Construction Work-force***

A number of submissions to the Draft EIS indicated concern that the influx of 1200 workers at the peak of construction would lead to social impacts in the Gove Peninsula community including:

- Exceeding the capacity of existing health care, recreational and policing services and facilities;
- Overuse and degradation of recreational areas on Aboriginal Protection;
- Increased crime and violence;
- Increased access to alcohol; and
- Inter-racial impacts.

The proponent has since indicated that the proposed construction will have to be completed within a shorter timeframe than initially planned and a larger workforce would be required, peaking at approximately 1500. This is believed to be a positive development from a social impact viewpoint as this theoretically shortens the time in which workers will be on site. While the proponent adequately addressed some of the above concerns in Section 21.7 of the Supplement, these issues still warrant further consideration.

In response to the concerns raised, the proponent has advised that the following initiatives will be implemented:

- Workers will be required to undertake a medical examination prior to an offer of employment and will be required to agree to a personal code of conduct during their period of employment (which is still to be drafted and made available);
- A complaints procedure will be established to investigate any complaints of unacceptable behaviour from construction workers and action taken where necessary;
- Alcohol management procedures;
- A Community Relations Manager is located at the Refinery site and a Community Relations Officer will be appointed;
- All construction personnel will receive cross-cultural training during site induction;

- Financial support provided to the Dhimurru Land Management Aboriginal Corporation as well as facilitation of discussions between Dhimurru and the construction contractors regarding the use and management of recreational areas and development of a management strategy;
- The provision of recreational facilities for construction workers.

Some of the issues that remain to be resolved with respective NT Government Departments include the availability of health services, the adequacy of police services during construction, and the adequacy of existing recreation facilities and clubs to cater for construction workers.

The issue of off-lease areas used for recreation will need to be carefully and thoroughly considered as it is suspected that these areas could be accessed without permits. This has potentially serious implications for the proponent's relationship with the Indigenous Community.

#### ***4.13.3 Community Consultation***

In submissions provided on the Draft EIS, several respondents expressed disappointment at the inadequacy of the consultation process for the refinery expansion. The Supplement summarises the consultations that were undertaken (Section 23.5) external to the four Regional Community Reference Group meetings convened between February 2003 and January 2004. During this period, the proponent's consultation program appeared to extend to no more than three discussions/meetings with some indigenous groups and less with others. Some of the organised meetings were poorly attended suggesting perhaps that the media/forums for discussion were unsuitable to encourage the required audience.

The proponent acknowledges too that discussions within the Regional Community Reference Group did not focus on the refinery expansion agenda and some respondents claimed that very little time was spent on this issue during some of these meetings.

The Yolngu Matha translation of the Draft EIS Executive was a great initiative by the proponent and should have been a powerful tool to inform the Yolngu people of the EIS findings. It appears that it was significantly underutilized with the circulation of the document occurring half way through the Draft EIS comments period. It is acknowledged that this was compounded by the unfortunate death of the former senior advisor to Dhimurru during this period. The proponent has the opportunity to improve their consultation by using this document to better inform the Yolngu of the expansion effects. As some members of the community are unable to read English or Yolngu Matha, it is recommended that public readings be encouraged at community locations, facilitated by a member of that community if possible.

#### **Recommendation 26**

**It is recommended that the proponent engage an independent and appropriately qualified person to prepare a social impact and management plan of the proposed Alcan Gove expansion in consultation with the Yolngu People, Nhulunbuy township and relevant government agencies. This Plan will be submitted in two parts:**

**PART 1 – A management strategy for the construction phase of the refinery expansion project will be developed and submitted to OEH and DBIRD prior to construction of the Third Stage. The strategy will address issues associated with the provision of services, access to off-site recreation areas, consideration of indigenous persons, values and law in the region, and any other issues specific to the influx of a construction workforce for the expansion project.**

**PART 2 – This social impact and management plan will incorporate the relevant outcomes from Part 1 and will:**

- **Provide detailed assessment of historical context for the establishment of the mine and refinery and analyse the background of the ongoing social impacts on Yolngu people.**
- **Examine existing and develop new management strategies to address and minimise both existing and potential impacts resulting from the refinery and mining operations.**
- **Examine the effectiveness of current community consultation systems.**
- **Develop a consultation strategy to enable effective and ongoing communication with the local and regional communities of the Gove area.**
- **Provide mechanisms to audit and refine the effectiveness of the management and consultation strategies.**

**The Plan is to be prepared and be provided to DBIRD and the OEH for review prior to commissioning of the expansion, as well as the major Indigenous groups and the NLC for comment.**

**The final management and consultation strategies from Parts 1 and 2 are to be included in the Construction and Operational EMPs when completed.**

#### **4.14 Cultural Impacts**

##### **4.14.1 NT Heritage Conservation Act**

The Supplement did not address concerns raised by OEH regarding statutory requirements under the *Heritage Conservation Act*. This demonstrates the proponent's possible confusion regarding the difference between sacred and archaeological sites and protection under relevant Aboriginal cultural heritage legislation within the Northern Territory.

Clarification concerning Aboriginal Cultural heritage places and their protection under the *Northern Territory Aboriginal Sacred Sites Act* and *Northern Territory Heritage Conservation Act* is provided below.

An Aboriginal 'sacred site' protected under the *Northern Territory Aboriginal Sacred Sites Act* refers to a site within the meaning of the *Aboriginal Land Rights (Northern Territory) Act 1976* and means:

a site that is sacred to Aboriginals or is otherwise of significance according to Aboriginal tradition, and includes any land that, under a law of the Northern Territory is declared to be sacred to Aboriginals or of significance according to Aboriginal tradition.

The *Northern Territory Aboriginal Sacred Sites Act* and all places protected under that Act are administered by the Aboriginal Areas Protection Authority.

An archaeological site or object refers to a 'prescribed archaeological place or object' within the meaning of the *Northern Territory Heritage Conservation Act*. Regulation (3) of the

*Heritage Conservation Regulations* identifies the following places as prescribed archaeological places:

- Places containing painting or rock carvings;
- Prehistoric or proto-historic occupation places;
- Places containing human remains or burial artefacts (not being cemeteries as defined by the *Cemeteries Act*).

Prescribed archaeological places (or sites) are places containing archaeological materials or evidence resulting from Aboriginal occupation, activities or visitation in the past.

The *Northern Territory Heritage Conservation Act* and all places protected under that *Act* are administered by the Office of Environment and Heritage.

Prescribed archaeological places or objects are protected under sections 29 and 39 of the *Act*. These sections effectively provide a 'blanket' form of protection for all archaeological places or objects regardless of whether these places have been recorded or not. Under the *Act*, it is an offence to alter, disturb, damage, destroy or carry out works of any kind to a prescribed archaeological place without the written consent of the Minister for the Environment and Heritage.

A 'site' or 'place' may contain features or objects relating to the Aboriginal tradition within the meaning of both a 'sacred site' and 'prescribed archaeological place or object' and therefore may be protected under the *Northern Territory Aboriginal Sacred Sites Act* and the *Heritage Conservation Act*. The proponent should note, however, that many 'prescribed archaeological places or objects' afforded statutory protection under the *Heritage Conservation Act* are not 'sacred sites' within the meaning of the *Northern Territory Aboriginal Sacred Sites Act*.

Consideration of places within the meaning of a 'sacred site' does not, therefore, constitute compliance with the statutory obligations for 'prescribed archaeological places or objects' (otherwise known as archaeological sites) within the meaning of the *Heritage Conservation Act*.

Further, consideration of places within the meaning of a 'sacred site' protected under the *Northern Territory Aboriginal Sacred Sites Act* does not indemnify the proponent against prosecution under the *Heritage Conservation Act* should they knowingly or unknowingly disturb or destroy a prescribed archaeological place or object without the written consent of the Minister for the Environment and Heritage.

#### **4.14.2 Register of the National Estate**

Following a review of the Draft EIS, the proponent was directed to liaise directly with the Australian Heritage Council (AHC) or Commonwealth Department of the Environment and Heritage (DEH) to identify whether the heritage values of registered places on the Register of the National Estate (RNE) might be affected by the proposed expansion.

This advice was provided to make certain that the AHC or DEH was afforded the opportunity to review the situation at Gove. The Office of Environment and Heritage, whilst maintaining a voluntary interest in conservation and protection of a RNE place, does not maintain the RNE, nor does it administer the *Act* responsible for establishment of this Register and so could not provide informed comment on the EIS in this matter.

#### **4.14.3 Cultural Heritage**

A submission to the Draft EIS identified that the proponent has made no attempt to establish the relationship of the location of archaeological places with the geographical landscape. Because it is seldom possible to provide 100% survey coverage of an area, models are often established to ascertain this relationship within a given area and thereby identify areas of low, moderate and high archaeological probability. The proponent was provided with a preliminary model for the varying archaeological probability within a number of landscape zones that occur within the proponent's existing mining lease. The model indicates that mining or associated activities within these areas is likely to result in the disturbance of previously unrecorded and unreported archaeological places.

The proponent has stated that more comprehensive data is available on past and present uses of the land by Indigenous and non-Indigenous people and on archaeological places and objects. Whilst some anthropological literature and ethno-historic accounts of Aboriginal traditions and histories do exist for the Gove Peninsula there is no detailed documentation of archaeological places or objects in these accounts.

It is acknowledged that activities associated with the refinery expansion will occur within the existing mining lease; however, the expansion of the alumina refinery will increase the mining rate within the lease and move into undisturbed areas with the potential to impact on previously unrecorded and unidentified archaeological sites.

The proponent was thus advised following review of the Draft EIS that an archaeological survey of previously undisturbed areas within the existing mining lease should be undertaken. This was not addressed. Instead, the proponent has since referred to two reports to support their case for the existence of adequate knowledge on archaeological places and objects. Of the two, Evans (1966) represents a selective historical account to identify 'sacred sites' on the Gove Peninsula and does not deal with or identify non-sacred sites of Aboriginal tradition; and Dames and Moore (1974) provides results of a survey of the RDA, which represents a small percentage of the total existing area leased by the proponent. The numerous sites identified in the latter survey tend to indicate that the remaining areas of the Gove Peninsula may contain considerable numbers of archaeological sites and these areas have not been subject to archaeological investigation.

The proponent has previously been issued with a current scope of works for an archaeological survey established in accordance with the provisions of the *Heritage Conservation Act*. A list of suitably qualified archaeological consultants that may be available to undertake the work is available through the OEH's Heritage Conservation Services.

The undertaking of an archaeological survey for previously undisturbed areas within the 'existing' mine lease will minimise the risk of inadvertent destruction of archaeological sites and therefore avoid breaches of the *Heritage Conservation Act*.

#### **Recommendation 27**

**The proponent will undertake an archaeological survey program of the existing mining lease to identify archaeological places and with the view to developing management strategies that will mitigate the impact of mining activities on these places. This survey program should be undertaken in two stages:**

- **Stage 1 - should involve an archaeological survey of those areas that will be impacted upon in the short to medium term and possess some potential to contain prescribed archaeological places or objects resulting from Aboriginal occupation activities and protected under the *Heritage Conservation Act 1991*. These areas include the Eldo deposit and that part of the refinery construction access road located on Wargarpunda Point. A survey of the existing mining fringe should also be undertaken.**
- **Stage 2 - should involve a series of stratified and random archaeological surveys to further define the nature of Aboriginal occupation on the Gove Peninsula. These surveys should also target areas proposed for mining in the medium to long term.**

#### **4.15 Sewerage**

The proponent has advised that the sewerage treatment plant that services Nhulunbuy is the responsibility of the Nhulunbuy Corporation (NC). Nevertheless, the influx of workers for the construction phase will increase the load on the existing sewerage system at Nhulunbuy and this is an impact attributable to the proponent that is required to be addressed through the EIS process.

A submission from the NT Department of Health and Community Services (DHCS) to the Draft EIS indicated that effluent disposal to the Nhulunbuy Golf Course should not increase unless provisions are made to prevent increased nutrient runoff into Nhulunbuy Lagoon and to ensure there is no ponding of water in the intertidal overflow area. The Nhulunbuy Corporation has responded through the Supplement and provides an assurance that during the dry season all effluent from the oxidation ponds is pumped to the golf course for irrigation purposes and discharge to the evaporation/infiltration/overflow pond only occurs during the wet season. This indicates that ponding is likely to occur in the intertidal overflow area. The DHCS has provided management advice in Section 4.12 of this Assessment Report to minimise the impacts of ponding with respect to biting insects.

The Nhulunbuy Corporation has also advised that an investigation has been undertaken into the water quality guidelines for irrigating the golf course and will be following up the matter with the DHCS. No further action by the proponent is required on this matter.

#### **4.16 Decommissioning**

##### ***4.16.1 Residue Disposal Area***

A closure plan has been submitted to DBIRD under the *Mining Management Act and Regulations 2001* and has been approved in principle. The closure plan appears to very comprehensive. Submissions to the Draft EIS, however, indicated concerns with regard to rehabilitation and decommissioning of the residue disposal area. Previous attempts at rehabilitation of the Northern and Taylor's Ponds have proved difficult due to poor drainage and contaminants in the sub-surface soils. Current disposal practices in the active RDA improve the potential for successful rehabilitation; the eventual neutralisation of residue and waste water with the expansion will lead to further improvements. The proponent is continuing to investigate options to improve the revegetation of Northern and Taylor's Ponds.

An issue was raised in the Supplement with respect to changed management regimes if rehabilitation of the RDA is proven to be successful. There is a concern that over time, water will be allowed to infiltrate into the ponds, which could lead to pond instability and

subsequent breaching of embankments. The proponent has indicated that the revegetation process will include provision of subsurface drainage to remove excess water from the soil profile so that it discharges safely without moving deeper into the residue storage. The proponent also maintains that the dry stacking of mud ensures very low permeability and therefore eliminates the potential for any water storage in the main body of the stored residue.

The closure plan indicates that the RDA will be managed for a period up to 100 years following decommissioning. After management of the facility ceases, and assuming that no other viable use for the residue has been found, there is a high risk that erosion of the RDA will occur over time even with established revegetation. This will be an ongoing consideration for the proponent as it develops and implements improved practices for the management of the RDA in the future.

### **Recommendation 28**

**The proponent will ensure that decommissioning is done according to the best environmental standards available at the time.**

#### **4.17 Monitoring**

A number of operational issues have been identified as requiring ongoing monitoring and review. The Northern Territory Department of Business Industry and Resource Development (DBIRD) has indicated that it will require the proponent to compile details of all proposed monitoring programs into a comprehensive monitoring table and present this table in the annual Mining Management Plan. The monitoring programs must have clear objectives and be implemented in such a way as to demonstrate the effectiveness of the company's environmental management system and their effectiveness in achieving the stated objectives.

The proponent is required to report monitoring data on a regular basis, to undertake an annual review of monitoring data and to submit an annual report on the interpretation of the monitoring data and the company's performance against stated environmental objectives or targets. Interpretation of monitoring data also requires analysis of developing trends so that potential issues can be identified and addressed well before they reach trigger values and become environmental issues.

## **5 ENVIRONMENTAL MANAGEMENT PLAN**

The proponent has provided Draft Environmental Management Plans for the construction and operational phases of the proposed expansion of the refinery within the Draft EIS. The proponent indicates that the EMP forms part of its ISO 14001 Environmental Management System, which is combined with its Health and Safety Management System to form an integrated Environment, Health and Safety (EHS) Management System. In this way, the EMP is revised internally through the EHS Management System review and also by the NT Government annually as part of the Mining Management Plan.

The Draft Operational Environmental Management Plan (EMP) includes the following components associated with construction:

- Waste management including minimisation, reuse, recycling and disposal;
- Management of fugitive sources of emissions to air such as odour, dust, smoke and fumes;
- Effects of construction noise on Galupa residents and refinery employees;

- Surface water issues involving chemical storage, vegetation clearing and rehab, sediment and erosion control;
- Soil contamination impacts;
- Weed and fauna pest management;
- Construction impacts on fauna and habitats;
- Effects of construction on mosquito breeding sites;
- Impacts to cultural heritage values;
- Social and community effects ;
- Health and safety;
- Incidents and complaints.

The Draft Operational EMP includes the above issues applicable to the operation of the expanded refinery and includes the following additional components:

- Greenhouse Gas emissions;
- Groundwater effects from spills;
- Water supply wellfield;
- Marine impacts from shipping and refinery outfall discharges;
- Aesthetics;
- Lighting.

These EMPs will need to be revised to incorporate the additional measures for environmental protection and monitoring that are contained in this Assessment Report.

The EMP, as part of the Mining Management Plan, will be the major vehicle for implementing management and monitoring commitments made by the proponent in the EIS and the recommendations detailed in this Assessment Report. As such, it will be a working document for the life of the expanded plant and it will require continual review in light of operational experience and changed circumstances.

### **Recommendation 29**

**Revised Environmental Management Plans covering construction and operation of the Third Stage Refinery Expansion are to be submitted to DBIRD and OEH for approval prior to commencement of construction and operation respectively. The EMPs will be included as an appendix within the Mining Management Plan. The EMPs shall include all proposed improvements and developments associated with the expansion project as well as projects discussed in the EIS that have already commenced as part of the proponent's continuous improvement program (currently referenced in the Mining Management Plan). In this case, the relevant components of the Mining Management Plan shall be incorporated into the appended EMP.**

**In preparing each Environmental Management Plan, the proponent will include any additional measures for environmental protection and monitoring contained in this Assessment Report and recommendations made by the Northern Territory Government with respect to the proposal. The EMP shall be referred to relevant NT Government agencies for review prior to finalisation, after which it shall become a public document. The EMP shall form the basis for approvals and licences issued under relevant NT legislation.**

## **6 CONCLUSIONS**

The Office of Environment and Heritage (OEH) considers that the environmental issues associated with the proposed project have been adequately identified. Appropriate environmental management of some of these issues has been resolved through the assessment process, while the remainder will be addressed through monitoring and management actions detailed in a comprehensive Environmental Management Plan (EMP), included as part of the Mining Management Plan.

The final EMPs for construction and operational phases of the expansion will be subject to review and approval by relevant Northern Territory agencies prior to their incorporation into the Mining Management Plan. They will be working documents for the life of the refinery and will require continual review in the light of operational experience and changed circumstances.

Based on its review of the EIS and the proponent's response to submissions from relevant NT Government agencies and the public, the Office of Environment and Heritage considers that the expansion project can be managed in a manner that avoids unacceptable environmental impacts, provided that the environmental commitments, safeguards and recommendations detailed in this Assessment Report and in the final EMPs are implemented, and regular reporting and compliance auditing are undertaken.

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- URS (2001a) *Gove Harbour Marine Baseline Investigations – April/May 2000*. Unpublished Report to Nabalco Pty Limited by URS Australia. Report No. R770.
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- URS (2001c) *Appraisal of Drimmie Arm – April / May 2000*. Unpublished report to Nabalco Pty Limited by URS Australia, June 2001. Report No. R768.
- URS (2003a) *Site Inspection of Light Fuel Tank Farm – Final letter Report, March/April 2003*. A letter report prepared for Alcan Gove Pty Limited by URS Australia.
- URS (2003b) *Marine Habitats of Gove Peninsula and Southern Melville Bay*. Unpublished Report to Alcan Gove Pty Limited by URS Australia. Report No. R954.
- URS (2003c) *Gove Harbour Marine Investigations July 2002*. Unpublished report to Alcan Gove Pty Limited by URS Australia, August 2003. Report No. R955.

## **APPENDICES**

- 1. LIST OF RESPONDENTS TO THE PER**
- 2. RESPONDENT MATRIX**
- 3. ENVIRONMENTAL COMMITMENTS AND SAFEGUARDS**

## APPENDIX 1 - LIST OF RESPONDENTS TO THE EIS

SUBMISSION NO.	NAME	ORGANISATION
1		Department of Business Industry and Resource Development
2		Department of the Chief Minister (DCM)
3	Norman Fry	Northern Land Council (NLC)
4		Department of Health and Community Services (DHCS)
5		Department of Infrastructure Planning and Environment (DIPE)
6	Barbara Singer	Office of Environment and Heritage (OEH)
7	Witiyana Marika	Dhimurru Land Management Aboriginal Corporation (DLMAC)
8	Ms Banduk Marika & Colin Lane	Yirrkala Dhanbul Community Association (YDC)
9	Sean Carroll	Private submission
10	Justin Tutty	Private submission
11		Museums and Art Galleries of the NT (MAGNT)
12	Noel Wright	Private submission
13		Aboriginal Areas Protection Authority (AAPA)
14	Peter Robertson	Environment Centre NT (ECNT)
15	Brian Livingston	Gove Combined Unions (GCU)
16	Ian Maclean	Gove Amateur Astronomers

## APPENDIX 2 – RESPONDENT MATRIX

Respondent	Glossary of Terms & Acronyms	ES 8.3 Residue Disposal	ES8.4 Port	ES9.10 Residue Disposal	ES10.4 Air Quality	1.5 Project Schedule	1.7 Planning Issues and Statutory Requirements	3.4.4 Crushing & Screening	3.6 Residue Disposal	3.6.4 Pond Design & Management	4.3.4 Residue Separation, Filtration & Washing	4.3.12 Refinery Inputs	4.4 Liquid Purification	4.5 Waste Water Inventory Reduction	4.6 Residue Disposal	4.7 Port	4.9.4 Construction Workforce	4.9.6 Construction EHS EMP	4.10 Gas Conversion	5.1 Water Supply	5.1.3 Current Water Usage	5.1.7 Wellfield Demand	5.1.8 Wellfield Modelling	5.1.9 Well Field Management & Monitoring	5.2 Energy	5.4 Sewerage	5.5.2 Roads	5.5.3 Shipping	6.4.2 Fuel Alternatives	6.5 Air Pollution & Control Technologies	7.2 Waste Management Standards	7.3 Current Waste Management Practices	7.3.1 Solid Wastes					
1. Department of Business, Industry and Resource Development																																						
2. Department of the Chief Minister (DCM)																																						
3. Northern Land Council (NLC)																																						
4. Department of Health and Community Services (DHCS)																																						
5. Department of Infrastructure Planning and Environment (DIPE)																																						
6. Office of Environment and Heritage (OEH)																																						
7. Dhimuru Land Management Aboriginal Corporation (DLMAC)																																						
8. Yirrkala Dhanbul Community (YDC)																																						
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16. Gove Amateur Astronomers																																						
17. Northern Territory Police																																						

Respondent	7.4.2 Construction Waste	7.5 Waste Management Strategy	8.5.1 Existing Emission Controls	8.5.3 Emission Control	8.7 Results of Air Dispersion Modelling	8.8 Health Risk Assessment	8.9 Odour	8.11 Air Quality Management	9.1 Alcan's Greenhouse Strategies	9.3 Greenhouse Gas Effects of Refinery Expansion	9.4 Management of Greenhouse Gas Emissions	10.3 Existing Noise Levels	10.5.1 Refinery Noise	10.6.1 Refinery Construction - Noise	10.7 Noise Management	11.3.1 Current Surfacewater Management - Refinery	11.3.2 Residue Disposal Area	11.4 Water Quality Monitoring Program	11.7.2 Seawater Cooling Discharge	11.9.2 Refinery Discharge Quality	11.9.4 Water Quality Monitoring & Impact Mitigation	12.1.3 Groundwater Standards	12.1.4 Existing Environment - Refinery	12.2.4 Existing Environment - RDA	12.2.5 RDA Groundwater Impacts from Expansion	13.2 Monitoring and Investigation Program	13.3.1 Water Quality	13.4.2 Gove Harbour Water Quality	13.4.3 Drimlie Arm Water Quality	13.5.1 Gove Harbour Sediment Quality	13.5.2 Drimlie Arm Sediment Quality							
1. Department of Business Industry and Resource Development (DBIRD)																																						
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16. Gove Amateur Astronomers																																						
17. Northern Territory Police																																						

Respondent	13.6 Refinery Expansion Marine Impacts	13.7.1 Refinery Outfall Discharge	13.7.2 Changed Shipping Movements	13.8 Marine Management	14.2.1 Refinery Outfall	14.2.2 Northern Beach	14.2.3 Drimlie Arm	14.3.1 Regional Influences & Marine Biogeography	14.3.2 Southern Melville Bay	14.3.3 Fishing	14.4 Marine Standards	14.5.1 Shipping	14.5.2 Benthic Macrofauna	14.5.3 Turtles	15.2.2 Data Sources – Terrestrial Biology	15.2.5 Regional Context	15.2.6 Flora Survey	15.2.7 Project Effects	15.2.8 Flora Management	15.3.5 Survey Results	15.3.6 Significant Fauna Species & Habitats	15.3.7 Impact Assessment	15.4.1 Previous Studies of Biting Insects	15.4.4 Impact Assessment	16.4.5 Soil Erosion	16.5.1 Earthquake History	17.8.2 Refinery – Visual Impact	18.6 Expansion Impacts - Lighting	19.2 Rehabilitation & Closure Standards	19.3.1 Mine Rehabilitation	19.3.2 Mine Closure Criteria					
1. Department of Business Industry and Resource Development (DBIRD)																																				
2. Department of the Chief Minister (DCM)																																				
3. Northern Land Council (NLC)																																				
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16. Gove Amateur Astronomers																																				
17. Northern Territory Police																																				

Respondent	19.4.1 Refinery Rehabilitation	19.5 Residue Disposal Area - Rehabilitation	19.5.1 RDA Rehabilitation	20.1 Introduction	20.2 Historical Context	20.5 Cross Cultural Relationships	20.6.1 Register of the National Estate	20.6.2 Archaeological & Heritage Place & Objects	20.6.3 Indigenous Sites of Significance	20.8.1 Impact of Alcan Gove Expansion	21.3.1 Nhulumbuy	21.4.2 Demography - Yirrkala	21.4.9 Harmony Djamarini Mala Group	21.4.11 Tourism	21.5 Social Impact of Existing Alcan Gove Presence	21.7 Social & Community Impacts	21.7.3 Community Facilities	21.8.7 Off-Site Construction	22.4 Economic Effects of Expanded Operations	23.5 Consultation Formats	24.2.3 Consequence Analysis	24.4 Emergency Response Plans	25.4.3 Draft Construction Environment Mngagement Plan
1. Department of Business Industry and Resource Development																							
2. Department of the Chief Minister (DCM)																							
3. Northern Land Council (NLC)																							
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16. Gove Amateur Astronomers																							
17. Northern Territory Police																							

## Appendix 3

Summary of environmental commitments made by the proponent and additional safeguards arising from review of the draft EIS and supplement.

Commitment/Safeguard	Page References			Recommendation from Assessment Report 42
	Draft EIS	Supplement	Assessment Report 42	
<b>Planning &amp; Future Expansion</b>				
Proponent will comply with <i>Public Health Act</i> and <i>Food Act</i> (in addition to legislation listed in EIS Section 1.7)	1-6, 1-7	8		
Proposed changes to be referred to Minister for determination under the <i>Environmental Assessment Act</i> .	4-16	12, 71	14	2, 3
<b>Water supply</b>				
In order to minimise the extra demand on the aquifer, Alcan Gove will implement a water demand management program which will include the following: Design the expansion to minimise the requirement for fresh water in plant maintenance and removal of spillages; Design to use waste water rather than fresh water wherever possible; and Define fresh water use targets for each operational area and install meters to measure real-time water use on-line.	5-3	15,16	18	5
The proponent has committed to undertake an agreed field program of drilling and testing at the location of proposed new bores. The scope of this field program is being developed in consultation with DBIRD and DIPE.		89	16-17	4
A water conservation and management strategy will be developed for the operational areas as well as for Alcan Gove managed properties in the town of Nhulunbuy. Annual water demand reduction targets will be established for each location, and performance against them reported publicly each year in Alcan Gove's annual EHSC report and directly to the NT Government through the Mining Management Plan.		15	18	

Commitment/Safeguard	Page References			Recommendation from Assessment Report 42
	Draft EIS	Supplement	Assessment Report 42	
<b>Infrastructure Requirements</b>				
Larger aircraft will be introduced prior to construction commencement to cater for increased passenger demand.	5-12			
All necessary infrastructure will be installed in accordance with the relevant requirements of the Northern Territory Government.		13		
<b>Waste Management</b>				
Alcan Gove will comply with the <i>NT Waste Management and Pollution Control Act 1998</i> and the <i>Waste Management and Pollution Control (Administration) Regulations 2001</i> .	7-2			
Waste management will be improved in future so that non-contaminated industrial waste will be disposed of at the community landfill rather than the RDA. Proponent is investigating recycling options for this waste.	7-7	6, 26	32	22
Proponent will implement a waste management strategy. Targets for waste management are: 30% reduction in non-process waste/tonne of alumina by 2009; 25% reduction in process waste/tonne of alumina by 2009. This strategy will be in accordance with relevant regulatory requirements, guidelines and the proponent's internal standards.	7-5, 7-8, 25-5, 25-14	26		
The proponent will undertake a study of projected waste streams including estimated increased quantities.	7-6, 25-14	25, 26	32	22
Alcan Gove has committed to eliminate all significant sources of "caustic to ground" and to progressively implement site-wide bunding and containment.	7-3, 12-4, 25-14		21-22, 23	
Alcan have committed to maintaining current improved practises of not placing scale material on ground.	7-3, 25-14	35	21-22, 23	
<b>PAMs</b>				
Environmental, health & safety requirements and capability will be one criteria used to select final PAM construction site.	4-19	12		
PAMs shipped from overseas will be subject to quarantine requirements in accordance with AQIS.		20	34	24

Commitment/Safeguard	Page References			Recommendation from Assessment Report 42
	Draft EIS	Supplement	Assessment Report 42	
The Construction EMP will be prepared to account for potential impacts associated with PAM construction off-site.		12	32	22
<b>Air emissions</b>				
Proponent will employ fuel switching strategy when wind changes towards populated areas.	5-10, 8-7, 15-11, 25-15	28	29-30	16
Alcan will commit to using low-sulphur fuel oil (1.5%) at all times if gas is not secured as a fuel source & Air NEPM is exceeded at any receptor.			29-30	?
Monitoring of the stack gases for hydrocarbons and particulates from the liquor purification process will be continually undertaken.	4-12, 25-15	30		
In the event that gas is not secured for the expansion, the proponent will implement particulate control technology on the SPS stacks.	25-15		30	18
Proponent has committed to confirming the effectiveness of mist eliminators on the new cooling tower by monitoring the health of the surrounding vegetation during the first two years following its commissioning. If effective, the proponent will retrofit eliminators to Stage 1 and 2 cooling towers or implement alternative controls.	15-10	60	27	14
The detailed design of the shiploader dust control system is currently being developed to achieve an alumina dust reduction target of 95% of existing dust loads. Details of the design will be provided to the respondent through the mining management plan process. By the end of 2007, the shiploader will be upgraded to achieve this target.	25-15	6, 27	28	
The proponent will implement best-practice dust control measures to minimise fugitive dust emissions on the refinery site. These will be documented in the Construction and Operational Environmental Management Plans.	8-8, 25-6, 25-15	60	28	15
Alcan Gove has committed to an ongoing vegetation monitoring program which will include wet season monitoring. In this way any seasonal variations in SO2 effects and stress on vegetation will be identified.	25-15	59, 60	27	14

Commitment/Safeguard	Page References			Recommendation from Assessment Report 42
	Draft EIS	Supplement	Assessment Report 42	
In the event that natural gas is not secured, DBIRD should engage a technical specialist to undertake a review of the air modelling work incorporated in the Draft EIS as well as proposed pollution control technologies to determine appropriate stack concentration limits for critical pollutants, including sulfur dioxide and particulates.			29	19
An air quality-monitoring program for the expanded refinery will be implemented.	25-15	31	30	16
<b>Greenhouse</b>				
Proponent is investigating the implementation of greenhouse offset measures.	9-7, 9-8, 25-16	34	31	
The proponent's EMP will include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions and will consult with OEH in this regard.	25-16	34	31	16
The proponent is committed to working with relevant NT Government groups, the NLC and Dhimurru Land Management to reduce emissions from savanna burning.	9-8			
The proponent is a signatory to the Australian Government's Greenhouse Challenge Program and is committed to quantifying emissions and developing action plans for limiting greenhouse gas emissions.	9-2, 25-16		31	16
<b>Noise</b>				
The proponent will continue to consult with the Galupa Community with respect to implementing a noise mitigation strategies at Galupa.	10-9	34, 85	31-32	21
Noise barrier will be constructed at Galupa in line with the wishes of the Galupa community.	10-9	34, 85	31-32	
The proponent has committed to ongoing noise monitoring in the Noise EMP. This monitoring will be staggered to cover seasonal variations.	25-7, 25-16	34, 35		
The noise model will be updated and resubmitted to DBIRD and OEH to account for the impacts of blasting during construction. Further attenuation measures will be implemented if necessary.		89		

Commitment/Safeguard	Page References			Recommendation from Assessment Report 42
	Draft EIS	Supplement	Assessment Report 42	
<b>Refinery Surface Water Management</b>				
Alcan Gove will implement a surface water management improvement plan, which will enhance the performance of the bunding and containment strategies. Alcan Gove is committed to continuous improvement to meet the requirements of bunding standards. Improvements will be completed by 2009.	11-8, 25-17	36, 38	23-25	10
Alcan Gove has committed to eliminate all significant sources of “caustic to ground” and to progressively implement site-wide bunding and containment.	11-5, 12-4, 25-17	36, 41	21-22	8, 10
<b>RDA Surface Water Management</b>				
The proponent will ensure that there is adequate storage capacity to match expected residue production.	11-9	7, 8, 48	27	
The proponent will prepare a report to be submitted to outlining all strategies that will be implemented to ensure that releases of residue, waste water and embankment material to the environment adjacent to the RDA, controlled or otherwise, do not occur.	11-11	42	26-27	13
The proponent will reduce volumes of alkaline waste water through production improvements, treatment and reuse.	4-13, 11-20, 25-17	6, 8	24-25	
<b>Storm surge impacts</b>				
The proponent will consult the Bureau of Meteorology in regards to local information for the Gove region and Melville Bay. This information will update current understanding of potential storm surge effects on the RDA including the predicted impact of sea level rise due to global warming.		38	26-27	12
<b>Surface Water monitoring</b>				
The current surface water quality monitoring program implemented by the proponent will continue but will be reviewed in consultation with DIPE and DBIRD and will be incorporated into the Mining Management Plan.	11-13, 11-21, 11-22, 25-17	40	23-27	10
<b>Groundwater Management</b>				
The proponent has committed to eliminate all significant sources of “caustic to ground” and to progressively implement site-wide bunding and containment.	11-5, 12-4, 25-18		21-2	8, 10

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The proponent is committed to ensuring that, in the long term, groundwater at the refinery is not contaminated.	12-4, 25-18	40, 41		
The proponent will upgrade the Light Fuel Tank Farm containment and treatment systems to provide adequate capacity to contain and prevent further incidents from occurring.	25-18		20-21	7
<b>Groundwater monitoring</b>				
The proponent will develop groundwater quality trigger values by December 2004 in accordance with ANZECC guidelines.	12-2	40, 84	19-20	6
The proponent will develop waste water treatment options for groundwater recovery flow into the refinery discharge outfall.		41	22	9
The proponent will prepare a monitoring and remediation program in conjunction with the integrated monitoring program recommended in the Assessment Report. Groundwater trends from the monitoring program will be reported in the Mining Management Plan.	25-18		19	6, 25
<b>Refinery Discharge</b>				
The proponent is committed to achieving a zero mixing zone for its discharge, the continual reduction of TSS (in discharge water), a reduction of the impact area in Melville Bay and will undertake research into remediation options (for the flocculent in Melville Bay).	11-5/11-8, 13-9, 25-20	39, 45-46	23-25	10
Bleed water from cooling towers will be directed into the washer train, not the refinery outfall channel.		25	24	
The proponent will investigate further options for ensuring real time monitoring data for outfall discharge is available at all times.		39	25	11
The proponent has committed to ongoing investigations into the nature of outfall effects on macro-invertebrate fauna and to reducing the input of flocculant.	25-20	48, 54	23-25	?
<b>Marine Ecology</b>				
Assessment of impacts on local marine food sources will be included in integrated monitoring program.		48	34-36	25

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Sediment monitoring will be included in the integrated monitoring program.		48	34-36	25
The proponent will undertake surveys contributing to current knowledge of local marine species distribution endemism in association with the NT Museum as part of the integrated monitoring program.		50	34-36	25
The effects of metals on benthic biota in Gove Harbour will be investigated through the integrated monitoring program.		51	34-36	25
In the event that gas is not secured to power the expanded refinery and fuel oil imports increase, the proponent will update GOVE PLAN to reflect the increases in fuel oil shipments that would occur. The proponent will provide OEH with a summary of these GOVE PLAN updates.	25-20	48, 55	33	23
The origin of incoming ships for the expansion project will be determined to allow management options for marine pests to be implemented.	25-20	47, 55	34	24
<b>Marine Monitoring</b>				
The proponent is to develop a monitoring program, to be submitted to DBIRD and OEH for review, which will integrate the existing discrete programs and parameters to effectively monitor the estuarine and marine environments around the proponent's existing and proposed operations. The proponent has committed to include biological monitoring within its marine health monitoring program, which would be included in this integrated program and undertaken in conjunction with traditional owners. It will take into account all relevant methods for developing water quality triggers.	25-20	44, 48	35	25
The proponent will further develop data on local conditions and include this in the development of trigger levels for investigation in accordance with the ANZECC guidelines. These locally applicable trigger values will be developed by December 2004.	13-3, 25-17	43, 44, 83	35	25

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<b>Terrestrial Ecology</b>				
The proponent intends to conduct further biological survey work within and surrounding the wider north-eastern Arnhem Land area in the future.		56		
Alcan Gove has committed to an ongoing fauna monitoring program which will include wet season monitoring. Alcan Gove has committed to conducting further ecological surveys in the Gove region.	15-22	61-64		
Alcan Gove has committed to undertaking an ongoing vegetation monitoring program over the lease area. This will include the monsoon rainforest areas in the vicinity of the mining activities. Vegetation monitoring program will need to be reviewed and endorsed by DIPE.	15-12, 15-22, 25-20	57, 61	28	
Should any significant fauna species be found through the fauna monitoring program, an appropriate management plan for these species will be implemented.		63		
<b>Weeds</b>				
Alcan Gove will incorporate the Miwatj Regional Weed Committee prohibited weeds list into the EMP once the strategic plan, which has been referred to DIPE for review and endorsement, is endorsed.		58		
Alcan Gove is committed to ongoing monitoring of the Monto Vetiver grass cultivar to ensure it does not become a weed.		59		
Alcan Gove will remove all weed species used in landscaping the refinery.		59		
All incoming vessels and equipment will be monitored by the proponent to ensure compliance with AQIS requirements.	15-11, 25-20	20, 47		
All vegetation removed will be chipped and used as mulch or burnt except those with seed stock or those that reproduce vegetatively.	15-11	61		
All construction areas will be regularly surveyed for weed infestation. If weeds are identified, they will be removed and weed management strategies will be reviewed.	15-11, 15-20			

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<b>Biting Insects &amp; fauna pests</b>				
All incoming vessels will be subject to AQIS quarantine procedures.	15-22, 25-21	20, 63		
Surveys & inspections for yellow crazy ants will be undertaken and any nests quarantined and treated	15-22, 25-21			
Monitoring for fauna pest presence will be undertaken.	15-22, 25-10, 25-21	63		
The proponent will ensure that all of the management measures provided as advice by the Medical Entomology Unit of the DHCS will be implemented as appropriate and included in its mosquito management plan.	15-22, 25-21	19, 65, 84, 85	36	
Any tyres given to the community will be holed to prevent pooling of water.	25-21	24		
<b>Cultural Impacts</b>				
There will be no unauthorised disturbance of sites of cultural heritage significance by the operation of the expanded refinery. Proponent will undertake an archaeological survey.	25-22	71, 73	40-42	27
Cultural heritage issues including feedback and complaints from Traditional Owners will be monitored and reported annually in the MMP	25-11, 25-23			
The proponent will consult with relevant groups on the matter of possible cultural significance of the outfall to the Galpu clan.		72		
The proponent will continue to support the Traditional Owners in maintaining important heritage places and values.	20-9			
<b>Social Impacts</b>				
The proponent has committed to ensuring that all construction personnel receive cross-cultural training before they begin work.		76, 77	37-39	
The proponent will continue to maintain and upgrade town and local facilities and services.	21-22, 25-12	78, 79	37-39	
The proponent has committed to supporting comprehensive programs to minimise recreational impacts, to manage them, and to rehabilitate recreation areas in consultation with the Yolngu people.	21-23, 25-12	66, 77, 83		

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The proponent is committed to supporting the local community both for the present and the long-term future. It will assist with the development of social and financial infrastructure that will help bring about a sustainable economy to underpin community development beyond the cessation of its operations in the area.	21-26	84	37-39	
During the construction phase of the expansion project, the proponent will provide specific support to Dhimurru for minimising the impact of extra visitors to recreation areas through a management strategy to be agreed with Dhimurru.		66, 77	37-39	
Construction workforce will be required to sign a code of conduct for the duration of their contract.	21-26, 25-12	12, 75	37-39	
Construction workforce accommodation will be fully self-contained to reduce the requirement for workers to leave the site and prevent entry to non-employees.	21-26	75, 77	37-39	
A social impact and management plan will be prepared prior to commissioning of the plant in two parts. Part 1 will consider the expansion project impacts and Part 2 will consider existing and ongoing social impacts associated with the history of Gove. This will include a strategy for continued community consultation.	21-19/21-27	74, 75	37-39	26
<b>Environmental Management Plan</b>				
A strategy for soil erosion management for all disturbed areas will be incorporated in the Construction Environmental Management Plan, which will be submitted to OEI and DBIRD for review.	4-20, 25-8			
Construction EMP will be prepared by construction contractor in accordance with the Draft EMP submitted by the proponent. The EMP will be submitted to OEI and DBIRD for review prior to construction. The requirements of the EMP will apply to the EPCM Contractor and all sub-contractors.	4-21, 25-4	12	44-45	29

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All contractors will be required to submit environment health and safety plans to be discussed negotiated and approved by the project management team and the proponent. Compliance audits will be conducted on all contractors during the life of the project.		83		
Operational EMP will be reviewed by the proponent and submitted to OEH and DBIRD for approval prior to commissioning of the expanded refinery.			44-45	29
Alcan will prepare a long-term fire management plan as part of their EHS Management Plan and Environmental Management Plan.		13		
All reporting on the performance of EMPs will be included annually in the Mining Management Plan.	25-6/25-24			
<b>Decommissioning</b>				
The proponent will ensure that decommissioning is done according to the best environmental standards available at the time.	19	67, 68	43	28