

# Air Liquide Australia Ltd Caroline Carbon Dioxide Purification Plant



## Environmental Impact Report

June 2001



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# Executive Summary

Air Liquide Australia Ltd own and operate a carbon dioxide (CO<sub>2</sub>) purification plant situated near Mt Gambier in the south east of South Australia. The plant produces approximately 21,000 tonnes of CO<sub>2</sub> per year and supplies liquid CO<sub>2</sub> to clients in South Australia and Victoria.

This Environmental Impact Report has been developed in accordance with the specific requirements of Part 12 of the South Australian *Petroleum Act 2000* and Regulations 10, 12 and 30 of the *Petroleum Regulations 2000*.

Potential environmental impacts that may result from the day-to-day operation of the plant are predominantly associated with the storage, handling and disposal of hazardous and liquid wastes generated by the plant and the risk of chemical, fuel or oil spills to land.

Air Liquide have developed a comprehensive set of system and site procedures to mitigate potential impacts. Implementation of these procedures is conducted in accordance with an ISO 9002 accredited Quality Assurance System.

As part of Air Liquide's aim to work toward best practice environmental management, a list of key environmental improvement initiatives to minimise the generation of wastes are also detailed within. These include the phasing out of silica gel and freon gas and the reduction of CO<sub>2</sub> emissions by 5% by December 2001.

# 1 Introduction

Air Liquide Australia Ltd own and operate the Caroline Carbon Dioxide Purification Plant near Mt Gambier in the south east of South Australia. Construction and operation of the plant was approved under the South Australian *Petroleum Act 1940* and the plant was commissioned in 1967. This Act has recently been repealed and replaced with the South Australian *Petroleum Act 2000*. Under the current Act operators must comply with a range of new requirements, particularly with regard to environmental management.

As a requirement of Part 12 of the *Petroleum Act 2000*, a regulated activity can only be conducted if an approved Statement of Environmental Objectives (SEO) has been developed. The SEO outlines the environmental objectives that the regulated activity is required to achieve and the criteria upon which the objectives are to be assessed. The SEO is developed on the basis of the information provided in an Environmental Impact Report (EIR). An EIR is provided by the licensee and describes an activity's likely impacts on the environment and management strategies to minimise these impacts.

Ecos Consulting (Aust) Pty Ltd has been commissioned by Air Liquide to prepare an EIR and SEO for the Carbon Dioxide Purification Plant. Preparation of both documents was based upon:

- site inspection and review of plant operations on October 18 2000;
- review of Air Liquide's existing environmental documentation (policies, procedures, incident reports, monitoring results, induction and training procedures, and audit reports);
- interviews with the Plant Manager;
- liaison with the Department of Primary Industries and Resources South Australia (PIRSA) to ensure that specific requirements of the EIR were fully understood; and
- through Air Liquide, consultation with, or correspondence from, the Environment Protection Authority, District Council of Grant, Department of Environment and Heritage, Forestry South Australia and Carter Holt Harvey.

This EIR addresses potential environmental impacts associated with the day-to-day operation of the plant and outlines strategies and procedural requirements for the appropriate management and mitigation of these impacts.

## 2 Air Liquide Operations

### 2.1 Location and Access

The Carbon Dioxide Purification Plant is located on Carba Road, approximately 12 kilometres southeast of Mt. Gambier, and occupies an area of almost 2 hectares (Figure 1). All access to the site is via Carba Road, which is an all-weather public road maintained by the District Council of Grant.

### 2.2 Land Tenure

The Plant is situated within Petroleum Production Licence 21, which overlies the Caroline Forest Reserve, managed by Forestry SA.

### 2.3 Plant

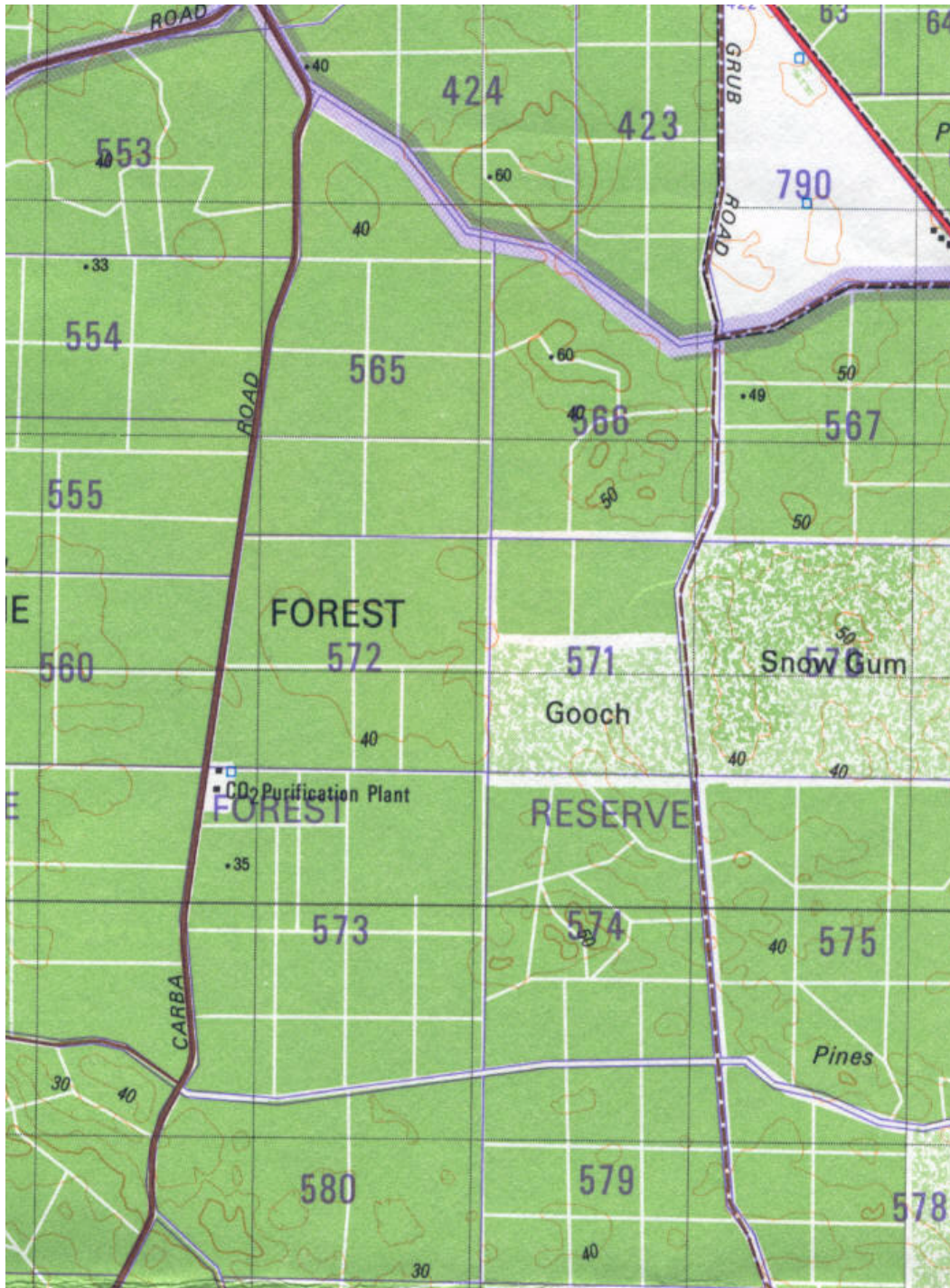
#### 2.3.1 Carbon Dioxide Purification Process

Carbon dioxide (CO<sub>2</sub>) was initially discovered at the plant site by Alliance Oil Development Australia in 1967. Construction of the wellhead and the associated purification plant was completed in 1967 and CO<sub>2</sub> production commenced immediately.

Currently, raw CO<sub>2</sub> is supplied to the Air Liquide plant from the well via a 70 metre flowline. The plant runs continuously and at the present time produces approximately 21,000 tonnes of CO<sub>2</sub> per year. The plant supplies liquid CO<sub>2</sub> to the soft drink, firefighting, medical and winemaking industries in South Australia and Victoria.

Raw liquid from the well contains approximately 90 – 94.5% CO<sub>2</sub>, and 6.5 -10% impurities. These impurities include sulphur compounds (mainly H<sub>2</sub>S), nitrogen and a number of light and heavy hydrocarbons. In addition, some free water is also contained within the raw liquid. A purification process is required to remove these impurities and produce CO<sub>2</sub> to a standard that meets consumer specifications.

A summary of waste generated as a result of the CO<sub>2</sub> purification process is given in Table 1.



**Figure 1: Plant Location.**

Source: S.A. Department of Lands, Gambier Topographic Map

**Table 1: Carbon Dioxide Purification Process Waste Products.**

Process	Type of Waste	Quantity Generated (annually)
CO <sub>2</sub> Vaporisation	Solid hydrocarbon Water	10, 000 l 9,000 l
Main Purification Train	Puraspec Activated carbon Water vapour	5,000 kg 2,500 kg undetermined
Moisture Removal	Silica gel Water vapour	800 kg undetermined
CO <sub>2</sub> Liquefaction	No waste generated	N/A
Distillation and Storage	CO <sub>2</sub> Methane  Nitrogen	25% total production (on average) 1-1.5% volume of vented CO <sub>2</sub> (quantity as above)  undetermined

### 2.3.2 Carbon Dioxide Vaporisation

Initially raw CO<sub>2</sub> liquid is heated and CO<sub>2</sub> is vaporised. Water, that is used in the heating process, is sourced from a licenced bore located on site. Heating water is dosed with corrosion inhibitor and sulphuric acid to prevent corrosion, control calcium build-up and maintain the pH of the water. Carbon dioxide vapour exits the vaporiser leaving behind some hydrocarbon and waste water. Waste hydrocarbon and water is stored in a bunded tank (Plate 1). Waste water is later removed from this tank and pumped to the "effluent" storage tank.

### 2.3.3 Main Purification Train

The bulk of sulphur impurities are removed from the CO<sub>2</sub> stream at this stage of the purification process. Both Puraspec media and activated carbon are used to absorb sulphur components. The adsorption process also removes odours from the CO<sub>2</sub> vapour and some hydrocarbons. During the purification process Puraspec is converted to copper sulphide and cannot be regenerated. Activated carbon is regenerated and used for a period of twelve months before it is replaced with new material.

### 2.3.4 Moisture Removal

From the main purification train CO<sub>2</sub> vapour flows to two absorption driers. The driers contain silica gel, which removes almost all moisture from the CO<sub>2</sub> vapour. Silica gel is regenerated for four to six months before being removed and replaced.

### 2.3.5 CO<sub>2</sub> Liquefaction

Once dried, the CO<sub>2</sub> flows through a dust filter before being liquefied. The dry stream is liquefied via refrigeration. At this stage the only significant contaminants still present in the CO<sub>2</sub> are nitrogen and methane.

### 2.3.6 Distillation and Storage

Low pressure CO<sub>2</sub> liquid is distilled then stored in vessels where it is held at approximately 1,750-1,800 kPa. During the distillation process a CO<sub>2</sub>/methane/nitrogen mixture vents to the atmosphere (methane makes up approx. 1 – 1.5% of 3,000kg CO<sub>2</sub> vented per hour).

### 2.4 Storage

The only flammable liquids stored on site are diesel (180 l), unleaded petrol (300 l), and a small quantity of paint. Unleaded petrol and paint are stored undercover in a workshop storage area (Plate 2). The diesel is contained near the wellhead and acts as a "tell-tale" gas leak indicator (Plate 3).

Some biocide (40 l) is kept in the workshop storage area.

Sulphuric acid (200 l), anhydrous ammonia (240 kg), and corrosion inhibitor (40 l) are stored alongside the number one cooling tower.

Small quantities of lubrication and refrigerant oil are also stored on site (total of approx. 100 l).

Aside from some pure CO<sub>2</sub> storage (in addition to processed CO<sub>2</sub>), the only other gases stored on site are cylindered oxygen and acetylene gases and a small quantity of freon. Freon is kept for refrigeration purposes.

### 2.5 Loading and Transport

On average, between three and five road tankers per day load liquid CO<sub>2</sub> on-site (Plate 4) and transport it to clients within South Australia and Victoria.

### 2.6 Waste Management

#### 2.6.1 Disused Solid Waste Pits

Two disused solid waste pits within an area of 4 x 5 m wide and 1 m deep were backfilled in 1984. All wastes are now currently disposed of off-site by a licenced contractor.

#### 2.6.2 General Waste

All general wastes (including solid wastes, paper and domestic scraps) are collected in a hopper for later removal to a licenced disposal facility.

### 2.6.3 Sewage

All sewage is stored in a concrete effluent pit near the western boundary of the site. A licenced waste disposal contractor pumps out the pits periodically and transports the waste to a licenced sewage treatment plant.

### 2.6.4 Chemical Wastes

Chemical wastes including spent silica gel, activated carbon and Puraspec are collected by a licenced waste disposal contractor for disposal off-site.

Empty chemical drums are returned to the bunded workshop storage area for subsequent collection and disposal off-site.

### 2.6.5 Gaseous Emissions

Venting of CO<sub>2</sub> vapour (including fugitive releases) and methane is required during operations. Air Liquide is currently aiming to reduce CO<sub>2</sub> losses from 25% to 20% by 2001. This will also reduce methane emissions.

## 2.7 Water Management

### 2.7.1 Stormwater

All rainwater runoff within the immediate vicinity of the plant is collected in concrete drainage channels and temporarily stored in a settling pit before being pumped to the "effluent" storage tank (Plate 5). Produced formation water is also stored in the storage tank. After a settling period all water from the "effluent" tank is pumped to an adjacent tank and aerated before being disposed of via irrigation of grassed areas within the plant site. Irrigation takes place via a single sprinkler that is moved throughout the site.

There are no natural drainage lines located either within the site or in the immediate surrounding environment.

### 2.7.2 Produced Formation Water

Produced formation water is temporarily stored in a holding tank before being pumped to the "effluent" storage tank. This water is disposed of along with stormwater for irrigation on-site.

The "effluent" storage tank is cleaned out once a year to remove any build up of solids (sediment and hydrocarbons). Hydrocarbons are derived from small quantities present in the produced formation water and from plant washdown and maintenance.

## 2.8 Well Operations

### 2.8.1 Well History

The source of the CO<sub>2</sub> (and produced formation water) is the Caroline-1 well which was spudded by Alliance Oil Development Australia N.L. in September 1966 and reached a total depth of 11, 066ft (3373m) in January 1967. The well was completed in February 1967 as a CO<sub>2</sub> producer.

The deepest formation penetrated is the Eumeralla Formation of the Otway Group.

### 2.8.2 Producing Formations

After a series of drillstem tests the well was completed in two upper units of the Otway Group (Waarre Formation and a transition unit between the Waarre and Eumeralla Formations). Production from the well since February 1968 has shown that the vast majority of the CO<sub>2</sub> comes from two small, perforated intervals in the Waarre Formation (8204-8210 and 8214-8230ft RKB). Figure 2 shows a stratigraphic table for the Otway Basin and Figure 3 illustrates the wellbore and the perforated intervals in the Waarre Formation.

### 2.8.3 Well Completion and Production

The well was completed as a single completion, producing through a 2 inch tubing with a packer set in the 5 ½ inch production casing at 8130ft. The open perforations are located at:

- 8204 - 8210 ft (6 ft);
- 8214 - 8230 ft (16ft);
- 9152 - 9172 ft (20ft); and
- 9303 - 9321 ft (18ft).

The plugged-back total depth was 9400ft, but fill has reduced this to 9322ft by 2001.

Casing was run and cemented with sizes, weights and depths as outlined in Table 2.

**Table 2: Casing Dimensions.**

Size (inches)	Weight (lbs)	Depth (ft)
19½	NA	163
13	48	740
9	36	3149
5½	17	9400 (J-55 and N-80)

## STRATIGRAPHIC TABLE - OTWAY BASIN

AGE	STRATIGRAPHY	LITHOGRAPHY	DEPOSITIONAL ENVIRONMENT	HYDROCARBON POTENTIAL		
				SOURCE	RES. SEALS	SHOWS
PLIOCENE	HEYTESBURY GROUP/ TORQUAY GROUP	Port Campbell Limestone Gellibrand Marl	Shallow Marine			
			Deep Marine			
MIOCENE	HEYTESBURY GROUP/ TORQUAY GROUP	Port Campbell Limestone Gellibrand Marl	Shallow Marine			
			Deep Marine			
OLIG.	HEYTESBURY GROUP/ TORQUAY GROUP	Port Campbell Limestone Gellibrand Marl	Shallow Marine			
			Deep Marine			
Eocene	NIRRANDA GROUP	1 2 3	Marine			
		Dilwyn Formation Pember Mudstone	Fluvio-Deltaic			
		Pebble Point Formation	Marginal Marine			
PAL	WANGERIP GROUP	Pebble Point Formation	Marginal Marine			●
CRETACEOUS	SHEBROOK GROUP Eastern View Coal Measures	Curdies Formation	Fluvial		G	
		Paaratte Formation	Marginal Marine			
		Belfast Mudstone	Prodelta			
		Flaxmans Formation	Marginal Marine			
		4 4	Fluvial Fluvial			
Early	OTWAY GROUP	Eumeralla Formation	Continental		G	●
		Pretty Hill Formation				
		Casterton Beads				
JURASSIC						
PALAEOZOIC	Basement					

1. Narrawaturk Marl
2. Mepunga Formation
3. Demuns Bluff Formation
4. Waare Sandstone

Figure 2: Stratigraphic Table of the Otway Basin.

## CAROLINE CO<sub>2</sub> COMPLETION DIAGRAM

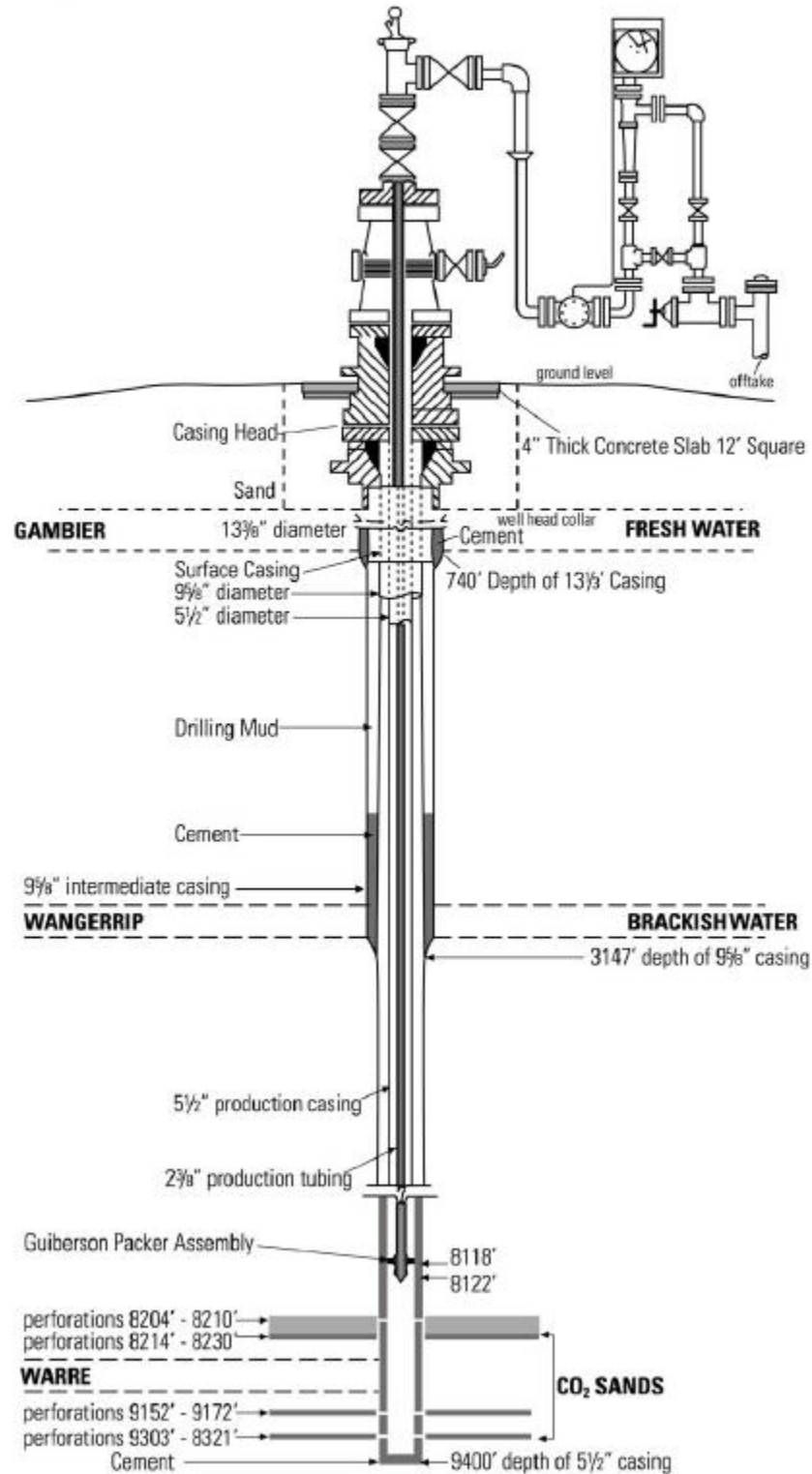


Figure 3: Down Hole Well Assembly

**Apart from intermittent production during 1968, the well has produced CO<sub>2</sub> almost continuously at an average rate of 1.25 million SCFPD (65 tonnes per day). The maximum continuous rate is approximately 1.9 million SCFPD (100 tonnes per day).**

**No workover has been performed on the well.**

## 3 Existing Environment

### 3.1 Land Use

The plant is situated within the Caroline Forest Reserve and surrounding land use consists solely of pine plantations for timber production. The nearest alternate landuse is grazing, some 4.5km to the south. The closest residence is over 5km from the Plant.

The forests in the Caroline region are primarily for wood production and have limited opportunities for recreation. Public access along Carba Road is permitted.

### 3.2 Landform and Soils

The plant site is relatively flat. The surrounding Caroline Forest area is generally low lying and gently undulating, with elevations ranging from 25 to 85 metres above sea level (Geddes 1981). There are no natural drainage lines (i.e. surface streams and rivers) in the area.

A calcarenite range (weathered dune) runs through the Caroline Forest region, hence soils in the area consist mainly of deep sands (Geddes 1981; Croft *et al.* 1999).

### 3.3 Groundwater

The groundwater level occurs at a depth of approximately 22m. The Department for Water Resources routinely samples groundwater (every 3 months) from the bore on the eastern perimeter of the plant site. Samples are analysed for a range of parameters (including major anions and cations, conductivity, salinity and pH). Samples are taken for a Department of Water Resources monitoring program which aims to assess the level and quality of groundwater at various bores in the south east.

### 3.4 Flora and Fauna

The plant site consists of maintained grassed areas with some scattered trees along the perimeter. Some of these are native to the area (eg *Eucalyptus obliqua*), while others appear to have been planted since the establishment of the plant (eg *E. globulus*). The site is surrounded by *Pinus radiata* plantations, with the nearest area of native vegetation being approximately 1.5 km to the east (Native Forest Reserve). The only potential source of weeds is via the movement of vehicles to and from the plant site. This risk is not considered significant as all vehicles (including tankers) access the site using public roads. Given the context of

surrounding land-use, the relatively small size of the plant site and absence of native vegetation in the area the consequences of any weed introduction are not considered significant. Little natural fauna habitat exists in the surrounding area.

### 3.5 Cultural Heritage

No items of indigenous or non-indigenous cultural heritage are present on the site.

### 3.6 Downhole Geology and Hydrology

The Gambier Formation of the Glenelg Group is the major ground water source in the region. This formation extends down to a depth of 640ft RKB (Figure 2). Below this depth only brackish (non-potable) water has been encountered.

### 3.7 Casing Corrosion/Detection System

The annulus between the 5½ inch casing and the 2 inch production tubing (above the packer) is almost completely filled (to the surface) with mud which was used to drill the well. The remaining space is filled with diesel oil, which is allowed to drain into the annulus as it expands or be expelled out of the annulus as it contracts due to temperature fluctuations.

The purposes of this system are:

- To ensure that air does not enter the casing/tubing annulus, thus providing corrosion protection; and
- To provide a surface indication of downhole problems such as ruptures in the tubing or casing by means of a check valve and pressure gauge.

## 4 Environmental Hazards, Potential Consequences and Management Strategies

The well and its wellhead pose a number of threats to the environment and public safety. These include, downhole blowout, well casing/tubing corrosion, wellhead rupture and chemical, fuel or oil spill. Potential environmental hazards resulting from the Carbon Dioxide Purification Plant operations are summarised in Table 3.

**Table 3: Potential Environmental Hazards.**

Operation	Hazard
Plant operation: <ul style="list-style-type: none"> <li>▪ CO<sub>2</sub> production</li> <li>▪ CO<sub>2</sub> purification</li> <li>▪ Storage</li> <li>▪ Loading and transport</li> </ul>	<ul style="list-style-type: none"> <li>▪ Chemical, fuel or oil spill</li> <li>▪ Liquid waste storage and disposal</li> <li>▪ Solid waste storage and disposal</li> <li>▪ Atmospheric emissions</li> <li>▪ Wellhead rupture</li> <li>▪ Fire or explosion</li> <li>▪ Downhole blowout</li> <li>▪ Well casing corrosion</li> </ul>
Site wash down and run-off	<ul style="list-style-type: none"> <li>▪ Disposal of contaminated run-off water</li> </ul>
Administration	<ul style="list-style-type: none"> <li>▪ Domestic waste disposal</li> <li>▪ Sewage effluent storage and disposal</li> </ul>

The proposed environmental objectives and management strategies for the environmental hazards and potential consequences of the Carbon Dioxide Purification Plant operations are outlined in Table 3. These have been developed to be consistent with Air Liquide's Environmental Policy (Appendix 1).

Site procedures are implemented in accordance with an ISO 9002 accredited Quality Assurance System. System procedures include training, record management, monitoring, auditing and reporting.

**Table 3: Environmental hazards, potential consequences and objectives and management.**

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
Chemical, fuel or oil spill.	<p>Contamination of groundwater and/or soil.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>• A spill is any unintended leakage or escape of a chemical, fuel or oil.</li> <li>• Any chemical, fuel or oil spill at the plant site is expected to be relatively low in volume (max. 300l of unleaded petrol) and localised (ie. within the contained storage area).</li> <li>• All spills, no matter what volume, are to be addressed.</li> </ul>	Avoid groundwater and soil contamination.	<p>Ensure that chemicals, fuels and oils are stored in a contained area and on a flat, impermeable surface.</p> <p>In the event of a spill ensure that spill response procedures are followed (refer Safety Training Manual – Cryogenic Liquids, Spills and Vapour Clouds or Material Safety Data Sheet) and that the incident is reported to the Plant Manager.</p> <p>Maintain existing spill response station.</p> <p>Bund sulphuric acid storage area.</p>	<p>Integrate environmental incident reporting into existing incident reporting systems (i.e. QIR).</p> <p>Provide appropriate training and/or induction to employees and contractors with regard to spill response and reporting.</p> <p>Establish and maintain a record of all spills and ensure that appropriate corrective actions are carried out.</p> <p>Ensure that relevant Material Safety Data Sheets and spill response procedures are posted in appropriate work areas.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
<p>Liquid waste storage and disposal:</p> <ul style="list-style-type: none"> <li>▪ stormwater</li> <li>▪ produced water</li> <li>▪ hydrocarbons</li> </ul>	<p>Contamination of groundwater and/or soil with hydrocarbons.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>• Discharge of stormwater and formation water via irrigation may result in saturation of the soil profile and/or build-up of hydrocarbons and salt.</li> <li>• The pH of the soil may also be affected (ie. decrease) by prolonged irrigation with formation water.</li> </ul>	<p>Minimise waste generation. Avoid groundwater and soil contamination.</p>	<p>Avoid creation of soakages by ensuring that the sprinkler is relocated before soil becomes saturated and pools of water develop.</p> <p>Inspect condition of grassed areas for signs of "die-off" or surface hydrocarbons.</p> <p>Minimise hydrocarbon content of discharge (irrigation) water by ensuring adequate retention time in hydrocarbon storage tank and "effluent" storage tank.</p> <p>Check effluent tank and bunded area to ensure that spills or leaks are not occurring.</p> <p>Any build up of hydrocarbons to be regularly removed by licenced contractor.</p> <p>Off-site disposal of hydrocarbons to be conducted by licenced contractor.</p> <p>Maintain contract with licenced waste removal contractor.</p>	<p>Sample and analyse liquid waste 6-monthly. Check results against ANZECC water quality guidelines for agriculture (test for 30mg/l or below for hydrocarbons).</p> <p>Develop a checklist for inspection of grassed areas, "effluent" tanks, hydrocarbon storage tank and bunds.</p> <p>Maintain a record of inspections and water quality monitoring data.</p> <p>Address any issues identified during inspections or monitoring.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
Solid waste storage and disposal	<p>Contamination of groundwater and/or soil.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>The following solid wastes are generated on-site:                             <ul style="list-style-type: none"> <li>Puraspec</li> <li>activated carbon</li> <li>silica gel</li> <li>domestic wastes</li> </ul> </li> <li>All waste is stored in a sealed area (approx. 6 x 4m) and collected and disposed of by a licensed waste removal contractor. Hence, the risk of contamination to the soils or groundwater is considered low.</li> </ul>	<p>Minimise waste generation. Avoid groundwater and soil contamination.</p>	<p>Contain and handle waste in containers and, where appropriate, within bunded areas.</p> <p>Maintain contracts with licenced waste removal contractors.</p>	<p>Phase-out use of silica gel and replace with Trockenperlen N (March 2001).</p> <p>Check and control waste removal contracts.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
Solid waste storage (historical)	<p>Contamination of soil and/or groundwater.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>▪ The following solid wastes were contained within the disused waste pits: <ul style="list-style-type: none"> <li>▪ Puraspec</li> <li>▪ activated carbon</li> <li>▪ silica gel</li> </ul> </li> <li>▪ There is the potential for localised (pits are 4 * 5m wide and 1m deep) contamination of the soil and/or groundwater by hydrocarbons and/or copper sulphate</li> </ul>	Avoid groundwater and soil contamination.	<p>Undertake soil and sampling (for petroleum hydrocarbons) in the vicinity of the disused waste pits (first quarter 2001).</p> <p>On the basis of the results of soil sampling, decide on the need for groundwater testing, and initiate if warranted.</p> <p>Carry out any necessary remediation of waste pits and the surrounding environment.</p>	<p>Ensure sampling and monitoring results are checked and recorded and that any necessary actions are implemented.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
<p><b>Atmospheric emissions:</b></p> <ul style="list-style-type: none"> <li>▪ CO<sub>2</sub> venting</li> <li>▪ fugitive emissions (CO<sub>2</sub>)</li> <li>▪ methane</li> <li>▪ disposal of "off-spec" CO<sub>2</sub> gas</li> </ul>	<p><b>Atmospheric pollution (greenhouse gas).</b></p> <p>Danger to health and safety of personnel, contractors and the public.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>▪ The only risks associated with release of off-specification gas arise from direct contact with CO<sub>2</sub> vapour (ie. suffocation and frostbite).</li> <li>▪ Plant emissions are off-set (to some extent) by local CO<sub>2</sub> absorption by the surrounding pine plantation.</li> <li>▪ Past emissions of "off-spec" gas have occurred infrequently (eg. once every eight to ten years).</li> </ul>	<p>Minimise Air Liquide's contribution to the "greenhouse effect".</p>	<p>Ensure that plant design and operational standards minimise fugitive emissions (as per Gas Operations Manual V.1&amp;2 and Site Operation Manual).</p> <p>Ensure that plant operating procedures result in efficient plant operation (refer Site Operation Manual).</p> <p>Ensure that plant operating procedures result in specified gas quality.</p> <p>Operate plant in accordance with existing specified procedures (refer Site Operation Manual).</p> <p>Monitor with gas chromatograph to provide more immediate analysis of product quality.</p> <p>Dispose of "off-spec" CO<sub>2</sub> gas away from the immediate vicinity of operations, personnel and the public (ie downwind and 30m from nearest road and/or personnel).</p> <p>Conduct a regular maintenance program to reduce fugitive emissions (refer Site Operation Manual).</p>	<p>Inspect and monitor maintenance works.</p> <p>Keep a record of maintenance works and ensure that works progress as scheduled.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
<b>Atmospheric emissions:</b> <ul style="list-style-type: none"> <li>▪ freon.</li> </ul>	Atmospheric pollution (ozone depleting substance).	Minimise Air Liquide's contribution to ozone depletion.	Store and handle freon appropriately.  Ensure that Freon is removed from site and disposed of by an accredited contractor	Phase-out use of freon gas for refrigeration and replace with R22 (2-5% ozone depletion capability of freon) by end June 2002.
Well casing corrosion	Contamination of soil and/or groundwater.  Comments: <ul style="list-style-type: none"> <li>• Currently wellhead pressure and a "tell-tale" diesel system indicate if there is any lose of pressure, and therefore potential leakage due to corrosion, in the well.</li> </ul>	Avoid groundwater and soil contamination.	Continue to monitor wellhead pressure and "tell tale" diesel system daily (refer Daily Operations Manual).  Continue well surveys (surveys carried out by Questa approximately every two years).	Maintain a record of daily inspections and monitoring data (refer Daily Operations Manual).  Ensure well survey reports are checked and filed and that any necessary works are carried out.

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
Wellhead rupture (refer to Appendix 2: Emergency Response Procedures - Situations)	<p>Danger to health and safety of employees, contractors and possibly the public.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>The risk of a wellhead rupture is considered to be low (as per Risk/Result Diagram – Emergency Response Procedures Caroline-1 Well (Appendix 2))</li> </ul>	Provide a safe working environment for employees, contractors and third parties.	<p>Continue to monitor pressure and temperature at the wellhead and the condition of well tubing every two years (well surveys carried out by Questa).</p> <p>Continue to monitor wellhead pressure and temperature daily (refer Daily Operations Manual).</p> <p>Record daily measurements of wellhead pressure and temperature (refer Daily Log Sheets and Daily Operations Manual).</p>	<p>Maintain Emergency Response Procedures (refer Emergency Response Procedures Caroline-1 Well and Training Safety Manual) and update as required.</p> <p>Ensure that all personnel and contractors are aware of relevant emergency response procedures.</p> <p>Ensure that emergency response procedures are posted in appropriate work areas.</p> <p>Maintain a record of wellhead survey reports.</p>
Downhole blowout	<p>Loss of production of CO<sub>2</sub> and/or contamination of soil and groundwater.</p> <p>Comments:</p> <ul style="list-style-type: none"> <li>All data obtained from well surveys indicate that this is highly unlikely to occur.</li> </ul>	Maintain well tubing in adequate condition to resist rupture.	<p>Continue to monitor wellhead pressure and “tell tale” diesel system daily (refer Daily Operations Manual).</p> <p>Continue well surveys (surveys carried out by Questa approximately every two years).</p>	<p>Maintain a record of daily inspections and monitoring data (refer Daily Operations Manual).</p> <p>Ensure well survey reports are checked and filed and that any necessary works are carried out.</p>

Environmental Hazards	Potential Consequences	Environmental Objectives	Management Strategies	
			Site Procedures	System Procedures
Fire or explosion	<p>Danger to health and safety of employees, contractors and possibly the public.</p> <p>Comments:</p> <p>Risk of fire or explosion is considered low as:</p> <ul style="list-style-type: none"> <li>• CO<sub>2</sub> is not flammable;</li> <li>• Hydrocarbons are present at levels below flammable limit; and</li> <li>• Other flammable materials (eg diesel and unleaded fuel) are present in small quantities.</li> </ul>	Provide a safe working environment for employees, contractors and third parties.	<p>Operate plant in accordance with approved procedures to prevent over-pressure (refer Daily Operations Manual and Gas Operations Manual).</p> <p>Maintain fire-fighting equipment on-site.</p>	<p>Ensure that all personnel and contractors are aware of relevant emergency response procedures (refer Emergency Response Procedures Caroline-1 Well).</p> <p>Ensure that emergency response procedures are posted in appropriate work areas.</p>
Storage and disposal of sewage effluent.	Contamination of groundwater and/or soil.	Avoid groundwater and soil contamination.	<p>Maintain contract with licenced waste removal operator.</p> <p>Inspect trench area weekly for obvious leaks.</p>	Check and control contracts.

## 5 Environmental Improvement

Air Liquide aims to work toward best practice environmental management for the Caroline Carbon Dioxide Purification Plant operation. To meet this commitment, Air Liquide will:

- promote environmental awareness among all personnel on site, including contractors, through appropriate training and inductions;
- develop environmental incident reporting procedures and integrate into existing ISO 9002 Quality Assurance System;
- comply with all requirements of PPL21;
- reduce CO<sub>2</sub> losses by 5% over the next twelve months;
- phase-out the use of freon gas and replace with R22 within the next 18 months;
- reduce solid waste generation by phasing-out the use of silica gel and replacing with Trockenperlen N within the next six months;
- undertake sampling of soil at the disused waste pits during the first quarter 2001;
- monitor the quality of water disposed of on-site via irrigation.

## 6 References

The following documents were reviewed as part of the preparation of the EIR:

Geddes, D.J. (1981). Plantation re-establishment following the Caroline Forest fire: an interim review. Woods and Forests Department of South Australia, Miscellaneous Publication No.2.

Croft, T., Carruthers, S., Possingham, H., and Inns, B. (1999). Biodiversity Plan for the south east of South Australia. Department for Environment, Heritage and Aboriginal Affairs.

## 7 Abbreviations

Air Liquide	Air Liquide Australia Limited
°C	Degrees Celsius
CO <sub>2</sub>	Carbon dioxide
Ecos	Ecos Consulting (Aust) Pty Ltd
EIR	Environmental Impact Report
H <sub>2</sub> S	Hydrogen Sulphide
kg	Kilogram
kPa	Kilo Pascals
l	Litre
m	Metre
mm	Millimetre
PIRSA	Primary Industries and Resources, South Australia
PPL	Petroleum Production Licence
ppm	Parts per million
SCFPD	Standard Cubic Feet Per Day
SEO	Statement of Environmental Objectives
SO <sub>2</sub>	Sulphur dioxide

# Appendix 1

## Environmental Policy



## MISSION STATEMENT

To be the most successful company in our industry by realising the potential of our people to provide innovative solutions for our customers.

## QUALITY POLICY

We dedicate ourselves to the understanding of our customers' expectations and to the total fulfilment of these expectations.

We shall carry out our activities in a manner which:

- Uses the framework of ISO 9000 Quality Standards to verify the quality of our systems,
- Ensures that our products and services satisfy the highest standards, and
- Looks for continuous improvement in the quality of our products through the applications of best quality practices.

*We shall achieve our objective to*

*DO THINGS RIGHT THE FIRST TIME, EVERYTIME.*

## ENVIRONMENTAL POLICY

We care for our environment and are committed to protect it.

We shall carry out our activities in a manner which:

- Complies strictly with all environmental legislation and regulations,
- Minimises the use of energy and materials, and
- Looks for continuous improvement through the application of best environmental practices.

*We shall achieve our objective of*

*ZERO ENVIRONMENTAL INCIDENTS*

## SAFETY POLICY

We care about our employees, customers and the general public and are committed to providing a safe and accident free workplace.

We shall carry out our activities in a manner which:

- Complies strictly with all safety legislation and regulations,
- Involves all personnel in a system of shared responsibility for safe operation, and
- Looks for continuous improvement in the workplace through the application of best safety practices.

*We shall achieve our objective of ZERO ACCIDENTS.*

A handwritten signature in cursive script, appearing to read 'D. Cliche'.

Dennis Cliche Managing Director

# Appendix 2

## Emergency Response Procedures Caroline-1 Well

## EMERGENCY RESPONSE PROCEDURES CAROLINE-1 WELL

### Situations

Seven possible situations are envisaged. Each of these will result in different responses from the well and will require different reactions from plant personnel.

These are:-

1. A rupture in the well's tubing above the point at which the flowing tubing pressure and static casing pressure are the same. (~750-800 mRKB)
2. A rupture in the well's tubing below the point at which the flowing tubing pressure and static casing pressure are the same.
3. Failure of the down-hole packer (at ~ 2478 mRKB) which separates the tubing from the casing annulus.
4. A rupture in the well's casing above the down-hole packer.
5. A rupture in the well's casing below the packer.
6. A rupture in the surface flowline from the well to the plant.
7. Complete or partial destruction of the well's xmas tree.

Should any of these situations occur, certain indications may be apparent.

These are listed below.

### Indications

1. The well will continue to flow. However, the pressure at surface in the annulus will rise. This rise should be noted on the small pressure gauge on the line leading from the well to the dieselene tank.
2. The well may cease to flow. The level in the dieselene tank will probably drop to zero. Mud (from the well's casing annulus) may be observed in the water measuring tank.
3. The well will cease to flow. The level in the dieselene tank will drop to zero. Mud (from the well's casing annulus) will be observed in the water measuring tank.
4. The well will continue to flow. However, the level in the dieselene tank will drop to zero.
5. An abrupt (over a period of a few minutes) increase in the well's water cut may be observed.
6. An escape of gas and water will occur from the ground between the well and the plant.
7. An uncontrolled escape of gas and water will from the remains of the xmas tree.

If any of these indications become apparent, Air Liquide's Primary Production Manager should be informed so that the appropriate remedy can be applied.

These are listed below.

#### Remedies

1. Close the large valve on the xmas tree through which the dieselene line enters the well. Make the decision whether to continue producing the well or to plan a workover to replace the well's tubing. (It may be that South Australian Government regulations preclude the option of continuing to produce the well).
2. Plan to work the well over - to replace the well's tubing - on an urgent basis.
3. Plan to work the well over - to replace the packer and the tubing - on an urgent basis.
4. Fill the casing annulus with dieselene. (This may require several kilolitres).
5. Use a service company to locate the depth of the hole and plan to work the well over to either:-
  - A. Install a through-tubing bridge plug above the hole but below the producing perforations.
  - B. Install a casing patch below the hole but above the producing perforations.
6. Shut in the well using the flowline valve on the xmas tree. Replace the flowline and put the well back on line.
7. Have Air Liquide's management place an urgent call to an overseas blow-out expert company. Evacuate the area. Do not use the bunker.

#### Danger to Personnel

It is considered that serious danger to personnel only exists only in case 7.

#### Risk/Outcome Graphic

The attached graphic shows the relationship between likelihood of occurrence and severity of outcome for each of the seven cases.

## CAROLINE-1

### RISK/RESULT DIAGRAM

RESULT			
CATASTROPHIC	7		
MAJOR	3      2 4      5      1		
MINOR		6	
	LOW	MEDIUM	HIGH
	RISK OF OCCURRENCE		



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<b>Procedure:</b>	<b>Environmental Procedure – Emergency procedures in case of a forest fire</b>
<b>Purpose:</b>	To provide a safe emergency response for all personnel
<b>Performed by:</b>	Plant Operators and Plant Manager
<b>Safety:</b>	

1. Alert all persons on site to assemble at the emergency evacuation area.
2. The most senior person on site is to account for all [persons.
3. The most senior person takes all assembled persons into Compressor Room (Safe Haven) or organises the site evacuation via Emergency Services.
4. The sprinkler drenching system is turned on via the Ducati Diesel pump and the valve on the northern end of the building is turned on.
5. No person is to leave the area until the most senior person present gives the all clear.
6. No person is to leave the site until Emergency Services advises it is safe to do so.
7. In the "Safe Haven", the most senior person on site will organise the breathing apparatus in the event that fire comes through the adjacent forest and evacuation is not possible.

# Appendix 3

## Plates



Plate 1: Bunded hydrocarbon storage tank (centre) and "effluent" storage tank (immediate foreground).



Plate 2: Contained storage area.



Plate 3: Well head (left) and "tell-tale" diesel system (right).



Plate 4: CO<sub>2</sub> transport tanker in loading area.



Plate 5: "Effluent" storage tank.