ENVIRONMENTAL IMPACT REPORT

PETROLEUM PRODUCTION BY STUART PETROLEUM LTD AT ACRASIA FIELD, COOPER BASIN, SA

Prepared for

Stuart Petroleum Ltd

by

Fatchen Environmental Pty Ltd

Adelaide, September 2003

SP-03-06

Author: TJ Fatchen

Rev. 2

FATCHEN ENVIRONMENTAL PTY LTD ACN 060 780 734

Ecological Survey, Management and Planning ABN 420 607 807 34

7 Hutchinson St (PO Box 462) Mt Barker SA 5251
Tel.: (08) 8391 1164 Fax: (08) 8391 5156

CONTENTS

1. PROPOSED ACTIVITIES

1.1 Introduction

Stuart Petroleum Ltd proposes to undertake full commercial production within the Cooper Basin from Acrasia Field (PEL 90), initially utilising oil production from Acrasia #1, Acrasia #2 and Acrasia #3 wells (Figures 1, 2). Extended oil production tests have already been undertaken at Acrasia Field. Extended and initial production tests have already been subject of earlier Environmental Impact Reports (EIR) and Statements of Environmental Objectives (SEO) (Fatchen Environmental June 2002 a,b;). The following EIR in many respects is similar to that for the extended production test. The main differences are:

- the increased scale and term of production, and the consequent increase of local and transportation infrastructure and transport movements.

- The increased water production likely as oil reservoirs are reduced.

The Acrasia #3 pad and adjoining area is proposed for the main oil handling, storage, loading and camp facilities. Process water cleaning and disposal will take place nearby. Minor facilities only will be in place at Acrasia #1 and Acrasia #2, upslope from Acrasia #3 to the east and west respectively: produced liquids from these wells will be transported to the Acrasia #3 facilities by low pressure flowline.

All three wells will require pumping: currently, jet pumps are in use at each well for the extended production test, with individual supply units at each pad. The supply would be replaced by a centralised pump station at Acrasia #3, with a small-diameter high-pressure pipe carrying water with or without low levels of biocide and anti-scaling agent to the downhole jet pumps. The high pressure pipe would follow the same route as the low-pressure flowlines. Beam or other forms of pumping may be used over the lifetime of the field.

Process water generated in oil extraction will increase as reservoirs deplete. The proposal is to clean process water in a three-stage operation, then dispose preferably via infiltration or a mix of infiltration and evaporation. Evaporation disposal has the greatest areal impact of any of the proposed developments associated with full production.

Oil will be loaded at permanent loading facilities at the Acrasia #3 pad. Transport is envisaged to be via triple trailer road train or equivalent (approximately 600 bbl/train) over the life of the field.

If sold into Queensland, or if there is a need to transport oil to Moomba but the Cooper Creek causeway at Innamincka is impassable, transport can be by an existing feeder rig/haul road eastward some 500m to the SA/Qld border, connecting to road networks in Queensland including the Burke and Wills Bridge over the Cooper Creek at Nappa Merrie.

If sold into South Australia, oil will be transported similarly westward along the existing Acrasia haul road, via Reg Sprigg 1 well, some 15km distance to the Innamincka-Cordillo public road (Figure 2). From here, oil may go south to receiving facilities at Moomba via the public road system, or to the nearer receiving facilities at Keleary using a short section of the public road then the Santos road system. An alternate direct haul road to the Keleary receiving station may be sought during the life of the field, subject to regulatory requirements.

Produced oil may be sold at the Acrasia Field loading point, or at the delivery point. Responsibility for the safe transportation of the oil is the prime responsibility of the transporter, under the *Dangerous Substances Act* 1979 and the *Environmental Protection Act* 1993. However, under the *Petroleum Act* 2000, Stuart Petroleum has responsibility for ensuring minimisation of impacts, and cleanup and remediation of impacts such as transportation spills, within its licence area (PEL 90) even where the oil has been sold at the Acrasia loading point.

1.2 Design and production requirements

Production and flow information in the following is taken from the Acrasia Oil Processing Facility Design Basis Document (GPA Engineering, August 2003).

1.2.1 Design life

The facility is based on a 10-year design life.

1.2.2 Facility requirements

The main elements of the permanent facility are:

Oil production

- Flowlines connecting Acrasia #1 and Acrasia #2 wells to the facility at Acrasia #3.
- Installation of two "Jet Pumps" located in a central location to enable increased production from existing wells.
- Provision for the installation of chemical injection facilities at the wellheads for treatment of emulsions if required.
- Possible additional chemical injection facilities for the treatment of bacterial impurities, and scale inhibition.

Crude oil dewatering and process water disposal

- Crude oil dewatering tanks
- Primary and Secondary Interceptor ponds for removal of remnant oil from process water. Ponds are intended to provide sufficient residence time to handle the maximum expected produced water flows and release water with no visible hydrocarbon for final disposal
- Final produced water disposal by infiltration, with a contingency for disposal via evaporation utilising local topography and avoiding disposal into defined drainage.
- Slop oil handling procedures and facilities to collect oily-water such as tanker ballast water to be incorporated into the oil dewatering system

Oil storage, handling and loading

- Crude oil storage tanks of sufficient capacity for optimal scheduling of tanker movements without disruption of production
- Crude oil tanker loading facilities in accordance with applicable standards.
- A possible future extension to 24 hour tanker loading operations

Other infrastructure

- Power generation and instrument air systems.
- Control hut and camp (already in operation as part of extended production testing)
- An increase in the fresh potable water storage capacity at the site.
- Installation of a new control system and communications infrastructure allowing a move to unmanned operation in the future.

1.2.3 Production parameters

The facility will be required to handle between 477 m^3/day (3000 US barrels/day) and 954 m^3/day (6000 US Barrels per day). The predicted oil production rates for the initial 4 years of full production are as follow. Wells are completed in more than one formation.

Financial Year	**August 2003**		**2003/2004**	**2004/2005**	**2005/2006**	**2006/2007**
Well / Formation	***Water*** ***m^3 (bbl) /D***	**Crude** ***m^3 (bbl) /D***	**Average Crude m^3 (bbl) /D**			
A#1 Tinchoo (U)	*80 (500)*	110 (700)	*	-	-	-
A#1 Hutton	-	-	270 (1700)	66 (415)	37 (230)	24 (150)
A#2 Tinchoo (L)	*80 (500)**	30 (200)*	24 (150)	18 (110)	14 (90)	4 (26)
A#3 Tinchoo (U)	*35 (220)*	115 (730)	64 (400)	**		
A#3 Poolawana	-	-	-	82 (515)	21 (130)	10 (60)
Totals	*195 (1220)*	255(1630)	358 (2250)	166 (1040)	72 (450)	25 (236)

* Well under Jet Pump enhanced production. A#1 shall be switched from free flow Tinchoo production to Hutton Jet Pump production in the fourth quarter 2003. All wells to be on Jet Pump production by end of 2003. ** A#3 returns to Tinchoo production in the financial year 2009/10. *Source: GPA Engineering August 2003*

The amount of water will increase as the oil reservoirs are depleted, but the overall fluid production rate will remain stable. At present (August 2003), the water stream is 43% of total fluid production. Well stream simulations are given in Appendices to the Design Basis Document. In the following, the maximum water volume is taken to be the 954 m^3/day maximum fluid production.

1.3 Process description

1.3.1 General

Details of process are given in the Acrasia Oil Processing Facility Design Basis Document (GPA Engineering August 2003). The process is outlined schematically in Figure 3. Production is from Acrasia #1, 400m east, Acrasia #2, some 2000m west, and Acrasia #3, at the facility.

All wells are proposed to have jet pumps in operation. Two high-pressure pumps, crude-oil fuelled, will be installed at the facility. These will deliver water to wellheads via 3.5 inch pressure tubing, laid on the surface, and then to downhole jet pumps. The feed to the pumps is produced water sourced from the production dewatering tanks. Pumps will generate about 22.0Mpag. Overpressure protection systems will be provided.

Flowlines carrying production fluid, laid above ground with slight slopes down to the facility, run to an inlet manifold. Fluid can be directed to any or all of a proposed three dewatering tanks for primary separation of water and crude. Tanks will be fitted with a dewatering leg for gravity drainage of water production to two interceptor ponds in series for further cleaning, with eventual oil-free water disposal to an infiltration sump (preferred) or a combined infiltration/evaporation area. A further water outlet provides the produced water feed for operation of jet pumps. Flowlines and power fluid pressure tubing will follow the same routes.

Crude oil from the dewatering tanks will feed to 6 vertical storage tanks with a total capacity of some 600 m^3 (3800 bbl). This is approximately two days storage, allowing a short term buffer in the event of transport disruption (eg by local rain). Dewatering and oil storage tanks will be together on a compacted clay bunded pad.

Crude oil from storage will be transferred to tanker loading by electric pump, with a standby pneumatic or diesel pump available for use in power outages. The tanker loading bay will be sufficient to allow a triple tanker road train to load, with multiple compartments filling simultaneously. The loading bay will be floored with compacted clay and bunded to contain spillage or breakdown.

Sumps for oil spillage capture will be provided as needed in storage and loading areas. A slops collection system will be in place, with recovered oil returned for dewatering. Tanker ballast water will be pumped to the dewatering tanks for primary separation of oil from water.

1.3.2 Chemicals

With increases in fluid production over present rates, oil-water emulsions may require either longer residence times in primary separation tanks, or the addition of emulsion breakers to process fluids, or both. Where emulsion breakers are used, there will be small amounts in produced water intended for disposal.

Sulphur reducing bacteria may occur in produced water storage areas, including primary separation tanks, and can lead to accelerated corrosion and premature failure of pipes, tankage and well completion. Monitoring will be carried out, and provision for the use of biocides in fluid streams must be available. Biocides will be used on tanker ballast water. As for emulsion breakers, some biocide if used will be present in water for disposal.

1.3.3 Water handling and disposal

From the initial dewatering tanks, water will move by gravity to a first stage interceptor pond, lined with artificial liner of minimal permeability. Associated with this pond will be a skimming system and a small storage for recovered slop oil: slop oil will periodically be transferred by vacuum truck to Moomba for appropriate treatment and disposal.

Clean water from the first interceptor pond will underflow by gravity to the second interceptor pond. This pond, dealing with almost totally clean water, will be clay-lined but without artificial membranes. The water take-off from this will include some form of shutoff such as a breaker siphon to avoid any disposal of any remnant surface hydrocarbon film. Residence times in the whole dewatering system are anticipated to be sufficient for removal of hydrocarbons, at a minimum to the point of no visible hydrocarbon present.

Final disposal is intended to be to a dug sump for infiltration, with a contingency for evaporative disposal only if infiltration alone is not sufficient. The infiltration sump and its holding is likely to require a minimal area, equivalent to or smaller than one of the proposed interceptor ponds. Evaporation would require a much larger area. As a worst case, the evaporation area needed for projected maximum water production, with allowance for rainfall and overland flow, is in the order 33 ha.

Approx. autumn-winter evaporation*	1.14m
Max. water production per day **	950m^3/day
Total water production, autumn-winter	173,375 m^3
Minimum evaporative area for total evaporative loss, production water only	152,083 sq m (approx 15.2 ha)
Inflow into pondages from an effective 100mm rainfall event: estimated catchment about 200 ha (2*10 ^{6}m^2) #	200,000 m^3
Minimum evaporative area needed for total evaporative loss, production water and runon	327,522 sq m (approx 32.8 ha)

* Mean annual evaporation about 3800mm/year; autumn/winter evaporation about 1140mm over six months (Marree Soil Conservation Board 1997) ** Design Basis Document (GPA Engineering August 2003) # Catchment size uncertain: appears to be of this order on LANDSAT sheets and in field inspection, but may be larger. Catchment of the drainage line adjoining Acrasia #3 is approx 5 sq km (500 ha)

1.4 Site layout and construction

1.4.1 Layout

An indicative layout of the Acrasia #3 facility and supporting infrastructure is given in Figures 4 and 5. The layout has been guided by site and process safety considerations detailed in the Design Basis Document (GPA Engineering August 2003) with the following particular characteristics:

- In the event of a tank or bund failure, hydrocarbons cannot drain toward the wellhead, other processing facilities or accommodation/administration areas.
- Separation distances allowing safe manual isolation in the event of fire in any area.
- Siting allows gravity flow for produced water movement through separation, cleaning and eventual disposal.
- Oil facility siting is out of defined drainage and not prone to significant flooding.
- Vehicle movement is separated from oil facilities. No flowlines cross roads.
- There is a single vehicle entry to the site, with separation of tanker and other vehicle movements.
- The site makes use of areas already impacted, particularly the Acrasia #3 pad and the current extended production test facilities, and so minimises the additional impact inherent in expanded storage and water handling.

1.4.2 Construction

Alterations within existing lease area

The bulk of the facility utilises the existing Acrasia #3 lease area, and existing road and related facilities. In Figure 4, the flowline routes approximate to the northern and western boundaries of the present lease. In keeping with previous EIRs, clay pads were limited in extent on the lease, associated with the actual Acrasia #3 wellpoint and support for heavy drilling equipment, the existing extended production test tank area, and loading bays.

It is proposed to extend the existing tank pad to provide for process and storage. The existing pad will be enlarged to the area shown in Figure 4, using a 300mm clay pad with clay from local borrow. The pad will be laid over the gibber surface, although the slopes at this point are under 2% and the gibber surface could be cut without risk of accelerated erosion. However, the natural slope evident in Figure 4 can be positively utilised in the tank layout for process water handling. The tank pad will not be lined: the depth of pad is sufficient protection both for minor spills and a low-risk catastrophic failure event. Bunding will be constructed using clay, with a geotextile facing itself covered by a shallow clay layer. The geotextile provides protection from erosion of bunds generally, and in major rainfall events accompanied by torrential overland water flows. Bunds will be maintained, and the combination of clay bund, geotextile protection and maintenance is expected to provide adequate safeguards under appropriate Australian Standards for the life of the facility. Such construction also makes rehabilitation at the end of the oilfield's life considerably simpler and cleaner than more permanent construction such as the use of concrete for pads and bunds.

Proposed roading is a rationalisation of existing tracks utilised for the extended production test. Tracks are and will continue to be laid clay formation on the original gibber surface, with grading only where very large gibber (30-50cm and larger stone) needed shifting for the placement of track material. Closed portions of tracks will be left for the present to follow unaided rehabilitation.

The tanker loading bay will be a modification of the existing loading bay, utilising a compacted clay floor. Soil tests have been undertaken and demonstrate that the compacted clay is non-permeable, and readily meets the requirements of AS1940 for impervious loading surfaces. Accordingly, no lining is intended for the loading bay. The volume of the bay, defined by surrounding bunds and rises at entry and exit, will be sufficient to more than provide for the spillage of an equivalent to a full road train compartment. The gentle natural slope of the area will be utilised as a natural fall to a small sump for suck-out of spills or rainwater accumulation. The bay and its bunds are laid over an uncut gibber surface.

Flowlines

Flowlines will be laid above the ground surface throughout. They will be supported on sleepers, either hardwood or treated softwood, the latter treated with creosote or similar but *not* with copper-chrome-arsenic based treatments in view of "clean green beef" issues of the pastoral enterprises in the district. Sleepers will be spaced so that flowlines stay supported without touching ground. Flowlines will be anchored to limit movement at critical points, particularly the crossing of the waterway alongside the Acrasia #3 pad. Generally, flowlines will be steel pipe with threaded couplings, but welded continuous pipe will be used at the floodway crossing.

The terrain and firmness of the gibber surface along the flowline routes is such that no ground preparation is needed, neither grading, cutting or rolling. Pipelaying vehicles are able to move across the gibber surface without permanent damage other than when the ground is wet, and laying will be undertaken in dry conditions only. Maintenance requirements are likely to be minimal and later vehicle use along pipelines also minimal.

Interception ponds and infiltration pit

The two interception ponds and the proposed infiltration area are outside the present Acrasia #3 lease. There is no simple means of fitting the interception ponds, as a built structure, within the lease area without creating conflicts between oil and water handling, and operation of the whole process. The proposed position allows for a simple gravity flow at all stages in the water clarification process.

The two interception ponds, including bunds and batters, will together occupy an area of some 100m x 30m. Construction will breach the gibber surface, and it is proposed to scrape and stockpile gibber and surface soil before commencing main excavation. The first interception pond will be lined with compacted clay with an artificial membrane such as HDPE. The second (final) interception pond, with minimal hydrocarbon present, will be lined with compacted clay only. Soil testing already carried out has indicated that local clay borrow materials are effectively impermeable when compacted. Bunds around the interception ponds will also be clay, with geotextile embedded as a precaution against erosion in a major rainfall or overland water flow event.

Local borrow materials will be used for bunds and floors of interception ponds: the material excavated may form part of the borrow.

The infiltration sump itself will be a pit similar to a drill sump: the area and depth has not been determined but the area is unlikely to be more than some 20m x 20m. Most of the proposed infiltration area is a natural sump for infiltration (gilgai), with heaving clays and no stone cover. Material from the sump will be stockpiled upslope for eventual use in rehabilitation at the end of the field's life.

Secondary facilities

A camp is already in place on the Acrasia #3 lease. The camp is on a small clay pad laid directly over gibbers. Secondary facilities, such as the jet pump, local fuel storage and power generation areas, will be constructed as small clay pads, either utilising the drilling pad for Acrasia #3 (jet pump motors) or where a current pad does not exist, with 30cm or so pads constructed from local clay borrow. These areas will be bunded sufficiently to contain spills and keep overland water flows out of the pad area.

1.5 Transportation

Oil produced will be progressively transported to receiving facilities either at Moomba, at Keleary, or in Queensland. The last entails a short movement from Acrasia #3 to the Queensland border then via the Queensland road system, and can also be used for oil transport to Moomba when the Innamincka causeway is not passable. The other alternatives will utilise the haul road between Acrasia #3 and the Cordillo-Innamincka public road, with the Santos road system being utilised for delivery to Keleary.

In the longer term of production, construction of a more direct route to the Keleary receiving facilities, parallelling Candradecka Creek, may be considered: such construction would be contingent first on Santos's receiving facilities being operable, would be the subject of separate notification, and would require both environmental and heritage clearances for the route and construction.

The maintenance of roads is a mixture of public, private and company operation. Currently, road maintenance from Reg Sprigg 1 outwards is carried out by Santos, as part of Santos road systems, and Stuart Petroleum pays a road maintenance component to Santos for upkeep on Santos roads and upkeep of part of the Cordillo-Innamincka road resulting from movement of oil trains. The road from Reg Sprigg 1 to Acrasia Field is directly maintained by Stuart Petroleum.

The rig road from the Cordillo Downs-Innamincka road to Acrasia Field will need upgrading. This basically rolled-gibber road has been minimally constructed, in keeping with the prior possibility of production tests indicating non-viability and a need, in such a case, for simple and inexpensive rehabilitation. The road is not adequate in terms of evenness or speed capability. In an upgrade, the carriageway will normally be 6m, and upgrade will primarily be by increasing the sections with laid formation. In particular, more formation will need to be laid on the very rough Reg Sprigg-Acrasia section, where the existing road is minimal, in keeping with the exploratory nature of works and operations up till now.

Forming will be required on portions of the road to avoid erosion and dust generation problems, and to minimise local transportation risk from uneven surfaces. On gibber surfaces, where formation is needed, clay borrow will be laid and formed over the gibber mantle, without the gibber mantle being cut. Most drainage lines along the Acrasia #1 access will be crossed at grade, to avoid redirection or damming and subsequent gullying from surface flows. On diffuse drainage in gibber, shallow spoon-drain crossings will be provided to avoid re-direction of diffuse flows by the road formation.

The required borrow for road upgrading will be taken from pit areas shown in Figure 6. Sites have been selected from several possibilities following heritage and biophysical examination and are equivalent to those proposed or actually in use for the extended production test.

Indicative vehicle movements for the facility construction are expected to be:

Installation	5 loaded, 5 unloaded tail roll truck movements	Further tankage delivery
	20-30 general truck movements	Delivery and installation
Oil transport	Continuing as for extended production test: 2-3 loaded, 2-3 unloaded double train movements /day	Oil delivery and return
Light vehicle	3/day movement	General purpose, crew changeovers; also includes estimate for access road upgrade
Access road construction/ maintenance	20 heavy vehicle movements for construction	Road upgrade setup and departure on the Acrasia 1 rig access road.
	Minor movements of construction/earthmoving equipment for minor construction work at installation, road maintenance. Stuart Petroleum has a contractor with equipment already present near the site.	Other upgrade/maintenance undertaken by contractors to Santos

* On present estimates

Following construction of facilities, the main use of roads during production will be by triple road train of 600 bbl/load, running four-daily (four laden movements, four unladen movements). Once the Acrasia #3 access has been upgraded, it is intended to run movements both in daylight and at night.

1.6 Manning and responsibilities

Production development and initial operation will be manned and overseen on a 24-hr basis. Two operators will man the Acrasia facility, and the site will be visited by specialist technicians for maintenance or modification works, and by tanker drivers for routine transport of produced crude. Stuart Petroleum's nominated representative will be responsible for supervision of the initial site preparation, enforcement of vehicle movement limitations, tidiness and cleanliness of the site and access, and supervision and documentation of remediation works. Ultimate responsibility for the road transportation of oil lies with the owner of the oil, but Stuart Petroleum will ensure that necessary impact avoidance and emergency response procedures or plans are in place within Stuart Petroleum's licence area including provision for oil purchased at the loading point.

Once the integrity and reliability of the permanent facility is proven, the operating facility will shift to an unmanned basis, a shift necessary for continued economic viability (Design Basis Document, GPA Engineering August 2003). Unmanned operations will be based on:

- Stuart Petroleum establishing a central control base in Moomba or Innamincka
- Establishing a telemetry system allowing an operator at the central facility to monitor system status at Acrasia, receive alarms, and shut down and isolate remotely when necessary
- A three-hour maximum response time between critical alarm and physical attendance on site
- Automation of local safety systems to allow isolation and shutdown locally on detection of malfunctions. Automation would necessarily apply in case of fire, jet pump failures, storage overfills and flowline ruptures. Resumption would require physical attendance of an operator.
- Instrumentation, automation and training of tanker drivers to load unassisted, as crude transport would remain by tanker road-train.

Unmanned operations would still entail regular attendance on site by tanker drivers and facility operators.

2. SUMMARY OF LOCAL ENVIRONMENT

The regional context for the area has previously been described in the Acrasia 1 EIR (Fatchen Environmental 2000), from which part of the following is drawn.

2.1 Landuse

The facility, the Acrasia Field generally, and access within South Australia all lie within the Innamincka Regional Reserve, but in an area where the primary landuse has been livestock grazing. Tourism use of the particular area is limited to transit along the Innamincka-Cordillo Downs public road (Figure 1). In particular, all areas lie outside the boundaries defining the areas of the Coongie Lakes Wetlands of International Importance under the 1971 Ramsar Convention. Parts of regional access do lie within this area, in particular the Cooper Creek crossing, Innamincka township and part of the Innamincka-Cordillo Downs road (Figure 1).

There are no special wilderness or conservation attributes known for the area, other than those which apply throughout the Regional Reserve generally.

- The area is not particularly remote, being at most 15km distant from the main north-south public access and an equivalent distance from major trucking yards to the northwest.
- The area is grazed by cattle, there is a major (drought reserve) pastoral bore some 13 km to the northwest at Mulga Bore, and a new pastoral dam has been developed near Acrasia #2.
- The area has been a focus of oil exploration, with seismic surveys intermittently from the 1960's to the late 1990's. There are at present five oil wells in the immediate locality (Stuart Petroleum and Santos), with at least a further well about to be drilled (VFI), together with the associated rig road.

Wilderness values are affected accordingly.

2.2 Landform and soils

Acrasia Field, the production facility and local access lie within the Merninie Land System (Marree Soil Conservation Board 1997). This is a gibber land system, of some 2100 km^2, comprising long gradual and relatively gentle gibber slopes, occasional mesas, alluvial plains, and drainage lines with small clayey floodouts.

Soils of the gibber slopes are a duplex shallow loam over light clay of moderate dispersibility. There is a dense gibber pavement, with stone also in the soil profile. On the summits of the gentle gibber crests, the pavement may be complete (100% cover), and partially exfoliated silcrete outcrops may be present. Gibber surfaces usually have some to major gilgai patterning, with relatively gibber-free areas of heaving clay carrying dense low vegetation.

An indicative slope map is given in Figure 6. Slopes of greater than 1º (>2%) are likely to erode irreversibly if the gibber pavement is disturbed. This imposes limitations on the safe cleanup of spills.

The drainage systems within PEL 90 have no connection to the Cooper Creek system to the south and only tenuous at most connection to the Coongie Lakes to the west . The Acrasia Field and production facility are in the headwaters of Dripie Creek, which appears to have no connection to the Coongie Lakes and the recently dedicated reserve under the National Parks and Wildlife Act which incorporates them (Figure 1) and local access from the public road is in the Candradecka Ck catchment, which appears to have only tenuous connection with the Coongie Lakes.

About Acrasia Field, the area is a gibber land system of long gradual and relatively gentle gibber slopes and drainage lines with small clayey floodouts. The facility itself is near the summit of the gibber areas, with very little slope (Figures 7-12), with only minor upslope run-on, and with diffuse drainage other than the beginnings of a defined drainage line bordering the southeastern segment of the Acrasia #3 pad (Figure 4, Figure 13). Other than over very short distances on the edge of this drainage line, erosion risks are minimal.

2.3 Vegetation and habitat

The primary vegetation cover on gibber is open perennial grassland of Mitchell grass with *Sclerolaena* spp. (bassias) and other grasses. Poorly defined drainage lines on crest areas have a denser cover of similar composition to surrounding gibber surfaces. Once drainage lines become incised, or otherwise well defined, a low tree cover may appear, with red mulga (*Acacia cyperophylla*) and gidgea (*Acacia georginae*) as main species. River red gum (*Eucalyptus camaldulensis*) appears only on major lines, and none in the general area of Acrasia Field. Mitchell grassland is also the primary cover on the alluvial plains crossed by regional access.

Acrasia Field and surrounds is vegetated by a mixed perennial grassland/shrubland of mitchell grass (*Astrebla pectinata* and caustic bush *Sarcostemma viminale* ssp *australis*, the latter abundant north, east and south from Reg Sprigg 1 (Figures 7, 8, 12). Cover at the time of initial inspection in May 2000 was in the order 25-40%, as a result of a major growth burst. Cover in mid-2002 had dropped to below 5% due to drought. Cover in July 2003 was 10%-20%. The bulk of the cover is provided by a multitude of ephemeral herbs and short-lived perennial species, In July 2003, the following were commonly present as a normal assemblage for this land unit:

Abutilon halophilum	Chinese lantern	*Erodium cygnorum*	Blue geranium
Aristida contorta	Three-awn	*Iseilema vaginiflorum*	Red flinders grass
Atriplex holocarpa	Pop saltbush	*Portulaca oleracea*	Pigweed
Atriplex spongiosa	Pop saltbush	*Psoralea cinerea*	Annual verbine
Calotis hispidula	Bogan-flea	*Salsola kali*	Buckbush
Calotis multicaulis	Bindy-i, bogan flea	*Sclerolaena brachyptera*	Shortwinged copperburr
Centipeda cunninghamii	Common sneezeweed	*Sclerolaena divaricata*	Pale poverty bush
Dactyloctenium radulans	Button grass	*Sclerolaena lanicuspis*	Hairy copperburr
Enneapogon avenaceus	Bottlewashers	*Sclerolaena ventricosa*	Copperburr
Eragrostis dielsii	Mulka	*Sida fibulifera*	Pin sida
Eragrostis eriopoda	Woollybutt	*Trianthema triquetra.*	Red spinach
Eragrostis setifolia	Neverfail	*Trigonella suavissima*	Cooper clover

Poorly defined drainage lines and broad washes have a denser cover of similar composition to surrounding gibber surfaces. Downslope from the facility, drainage lines have dwarf bushes of whitewood (*Atalaya hemiglauca)* (Figure 13) or punty bushes *Senna artemisiodes* subspecies, particularly limestone senna *S. a. oligophylla,* with an increased abundance of herbs particularly cooper clover *Trigonella suavissima* and annual verbine *Psoralea cinerea*.

Fauna of the area can be expected to be typical of the Merninie Land System, as outlined in Marree Soil Conservation Board (1997), as there are no unusual habitat characteristics in the area.

2.4 Biophysical significance and sensitivity

DEH database has one record of a rare, vulnerable or endangered plant species collected in the district. This is the bluebell *Wahlenbergia aridicola* PJ Smith, with the indicated locality on the Innamincka-Cordillo public road, south of Candradecka Creek. At last search, there was no record of rare or threatened species under the SA NPWS Act or the EPBC Act about Acrasia Field or its immediate access. Development areas and their surrounds have been variously inspected for vegetation and habitat in 2000, 2002 and 2003, under different stages of growth. The habitats and the vegetation present show no special characteristics which might suggest a heightened possibility of such a species being present: if such species are in fact present, though undetected, they can be expected to be found throughout equivalent habitat in the general area.

The proposed facility and its surrounds possess no characteristics indicating particular conservation significance, or the possibility of particular significance. It occupies a small area within an extensive land unit (upper gibber surfaces and rolling gibber downs), itself within an extensive land system, and with the exception of the local concentration of *Sarcostemma* in the general area and extending westward into Queensland, vegetation and habitat is typical of the Merninie land system gibber areas.

As with the facility, the access possesses no characteristics indicating particular conservation significance, or the possibility of particular significance. The access traverses land units which are extensive, with vegetation and habitat common throughout the Merninie land system gibber areas and minor drainage.

Impact significance and mitigation therefore becomes a matter of "good housekeeping" and conformity with licence requirements, not to do with any single aspect of the biophysical environment in particular.

2.5 Groundwater

The Acrasia Field wells intersect the shallow aquifers of the Winton Formation, and aquifers of the Cadna-Owie, Namur, Adori, Hutton, Poolowanna, Tinchoo and Wimma Formations.

There is no near-surface groundwater to speak of, although sediments in the Winton Formation are formally regarded as aquifers. Water for drilling purposes has had to be sourced from purpose-drilled water wells on the adjoining plains, or from pastoral bores (eg Mulga Bore) again on the adjoining plains.

2.6 Heritage

There are no sites or items of non-indigenous heritage present. There is Aboriginal cultural material present in the general area. Production activities are proposed either for areas which have previously been cleared for use, or which were examined on the ground and cleared for use in June 2002 and July 2003 by representatives of the signatories to the CO-98E Native Title Agreement, or pending inspection and clearance in the case of possible future evaporation areas.

3. ENVIRONMENTAL RISKS AND RISK MINIMISATION

3.1 Downhole risks

No downhole environmental risks are anticipated. The main sources of risk were dealt with in the Acrasia #1, #2 and #3 EIRs. All wells are production cased and completed. Any workover would be subject to notification.

3.2 Risks to the natural environment

3.2.1 Processes creating risks

The primary risks to the natural environment arise from:

- Failure of flowlines leading to hydrocarbon spillages
- Minor to catastrophic failure of storage facilities leading to hydrocarbon spillages
- Spills during loading
- Spills during transportation
- Facility or wellhead fires
- Transportation fires
- Impacts of spills extending downslope or downstream beyond the initially affected area
- Hydrocarbon pollution of stock or natural waters from spillages
- Hydrocarbon pollution of stock or natural waters from the disposal of process waters
- Deterioration of access under increased traffic and potential erosion issues resulting from the deterioration
- Sourcing of materials for road maintenance
- Limitations on remediation of spill affected areas, particularly on the gibber landscapes.

Other risks to the natural environment appear to be low.

Table 1 summarises possible risks, their avoidance or amelioration, and suggested environmental objectives to be pursued during operations.

3.3 Risk minimisation

3.3.1 Design basis document and risk assessment

Detail of response to risks in the design of the facility are provided in the Design Basis Document (GPA Engineering August 2003). The following section deals with the minimisation of environmental risks with reference to the natural environment and the proposed design.

3.3.2 Codes, standards and regulations

The design basis incorporates the following standards relevant to managing the risks listed in Section 3.2

AS 4360	Risk Management
AS 1271	Safety Valves for Boilers and Unfired Pressure Vessels
AS 1692	Tanks for Flammable and Combustible Liquids
AS 1940	The Storage and Handling of Flammable and Combustible Liquids
AS 2381	Electrical equipment for Explosive Gas Atmospheres
AS 2430	Classification of Hazardous Areas
AS 2885	Pipelines Gas and Liquid Petroleum – Design and Construction
AS 3000	SAA Wiring Rules
AS 4041	Pressure Pipes
ANSI B31.3	Chemical and Petroleum Refinery Piping

3.3.3 Risk assessment and emergency response

Risk assessment and response procedures will be developed and maintained appropriate to known hazards and risks. A preliminary Risk Assessment Overview has been prepared (GPA Engineering, August 2003). This Risk Assessment Overview threat categories, threat events, mitigation responses and ranks severity of risks with and without action, and indicates design and construction actions, and procedures required. The last will form part of the Production Operation Manual.

All risks are ranked on a 5-point scale (Very High-High-Medium-Low-Very Low). Risks which rank High to Very High in the absence of any provision or action relate to fire, overpressure issues, containment for spillages, crude loading, and pollution or land degradation from produced water. Under the proposed risk mitigation actions, all risks are reduced to Low to Very Low. (GPA Engineering, August 2003).

3.3.4 Risk minimisation under remote operation

As described in Section 1.6, the intent is to eventually shift the Acrasia facility to an unmanned basis. This will only take place once the integrity and reliability of the permanent facility is proven. The key operating elements will be:

- a central control base in Moomba or Innamincka with a three-hour maximum response time between critical alarm and physical attendance on site
- a telemetry system allowing an operator at the central facility to monitor system status at Acrasia, receive alarms, and shut down and isolate remotely when necessary
- Automation of local safety systems to allow isolation and shutdown locally on detection of malfunctions.
- Resumption of operations requiring physical attendance.
- Development of appropriate facilities and training for tanker drivers to load unassisted.
- Routine visits by facility operators at least once every two days.

3.3.5 Flowline failure

Oil flowline pipes are not under high pressure. Pipes will be laid supported, above ground and not in contact with soil. For the facility life, corrosion from weather will not be at issue. The flowline from Acrasia #2, which crosses defined drainage particularly alongside the main facility, will be anchored on the drainage crossings. The defined drainage has only a slight slope, and while there may be short-term high volume flows, stream velocities will not be high and waterborne debris will be limited to small stones. Procedures will be implemented as part of Production Operations Manual (POM) for routine line checking. Under future automation, these will include sensors of flowline state and automatic shutoffs.

Jet pump line failures at worst will deliver a small quantity of water with minor amounts of biocide and emulsion breaker before pressure sensors in the circuit shut down the pressure pumps. Procedures will be in place in the POM for checking and maintenance.

Risks of vehicle damage to pipe will be minimized. Routine vehicle movement will be directed away from all surface-laid pipes. The design separates normal vehicle-use areas from delivery lines (Figure 4). Warning signage will be provided.

3.3.6 Spillages at facility

The highest risks of spillages at the facility are associated with tanker filling operations, and with storage tank overfill. Specific procedures will be developed and implemented as part of a formal Production Operations Manual (POM) to mitigate tank storage, bund compound and road tanker filling overflow risks. These procedures will include requirements for emergency manual isolation of the inflow and outflow, and for the design and integrity management of bund containment systems. Systems, procedures and training will be appropriate for unassisted filling by tanker drivers.

Bunding will be provided as a secondary containment about the dewatering and storage tanks (Figure 4). The volume enclosed by the bund will be sufficient to cope with catastrophic failure of tanks. A major spill into the bund would be pumped out using portable equipment and transferred to slops storage or transported from site for eventual salvage.

The tanker loading bay will be bunded, and floored with packed clay, with sufficient internal volume to accommodate a full three-unit road train and provide for catastrophic spillage or fire isolation.

All bunds and interceptor pond walls, being permanent, will have geotextile included in construction to protect against washoff and erosion over the life of the facility.

The bunding is envisaged as sufficient secondary containment not to require additional bunds or catches to avoid spillage into general drainage, or towards the (distant) site accommodation or other ignition sources.

The crude loading pump, the jet pump, other powered utilities such as generation plant, and local ready-fuel tanks will have their own secondary containment bunds, both to isolate any spill and also to limit and simplify firefighting.

To minimise loss of fluids for production items located outside these bunded areas, the following will apply:

- High containment integrity systems will be used. Steel piping will be used: product containment integrity will be assured by compliance with AS4041 (*Pressure Piping*) and pressure testing to withstand the highest forecast production operating pressures and production conditions.
- Piping and equipment systems will be appropriately routed and guarded to prevent mechanical interference and damage which might cause a lessening of containment integrity. Procedures including signage will be provided to restrict access to only authorised personnel.
- Installation and operation will provide for preventing overpressure from thermal or production shock effects
- Regular inspections will apply
- The emergency response plan developed for the extended production test will be expanded as necessary and implemented.

3.3.7 Fire

The primary strategy for fires at the storage and loading facility is containment and isolation. The separations indicated in Figure 4 should prevent an escalating event as well as allow for the safe manual use of appropriate shutoff devices. Later automation will include remote shutoffs. The use of high integrity delivery equipment should limit initial losses.

In an emergency event where an item of plant is on fire, production flows will be manually isolated where it is safe to do so. In the case of a fire associated with the storage tanks, it is intended to simply let it burn out. There will be provision for firefighting first attack using fire extinguishers if the fire is at the loading pump or at the tanker, but if initial attack is not successful, fires in these situations will also be allowed to burn out. Personnel will be evacuated as necessary. Specific procedures will be developed as part of the site's emergency response plan, and approval to accept this plant loss strategy, under AS1940, will be sought from the relevant authority.

Ignition potential will be minimised by providing earthing in accordance with AS3000.

Transportation fires will be left to burn out. Emergency response plans will be drawn up, but the reality of the remoteness of the locality and the shortage of ready water sources and distance away of specialised firefighting equipment mean that, in real terms, a transportation fire which cannot be extinguished with initial attack equipment (truck-mounted fire extinguishers) will have progressed too far by the time major liquids-fire equipment could be brought to the scene. Emergency response plans will, however, provide for the use of earthmoving equipment to contain and extinguish any secondary fires started by the transportation fire.

3.3.8 Hydrocarbon pollution to stock and natural waters

Issues of hydrocarbon pollution arise from disposal of produced water; and from transportation spillages. Disposal of produced water, as the main impact of operations, is discussed separately in Section 3.4

There is a possibility of transportation spills resulting in some hydrocarbon pollution of natural and surface stock waters. The risk will be minimised by not transporting oil in conditions conducive to accidents nor across areas likely to transport spills into water bodies:

- No movement in wet conditions
- No night movements where wet conditions are impending
- No fording of flowing streams other than at sealed and depth-gauged defined causeways (at present, Innamincka only)

3.3.9 Spill prevention and remediation in gibber

The gibber areas regarded as presenting the highest transportation spill hazard are on the Acrasia haul road. Although partly upgraded for the extended production test, this is still an uneven and narrow carriageway. The hazard will be reduced by further upgrading, particularly to bring the section between Reg Sprigg #1 and Acrasia #2 up to an equivalent standard of the Reg Sprigg to Cordillo-Innamincka Road section, and to improve rough areas of the latter section. Risks will further be reduced by maintaining limits on vehicle speeds along the access (40-60 km/hr) as well as prohibitions on tanker and train movements in wet conditions.

Gibber areas present a particular problem in spill remediation if any slope is present. Generally, small spills will have least permanent impact if they are simply left to bio-remediate, as this does not entail disturbance of gibbers. Large spills on flat (<2% slope) surfaces, large enough to require additional treatment, could be land-farmed in place, or contaminated soil removed for landfarming or other disposal elsewhere, but on sloping surfaces such actions will inevitably lead to accelerated and irreversible erosion: the remediation in the long term is likely to have more impact than the original spill.

Accordingly, it is proposed to leave large spills in sloping gibber surfaces in place, but provide separation pondages in depositional areas downslope to catch contaminated runoff and sediment. Temporary fencing of a major spill and the catches would be necessary to prevent impact on stock.

3.3.10 Community resources and safety

The estimated 4 road trains per day will have some impact on the Innamincka-Cordillo Downs public road. Possibilities of major damage will be limited by the prohibition of movements in wet conditions. Upkeep costs in relation to road train use are being provided to Santos for road maintenance

There will be a further marginal increase in public risk from the increased presence of oil tankers. Adherence to legislation governing transportation provides the main risk mitigation. Signage warning of trucks entering will be maintained at the intersection of the Acrasia access road and the Innamincka-Cordillo Downs road, and at the Queensland border. The proposal to move some loads at night is unlikely to increase public risk, given the low level of public, particularly tourist movement in the region during dark.

Public risk will be reduced if oil can be trucked to receiving facilities at Keleary (Figure 2). In this case, tankers would only use the public road system between the Acrasia-Cordillo Rd intersection and the Keleary-Innamincka Rd intersection, rather than the full haul to Moomba via Innamincka.

3.3.11 Aboriginal heritage

Risks to Aboriginal cultural heritage relate to

- the development of the Acrasia #3 site as the central facility,
- flowlines and associated access,
- sourcing of materials for road upgrading,
- provision of ponds, digging of infiltration sumps and possible development of an evaporation disposal area, and
- damage incurred in the cleanup of transportation spills.

The Acrasia Field wells and facility site, flowline routes and transport routes are on areas already cleared for use by representatives of the signatories to the CO-98E Native Title Agreement. Potential borrow areas were examined on the ground in June 2002 by representatives of the signatories to the CO-98E Native Title Agreement. Of a multiple of sites examined, those indicated in Figure 6 were cleared for use, in some cases with specific instructions on alignment and access. Not all have yet come into use.

The infiltration pond and potential evaporation areas will be subject of a further inspection under the CO-98E Native Title Agreement before final design and development.

3.3.12 Non-indigenous heritage

In the absence of any particular non-indigenous heritage items or relationships, the activities pose no known or anticipated risk to non-indigenous cultural aspects.

3.4 Produced water disposal impacts and amelioration

3.4.1 Water handling

The proposed handling of produced water as detailed in the Design Basis Document provides for:

- Initial separation of water in dewatering tanks and its drainage to:
- Further separation in a dedicated, artificially lined interceptor dam with skimming booms; with entrained oil returned to slops storage for salvage and treatment elsewhere;
- Final clarification in a second interceptor pond with a compacted clay liner, with provision for clean water offtake which avoids any possibility of any remnant surface oil film becoming entrained in the clean water take off;

- Residence times in interceptor ponds sufficient for full separation of oil and water;
- Infiltration of clean water offtake into an infiltration sump in a low point, not associated with defined drainage.

The intention is to keep the process water out of normal surface drainage There are multiple reasons for doing so:

- Avoiding the encouragement of new grazing pressures from domestic stock and wildlife
- Minimising concentrations of water-dependent fauna
- Minimising opportunistic plant growth, whether water-reliant native species or aliens
- Minimising any downstream influences

While the proposed water handling should result in water with no oil visible (ie <30ppm hydrocarbon content), it should be noted that produced water may contain traces of emulsion breaker, and of biocides used to control sulphur reducing bacteria. This is further reason for minimising the access to the produced water by stock, given increasing market requirements for "clean" beef, and limiting fauna access. Pondages and the infiltration sump area would be fenced.

3.4.2 Infiltration as preferred disposal option

Absence of groundwater

There are no near-surface or unconfined aquifers which provide any groundwater resources to speak of. Sourcing water needed for drilling or road maintenance from the gibber uplands is almost impossible. All pastoral bores in the district are in dunefield or floodout on the surrounding plains, and are seasonally sensitive, indicating their main recharge is from surface runoff into the dunefield and sandplain sediments. Water bores drilled for exploration water sources have all had to be drilled off the gibber uplands, for example at Streeton 1. Water for drilling at Acrasia, and for rig road maintenance, has had to be sourced from Mulga Bore, on the Cordillo-Innamincka Road. Hence disposal by infiltration into the near-surface aquifers is unlikely to impact on local, near-surface groundwater sources.

A groundwater mound will develop and extend subsurface during the life of the operation. In the longer term, the mound will eventually disperse, whether through spread below surface or through capillary losses to the surface. Acrasia Field's position on the crest of the gibber plateau is distant from any break-aways or escarpments (Figure 6), and accordingly there is no general risk of temporary springs appearing as a result of the mound. There is a minor risk that disposed water may make its way subsurface and re-appear in the downslope drainage between Acrasia #3 and Acrasia #2 wells. A shallow piezometer well (to 10m-15m depth) should be installed between the disposal point and the drainage line to monitor this risk.

Ease of infiltration

Below the surface clay and gibber cap, much if not most of the gibber plateau will allow rapid infiltration. Pastoral dams dug on the gibber surfaces need compacted clay lining to hold water. Wellsite turkey nests need lining to have any hope of consistently holding water. The original borrow pit at Acrasia #1 crossed a poorly defined low point which at Acrasia #3 wellsite becomes an incised occasional watercourse. The Acrasia #1 borrow pit has been filled by flows following rain several times since Acrasia #1 was drilled in 2002, but will not hold water for more than a few days. Cleaned production water from the extended production test is being disposed into the borrow pit, but does not pool at all.

The proposed infiltration area is a topographic low point in a very gently undulating plateau surface. It is out of defined drainage, and although overland flow will enter the area in moderate to major rainfall events, the area can be readily bunded to prevent temporary overflows from reaching defined drainage. The gilgai in its base (Figure 10, 11) is grey heaving clay, very strongly crabholed and free of gibber and any perennial vegetation, features suggestive of very rapid water infiltration: it is unlikely that water would be naturally held for more than 24-48 hrs after runon from rainfall. An excavated sump in this low point, as indicated in Figure 5, should provide a more rapid infiltration path than the existing surface, as well as a partial buffer for runon up to moderate rainfall events (eg 25-50mm/24hrs).

Major to extreme rainfall events are still likely to result in surface run-on moving through the infiltration area: for example, if the upslope catchment is in the order 100ha, a 100mm rainfall over a short period (2-4 hrs) could deliver 100,000 m^3 through the infiltration area. In these circumstances, the overland flow would simply continue to surface drainage, and any process water entrained with it. The final protection here is that the disposal water would be already clean of hydrocarbons because of the water treatments already applied, and the dilution factor inherent with such large natural flows.

3.4.3 *Possible future evaporation options*

It is possible that, contrary to expectation and the already demonstrated ease of infiltration disposal, infiltration alone may not be sufficient for process water disposal. Also, as the proportion of water produced increases, infiltration rates may slow down due to the buildup of the disposed water plume, transmissivities may vary, or simply production rates may run ahead of infiltration rate per unit area. As contingency, therefore, a fall-back combined evaporation and infiltration disposal is proposed. The area north to northwest of Acrasia #2 and the proposed infiltration sump is level enough to provide an evaporation pondage with minimal bunding, both to allow for process water and to cope with overland flow from the slightly higher slopes about Acrasia #1. The area does not include any clearly defined drainage line, and is mitchell grassland on patterned gibber/gilgai soils typical of the whole area of the Acrasia Field and lacking any local significance. The general area is shown in Figure 12.

This is emphatically a fall-back option. It entails a much greater surface and biological impact than the infiltration disposal system. On current information, it does not appear necessary because of the "leakiness" of the sediments and stone immediately below the clay mantle. If undertaken, it would require extended fencing, as well as further borrow requirements for the bunding needed to cover low points. Nevertheless it may be necessary, if infiltration is less effective than expected, to apply part or all of this proposal to handle produced water disposal from the Acrasia Field.

4. SITE CLEANUP AND REMEDIATION

Unlike an exploration operation, a producing field has permanent facilities and access which require a greater degree of engineering, and which are less amenable to unaided or minimal effort rehabilitation on conclusion of activities.

In outline, the long term rehabilitation of the field and access once reservoirs are exhausted requires:

- The removal of all plant, tanks, flowlines, camps etc
- Plugging and abandonment of wells
- Drying of ponds and removal of synthetic liners
- Bioremediation of any contaminated soil surfaces
- Infilling of pondages and sculpting of pad edges
- Active rehabilitation of pad areas and roads, including scarifying
- An ultimate aim of a rehabilitated area which blends with the surrounds even though land contours and cover may have been altered by the development and use of facilities.

A detailed rehabilitation plan will be developed and costed during the term of production.

5. REFERENCES

Marree Soil Conservation Board (1997) "Marree Soil Conservation Board District Plan" ISBN073084203 7

Fatchen TJ (July 2002a) "Environmental impact report: proposed extended production test by Stuart Petroleum NL at Acrasia field, Cooper Basin, SA" Prepared for Stuart Petroleum NL by Fatchen Environmental Pty Ltd. Adelaide, July 2002 SP-02-04b

Fatchen TJ (July 2002b) "Draft statement of environmental objectives: extended petroleum production test by Stuart Petroleum NL at Acrasia Field, (PEL 90, Cooper Basin)" Prepared for Stuart Petroleum NL by Fatchen Environmental Pty Ltd Adelaide, July 2002 SP-02-04c

Fatchen TJ (June 2002a) "Environmental Impact Report: proposed petroleum production test by Stuart Petroleum NL at Acrasia 1 (27º 14' 3.94" S 140º 59' 43.21" E)" Prepared for Stuart Petroleum NL by Fatchen Environmental Pty Ltd Adelaide, June 2002 SP-02-04

Fatchen TJ (June 2002b) "Draft Statement of Environmental Objectives: Initial Petroleum Production Test by Stuart Petroleum NL at Acrasia 1 (PEL 90, Cooper Basin)" Prepared for Stuart Petroleum NL by Fatchen Environmental Pty Ltd Adelaide, June 2002 SP-02-04a

Fatchen TJ (2000) "Declaration Of Environmental Factors & Environmental Impact Report: proposed petroleum exploration drilling by Stuart Petroleum NL at Acrasia 1 (27º 14' 3.94" S 140º 59' 43.21" E) " Prepared for Stuart Petroleum NL by Fatchen Environmental Pty Ltd Adelaide, June 2000 SP-00-01

GPA Engineering (August 2003) "Acrasia design basis document". Report for Stuart Petroleum on Acrasia Permanent Crude Oil Processing Facilities. GPA Engineering, Adelaide.

GPA Engineering (August 2003) "Preliminary overview risk assessment". Report for Stuart Petroleum on Acrasia Permanent Crude Oil Processing Facilities. GPA Engineering, Adelaide.

Table 1: Risks, impacts and management in relation to environmental objectives

Environmental objective	Possible impact	Main sources of risk	Avoidance, management, mitigation
Avoid disturbance to sites of Aboriginal and non-indigenous heritage significance	Intrusion or physical site damage to areas of Aboriginal and non-indigenous heritage significance	Access upgrades and maintenance, construction, vehicle and people movement	Use of existing access limits scope for impact. New construction on areas adjoining or close to existing pads, cleared for use by indigenous stakeholders. Borrow for road construction and taken either from existing borrow sources, or from new sources cleared by indigenous stakeholders. Infiltration and evaporation areas to be surveyed and cleared before use.
Minimise disturbance to vegetation and habitat	Physical damage to soils, vegetation and habitat; fires; oil spillage	Access upgrades; construction of new pondages and infiltration pits; natural limits on rehabilitation; fires at well or in transit; spillages and spread of spilled oil	Use of existing access; upgrade of Acrasia access to reduce risk of transportation accidents resulting in spillages. Borrow for maintenance taken either from existing pits, or from new sources checked for low erosion hazard, heritage values and vegetation or habitat significance New pondages constructed in inspected areas of low erosion risk. See procedures to limit risks of spills, under "Avoid spills" (below)
Minimise soil impacts Minimise disturbance to gibber surfaces	Accelerated soil erosion. Potential start-up of long term irreversible erosion on gibber slopes >2% Road formation creating water interception problems.	Access deterioration Drainage associated with new road formation Interceptor pond development	As well as spillage issues, road formations need upgrading to stop dust generation and widening of the right of way by vehicles avoiding dust and to cope with increased traffic. On gibber areas, formation developed by laying clay directly over gibber mantle without cutting the mantle, to avoid drain-initiated gullying. Obvious drainage crossed at grade, and shallow spoon drains provided to minimise redirection of overland flow by formation. Existing access route will be followed; other risks minimised accordingly. Borrow taken from level or near-level areas. New interceptor ponds and infiltration sump built on near-level areas with minimal erosion risks.
Avoid disturbance to rare, endangered, vulnerable species	Oil contamination	Oil loading spills; transport spills; construction of new pondages	No such species known to be present along access within lease area; if present, then associated with common habitat and can be expected to be widespread in district. Interceptor ponds and infiltration pits, and potential evaporation areas have no unusual characteristics.
Avoid impacts on high biological value or wilderness value areas	Oil contamination in high biological or wilderness value areas; fires originating from oil spillages extending into high value areas	Oil loading spills; transport spills; secondary fires from transportation fires; construction	No high biological value areas within lease near access. Wilderness values are limited by the presence of five oil wells/wellsites in the immediate vicinity, a sixth about to be drilled, together with pastoral dam construction and proximity to Cordillo Downs-Innamincka road. There is only a tenuous downstream connection at best between the lease area and the Ramsar "triangle". New pondages reduce risks associated with local water ways. Over most of the lease roads, the carriageway is normally sufficiently distant from drainage lines for even extreme events such as complete road train spill not to reach watercourses, other than at immediate crossings.

(Table 1 cont...)

Environmental objective	Possible impact	Main sources of risk	Avoidance, management, mitigation
Avoid flowline, storage and loading facility spills; rapid cleanup and impact minimisation following spills	Pollution through flowline breaks, local oil spills, tank or filling point overflows	Oil flowlines, storage, pumping, loading facilities: corrosion, overpressure, physical disruption (eg by vehicles)	Flowlines and jet pump fluid lines laid above ground, supported and not in contact with soil. Flowlines/fluid lines anchored where local drainage is crossed, using a single integral pipe (no threaded joints at crossing). Regular visual inspection for leakage. Flow sensors and automatic cutoffs as further guard against rupture. Routine vehicle movement routed away from laid pipes, storage and process areas. Signage and barriers to prevent vehicle movement. Procedures for non-routine vehicle use within facility and flowline areas. High containment integrity systems using steel piping and complying with AS4041 *Pressure Piping.* Piping pressure tested to the highest forecast production operating pressures and production conditions. Tanks and manifolds bunded with bunds sufficiently large to provide for catastrophic tank failure. Pumps and secondary fuel supplies independently bunded to cope with local failure Hard-piped to loading pump and loading point. Loading area to be lined by compacted clay pad, over gibber surface. Flexible hose with cutoffs for train loading; any minor spillages at loading point to be left to evaporate and bio-remediate. Excessive contamination of surface clay to be either bioremediated in place or landfarmed on other portions of pad or removed for disposal at Moomba. Major spills will be held by lining and bund, salvaged by pumping. Procedures in place for minimising overflow and loading spill risks, and integrity management. Attendance at equipment at all times during road tanker filling. Filling systems, storage tank operation and tanker procedures in accordance with AS1940 *The Storage and Handling of Flammable and Combustible Liquids*
Minimise fire risk at facility; prevent the spread of any fires to wellhead	Loss of resource (also OH&S considerations not covered in this EIR)	Spillage, overflow, ignition sources	Minimisation of ignition potential through earthing facility and tanker in accordance with AS3000. Containment and isolation of fires. Maintenance of separation distances of well, tanks, pump and tanker to avoid escalating events and to allow manual shutoff/isolation of fuel. Bunding as above. First attack extinguishers present for fires at loading pump or at tanker. Tank fires, or fires where first attack failed, allowed to burn out (approval will be sought under AS1940)

(Table 1 cont...)

Environmental objective	Possible impact	Main sources of risk	Avoidance, management, mitigation
Avoid transportation spills; minimise the likelihood of spread of a transportation spill; minimise impacts of fire from any transportation spill	Pollution through transportation oil spills; spread of spills; secondary fires from transportation fire	Road crashes, movement in unsafe (eg wet) situations, spillage in periods or locations where oil can be easily spread, particularly wet areas and flowing watercourses.	Procedures to limit risks of major spill, or to remediate, to include: --No movement on wet roads or in wet conditions --No full train night movements when wet conditions are impending --No "wet wheel" fording of flowing watercourses other than sealed floodways with depth markers. A fording depth limit to be determined in consultation with regulatory authorities --Low speed limitations on vehicle movement on the Acrasia #1 Access road (40-60 km/hr) In the event of a spill in transit within the lease area, contaminated soil on sandplain or dune will be either landfarmed in place for bio-remediation, or in extreme cases removed for pit disposal. Contaminated soil from spillage at a watercourse crossing will be removed. Owner of oil/transportation company will be required to have spill contingency and emergency response plans in place, and conform to Dangerous Substances Act 1979 and Environment Protection Act 1993 Actual transportation fires permitted to burn out. Earthmoving equipment will be brought to a transportation fire to contain and extinguish secondary fires resulting.
Minimise adverse impact on livestock; Avoid contamination of stockwaters with hydrocarbons; Avoid contamination of natural surface waters with hydrocarbons; Avoid contamination of usable groundwater with hydrocarbons	Interference with stock; pollution of stock water; pollution of surface waters or streams, contamination of groundwater	Formation water disposal with hydrocarbons present	Formation water separated and cleaned through --initial separation in dewatering tanks --extended time separation of entrained oil in an interceptor pond, with continuous skimming of separated oil --final clarification in a second interceptor pond with takeoff via a breaker siphon or similar to prevent any remnant surface film reaching outlet Disposal of cleaned water --into infiltration sump distant from defined drainage --as contingency, into an associated freeform evaporation area sufficiently large for complete evaporation and distant from defined drainage Stock and kangaroo fencing around water storage and disposal areas. No local groundwater of any quantity present. Installation of a downslope piezometer to check for possible movement of groundwater plume toward defined drainage; increase in ratio of infiltration/evaporation if groundwater movement from disposal detected.

(Table 1 cont...)

Environmental objective	Possible impact	Main sources of risk	Avoidance, management, mitigation
Minimise visual impacts	Visual impacts through obtrusive access and development and/or visible long-term persistence of facility and access.	Access and facility construction	Access already exists, visual alterations due to formation construction are incremental only. Facility is out of sight and most access is masked from the Innamincka-Cordillo Downs road.
Minimise public and third party risks Minimise workforce hazards	Creation of new public and workforce risks: road train collisions, spills, fire	Oil transport; fire hazard at loading point	Signage on rig road/public road intersection prohibiting entry, warning against trespassing, and warning of danger associated with petroleum activity and truck movements. Limitations on road train movements as above. Protection of wellhead by cutoff valves. Firefighting provisions (extinguishers) for loading area and pump bunded area. Separation of wellhead, pump, tanks and loading sufficient for isolating major fires. Fully earthed storage and loading facilities. Productions Operation Manual with procedures developed and maintained.

6. FIGURES

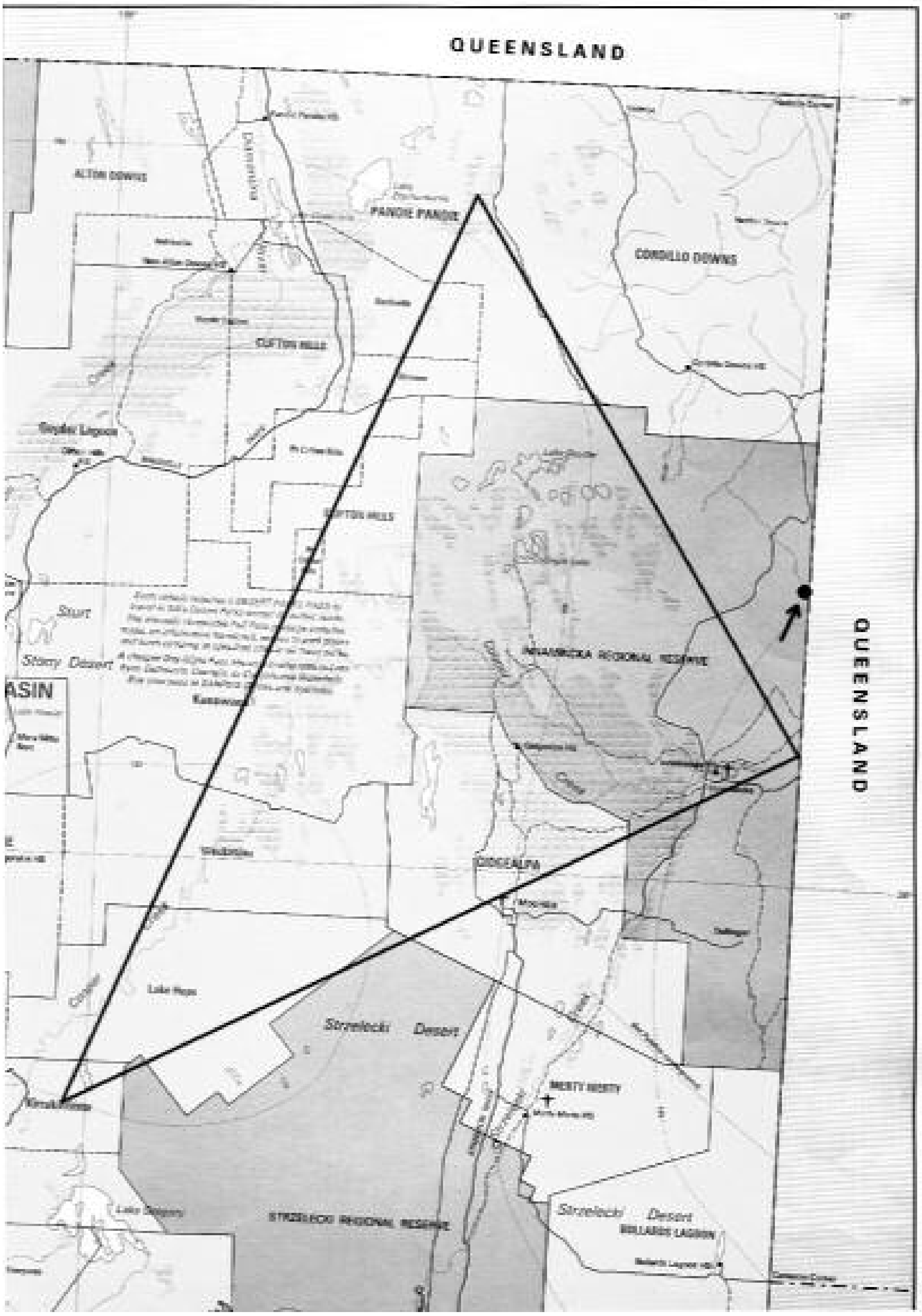

Figure 1. General location of Acrasia Field (arrowed) in relation to Innamincka Regional Reserve, Ramsar Wetlands and local infrastructure. (Map base: DENR Pastoral areas 1:250000, 1993)

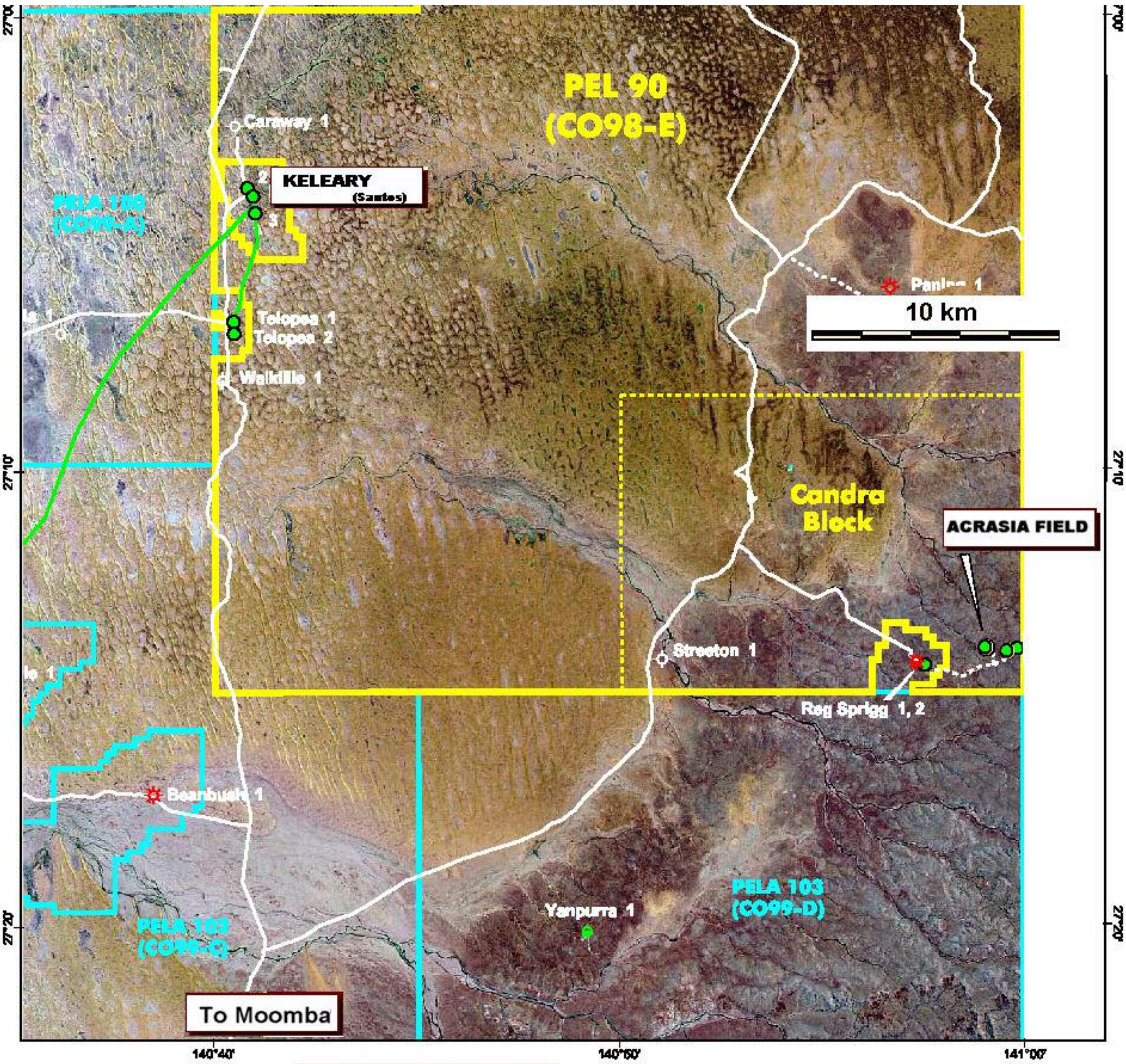

Figure 2. Local infrastructure and roads (Source: Stuart Petroleum)

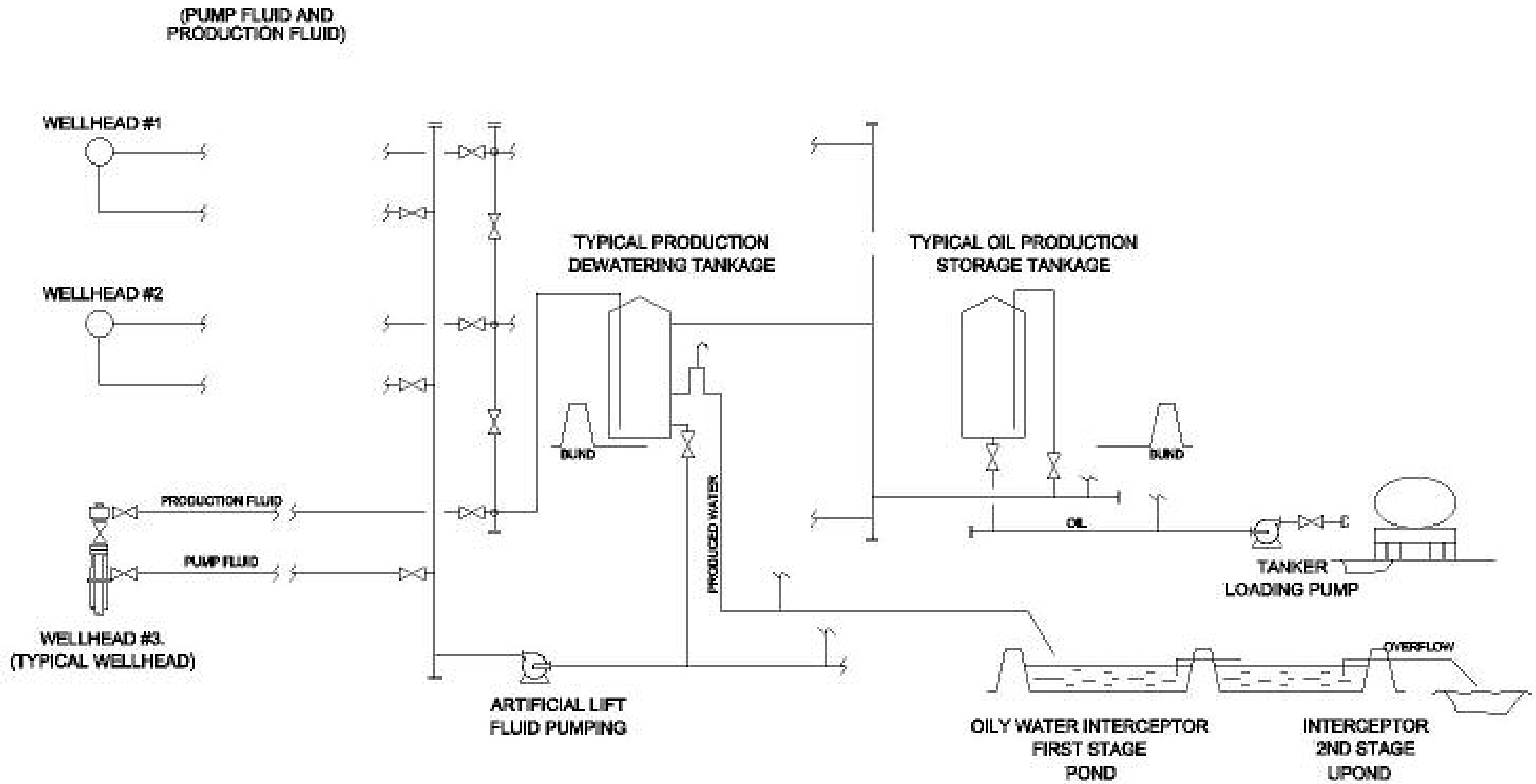

Figure 3. Schematic of process (source: GPA Engineering, August 2003)

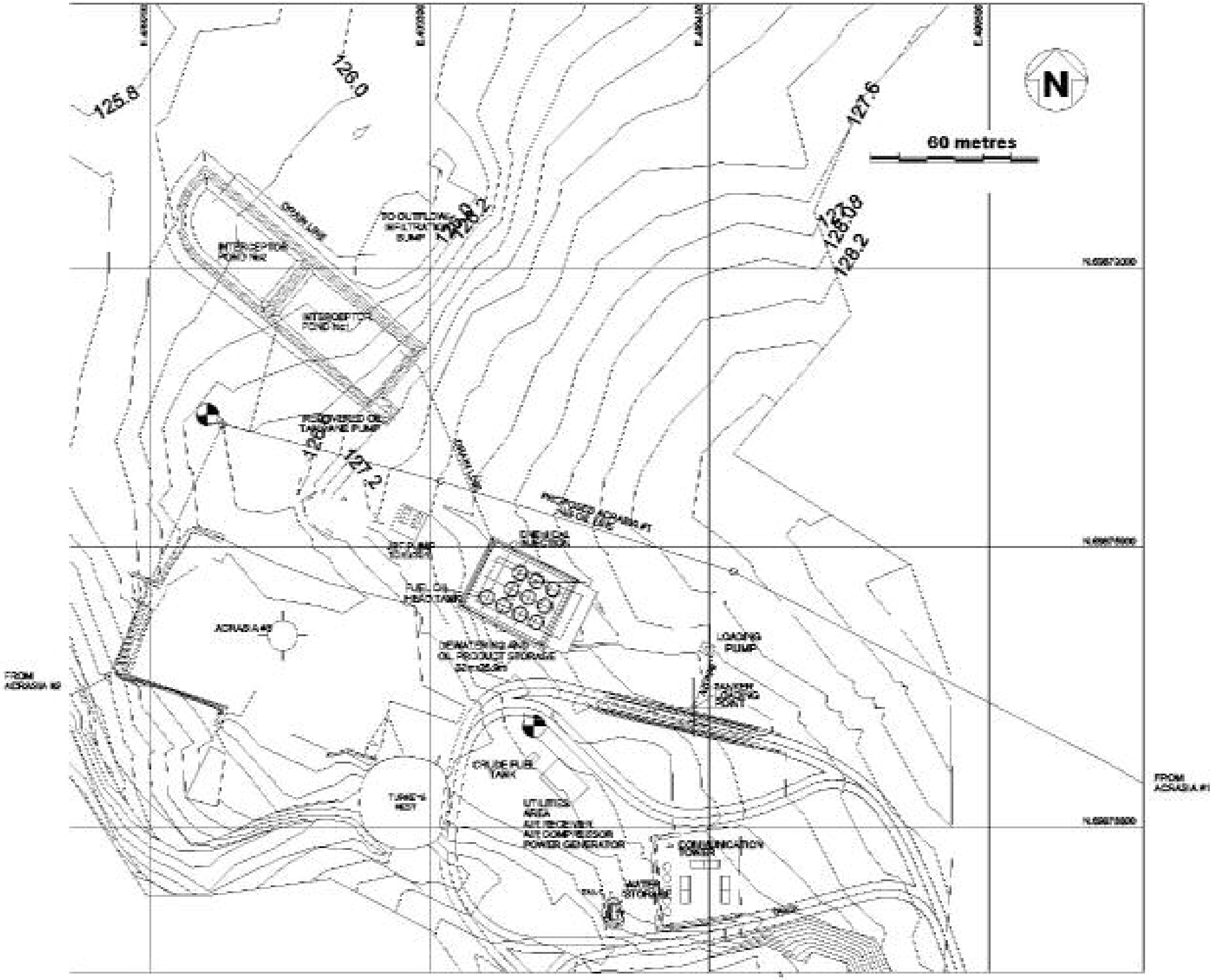

Figure 4. General layout of main process and loading area at Acrasia #3. Contour interval 20cm. (Source: GPA Engineering, August 2003)

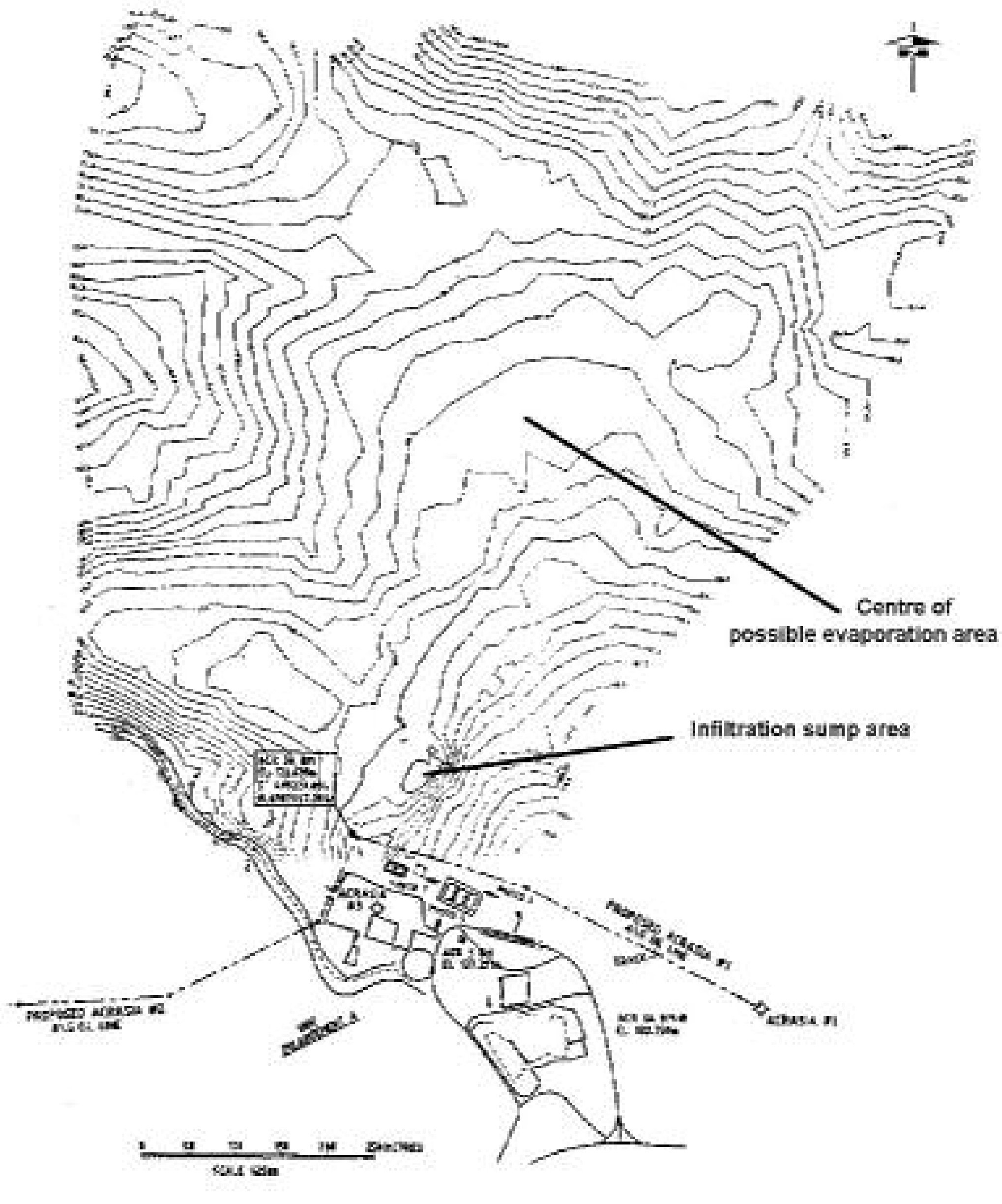

Figure 5. Cleaned process water disposal. Contour interval 20cm (0.2m). Interceptor ponds (see Figure 4) not shown on this figure. Infiltration sump and possible evaporation area are away from defined drainage along lower left (southwest) of figure. (Source: GPA Engineering)

Figure 6. Existing or future borrow areas cleared for heritage purposes along Acrasia Field proposed haul road.

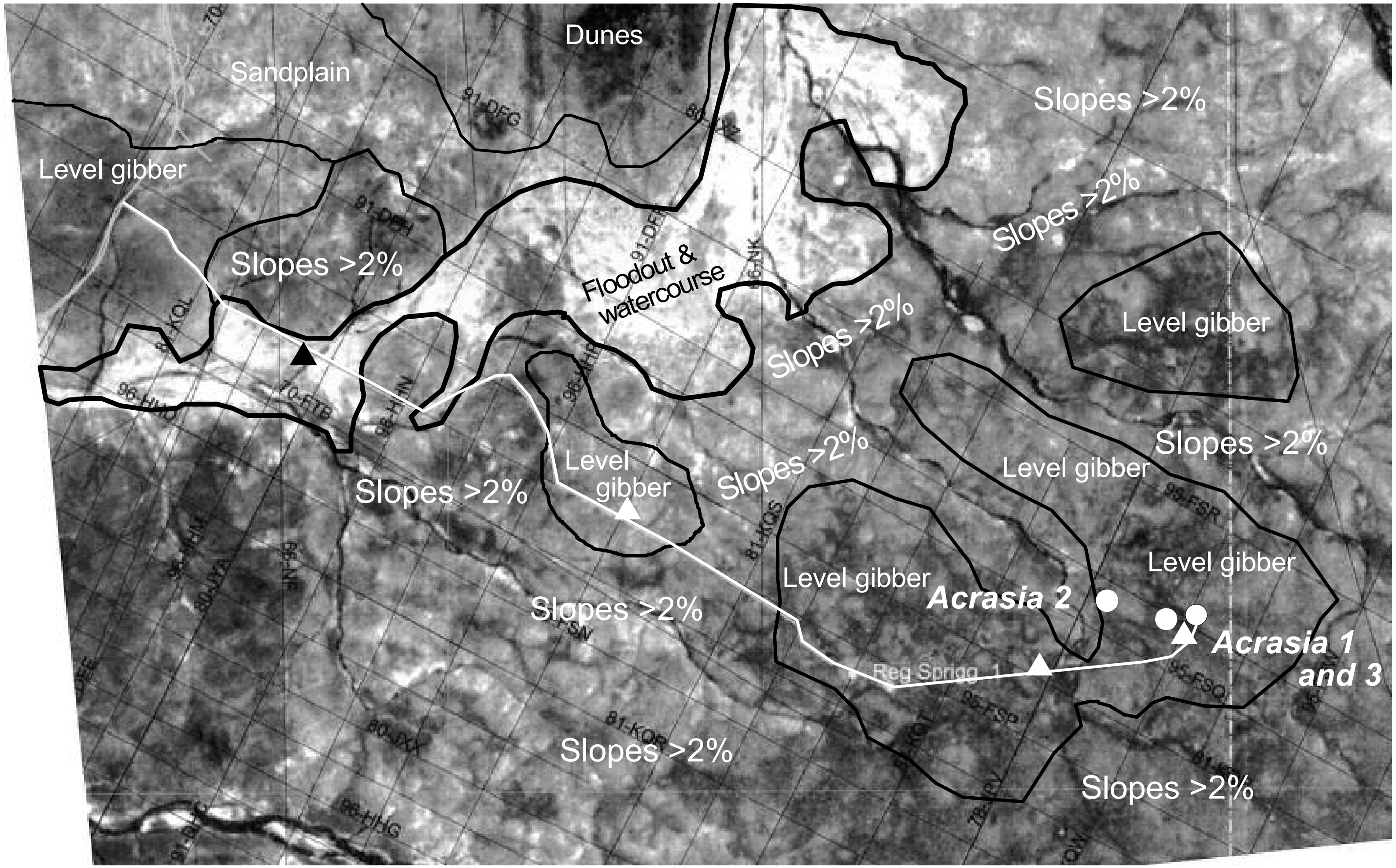

Figure 7. Flowline route from Acrasia #1 to Acrasia #3, looking toward Acrasia #1. Mitchell grassland with *Sarcostemma* on gentle gibber slopes

Figure 8. On flowline route from Acrasia #2 downslope to Acrasia #3. Mitchell grassland on gibber with *Sarcostemma.* Hose is a temporary water disposal line leading to the turkey's nest at Acrasia #3.

Figure 9. Acrasia #3 pad and camp area from borrow pit , looking southwest toward Acrasia #2 in distance. Main facility is proposed for area behind and to the right of the current tanker loading. Tankage will be in the current tank area. Water disposal is to right of frame.

Figure 10. Proposed infiltration sump area, looking SE to Acrasia #3 tank area.

Figure 11. Proposed infiltration sump area, looking NE along low point. Mitchell grassland with scattered individuals of *Sarcostemma* (green bushes). Note the absence of any vegetation on the grey heaving and crabholed clays of the gilgai. The background includes part of the area which can be used for evaporative disposal if needed.

Figure 12. Possible evaporation area. Very gently undulating gibber surface, with mitchell grass and *Sarcostemma* emergent.

Figure 13. Downslope from Acrasia #3 pad. Gentle gibber slopes leading into defined drainage. Distant shrubs are dwarf whitewood (*Atalaya hemiglauca*) in a broad drainage wash. The intention of infiltration or evaporative disposal is to avoid process water entering this drainage wash.