

Proposed solar salt project at Onslow

Gulf Holdings Pty Ltd

**Report and recommendations of the
Environmental Protection Authority**

**Environmental Protection Authority
Bulletin 495
January 1991**

Proposed solar salt project at Onslow

Gulf Holdings Pty Ltd

**Report and recommendations of the
Environmental Protection Authority**

ISBN 0 7309 3452 7
ISSN 1030-0120

Contents

	Page
Summary and Recommendations	i
1. Introduction	1
1.1 Market for salt	1
1.2 Regional setting	2
1.3 Productivity	2
1.4 Direct and indirect impacts	2
2. Background	3
3. Project description	3
4. Existing environment	6
5. Public submissions	6
6. Environmental impacts	7
6.1 The effects of flooding	7
6.1.1 Impacts on roads	7
6.1.2 Impacts on islands in the path of floodwaters	8
6.1.3 Isolation of animals	9
6.2 Changes to Beadon Creek	9
6.3 Discharge of bitterns	10
6.4 Noise from processing plant	12
6.5 Groundwater regime	12
6.6 Marine impacts	13
6.6.1 Dredging of shipping channel	13
6.6.2 Shipping movements	14
6.7 Oilspills	14
6.8 Construction Camp	15
6.9 Other Impacts	15
6.9.1 Access to sensitive coastal areas	15
6.9.2 Storm surge	15
6.9.3 Borrow pits	16
6.9.4 Brine flies	16
6.10 Social	17
6.10.1 General discussion of social impacts	17
6.10.2 Local employment opportunities	18
7. Discussion and conclusion	18
8. References	20
Figures	
1. Project Location	4
2. Location of Facilities	5
Appendices	
1. Commitments by proponent	
2. Submissions and proponent's responses.	

Summary and recommendations

In August 1989 Gulf Holdings Pty Ltd submitted to the Environmental Protection Authority a proposal for the establishment of a solar salt facility, to produce and ship salt from the port of Onslow. The proposal seeks to establish condenser and crystalliser ponds on coastal flats near Onslow, and associated processing facilities to produce up to 1.5 million tonnes of salt a year. The salt would be loaded by conveyor onto ships which would berth at the end of a one kilometre long trestleway proposed for the vicinity of Beadon Point, immediately west of Onslow.

Because of the complexity of the proposal and high levels of concern expressed by Onslow residents an Environmental Review and Management Programme (ERMP) was requested from the proponent by the Environmental Protection Authority. This was released in mid-April 1990 for a public review period of 10 weeks and drew a response of 50 submissions from members of the public, industry and government agencies.

The proposal involves the pumping of seawater from Beadon Creek sequentially into eight condenser ponds, each progressively more saline as evaporation continues, with the water finally entering the crystallisers, where salt is precipitated and the residual liquor (known as bitterns) is discharged via a channel into Middle Creek (see Fig 1). The salt is then mechanically harvested and transported in trucks to the washing facilities and stockpiled, ready for transport via a conveyor onto a trestleway or jetty with berthing facilities for ships of up to 28000 tonnes. At the proposed production rate ships are expected to visit about once a week on average.

Construction of the ponds would take four months but the process plant and trestleway would not be commenced until the second year, as the salt-making process requires 18 months for the first batch to be produced. A peak workforce of 100 is envisaged for the construction stage, to be housed either in the existing caravan park or on the former West Australian Petroleum site on the east side of Onslow. The operations stage is expected to employ about 40 people who would be based in company houses in Onslow.

Onslow lies on the coastal plain on a low island surrounded by flood-prone tidal flats. It has in the past frequently been cut off from the mainland proper by cyclones and heavy rain, and storm damage to the town has often been considerable. The community comprises 600 to 800 residents, including a seasonal tourist component. The town has a high unemployment level and lacks a significant industrial or commercial base.

The proposed ponds would occupy 77km² of saline tidal flats in a crescent running from the southeast to the southwest of Onslow, including 230 ha (12%) of algal mats in the Onslow area. These mats are thought to be a source of nitrogen for the mangroves and near-shore marine nursery habitat.

Floodwaters from inland would be forced to deviate from existing exits to the sea in order to travel around the perimeter walls of the ponds before emptying into creeks further along the coast. Beadon Creek in particular would have much of its upper catchment area lost to the ponds.

Possible impacts associated with the location of the ponds include increased volumes of floodwater crossing roads in their vicinity, greater scouring and erosion of land during floods and resultant stock losses, as well as the isolation of animals on islands as the ponds are filled. The Authority has recommended that there should be no worsening of road access over present levels, that roads should be protected from damage arising from the effects of flooding, that remedial measures to protect or rehabilitate land from erosion should be undertaken if necessary and that marooned animals should be resettled if appropriate. The question of the degree of impact to the mangroves of Beadon Creek with its associated marine nursery habitat, and the effects of bitterns discharge on Middle Creek and the adjacent mangrove trees was raised.

The Environmental Protection Authority noted the proposal involved no direct loss of arid zone mangroves or algal mats. However the proposal is of such a nature and magnitude that significant indirect loss of mangroves and algal mats could result. In the face of a lack of definitive data the Environmental Protection Authority has adopted the conservative position of requiring Gulf to ensure there is no secondary loss of mangroves and algal mats and has made various recommendations to this effect.

Effects on groundwater are expected to be restricted to the vicinity of the ponds and not to threaten Onslow's gardens; however the Environmental Protection Authority has recommended monitoring sites be installed near Beadon Creek, within the townsite and on island foreshores, and that appropriate rehabilitation of salt-affected areas be undertaken if necessary.

Marine impacts include the effects of dredging the shipping channel, release of ballast water containing foreign organisms from ships, and possible oil spills. The potential impacts of dredging include silting of Wards reef and the mouth of Beadon Creek. A dredging plan will minimise the chance of dredge plumes spoiling the reef, and monitoring sites have been recommended for both the reef and the mouth of Beadon Creek. The Environmental Protection Authority has recommended that the proponent should be required to remove any silt blocking Beadon Creek mouth if it has been derived from the dredged material. With respect to the release of toxic organisms from ballast water, the proponent has given a commitment to comply with the industry standards when salt carriers commence loading at Onslow. The possibility of impacts arising from oilspills will be dealt with in an Oilspill Contingency plan to be prepared by the proponent, to the satisfaction of the Environmental Protection Authority.

Other potential impacts, such as access to sensitive coastal areas, storm surge damage, borrow pits and brine flies were recognised. The proponent has made appropriate undertakings to address access and borrow pits, while storm surge and brine flies have been discussed and put into their proper perspective. The Authority is confident that these issues should not be a problem to residents in Onslow.

Potential social impacts including access to the back beach and the trestleway, job prospects, marginalisation of some sectors of the community and effects on the town's existing facilities have been discussed, and the Environmental Protection Authority has recommended that liaison, consultation and management structures be put in place to ensure that problems are recognised and promptly and effectively dealt with.

The Authority recognises that the Onslow community is polarised over the proposal. However, the proposal has been substantially modified from the original concept as a result of the interaction between the proponent, townspeople and government agencies. The proponent's commitments, together with the Authority's recommendations will minimise and manage the potential impacts of the proposal, and the Environmental Protection Authority concludes that the project is environmentally acceptable if carried out in the modified manner now proposed, and subject to the recommendations in this report.

Environmental acceptability

Recommendation 1

The Environmental Protection Authority concludes that the proposal to construct a solar salt field, as described in the Environmental Review and Management Programme and modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and the government agencies that were consulted, is environmentally acceptable.

In reaching this conclusion, the Environmental Protection Authority identified the main factors requiring detailed consideration as: flooding and erosion; impacts on nearby coastal creeks (particularly Beadon Creek) and their attendant mangrove systems; the effects of noise on Onslow residents; changes to the marine environment from the proposed dredging; and environmental impacts associated with likely changes to the community of Onslow.

The Environmental Protection Authority considers that these and other issues have been addressed by either environmental management commitments given by the proponent or by the Environmental Protection Authority's recommendations in this report.

Accordingly the Environmental Protection Authority recommends that the proposal could proceed, subject to:

- the proponent's commitments; and**
- the Environmental Protection Authority's recommendations in this report.**

Environmental supervision and reporting

The construction and commissioning phases of the project will require close supervision by suitably qualified personnel to ensure that all aspects are carried out with due recognition of environmental impacts and processes

Recommendation 2

The Environmental Protection Authority recommends that a suitably qualified environmental supervisor be required to be on site at all times during the construction and commissioning phases of the project, to prepare and carry out environmental induction programmes for construction and operations workers and to ensure that work is performed in an environmentally acceptable manner.

Road access to Onslow

Construction of the ponds as proposed will result in the diversion around the ponds of floodwaters from the south, increasing the flow across roads into Onslow and possibly cutting access to town for longer periods after heavy rain, unless the appropriate engineering works are undertaken. The proponent has undertaken to ensure that floodwaters at the main road crossing will not rise to a depth of more than 200mm above the crown of the road and that the floodway will be suitably armoured to protect the road formation.

Recommendation 3

The Environmental Protection Authority recommends that appropriate steps, to the satisfaction of the Minister for the Environment on advice from the Department of Main Roads, should be taken by the proponent prior to construction of the ponds to ensure that access on recognised roads in the vicinity of the development will not be compromised by construction associated with this proposal, and that floodways and causeways will be protected from damage caused by floodwaters arising as a result of this proposal.

Effects of flooding

The Authority believes that a further effect of the diversion and channelling of floodwaters may be to cause erosion and increase the amount and duration of flooding and waterlogging of pastoral leasehold areas, with potential adverse effects on stock caught by this flooding.

Recommendation 4

The Environmental Protection Authority recommends that, where lands are affected by erosion, flooding or stock losses as a result of this project, remedial measures should be undertaken and appropriate compensatory arrangements should be made with affected leaseholders or landowners (as the case may be), to the satisfaction of the Minister for the Environment.

Fauna survey

As a result of the creation of the salt ponds a number of islands will be formed which may have the effect of marooning some animals that would otherwise enjoy unrestricted access. The number and variety of these species needs to be documented so that a plan can be formulated to resettle any fauna, the survival of which would be compromised by the formation of islands by the proponent.

Recommendation 5

The Environmental Protection Authority recommends that before any site works commence a survey of the indigenous fauna be carried out on the land which will be isolated by the flooding of the salt ponds and that a suitable programme be proposed and implemented by the proponent to ensure that populations of the animals on affected islands are suitably relocated, if appropriate, to the satisfaction of the Environmental Protection Authority on advice from the Department of Conservation and Land Management.

Beadon Creek

The pumping of water from Beadon Creek, as proposed by Gulf, could result in there being less tidally wetted area of mangrove and algal mat, particularly upstream from the creek's eastern arm. This is expected to manifest as an overall loss of algal mat and mangrove trees. Construction of the ponds would also cut off Beadon Creek from its inland source of floodwater, resulting in reduced flushing of the creek.

The effects of these changes are difficult to quantify, are likely to take a considerable time to become apparent and will be partly affected by the timing and severity of rainfall events. The Environmental Protection Authority has determined that loss of mangroves and algal mat due to these indirect processes is an unacceptable impact.

Recommendation 6

The Environmental Protection Authority recommends that the proponent be required to construct and manage the facility such that there be no secondary impacts off the actual site, including no indirect loss or detriment of mangroves or algal mats off site, to the satisfaction of the Environmental Protection Authority.

Options were sought from the proponent to minimise the likelihood of the occurrence of indirect impacts. One proposal was to construct a floodwater channel through the condensor ponds to enable freshwater overland flows to empty into Beadon Creek as they do currently. The Environmental Protection Authority endorses this option.

Recommendation 7

The Environmental Protection Authority recommends that, to ensure that Beadon Creek continues to receive freshwater overland flows, a flood water channel through the ponds should be incorporated into the final design of the proposal and built at the time of construction of the ponds, to the satisfaction of the Environmental Protection Authority.

The Environmental Protection Authority requires that the regime for pumping water from Beadon Creek will not reduce the tidally wetted areas and lead to a loss of mangroves and algal mats. This requires the pumps to be turned off for certain periods of the tidal cycle.

Recommendation 8

The Environmental Protection Authority recommends that pumping from Beadon Creek into the condensor ponds should occur only on outgoing tides unless the proponent can demonstrate, to the satisfaction of the Environmental Protection Authority, that other pumping regimes would have no adverse environmental impacts on the algal mats.

It will be necessary to design an appropriate management plan and monitoring scheme to give early warning of adverse effects to the mangroves, possibly arising from changes to the groundwater regime. The proponent has committed to a monitoring programme in the Beadon Creek area which should document any changes. However, in addition the Environmental Protection Authority believes that there should be a commitment or a recommendation to immediately rehabilitate any areas that are adversely affected by the pumping and pond construction.

Recommendation 9

The Environmental Protection Authority recommends that a growth monitoring plan for mangroves and algal mats off site in the Beadon Creek area be prepared prior to the completion of pond construction by the proponent to the satisfaction of the Environmental Protection Authority. In the event that monitoring shows any areas of mangroves or algal mats are likely to be or have been adversely affected by the project, the Environmental Protection Authority recommends that the proponent prepare and implement a plan for rehabilitation of these mangroves and algal mats, to the satisfaction of the Environmental Protection Authority.

Bitterns

The discharge of bitterns into Middle Creek will affect the biota of this system. It was chosen for its relatively sparse mangrove population and lesser attraction as a fishing spot than other creeks such as Four Mile. The company proposed to discharge bitterns at half tide or higher so as to maximise the effects of dilution before discharge to the sea on the outgoing tide, and has committed to monitoring groundwater at sites in Four Mile Creek and Middle Creek. However the Environmental Protection Authority considers that this would be likely to bring partly diluted bitterns upstream on the rising tide and adversely affect adjacent mangroves. Accordingly, Gulf should canvass and choose an option with less potential to impact upon the mangroves, such as altering the bitterns discharge regime, or constructing an ocean outfall.

Recommendation 10

The Environmental Protection Authority recommends that discharge of bitterns into Middle Creek should occur only on outgoing tides, or into the ocean via an appropriate outfall channel, whichever is the most environmentally acceptable. An appropriate monitoring programme for Middle and Four Mile Creeks and the bitterns channel should be prepared and subsequently implemented to the satisfaction of the Environmental Protection Authority. If monitoring shows mangroves are likely to be or have been affected in the Four Mile Creek or Middle Creek systems as a result of the discharge of bitterns, or that erosion of the bitterns channel and surrounds is occurring the proponent should prepare and implement a plan for a revised bitterns discharge regime and for rehabilitation of affected areas, to the satisfaction of the Environmental Protection Authority.

Recommendation 11

The Environmental Protection Authority recommends that any proposal for re-dissolution of bitterns with seawater pumped from Middle Creek should be referred to the Environmental Protection Authority for assessment.

Noise

Because of the proximity of the processing plant to residential areas of Onslow, noise from the plant will be at its most noticeable when shiploading is under way on hot humid nights and could reach unacceptable levels. After discussions with the Environmental Protection Authority, the proponent has made further commitments (Appendix 1) to monitor sound levels in affected areas in Onslow by setting up an automatic recording station, and to implement a management plan to ensure that noise levels are acceptable to the community.

Recommendation 12

The Environmental Protection Authority recommends that the noise abatement measures proposed by the proponent, including the placement of appropriate earth bunding, reduction of sound levels on specific noise-making machinery, daytime shift-only operation of the washplant, use of rubber tyred vehicles rather than bulldozers where possible and the restriction on the use of those dozers to the western side of the salt stockpiles from 9pm to 6am should be implemented.

In addition the Environmental Protection Authority recommends that the proponent be required to ensure that the introduced noise from the project does not cause the noise in the surrounding residential areas to exceed:

- 50dB(A) from 7am to 7pm Monday to Saturday;
- 45dB(A) on Sunday and from 7pm to 10pm Monday to Saturday; and
- 40dB(A) from 10pm to 7am every day.

These levels should not be viewed as normal operating levels for the plant. They are the upper limits above which action will be taken by the Environmental Protection Authority. The Environmental Protection Authority considers that noise below these levels is not unreasonable provided it does not include tonal components, impulses or other intrusive characteristics.

Groundwater

Changes to the groundwater regime as a result of the creation of the salt ponds were a source of concern to many residents of Onslow. The proponent's own investigations indicate that this effect is likely to be restricted to the immediate environs of the ponds and is not likely to affect vegetation on any but the lowest and smallest of the islands adjacent to the ponds. The Environmental Protection Authority is in general agreement with this view but, because there are no data from a formal groundwater survey, believes that sites should be set up in Onslow to monitor groundwater levels and salinities in case of unexpected changes as a result of the creation of the ponds. If vegetation is lost from the lower edges of islands as a result of rising levels of saline water there is the likelihood of erosion of some of this foreshore. The Environmental Protection Authority believes that monitoring should include surveillance of island foreshores and that the proponent should be prepared to plant salt-tolerant species on areas that become salt affected and denuded as a result of a changing groundwater regime.

Recommendation 13

The Environmental Protection Authority recommends that the proponent should install groundwater monitoring sites within the townsite of Onslow and continue to monitor these sites for a minimum period of 10 years from when the ponds are filled and take whatever action is necessary to maintain Onslow's gardens against saltwater encroachment from the ponds, to the satisfaction of the Environmental Protection Authority. The Environmental Protection Authority further recommends that island foreshores should be monitored for the effects of rising saline groundwaters and that areas where vegetation has been subsequently lost as a result of increased salinity should be rehabilitated by planting with salt tolerant species.

Dredging

Offshore operations will require construction of a trestleway and a dredged channel to deeper water for regular shipping access. Blasting is not expected to be required. The dredging will give rise to a short period of high turbidity which has the potential for impact on the corals on Wards Reef, unless the dredge plume is carefully managed. Maintenance dredging may be required from time to time depending on the frequency of storms and cyclones, but the proponent does not expect dredge spoil to cause silting at the mouth of Beadon Creek.

Recommendation 14

The Environmental Protection Authority recommends that no channel blasting be permitted near Wards Reef without further environmental assessment by the Authority, and that the reef should be monitored to ensure that it will not be adversely affected by dredge plumes or silt from the dredge spoil. The Environmental Protection Authority also recommends that if dredge spoil causes siltation of the mouth of Beadon Creek the proponent be responsible for the prompt removal of the obstruction.

Oil spills

There are attendant hazards associated with the movements of ships in the shallow coastal shelf off Onslow, and with the spillage of oil. Fuel lines placed along the trestleway could also leak. A spill along the coastline would be likely to impact on mangroves and marine nursery habitats. The proponent has recognised these concerns and proposes to create an oilspill contingency plan to address these matters.

Recommendation 15

The Environmental Protection Authority recommends that, prior to the construction of the trestleway, the proponent prepare an oilspill contingency plan to deal with both offshore and onshore spills, to the satisfaction of the Environmental Protection Authority on advice from the State Committee for Combatting Marine Oil Pollution.

Access to Back Beach and trestleway

Back Beach is a significant recreational feature to the residents of Onslow. The community has expressed concern that the recreational use and enjoyment of the Back Beach area by residents and tourists would be adversely affected if the proposed trestleway were to prohibit or restrict public access to the beach. The Environmental Protection Authority considers that maintaining existing public access to Back Beach is important and that allowing the public access to the trestleway would be a benefit to Onslow residents and tourists.

The proponent has indicated that the trestleway would be a steel piled structure which could be positioned in such a manner as to straddle the beach area giving an uninterrupted shore line.

Recommendation 16

The Environmental Protection Authority recommends that the proponent should ensure through proper design of the trestleway that the existing level of public access to Back Beach is not restricted, and endorses the proponent's commitment to provide public access to the trestleway.

Construction workforce accommodation

The proponent has indicated that the construction camp will not be established on a new site, but either the existing caravan park would be used or a temporary camp would be set up on WAPET's former site.

The Environmental Protection Authority wishes to ensure that, whatever the final choice of location, matters of rubbish disposal and the behaviour of personnel are taken into account in the proponent's management plan.

Recommendation 17

The Environmental Protection Authority recommends that the proponent's environmental management programme take into account potential problems associated with the disposal of rubbish and the behaviour of personnel arising from its construction camp.

Liaison and monitoring

The impacts the salt project would have on the character of Onslow and the lifestyles of its residents have been primary concerns of the local community.

Recommendation 18

The Environmental Protection Authority supports the proponent's commitment to ongoing community consultation and recommends that formal liaison and monitoring processes be established by the proponent to the satisfaction of the Environmental Protection Authority, on advice from the Social Impact Unit, to monitor, review and manage the social impact of the project throughout its life. The Environmental Protection Authority further recommends that reporting on this liaison, monitoring and management of the social impacts should be required as part of the proponent's monitoring reports to the Environmental Protection Authority.

Rehabilitation and care and maintenance

Requirements for limestone and other materials for construction work will lead to the establishment of a number of borrow pits. The proponent has undertaken to clean up these sites and respread the topsoil on completion of construction. Once under way the life of the salt field is expected to be several years or decades, provided favourable markets prevail. However, at the end of that period there will be a requirement to leave the area in such a way as to encourage the land to rehabilitate.

In the event, however, of a decision being taken to place the project on a care and maintenance basis for a period of time, it will be necessary for the proponent to provide adequate standby provisions to ensure that the area remains environmentally stable. This may require that environmental monitoring programmes are continued so that any adverse changes can be promptly detected and acted upon.

Recommendation 19

The Environmental Protection Authority recommends that borrow pits be left in a safe, stable and rehabilitated condition as soon as possible after use, with walls battered and topsoil respread so as to encourage revegetation. At least six months before the end of the life of the project, the proponent should prepare and subsequently implement a plan for rehabilitation addressing the entire project area, to the satisfaction of the Environmental Protection Authority. In the event of the project being placed on a care and maintenance basis it is recommended that a plan to ensure that adverse environmental changes will be detected and managed to the satisfaction of the Environmental Protection Authority should be prepared and submitted to the Environmental Protection Authority at least three months prior to shutdown.

Environmental management programme

While the Authority has concluded its assessment of Gulf's proposal it considers that there are a number of aspects needing to be included in the company's Environmental Management Programme, which should ensure the coordination of environmental monitoring, management and auditing activities.

Recommendation 20

The Environmental Protection Authority recommends that, prior to the start of construction of each phase of the proposal, the proponent prepares, submits and subsequently implements an Environmental Management Programme (EMP) that addresses, where appropriate, the monitoring, management, auditing and reporting requirements of the following issues:

- impacts associated with onshore and offshore construction;
 - fauna survey and relocation plan for islands isolated by salt ponds;
 - ongoing monitoring in Beadon, Middle and Four Mile Creek systems to safeguard the mangrove and algal mat environments;
 - the mouth of Beadon Creek to maintain present access levels ;
 - noise levels in Onslow arising from the processing facilities;
 - oilspill contingency plan to minimise impacts from onshore and offshore spills;
 - groundwater salinity and levels in the town of Onslow and on susceptible islands;
 - community consultation, monitoring and liaison;
 - areas under rehabilitation,
- to the satisfaction of the Environmental Protection Authority.

Minor and non-substantial changes

The Authority notes that during the detailed implementation of proposals, it is often necessary or desirable to make minor and non-substantial changes to the designs and specification which have been examined as part of the Authority's assessment. The Authority believes that subsequent statutory approvals for this proposal could make provision for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

Lapsed proposal

The Authority believes that any approval for the proposal based on this assessment should be limited to five years. Accordingly, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

1. Introduction

As part of its assessment of the environmental effects of this and other current proposals for expanded solar salt production in Western Australia the Environmental Protection Authority called for a review of the market factors, productivity in relation to environmental impact, and broad regional environmental setting.

1.1 Market for salt¹

The total world output for salt is around 180 million tonnes per year, of which 22 million tonnes is traded internationally. WA supplies 27% of this and is the largest exporter of salt in the world. In 1989 this amounted to nearly 6 million tonnes, worth about \$112 million.

The 1989-90 period was characterised by continuing interest in capacity expansion throughout the industry in WA, brought about by improved world prices for salt, as increasing demand relieved the oversupply problems common to the 1970s and early 1980s. The Environmental Protection Authority received proposals from Gulf Holdings for a field at Onslow and from the three other producers in the State to expand their existing operations. The current situation is :

- Dampier Salt at Lake Macleod has increased capacity to 1.5 million tonnes per year (MTPA);
- Dampier Salt at Karratha, from 2.5-3.0 MTPA granted environmental approval 23/11/90;
- Shark Bay Salt at Useless Inlet, from 0.65-1.2 MTPA under Environmental Protection Authority assessment;
- Leslie Salt near Hedland, from 2.25- 2.75 MTPA under Environmental Protection Authority assessment;
- Gulf Holdings' new proposal at Onslow, for 1.5 MTPA (this proposal).

Overall the demand for salt in the major consuming Asian countries is expected to increase by no more than 2% compound for the next few years. However, domestic salt production in Taiwan and Korea is very inefficient and takes place upon increasingly scarce and valuable coastal land. The eventual closure of these fields is likely, resulting in an increased demand for imported salt, predominantly from Australia, for the large chemical (chloralkali) industries in those countries.

If all the current salt proposals worldwide come to fruition in the next year or so it is certain that there will be an oversupply of salt in 1993/4. However, the operators have the following options if demand is poor:

- taking excess crystallisers temporarily out of the brine cycle;
- leaving a thicker salt floor in the crystallisers as an unharvested stockpile; and
- increasing harvested stockpiles.

Salt production is an activity in which WA enjoys significant advantages due to the favourable climate, terrain and coastline over large areas of the north. While Mexico can compete with WA in this regard it is further from the major North Asian markets.

Existing producers have operational and commercial reasons to expand, these being:

- the need for a 20-25% buffer of excess capacity. This may be necessary to build up stocks in case the operation is affected by cyclonic rain, or to meet a sudden surge in demand caused by climatic conditions elsewhere;
- the solar salt industry could be selling to its theoretical capacity in under three years, which is a serious constraint given the 2-3 year lead time for saltfield expansion to become productive; and
- the need to reduce unit costs and so improve worldwide competitiveness.

The Onslow salt proposal is 100% owned by Gulf Holdings Pty Ltd which has developed the engineering and environmental feasibility before joint venturing with a major partner. Recently Gulf has entered into a joint venture with Wesfarmers Ltd. Under the terms of this agreement Wesfarmers has an option to acquire up to a 51% share by contributing towards the cost of construction of the project, but may choose to withdraw from the venture at any time up to that point if its research indicates that the market is unfavourable.

1.2 Regional setting

The Onslow salt project is proposed for tidal flats immediately inland from communities of mangrove trees which characteristically line coastal creeks along the Pilbara coastline. These are the only mangroves in Australia which inhabit an arid zone coastline. They form part of an ecosystem which includes algal mats and the nearshore marine environment. This system as a whole is responsible for binding substrate, reducing erosion of the tidal flats and creek banks (especially important along this cyclone-prone coastline), and for acting as a generator and repository of nutrients such as nitrogen, and phosphorus². This in turn lays the food base for microorganisms which live in the algal mats and mangroves, which are preyed upon by creatures higher up the food chain, like crabs, birds and fish in the nearshore environment.

In recognition of the high environmental significance of this system the Conservation Through Reserves Committee (CTRC) in 1974 recommended to the Environmental Protection Authority that **"...development for solar salt production be restricted to the supratidal zone landward of the mangrove thickets, and that any extension require the approval of the Environmental Protection Authority."** in the coastal region Exmouth Gulf to Mary Anne Islands. This recommendation was subsequently endorsed by the Environmental Protection Authority in its report to Government in 1975³ and is an important cornerstone in the Environmental Protection Authority's assessment of this proposal.

The mangrove community at Onslow covers an area of 9.4km² and forms a small portion of the total Pilbara population which stretches intermittently from Exmouth Gulf to Eighty Mile Beach east of Hedland. A survey of mangroves by Johnstone⁴ examined their distribution and characteristics along the Pilbara coast. Compared to elsewhere in the survey the Onslow mangroves are not as well represented in terms of their size, density and diversity of species, with three species being recorded versus up to seven in some other locations. Locally, however, they are crucial as nursery areas for prawns and fish.

1.3 Productivity

Solar salt production is inherently attractive from an environmental viewpoint in that it uses solar energy and is sustainable, apart from the resources consumed in pumping and harvesting.

However it requires large areas of ponds which have the potential for major environmental impacts. Clearly, ponds located on land of low environmental sensitivity are to be preferred, but also the productivity of the process is highly relevant in that it determines the extent of the environmental impacts of the ponds.

For example, the Dampier "process enhancement" recently assessed by the Authority proposes increased productivity with no expansion of ponds and therefore no associated environmental impacts.

A proposal which is environmentally efficient in that it avoids environmentally sensitive land, or at least maximises productivity relative to minimised environmental impacts is more environmentally acceptable.

1.4 Direct and indirect impacts

The mangroves and algal mats adjacent to the proposed ponds are an important part of the total environment in the area, and should not be compromised.

The environmental impacts from the construction and operation of the ponds are of two sorts. There are some direct impacts from the construction (destruction of some vegetation, creation of bunds and borrow pits etc). These can be quantified, and, by appropriate design, minimised so the Authority is able to make an assessment of the environmental acceptability of these impacts.

Once the ponds are in place and operating there is also the possibility of indirect (secondary) impacts. Depending on their design, ponds may restrict the flow of fresh floodwaters to the algal mats and mangroves. Also, depending on the pumping regime, the pumping of water from the tidal creek may reduce the area which is tidally wetted on a regular basis.

The effect on the mangroves and algal mats of these indirect changes in water flushing is not well known but could lead to a secondary loss of both mangroves and algal mats, the extent of which it is impossible to predict. In this situation the Environmental Protection Authority has adopted a conservative course and made recommendations that reflect the high level of caution which is appropriate to this sensitive environment.

2. Background

In August 1989 Gulf Holdings Pty Ltd (Gulf) submitted to the the Environmental Protection Authority a proposal for the establishment of a solar salt facility, to produce and ship salt from the port of Onslow. The proposal seeks to establish condenser and crystalliser ponds on coastal flats near Onslow, and associated processing facilities to sell up to 1.5 million tonnes of salt a year. The salt would be loaded by conveyor onto ships which would berth at the end of a one km long trestleway (jetty) proposed for the vicinity of Beadon Point, immediately west of the 'new town' of Onslow.

The proponent was requested by the Environmental Protection Authority to prepare an Environmental Review and Management Programme (ERMP). Public meetings and information days were held on October 4th, 1989 and May 21st, 1990 in Onslow to allow for an interchange of views between Gulf and the residents of Onslow. The ERMP was released in mid-April for a public review period of ten weeks. Copies could be bought from the proponent or read in public libraries in a number of Pilbara centres and in Perth. The review period closed at the end of June 1990 with a total of 50 submissions having been received from the public and Government agencies. Concerns raised in these submissions were relayed to Gulf for their response and the concerns and responses have been taken into account in the recommendations in this report.

3. Project description

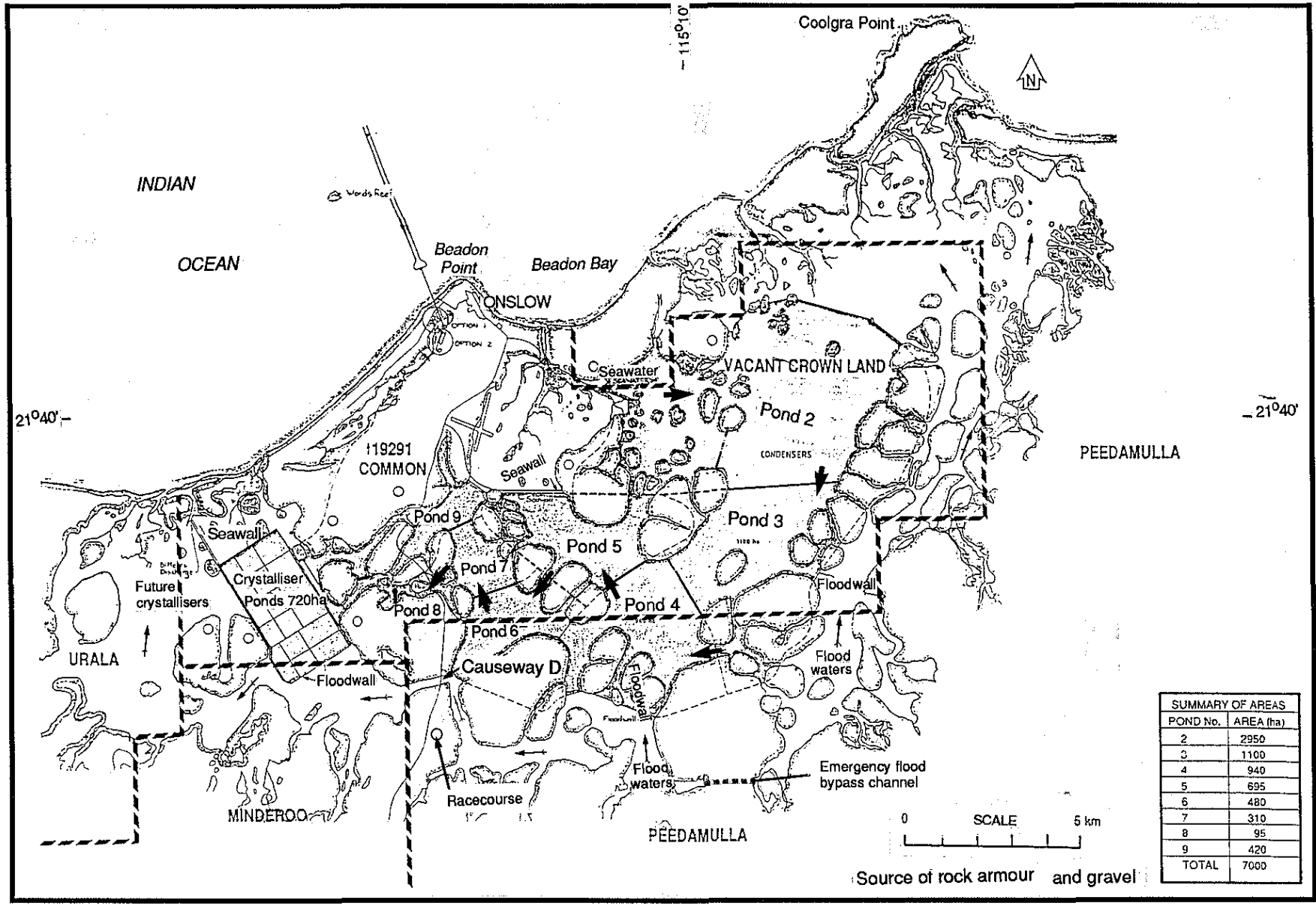
The proposal involves pumping seawater from Beadon Creek into condenser ponds covering an area of 70 km² of saline flats to the southeast and south of Onslow (Figure 1). Starting at Pond 2 the water would be led sequentially through the eight ponds, becoming more salty as evaporation proceeds, from where it would be channelled into crystalliser ponds, totalling 7 km² in area and located 9 km southwest of town. Here, via the final stage of evaporation, the salt crystallises out and is mechanically harvested and loaded into trucks for transport to the processing plant. The by-product is highly saline water called bitterns, which would be released from the crystallisers into Middle Creek at the rate of about 25000m³ per day under full production.

Washing facilities, power plant and 500,000 tonne capacity stockpiles are planned to be located about one km southwest of the nearest residential subdivisions (option 2 on Figure 2) and would be joined to the crystallisers by a gravelled haul road. To transport the washed salt to the ships offshore a 1.4 km overland conveyor passing under the road leading to Four Mile Creek is proposed to link up with a 950m trestleway. This would begin immediately southwest of the carpark and recreational facilities on Onslow's 'back beach'. A 120 metre wide channel would need to be dredged a distance of 4km to a water depth of 9m in order to give access at half tide or higher to ships of up to 28000 tonnes.

Project construction would be staged, with the earthworks associated with pond construction taking about four months to complete and pumping of seawater from Beadon Creek into Pond 2 beginning in the third month of construction. The process plant and trestleway would not be commenced until the second year as the salt-making process takes 18 months for the first batch to be produced.

The construction workforce is expected to peak at 100 and would be accommodated in the existing caravan park or on the site near Beadon Creek recently vacated by West Australian Petroleum. About 10-15 of the 40 permanent employees are expected to be accommodated in singles style units, with the others in family houses, most of which would need to be built by the proponent.

Figure 1: Project location



SUMMARY OF AREAS	
POND No.	AREA (ha)
2	2950
3	1100
4	940
5	695
6	480
7	310
8	95
9	420
TOTAL	7000

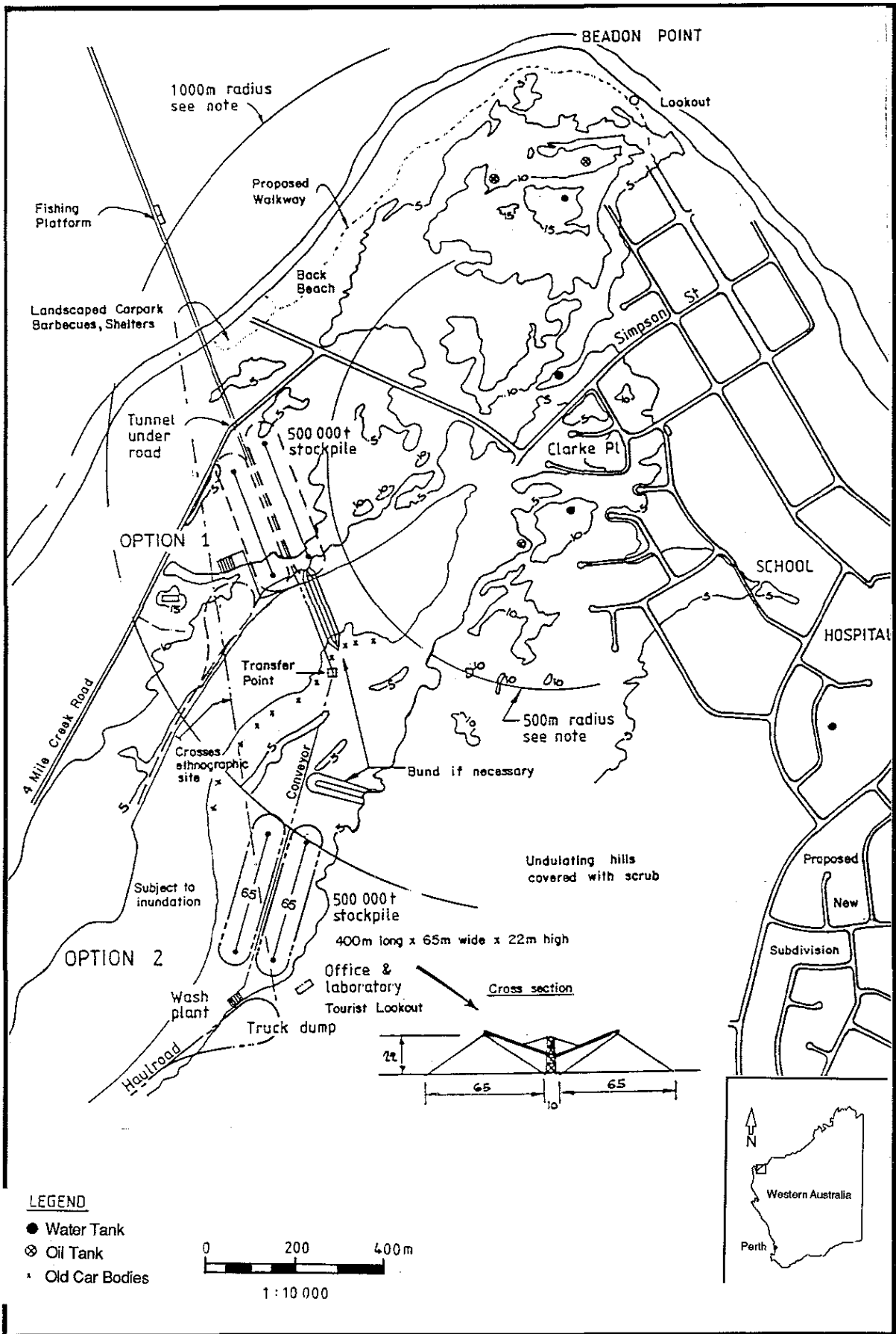


Figure 2: Location of facilities

4. Existing environment

Onslow lies on the Pilbara coastal plain between the Cane and Ashburton Rivers. The town was originally settled near the eastern side of the mouth of the Ashburton River to cater for the need to link with coastal shipping traffic, but continued weather-related problems with access to these ships and the destruction of the wooden sea jetty during a cyclone prompted resettlement in 1925 at Beadon Point, some 25 km to the east.

Extensive tidal and supratidal flats linked to the sea through breaks in the coastal dunes surround the present town, which can be cut off from the mainland as a result of high seas or heavy rains. The total area of flats within 100 km of Onslow is around 1650 km². They are characterised on their seaward margins by the development of mangrove and algal mat communities. The greater part of the flats is usually above high tide and highly saline as a result of solar evaporation.

A number of sandy 'islands' are developed on the flats, varying in size from less than a hectare to several square kilometres, and in height from a metre to over 15 metres above sea level. The smaller of these are dominated by species of spinifex, while the larger islands maintain enough rain-fed groundwater to encourage in addition Acacia, Cassia and Eucalypt shrubs and trees. Many of the islands have developed on a base of well cemented coralline limestone. Onslow is built on the largest of these in the area.

The town's annual rainfall is 265mm on average, with the majority falling during the summer, often associated with tropical cyclones or depressions. Rainfall is, however, highly variable and droughts lasting years followed by exceptionally heavy (often destructive) rains are not uncommon. An account by Webb⁵ of the town's history of natural disasters shows that 14 cyclones or "serious blows" were recorded in Onslow in the period from 1934 to 1967. A portion of the town's wooden jetty (severely damaged by cyclones at least four times between 1934 and 1963) can still be found where it was washed some kilometres inland during a cyclone.

The mangroves of the Pilbara coast are unique in Australia because they are the only stands growing in a tropical arid climate. Together with the algal mat system they are considered to be an important part of the coastal ecosystem. They contribute nutrients important for the survival of a wide range of fauna, as well as for the maintenance of the nursery habitats of crustaceans and fish.

Around Onslow three species of mangrove have been observed out of a total of seven recorded along the Pilbara coast. It is estimated that these mangroves comprise between 5% and 8% of the total inventory of the Pilbara coast. Locally the stands occupy about 9.4 km² along the coast from Coolgra Point (15 km north east of Onslow) to Hooley's Creek (25 km south west). In the same area there are around 19.7 km² of algal mats.

Water turbidity offshore is frequently high as a result of wind stirring up fine bottom sediments. Ward Reef, situated 2.5 km off Beadon Point, is the site of a colony of corals, but elsewhere the sea floor is dominated by bare muds, fine silts and sands in places covered with algae or rare patches of seagrass.

The town of Onslow is a community of 600-800 residents, including a large Aboriginal community, as well as tourists who reside in Onslow on a seasonal basis.

The local economy is based on pastoral and commercial fishing activities, a few low key tourist facilities and government services. There are offshore oil and gas operations which fly people in and out of Onslow. However at present Onslow lacks a significant industrial or commercial base.

A lack of local employment opportunities has led to Onslow's unemployment rate being significantly higher than that of the Pilbara as a region. Onslow also has a much higher dependence on government funding in the form of social security benefits and salaries for government workers.

5. Public submissions

During the public review period a total of 50 submissions were received. Of these, 19 were from residents of Onslow, seven came from others who did not have an Onslow address, a further seven were submitted by companies and 17 came from Government agencies. As well, considerable

correspondence was received before and after this time. Many submissions were detailed and raised complex issues relating to both social and environmental matters. Issues causing the most concern included: fear of worse flooding, erosion and stock losses on adjacent pastoral leases; effects on the brackish groundwater source; impacts on Beadon Creek and the prawn fishery; noise and visual intrusion from the processing facilities; impacts of construction and the construction crews on the town; effects of the operational stage on the social fabric of Onslow (both positive and negative); aboriginal sites; loss of access to Back Beach; and public use of the trestleway. These impacts and others are discussed in Section 6. Specific questions raised in submissions and the proponent's responses to them are included in Appendix 2.

6. Environmental Impacts

One of the reasons why this proposal attracted a high level of formal assessment is because it was recognised that there were likely to be several complex issues potentially leading to significant environmental impacts. The role of the public via the open days and from their written submissions in bringing many of these issues to the attention of the Environmental Protection Authority is gratefully acknowledged. The questions raised in submissions and the proponent's responses are included as Appendix 2. The main concerns were seen to be:

- the effects of flood damage on the land and on road access;
- a lack of specific data about the flora and fauna of the "islands" affected by the proposal;
- initial and longer term impacts to Beadon Creek and others in the area, including their attendant mangrove systems;
- the effects of noise from the processing plant and conveyor on Onslow residents;
- the marine environment;
- changes to the groundwater regime;
- the social impacts on Onslow; and
- management and rehabilitation of disturbed areas.

The Environmental Protection Authority has, in its assessment, considered the likely direct impacts and the indirect effects of the proposal. The latter are far more difficult to predict and the assessment was often faced with a lack of research data or directly comparable examples from which to base conclusions. In this situation the Environmental Protection Authority has adopted a conservative course and made recommendations that reflect the high level of caution which is appropriate to this sensitive environment.

6.1 The effects of flooding

6.1.1. Impacts on roads

The siting of the ponds increases the risk of reduced access to and from Onslow, by raising water levels across the road during and after heavy rain. This would occur because floodwater from inland would be diverted around the ponds and required to squeeze through much narrower channels than at present.

Concerns were raised in some submissions that in times of flood the Ashburton River overflows and that some of its water is diverted northeastwards across the main Onslow road into the area of tidal flats which would be occupied by the salt ponds. Aerial reconnaissance has led Gulf to the conclusion that this cannot happen, but there is no formal documentation to support this conclusion. The overflowing of the river in times of flood is not caused by earthworks associated with the proposal, but they will have a significant bearing on the total amount of floodwaters that could be expected to cross the road at the causeway in the vicinity of Onslow's racecourse.

The Environmental Protection Authority sought advice from the Main Roads Department (MRD). MRD agreed that some of the fresh water runoff that would naturally be distributed on the coast east of the road would instead be diverted and concentrated to cross the causeway immediately to the north of the racecourse from east to west (in future referred to as "causeway D" and shown on Fig 1) and offered the following comments:

"The function of causeway D will therefore be changed to a normal floodway. As such MRD needs to ensure that these changes do not lower the existing serviceability of the road of 20 years ARI (average return interval) when overtopped and that no damage will occur for the 100 year flow."

While the thrust of the MRD's comments is directed towards the main road the Environmental Protection Authority wishes to ensure in addition that modifications to the floodwater paths would not result in a prolonging or worsening of the effects of flooding across any recognised roads in the vicinity of the development, and makes the following recommendation:

Recommendation 3

The Environmental Protection Authority recommends that appropriate steps, to the satisfaction of the Minister for the Environment on advice from the Department of Main Roads, should be taken by the proponent prior to construction of the ponds to ensure that access on recognised roads in the vicinity of the development will not be compromised by construction associated with this proposal, and that floodways and causeways will be protected from damage caused by floodwaters arising as a result of this proposal.

Because the proponent has not prepared accurate calculations and drawings, the MRD declined to comment on Gulf's estimated flow rates across road crossings. Instead the matter was discussed with Gulf's engineering consultants who have agreed on behalf of the company to provide the following data if environmental approval for the project is given:

- a study of catchments that could contribute to flows over causeway D (this would settle the question about flows from the Ashburton River crossing the main road),
- causeway design flows and the methods and assumptions used to arrive at the results;
- the serviceability (defined as a critical depth of 200mm of water at the crown of the road) of causeway D as a floodway to then be investigated for ARI's of 2, 5, 10, 20, 50 and 100 years;
- depth and duration of flooding for the various ARI's at causeway D, to allow assessment of the stability of the existing embankment under saturated conditions;
- details of protection against damage of causeway D for the 100 year flow; and
- if causeway D is inadequate to be trafficable to light vehicles for the 20 year flow, details of a new floodway to MRD design standards will be provided and the proponent will undertake to build it.

In addition the proponent has proposed a contingency plan to enable exceptionally heavy flows to escape to the east, by creating an emergency flood bypass across low lying land some 8km to the east of the main road (see Fig 1). This would consist of a channel about 100m wide linking tidal flats and enabling excess water to be diverted to the northeast.

6.1.2. Impacts on islands in the path of floodwaters

Diversion of floodwaters around the ponds would dam up these flows at certain places where the escape path is constricted by terrestrial islands (see Fig 1). There is potential for floodwaters to scour and erode, especially around these areas of constriction, and, possibly to increase flooding and stock losses on adjacent pastoral properties. Gulf believes that the latter impacts are extremely unlikely to occur because the ground levels on surrounding pastoral properties would prevent inundation from diverted water above heights currently reached during floods. Without detailed survey information this is difficult to confirm. However the Environmental Protection Authority is prepared to await the results of later detailed surveys which the company would be carrying out as part of its catchment studies (above) which would quantify the volume of water expected to pass around the outside of the ponds.

Recommendation 4

The Environmental Protection Authority recommends that, where lands are affected by erosion, flooding, or stock losses as a result of this project, remedial measures should be undertaken and appropriate compensatory arrangements should be made with affected leaseholders or landowners (as the case may be) to the satisfaction of the Minister for the Environment.

6.1.3. Isolation of animals.

The proposed filling of the salt ponds would isolate over 30 "islands" of varying size so that any animals which happen to be on them at the time could possibly become marooned. Little if any formal biological survey work has been carried out on these islands and, as a result, not much is known about the species which inhabit, or visit these areas.

This has led to the situation where the Department of Conservation and Land Management (CALM) and the W.A. Museum are believed to have stated that there are no recorded rare or endangered species in the area. This was interpreted by the proponent to mean that there are unlikely to be rare or endangered species, whereas the Environmental Protection Authority believes that the lack of sightings of rare or endangered species is more likely to be the result of a lack of survey data. There are in fact unconfirmed sightings of rare marsupial hopping mice from the vicinity.

After subsequent discussions with the Environmental Protection Authority, Gulf has agreed, subject to the proposal proceeding, to commission an appropriate survey of all the islands which would be isolated, and to propose and implement a "rescue and resettlement" operation for any of the larger animals adversely affected by being marooned on these islands.

Recommendation 5

The Environmental Protection Authority recommends that before any site works commence a survey of the indigenous fauna be carried out on the land which will be isolated by the flooding of the salt ponds, and that a suitable programme be proposed and implemented by the proponent to ensure that populations of the animals on affected islands are suitably relocated if appropriate, to the satisfaction of the Environmental Protection Authority on advice from the Department of Conservation and Land Management.

6.2. Changes to Beadon Creek

In the early stages of design of the ponds and the pumping station the proponents recognised that there was the potential to impact heavily on the mangrove systems of adjacent creeks. The sensitivity of these areas was highlighted by the proponents' consultant, resulting in a number of alternative pond configurations being canvassed in the ERMP. The final choice reflects a desire to minimise direct impacts to the mangroves, with the only area to be directly affected being on the east arm of the creek where the pumps would be located, amounting to around 1 ha of clearing.

The catchment area of Beadon Creek would be reduced and cut off from its floodwater source by the ponds, which would occupy the tidal flats immediately upstream of the the creek. Mangrove trees are dependant on a supply of water within a certain salinity range in order to grow, and the effects of irregular flushing from fresher floodwaters are poorly understood. However it is believed that the fresh water reduces groundwater salinity levels for a period and invigorates mangrove trees.

Approximately 10km² of the catchment of Beadon Creek would remain after construction of the ponds, and the effect of this reduction is not known. The proponents have suggested that the position of the pond upstream might even benefit the mangroves, by allowing seepage of water from the pond at salinity levels below those currently existing in the ground under the proposed ponds.

The ponds would be filled by pumping water from the eastern arm of Beadon Creek, on a continuous basis except for a cutout at low water levels. The ERMP indicated that the pumping rate would be 12m³/sec, and concerns were raised that there were likely to be significant impacts on the creek including:

- reduced tidal levels upstream and in the other arms of Beadon Creek due to the effects of drawdown;
- a reduction in the creek's ability to provide safe upstream anchorages during cyclonic conditions;
- scouring of the creek banks due to the increased speed at which water would flow up it, especially on the incoming tide;
- effects of large numbers of fish eggs, fry and prawn larvae being drawn into the ponds, hence lost to the creek nursery system.

In their reply to submissions the proponents have refined their calculations. They now say that their water requirements would be comfortably met at a pumping rate of 8m³/sec and that the speed at which water would travel up the creek to the pumps would be less than 1m/sec, at which speed scouring of the banks could not occur. The effect on fish and prawn populations is considered to be small and recruitment could be expected to occur from the other arms of Beadon Creek. The overall effect on the nursery would be likely to be small as other creeks in the area would not be affected.

On the issue of reduced water levels in the creek the effects would be negligible on the areas where boats would be likely to require anchorage, which are at least 1km downstream from the pumpsite. However the drawdown near the pumps and further upstream in the eastern arm of the creek is calculated to be up to 10cm vertically at spring high tide. On the flat areas of algal mat and mangrove at the upper limits of the tides this vertical distance could translate to a considerable horizontal area, resulting in areas of mangrove and algal mat which are no longer tidally wetted. Exactly how much area is affected has not been quantified by the proponent and would require a detailed survey. The impacts on mangrove viability over the medium to long term are unknown.

The Environmental Protection Authority pointed out to Gulf its position that there should be no significant direct or indirect impacts which could threaten the viability of the mangrove/algal mat systems.

Recommendation 6

The Environmental Protection Authority recommends that the proponent be required to construct and manage the facility such that there be no secondary impacts off the actual site, including no indirect loss or detriment of mangroves or algal mats off site, to the satisfaction of the Environmental Protection Authority.

The company was asked to provide assurances that this could be achieved. Options were put forward that could be implemented to address the potential problems of loss of catchment area floodwaters and reduced wetted area of algal mats and mangroves arising from the effects of pumping from the creek. These included a proposal to create a channel through the condenser ponds to allow floodwaters to travel northwards (as they presently do) and flow into Beadon Creek. The Environmental Protection Authority believes that, in the absence of data of the effects on the mangroves of loss of floodwaters, this will be necessary to ensure their long term viability, and that this channel should be incorporated into the final design plan for the proposal. This channel would also reduce the amount of floodwater that would otherwise have to be diverted around the ponds and in so doing would reduce the potential effects of erosion discussed in Section 6.1.2.

Recommendation 7

The Environmental Protection Authority recommends that, to ensure that Beadon Creek continues to receive freshwater overland flows a flood water channel through the ponds should be incorporated into the final design of the proposal and built at the time of construction of the ponds, to the satisfaction of the Environmental Protection Authority.

With regard to the reduced wetted area of algal mats and mangroves from pumping there is again a lack of specific information on the extent of the area to be affected, and on what the wetting requirements of the algal mats might be. The Environmental Protection Authority considers that, unless the proponents can demonstrate that the proposed pumping regime will have no effect on the viability of the algal mats, there should be pumping only on the outgoing tides, so that all areas currently wetted remain so.

Recommendation 8

The Environmental Protection Authority recommends that pumping from Beadon Creek into the condenser ponds should occur only on outgoing tides unless the proponent can demonstrate, to the satisfaction of the Environmental Protection Authority, that other pumping regimes would have no adverse environmental impacts on the algal mats.

The location of the condenser ponds raises the possibility of affecting the groundwater regime to the detriment of the mangroves. As the exact effects are not known (and may in fact be positive) the company has committed to a monitoring and management programme which, by collecting data on

groundwater levels and salinity in the vicinity of representative mangrove sites, will ensure that early warning signs of mangrove mortality are detected and acted upon. Gulf has begun a groundwater monitoring programme at Beadon Creek to establish base level data and will propose an appropriate management and response plan if environmental approval is given.

Recommendation 9

The Environmental Protection Authority recommends that a growth monitoring plan for mangroves and algal mats off-site in the Beadon Creek area be prepared prior to the completion of pond construction by the proponent to the satisfaction of the Environmental Protection Authority. In the event that monitoring shows any areas of mangroves or algal mats are likely to be or have been adversely affected by the project, the Environmental Protection Authority recommends that the proponent prepare and implement a plan for rehabilitation of these mangroves and algal mats, to the satisfaction of the Environmental Protection Authority.

6.3. Discharge of bitterns

Bitterns would be discharged into the restricted environment of Middle Creek at the rate of 2.1 million m³/year. Allowing for the fact that they would not be discharged at all times (because of tidal cycles and seasonal effects) the volume quoted in the ERMP was 25000m³/day maximum, although the average figure is only of the order of 6000m³/day. This is expected to have a significant impact on the fauna in Middle Creek, as the water would become too saline for the normal populations to persist. In this way Gulf's proposal differs from that at the Dampier salt works (with which it was compared by the proponent), where bitterns are discharged directly into Nickol Bay and freely disperse.

The Environmental Protection Authority regards the change in the benthic environment of Middle Creek as being a cost of the project, but wishes to ensure that adjacent mangrove trees are not affected. One way to minimise the risk of damage would be to control the timing of the discharge of bitterns. Gulf's ERMP states that discharges would occur only at times of above average tide. The Environmental Protection Authority believes that, while this regime would maximise efficient mixing of the bitterns with creek water, it would also bring this hyper-saline water into contact with the root systems of adjacent mangroves and increase the risk of them being affected. Accordingly the Environmental Protection Authority has requested the proponent to ensure that the bitterns are discharged only on the ebb tide, so that the movement of groundwater adjacent to the creek is towards the creek. This should minimise contact of the bitterns with the root systems of mangroves.

A groundwater monitoring programme is proposed for Middle and Four Mile Creeks by Gulf, to check for changes to the salinity and levels of groundwater, brought about either by bitterns discharging, or through seepage from the crystalliser ponds 1km upstream. Seepage from the ponds should be a temporary effect for each crystalliser cell, because its floor rapidly becomes coated with a layer of impervious salt once precipitation begins. The details of this monitoring would be discussed with the proponent's biological staff after environmental approval is given.

Observations at other salt projects show that erosion of the bitterns channel walls leading to scouring of the adjacent algal flats could occur if the channel walls are not supported, and operations would need to be carefully observed to ensure that this did not happen in this case.

Recommendation 10

The Environmental Protection Authority recommends that discharge of bitterns into Middle Creek should occur only on outgoing tides, or into the ocean via an appropriate outfall channel, whichever is the most environmentally acceptable. An appropriate monitoring programme for Middle and Four Mile Creeks and the bitterns channel should be prepared and subsequently implemented to the satisfaction of the Environmental Protection Authority. If monitoring shows mangroves are likely to be or have been affected in the Four Mile Creek or Middle Creek systems as a result of the discharge of bitterns, or that erosion of the bitterns channel and surrounds is occurring the proponent should prepare and implement a plan for a revised bitterns discharge regime and for rehabilitation of affected areas, to the satisfaction of the Environmental Protection Authority.

6.4. Noise from processing plant

At present Onslow is a very quiet coastal town which is an attractive feature for many of the town's residents and tourists. They are concerned that locating the stockpiles, conveyor and washplant close to residential areas such as Clarke Place (600m from the centre of the stockpiles) will disturb the peaceful nature of the town, especially at night. Potential problems could arise because shiploading is expected to take up to 24 hours of uninterrupted operation, and noise at night is often a greater source of irritation than the equivalent source during the day.

This led to a proposal from Onslow's residents that the processing facilities be relocated. Gulf undertook to shift the plant, resulting in the change from Option 1 to Option 2, as shown on Fig 2. This move has increased the separation to a minimum of 700m from the nearest settled areas (Hooley St) and about 900m from the end of Clarke Place.

The sound analysis which was commissioned by Gulf was evaluated by the Environmental Protection Authority to assess its conclusions. This document highlighted the main sources of noise as being tracked vehicles (the bulldozers which would be expected to work on the salt stockpiles), and the power station. The Environmental Protection Authority considered that conveyor noise and reversing beepers on the dozers and front end loaders also had the potential to cause a nuisance and sought a more specific management plan from the proponent.

Gulf has tendered an acceptable noise management proposal which is set out fully in Appendix 1 and summarised below:

- automatic noise level recording from a monitor stationed in Clarke Place;
- noise problems arising from fixed plant items will be dealt with by servicing, repairing, insulating or withdrawing as necessary;
- noise problems arising from mobile plant will be dealt with by withdrawing the equipment from service until it can be suitably muffled, or new work practices will be developed;
- rubber tyred rather than tracked machines will be used wherever practicable;
- no tracked machines will be allowed to operate on top of the stockpiles between 9pm and 6am, unless it can be shown that the resulting noise does not exceed acceptable levels; and
- washplant and haul trucks will initially operate on a single daylight shift.

Recommendation 12

The Environmental Protection Authority recommends that the noise abatement measures proposed by the proponent, including the placement of appropriate earth bunding, reduction of sound levels on specific noise-making machinery, daytime shift-only operation of the washplant, use of rubber tyred vehicles rather than bulldozers where possible and the restriction on the use of those dozers to the western side of the salt stockpiles from 9pm to 6am should be implemented.

In addition the Environmental Protection Authority recommends that the proponent be required to ensure that the introduced noise from the project does not cause the noise in the surrounding residential areas to exceed:

- 50dB(A) from 7am to 7pm Monday to Saturday;
- 45dB(A) on Sunday and from 7pm to 10pm Monday to Saturday; and
- 40dB(A) from 10pm to 7am every day.

These levels should not be viewed as normal operating levels for the plant. They are the upper limits above which action will be taken by the Environmental Protection Authority. The Environmental Protection Authority considers that noise below these levels is not unreasonable provided it does not include tonal components, impulses or other intrusive characteristics.

6.5. Groundwater regime

Construction of salt condenser and crystalliser ponds "upstream" of Onslow and creek catchments has been an issue of great concern to many Onslow residents because of the possibility of affecting the brackish groundwater lenses that underlie Onslow and some of the other terrestrial islands. This

water supply is regarded as essential to the native vegetation which covers and stabilises these areas. Because of its lower salinity it floats on the hypersaline groundwater that underlies the tidal flats and the islands. Filling the ponds with salty water would cause seepage of saline water into the underlying soils and raise the static groundwater levels, forcing the brackish layer upwards.

These points were put to the proponents for their response and their full answer is set out in Appendix 2. Whilst they agreed with the general mechanisms raised (above) they cited a number of factors which were likely to minimise any effect on the brackish water supply:

- not all islands have a lens of brackish water - it depends on the soil type;
- in the condenser ponds the salinity of the contained water would be lower than that of the existing groundwater below the tidal flats. Thus their effect would be to dilute the groundwater;
- leakage from the ponds would be minimal because of the fine grained, relatively impervious nature of the soil, the low gradients and the self-sealing properties of the crystallisers;
- as the islands generally rise steeply away from the beach area on the tidal flats only a very narrow margin of growth around the perimeter of each island would be affected;
- Onslow is at least 3km away from the nearest pond margin and there is a large relatively impervious land mass of clay and gravel in the intervening area; and
- groundwater moving northwards along Onslow island from the direction of the salt ponds would, because of the topography of the area, tend to migrate into the landlocked salty depression that parallels the coastline west of town. Evidence of the direction of flow of water comes from the tamarisk and eucalyptus trees which grow adjacent to this depression. If the flow of water was from the depression to the trees they would not be able to survive; they must be obtaining a relatively fresh source from the direction of Onslow or the dunes.

The Environmental Protection Authority sought expert advice on this matter because of the expressed concern that this effect would lead to widespread damage of Onslow's gardens, and has concluded that this effect would be most unlikely to be evident beyond the periphery of the salt ponds. If vegetation is lost from the lower edges of islands within or near the ponds as a result of rising levels of saline water there is the likelihood of erosion of some of this foreshore. The Environmental Protection Authority believes that monitoring should include surveillance of island foreshores and that the proponent should be prepared to plant salt-tolerant species on areas that become salt affected and denuded as a result of a changing groundwater regime.

Bearing in mind that the proponent has not carried out a formal groundwater survey the Environmental Protection Authority believes that sites should be set up in Onslow to monitor groundwater levels and salinities, in case of unexpected effects.

Recommendation 13

The Environmental Protection Authority recommends that the proponent should install groundwater monitoring sites within the townsite of Onslow and continue to monitor these sites for a minimum period of 10 years from when the ponds are filled and take whatever action is necessary to maintain Onslow's gardens against saltwater encroachment from the ponds, to the satisfaction of the Environmental Protection Authority. The Environmental Protection Authority further recommends that island foreshores should be monitored for the effects of rising saline groundwaters and that areas where vegetation has been subsequently lost as a result of increased salinity should be rehabilitated by planting with salt tolerant species.

6.6. Marine impacts

6.6.1. Dredging of shipping channel

The proposed dredging of the shipping channel and dumping of the associated spoil 600m to the east could give rise to a number of impacts. These include the possible silting of corals on nearby Wards Reef during dredging, and mobilisation of dredge spoil during cyclones and storms, leading to silting of the mouth of Beadon Creek. Although the proponent sees no requirement for blasting of the channel the issue was raised in a submission because trenching operations elsewhere off the Pilbara coast have often come across much harder substrate than anticipated. Blasting in the vicinity of the reef would have severe impacts and any proposal would have to be assessed separately by the Environmental Protection Authority.

The risk of dredge plumes drifting onto Wards Reef can be minimised by careful management and observation of tidal drift whilst dredging is being carried out. Gulf has undertaken to prepare appropriate plans to ensure that dredge spoil would not drift onto the reef. These would include specifying the designated dimensions and position of the spoil dump in the dredge contract, and briefing the project supervisors and the dredgemaster on the importance of adhering to these measures.

The longer term movements of spoil where caused by storms or cyclones are unknown although it is anticipated that maintenance dredging of the channel would be required at irregular intervals, depending on the frequency and severity of storms. Gulf intends to monitor the spoil banks to determine whether material is drifting towards the shore or the mouth of Beadon Creek, and undertakes to remove any accumulation of spoil from the creek mouth (see Appendix 1 for details of supplementary commitments).

Recommendation 14

The Environmental Protection Authority recommends that no channel blasting be permitted near Wards Reef without further environmental assessment by the Authority, and that the reef should be monitored to ensure that it will not be adversely affected by dredge plumes or silt from the dredge spoil. The Environmental Protection Authority also recommends that if dredge spoil causes siltation of the mouth of Beadon Creek the proponent be responsible for the prompt removal of the obstruction.

6.6.2. Shipping movements

The dredged channel may be required to be surrounded by an exclusion zone to ensure safe passage of salt carriers. This is a matter to be determined by the Department of Marine and Harbours at the time when the dredging and trestleway proposal is referred to them by the proponent. Similarly the potential for ships to run aground is one that is most appropriately dealt with by that Department in consultation with the proponent in setting the design parameters of the shipping channel.

The salt cargo ships carry ballast water which is used to keep them stable whilst sailing without a full load. Upon approaching their loading destination, and into waters protected from heavy weather the ships jettison their ballast load. If organisms are present in that ballast water they will then be released into the local seas, creating a potential hazard to local fisheries. This matter is common to all shipping in coastal waters and is recognised by the relevant authorities (Australian Quarantine and Inspection Service in conjunction with the State Department of Agriculture's Quarantine branch) who have prepared a comprehensive set of voluntary guidelines for ship's masters to follow in Australian waters.

Gulf have committed to preparing a ballast plan which would be consistent with industry standards of the time prior to allowing salt carriers to berth at their jetty.

6.7. Oil spills

The proponent has recognised the attendant risks of bringing shipping into shallow coastal waters in an environmentally sensitive area and has committed to preparing an oilspill contingency plan. This should recognise that leaks may also occur from installations onshore and from pipes carrying fuel along the trestleway, which may be included as part of the proposal.

Recommendation 15

The Environmental Protection Authority recommends that, prior to the construction of the trestleway, the proponent prepare an oilspill contingency plan to deal with both offshore and onshore spills, to the satisfaction of the Environmental Protection Authority on advice from the State Committee for Combatting Marine Oil Pollution.

6.8. Construction camp

At the present time the proponent has not made a firm decision on the location of its camp for construction workers. This is because it would be preferable to use the existing caravan park if the timing of the project is outside the tourist season. If construction should coincide with the tourist period in winter Gulf would instead locate construction teams at the former WAPET site near Beadon Creek, requiring the setting up of appropriate mobile units. The behaviour of the construction teams and potential problems associated with the disposal of camp rubbish should be addressed in the proponent's environmental management plan.

Recommendation 17

The Environmental Protection Authority recommends that the proponent's environmental management programme take into account potential problems associated with the disposal of rubbish and the behaviour of personnel arising from its construction camp.

6.9. Other impacts

6.9.1. Access to sensitive coastal areas

The pond walls would allow conventional vehicles access to areas which are currently only able to be reached on foot, by all - terrain vehicle, or by boat. Apart from any safety considerations for these people whilst travelling on the proponent's leases, uncontrolled visits by members of the public could result in overexploitation of resources such as the mud crab. The proponent has advised the Environmental Protection Authority that access to areas under the salt leases would be restricted or prohibited, and the Authority is in favour of this approach.

6.9.2. Storm surge

Many submissions raised the spectre of worse flooding through the town as a result of the project during periods of high tides and storm surge caused by cyclones and tropical lows. From a community which has many times been exposed to extremely destructive cyclones this concern is understandable. The points raised were addressed by the company in its responses to submissions (Appendix 2), the main points of which are summarised here:

- the configuration of the coastline and the sea bottom at any particular place is what determines its tidal range and storm surge characteristics. Beadon Creek has neutral characteristics, by which is meant its configuration is such that it neither increases nor diminishes the tidal surge when compared to that of the open sea. By contrast the head of Exmouth Gulf is strongly convergent, which particular geometry increases the tidal range during storms and cyclones. The difference is that Exmouth Gulf is a large inlet with unrestricted access to the open sea, unlike the creeks at Onslow.
- the extent of sea level rise above normal (non-cyclonic) levels depends on many factors, the main ones being the extent of the drop in barometric pressure, the phase of the tide, and the speed and the direction of the wind;
- cyclone surge is different in the speed at which it travels when compared with a tidal wave (tsunami) as generated by an earthquake. Compared to a tidal wave the surge travels relatively slowly, with the cyclone, and is similar to a rise in tide. The incoming velocity of the surge component at Onslow during a high cyclonic surge is not more than 0.2 metres per second. This can be verified with a simple calculation using depths measured at various distances offshore; and
- knowing the velocity of incoming water it is possible to calculate the resultant conversion of kinetic energy of the water mass to the static rise in sea level (ie the potential energy) where this water mass comes up against a fixed barrier such as a sea wall or bund. This value for Onslow is less than 1cm.

What this means is that, whatever the surge level from a cyclone, the increment as a result of natural or artificial barriers (such as the proposed pond sea walls) is less than 1cm.

The Environmental Protection Authority sought advice from the Department of Marine and Harbours on the characteristics of storm surge and the likely impacts of the proposal on the town of Onslow. The Department agrees with the explanation of storm surge given by Gulf and goes on to say: "Existing developments at Onslow are unlikely to suffer greater storm surge due to the presence of the ponds."

The Department did, however, comment on the design level set for the bunds (4.5m above chart datum) which they believe to be too low. Their comments have been forwarded to Gulf for further consideration. It needs to be remembered that the nearest pond wall to Onslow would be 5km inland and that the only time that this wall could be under threat from storm surge would be when winds were from the north. Under these conditions storm waters impacting on the bund would be driven further away south from town if it were to be breached. The Environmental Protection Authority considers that, while the breaching of a bund could be a serious matter to the proponent due to the resulting loss of salt production, it poses little threat of additional environmental impact and no danger to inhabitants at Onslow. In the event of closure of the project, Recommendations 4 and 19, which relate to flooding and rehabilitation, have been made to ensure these aspects are adequately provided for.

Recommendation 4

The Environmental Protection Authority recommends that, where lands are affected by erosion, flooding or stock losses as a result of this project, remedial measures should be undertaken and appropriate compensatory arrangements should be made with affected leaseholders or landowners (as the case may be), to the satisfaction of the Minister for the Environment.

6.9.3. Borrow pits

The Environmental Protection Authority considers that the proponent's ERMP generally dealt with the management of borrow pits in a satisfactory manner. Although the locations of the borrow pits for limestone were not specified, the commitment by Gulf to make safe, fence off, cover with topsoil and re-seed quarry sites with local species demonstrated a proper concern for the sensitivity of these areas. Further commitments sought in submissions, that the proponent would rehabilitate the pits as soon as no longer required (rather than at the completion of construction) and that the pits should be recontoured, ripped and battered as necessary, were agreed to by Gulf.

Recommendation 19

The Environmental Protection Authority recommends that borrow pits be left in a safe, stable and rehabilitated condition as soon as possible after use, with walls battered and topsoil respread so as to encourage revegetation. At least six months before the end of the life of the project, the proponent should prepare and subsequently implement a plan for rehabilitation addressing the entire project area, to the satisfaction of the Environmental Protection Authority. In the event of the project being placed on a care and maintenance basis it is recommended that a plan to ensure that adverse environmental changes will be detected and managed to the satisfaction of the Environmental Protection Authority should be prepared and submitted to the Environmental Protection Authority at least three months prior to shutdown.

6.9.4. Brine flies

Brine flies can be dangerous to humans. Locally there are two species which look very similar. Bites in the eyes from one species may result in acute allergic reactions for which hospital treatment is necessary. The flies breed in saline waters two or three times during the summer season, and exist in the larval phase over winter. Their habitats are waters with a broad salinity range but they are most prevalent in salinities of 70 to 140 parts per thousand, because their natural predators cannot tolerate these higher salinities. This corresponds at Onslow to Ponds 3 and 4 (see Figure 1), which are the most distant ponds (a minimum of 8km) from Onslow, far enough away to ensure that the flies would not be a nuisance in town.

6.10. Social

6.10.1 General discussion of social impacts

Community acceptance of the salt project depends to a significant degree on the suitable siting and operation of the project's trestleway, conveyor, salt stockpiles and washplant. From the time the proposal was first discussed, the community indicated as a whole that it would prefer a site on the other side of Beadon Creek which would have placed the project much further from residential uses than the currently proposed site and closer to existing industrial users. However, the proponent has shown that there is no site east of Beadon Creek which would be viable. Concerns about the proposed site include the potential disruption of nearby residents due to noise, dust and visual impacts, loss of community access to Back Beach, and impact on the character of the town of Onslow.

Noise impacts to residents were dealt with in Section 6.4. The proponent is aware of the many submissions which referred to the loss of amenity of Back Beach and has designed the trestleway and conveyor system to allow continued access.

Recommendation 16

The Environmental Protection Authority recommends that the proponent should ensure through proper design of the trestleway that the existing level of public access to Back Beach is not restricted, and endorses the proponent's commitment to provide public access to the trestleway.

The salt proposal has the potential to positively impact on the social and economic well-being of Onslow. There is no doubt that the direct and indirect job opportunities generated and the new families brought to Onslow by the project would add economic and social vitality to the community and help reduce the community's dependence on Government support.

This is not to imply that the salt project would solve all the welfare problems of Onslow. For some in Onslow their current lifestyle, which stems in part from the lack of an economic base, suits them very well. There has been some concern expressed that the project with its introduction of well paid workers to Onslow would lead to a further marginalisation of some sectors of the community. It is hoped that this situation will be minimised through the generation of local employment opportunities. Yet some who are presently disadvantaged will choose not or will not be in a position to take advantage of these opportunities. The extent to which social marginalisation will be a problem is very difficult to predict. It is a situation that warrants monitoring by relevant government agencies. Appropriate responses can then be initiated, if necessary, to ensure that any cost in terms of marginalisation does not outweigh the significant opportunities the project offers to the community in terms of jobs and in the longer term upgrading of local facilities and services which could positively impact those currently socially or economically disadvantaged.

For those who desire a change the salt project can bring opportunities. The proponent has been liaising with both State and Commonwealth employment and training agencies to develop programmes to assist the local community to take advantage of employment opportunities generated by the project.

At this point in time it is difficult to assess the exact impact the added population would have on existing facilities and services in the community. The size of the new population would depend on the number of local residents who gain positions on the project. An added population of say 250 people could very well provide some justification for upgrading services and facilities. Although some existing facilities such as the local school appear physically capable of handling the likely increase in enrolment, additional resources could be required (eg teachers). There will be a need for the proponent and Shire to liaise with relevant government agencies such as the Education Department to ensure that existing facilities and services are not unduly stressed by the added population and that the town is able to take advantage of any opportunities the new population may create in terms of justification for upgrading services and facilities.

6.10.2 Local employment opportunities

One of the most significant potential benefits to the existing Onslow population is the creation of local employment opportunities. The State Department of Employment and Training considers it not unrealistic to expect that 25% of the workforce potentially could be recruited from the local population. However, if such levels are to be realised it is essential that the local community be able to access these opportunities and be given every opportunity to acquire the necessary skills to gain employment during both the construction and operations phases of the project.

The Environmental Protection Authority supports the proponent's commitment to employ, in conjunction with the Federal Department of Education, Employment and Training, a person to liaise with the local Aboriginal community in the establishment of an Aboriginal employment action plan.

The Environmental Protection Authority supports the proponent's commitment to being an equal opportunity employer as well as the commitment to give employment preference to existing Onslow residents. The Authority supports the proponent's commitments to establish at least two ongoing training positions for unskilled workers; specific employment training strategies for the local community; and the provision of opportunities for training courses in conjunction with the Department of Employment and Training.

If the local community is to reap the maximum employment benefits of the project these commitments must apply to the construction phase of the project as well as the operations phase. The proponent is encouraged to continue liaising with Department of Education, Employment and Training and Department of Employment and Training to ensure that Onslow residents have the best chance possible to attain employment during all phases of the project.

Recommendation 18

The Environmental Protection Authority supports the proponent's commitment to ongoing community consultation and recommends that formal liaison and monitoring processes be established by the proponent to the satisfaction of the Environmental Protection Authority, upon advice from the Social Impact Unit, to monitor, review and manage the social impact of the project throughout its life. The Environmental Protection Authority further recommends that reporting on this liaison, monitoring and management of the social impacts should be required as part of the proponent's monitoring reports to the Environmental Protection Authority.

Recommendation 20

The Environmental Protection Authority recommends that, prior to the start of construction of each phase of the proposal, the proponent prepares, submits and subsequently implements an Environmental Management Programme (EMP) that addresses, where appropriate, the monitoring, management and auditing and reporting requirements for community consultation, monitoring and liaison, to the satisfaction of the Environmental Protection Authority.

7. Discussion and conclusion

The people of Onslow are strongly polarised over this proposal. Many live there because the quiet life appeals, and are against a proposal which would have such an obvious effect on their community. Some people are keen to see the industry established provided that the processing facilities are moved considerably further from town than is currently proposed, so as to minimise the impacts from noise and salt dust to town. Gulf has said that moving these any further from the jetty is not feasible and that, in changing from Option 1 to Option 2 (Fig 2) they have recognised and dealt with the noise issue.

Solar salt industries have the advantage from an environmental viewpoint of being sustainable and relatively non-polluting. However, the ponds would cover a large area of land and have the potential to significantly impact the environment if not designed and managed appropriately.

This proposal would offer long term employment to about 40 people and could assist in attracting better services to Onslow and making it more independently based. Onslow presently has few money-generating activities, these being mainly prawn trawling and low key tourism, based on fishing. The ERMP and submissions highlighted the potential benefits of the proposed jetty, leading as it would to deeper water and offering access to other shipping traffic and people wishing to fish off it.

The salt proposal could further marginalise the Aboriginal population of Onslow. However the company has committed to establishing an Aboriginal Employment Action Plan and to creating employment training strategies which should minimise this tendency.

The issue of most concern to those who live on the west side of Onslow is that of the noise from the processing and loading facilities. Noise would be created mainly by the dozers used to move the stockpiles of salt and from the loading operation which requires a 2 km conveyor to take the salt from the stockpile to the head of the jetty. Daytime loading is not expected to cause a nuisance but the exercise is expected to take up to 24 hours to complete per ship, at an average frequency of one a week. Night-time activities under certain weather conditions, unless carefully managed, may cause unacceptable noise levels to some residents because ambient conditions are so quiet.

Beadon Creek is highly regarded by the locals, both as a fishing and swimming venue, and for its safe harbour. It is the largest creek in the area and, together with the others, is thought to be responsible for providing the nursery habitat for prawns and fish. Its future is difficult to predict in the longer term as a result of reducing its catchment area and pumping seawater from it into the ponds, but it is likely that it would change to some degree in response to loss of nutrients from inland and from the drawdown caused by the pumping unless an effective monitoring and management plan is put in place by Gulf.

Finally some consideration must be given to the scenario when the operation is shut down, temporarily or permanently.

The proposed management of some of these issues in the proponent's ERMP gave cause for concerns about how some potential impacts were to be minimised or avoided. Because of the incremental impacts of a number of existing and proposed coastal developments in the Pilbara region the Environmental Protection Authority asked for a regional literature study of the distribution and characteristics of mangroves in the Pilbara area so that the possible impacts to those of the Onslow area could be put into context.

As a result of this review the Environmental Protection Authority determined that there should be no permitted significant direct or indirect impacts arising from the project which could threaten the viability of the mangrove / algal mat systems.

Representatives of the company were made aware of this requirement and ways of preventing impacts have been discussed. The Environmental Protection Authority sought and has received from Gulf more specific commitments on those issues (see Appendix 1) and is satisfied that this requirement can be met, provided that the commitments and recommendations in this report are upheld.

There is that portion of the Onslow community which treasures its sleepy nature and would not welcome a major new development of any type. With the implementation of an appropriate impact management programme, the degree of social impact these people would experience would be reduced but not eliminated fully.

However, for many of Onslow's residents the project represents an opportunity for Onslow. They would welcome the new job opportunities, the economic spin-offs and potential for upgrading facilities that the added population could bring. Yet they too are not prepared to accept the project, despite its potential social benefits, if their quality of life were to be seriously eroded by the operational effects of the salt facilities. **This highlights the need for a high level of commitment on the part of the proponent to monitor and manage the operational effects of the salt facilities.**

On this basis the Environmental Protection Authority concludes that the proposal is environmentally acceptable.

In coming to this conclusion the Environmental Protection Authority wishes to emphasise that it refers only to Stage 1 of the proposal which is the subject of the proponent's ERMP, and that this

assessment assumes, on advice from the proponent, that Stage 1 is able to stand independently of any expansion proposals which may be referred in the future to the Environmental Protection Authority. The Authority also requires that any such proposals be referred to the Authority for separate assessment.

The Authority considers that during the detailed implementation of proposals, it is often necessary or desirable to make minor and non-substantial changes to the designs and specifications which have been examined as part of the Authority's assessment. The Authority believes that subsequent statutory approvals for this proposal could make provision for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

8. References

1. Extracts from unpublished notes provided to the EPA by the Department of State Development
2. Ecological significance of Blue-green Algal Mats in the Dampier Mangrove Ecosystem. Department of Conservation and Environment Technical Series 2, May 1986
3. Conservation Reserves for Western Australia, as recommended by the Environmental Protection Authority. Systems 4,8,9,10,11,12, (1975)
4. Mangroves and Mangrove Birds of Western Australia. R E Johnstone, in: Records of the Western Australian Museum Supplement No32, 1990
5. Webb M & A :Edge of Empire, 1983

Appendix 1

Proponent's commitments

Extract
From Proponent's ERMP

SECTION 10 - SUMMARY OF COMMITMENTS

The following is a summary of commitments made by the Proponent:

Dust Dust will be suppressed in areas likely to affect residents.
(Section 8.3.1.1).

Noise Noise will be maintained at or below statutory levels for
residential areas through construction of bunds, work
practice and design of machines. Noise will be monitored
in the early stages of operation and if unacceptable levels
are detected, the Proponent will take action to reduce
emissions to acceptable levels. (Section 8.3.1.2, Section
8.3.2.1).

Dredging Dredging will be carried out as far as possible during
winter to reduce the impact of suspended sediment (Section
8.3.1.3). The plume will be monitored and if it drifts onto
Wards Reef, disposal will be moved to another area.

Disturbance
to
Countryside A condition of the Construction Contract will specify
that personnel are to keep to designated tracks and to
extract material only from selected sites to reduce the
impact of vehicles and quarrying on the countryside.
(Section 8.3.1.4).

Social
Impact Noise and dust emissions will be managed and movement of
vehicles on local roads will be minimised. (Section
8.3.1.5).

A part-time community worker will be engaged to assist the
new workforce integrate with locals. (Section 8.3.1.5).

Aboriginal

Sites Consultation with local Aboriginal people will be ongoing during construction near known sites. (Section 8.3.1.6).

Water Supply The Proponent will, subject to agreement, contribute towards the cost of upgrading the water supply main in conjunction with WAWA. (Section 3.2.10.2).

Light Light emissions will be managed through design so as to have minimal impact on Back Beach and the adjacent residential area. (Section 8.3.2.2).

Bunds,
Seawalls,
Dredged
Channel

All structures and machinery will be maintained to a high standard. (Section 8.3.2.3).

Bitterns Bitterns will be discharged in a controlled manner into Middle Creek during average and above tides. Monitoring will assist in determining the volume capable of being discharged without significant impact on the creek system. (Section 8.3.2.4).

Rehabilitation

All quarry sites will be made safe and rehabilitated apart from those required for maintenance. (Section 8.3.2.5).

Tree Planting A tree planting programme will be initiated for the areas affected by the Project, including the new subdivision. If the Bindi Bindi community wishes to supply and maintain the trees they will be contracted to do so. (Section 8.3.2.6).

Access

In conjunction with W.A.W.A., an all weather controlled access road will be maintained along the pipeline which will be dependent on the resolution of public liability, insurance, security, ongoing maintenance and operational matters. All access to bunds and sea walls will be fenced off (Section 8.3.2.7).

Fuel Storage

& Conveyance Fuel will be stored and conveyed according to standard regulations. A tug/workboat with boom and skimmer and line boat permanently stationed at Onslow will be equipped to deal with marine spills. (Section 8.3.2.8).

Employment &

Training

(Section

7.4.2.10)

The Proponent will:

- 1) employ a person, in conjunction with DEET, to liaise with the Aboriginal community to establish an Aboriginal Employment Action Plan;
- 2) create specific employment training strategies for the local community and provide opportunities for training courses in conjunction with DET. (NB. DET has committed itself to providing a community based resource person to liaise with the person in 1) above);
- 3) make provision to train at least two unskilled workers in specific skills and tasks and provide for formal industrial training.

Monitoring

The monitoring programme described in Appendix 3 and Section 8.4 will be initiated and maintained. In summary the following will be monitored:

- a) Dust and suspended sediment during construction and operation,
- b) Noise during construction and operation,
- c) Bunds, seawalls and dredged channel,
- d) Bitterns discharge,
- e) Impact on mangroves and Wards Reef,
- f) Rehabilitation and tree planting programme,
- g) General access to the coast,
- h) Floodwaters across the highway.

This biological work will be carried out under the supervision of a contract biologist with experience in this field. The details of the monitoring programme, designed to

clarify the impacts of bunding and ponding on the biological communities, will be finalised on site in conjunction with officers of the EPA once the Project receives the go-ahead.

Contributions to Onslow (Section 2.6.1 vi) a)-f)).

The following projects, to which a financial contribution may be made, have been suggested by the Proponent as being possible subject to resolutions of public liability, insurance, security, ongoing maintenance and operational matters:

- a) the provision of controlled access to a jetty fishing platform, look-out points and some embankments;
- b) the construction of a sealed walkway/cycleway around Beadon Point connecting the town to the jetty;
- c) the upgrading of facilities at Back Beach providing landscaped carparking, barbecues and sun shelters;
- d) the assistance in developing the Workers Club;
- e) the establishment of a second caravan park probably at the Wapet Camp Site to be used by the Proponent during construction. Once the construction workforce leaves the site, the park would be open to the public.
- f) the establishment and maintenance of a tree planting programme in the whole area in conjunction with the Shire.

The Proponent also notes the recommendation in Appendix 3 and accordingly the ponds will be stocked with a native artemia such as Parartemia (brine shrimp).

27th November 1990 - (Revised 11th December 1990)

The Director
Environmental Protection Authority
BP House
1 Mount Street
PERTH WA 6000

Attention: Messrs R Sippe and D Betts

Dear Sir,

ONslow SALT PROJECT ERMP

Further to our meeting on November 23rd we hereby provide the further specific assurances on the matters requested.

Prior to the commencement of any site works it is Gulf's intention to prepare a record of the current physical and biological environment by means of landsat images, aerial photographs, videos, still colour photographs, site surveys, soil samples, levels and the like as considered appropriate by the Company. These records will serve as a reference to claims made of any damage which has resulted from works carried out by the Company.

1. **Flooding and Erosion**

(a) **Road Access**

(i) Main Road

The Company undertakes to maintain reasonable access to Onslow such that the flood access on the causeway at Point D will not cause additional restriction to highway access beyond that caused by the existing creek crossings on the main road at Points E and F further inland.

(ii) Urala, Peedamulla Roads

The Company believes its works will have no impact on these gravel roads which are closed in flood time for a considerable number of days. However, the Company undertakes that it will reasonably do such things as are necessary to ameliorate or eliminate any impact that has been caused as a result of the project.

(b) Pastoral

If as a result of the Company's works floodwaters backup in natural creeks and cause loss of pasture, stock, fences or other damage to pastoral property outside the Company's leases, the Company will discharge its legal obligations to compensate the pastoral leaseholder for the loss incurred.

(c) Erosion

If detrimental scouring occurs in creek beds, creek walls or the salt flats or along the edges of islands as a direct result of the Company's works, the Company will repair and/or stabilise such erosion by stonepitching, regrading or redesign as appropriate to the reasonable satisfaction of the Minister for the Environment.

(d) Racetrack

The Company commits to monitoring the situation in the area of the existing Onslow racetrack to determine if its works are increasing the incidence of flooding. If this can be proved the Company undertakes to carry out such remedial works as may be reasonably necessary eg. a bund around the racetrack.

(e) Indigenous Animals

The Company has committed to carrying out a flora and fauna survey of the islands before work commences.

If isolated islands within the ponds become over populated or fauna is endangered as a result of the Company's works the Company will undertake a study by experts of the situation to determine which animals can survive under the new conditions and which animals will need to be removed by the Company to the mainland or larger islands and put into effect remedial management practices.

2. Beadon Creek

The Company has initiated a monitoring programme in the Beadon Creek catchment. If damage is occurring to mangroves as a result of the Company's works, the Company undertakes to carry out a study by experts to determine the nature of the problem and its possible remedies eg.

- (a) restriction of pumping at high tide;
- (b) irrigate creek headwaters with seawater from the creek or the first evaporation pond to promote mangrove growth;
- (c) propagate mangroves in irrigated areas.

The Company undertakes to carry out the most appropriate remedy to the extent reasonably necessary.

3. Dredge Spoil

(a) Construction

The Company is committed to monitoring the dredging operation with the aim of minimising the impact on environmentally sensitive areas and the adjacent trawling grounds including the spoil banks and mouth of Beadon Creek.

Specifications will provide for spoil to be kept within the designated areas and heights stated in the ERMP and kept reasonably level. The project supervisors and dredge master will be educated on the importance and relevance of the specifications.

(b) Restricting Mouth of Beadon Creek

The mouth of Beadon is subject to siltation as a result of normal littoral processes and the groyne.

The spoil banks will be monitored to determine whether material is drifting towards the shore or the channel.

If material from the spoil banks is contributing to siltation at the mouth of Beadon Creek then the Company will:

- remove such accumulation due to its works;
- take reasonable steps to prevent such accumulation from recurring.

4. Noise

In reference to Point 2 of our letter of November 13th the Company agrees that noise levels will be monitored continuously for a period of 12 months whereupon the need will be reviewed and continued if necessary as agreed with the EPA.

If the management procedures outlined for noise control meet statutory requirements but do not meet community expectations, the Company will consider in conjunction with the EPA the possibility of specific works such as local bunds, walls or double glazing to satisfy affected residents who are proven to suffer injurious affect.

If monitoring indicates noise levels are exceeding statutory criteria during ship loading at night due to exceptional meteorological conditions, and it is reasonably practical to do so, the Company will cease ship loading until weather conditions change sufficiently to enable operations to be carried out without exceeding those statutory limits.

If noise levels do not exceed statutory criteria but are the source of a continuing nuisance to Onslow residents. The Company will consul with the EPA and the Shire of Onslow and thereafter take such measures to ameliorate the continuing nuisance as the Company, the EPA and the Shire consider reasonable.

5. **Impact of Shipping**

The Company confirms its undertaking in the ERMP to construct all fuel facilities with the most up to-date protection measures. In addition:

- (a) an oil spill contingency plan consistent with the then current industry standards will be in place together with all such equipment needed before any commercial shipping is allowed to use the Company's jetty;
- (b) a ballast plan consistent with the then current industry standards also be in place before any salt carrying ships are allowed to use the Company's jetty.

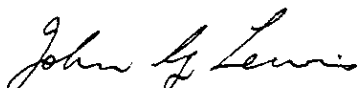
6. **Access to Jetty**

The Company confirms its undertaking in the ERMP that the public may use the jetty at their own risk from 6.00 am to 10.00 pm whenever the jetty is not required for reasonable operational purposes.

The Company in conjunction with the Shire will maintain third party insurance for use of the jetty and assist in maintaining Local Authority by laws on and near the jetty. If the public consistently abuse the privilege offered or damage the Company's property, the rights of access will be restricted or with drawn.

We trust these specific assurances cover the situation. If any changes or additions are required we will be pleased to assist.

Yours faithfully,
GULF HOLDINGS PTY LTD



JOHN G LEWIS
DIRECTOR

GULF HOLDINGS PTY LTD

Level 1 379 Murray Street
West Perth 6005
Western Australia 6005
Phone: (09) 322 4097
Fax: (09) 481 1165

13th November 1990 - (Revised 11th ^{December} November 1990)

The Director
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Attention: Mr Doug Betts

Dear Sir,

MANAGEMENT OF NOISE

Following our meeting yesterday regarding noise we write to confirm the following:

1. Gulf made a commitment in the ERMP (page 127) "..... noise will be maintained to acceptable levels". Gulf now further agrees that acceptable shall include acceptable to the EPA provided such judgement is not outside normal industry and residential standards.
2. It is also agreed that noise levels will be monitored continuously by an automatic recorder near Clarke Place during the early stages of full scale operation to ensure that the acceptable standards and predictions are being met. The recordings will be displayed in the Supervisor's office for his attention if needed. (Section 8.4.3)

Continuous monitoring shall be for a period of 12 months whereupon the need will be reviewed and continued if necessary as agreed with the EPA.

3. If a problem arises due to an item of fixed plant then such equipment will be serviced, repaired, insulated or withdrawn as necessary. Insulation includes building and modification of bunds (Section 7.2.7.1). Such rectification shall be to the satisfaction of the EPA and other statutory authorities.
4. If a problem arises due to an item of mobile plant then such equipment will cease operation until it is suitably muffled or new work practice developed as necessary. Such rectification shall be to the satisfaction of the EPA and other statutory government authorities.
5. Gulf undertakes to use rubber tyred rather than tracked machines wherever reasonably practicable especially for trimming the stockpiles.

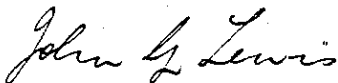
Cont.../2

6. No tracked machines will be allowed to operate on top of the stockpiles between the hours of 9.00 pm and 6.00 am unless it can be demonstrated that noise from these operations does not exceed statutory or acceptable levels.
7. Gulf confirms that the washplant and haul trucks will operate on a single daylight shift in the first few years. Before operating the washplant, haul trucks and stockpiling at night, an appropriate submission complete with tests, noise predictions, work practice and management strategy will be made to the EPA.
8. If monitoring indicates noise levels are exceeding the EPA's statutory criteria during shiploading at night due to exceptional meteorological conditions and it is reasonably practical to do so, the Company will cease shiploading until weather conditions change sufficiently to enable operations to be carried out without exceeding those statutory criteria.
9. If noise levels do not exceed statutory criteria but are the source of a continuing nuisance to Onslow residents, the Company will consult with the EPA and the Shire of Onslow and thereafter take such measures to ameliorate the continuing nuisance as the Company, the EPA and the Shire of Onslow consider the reasonable.

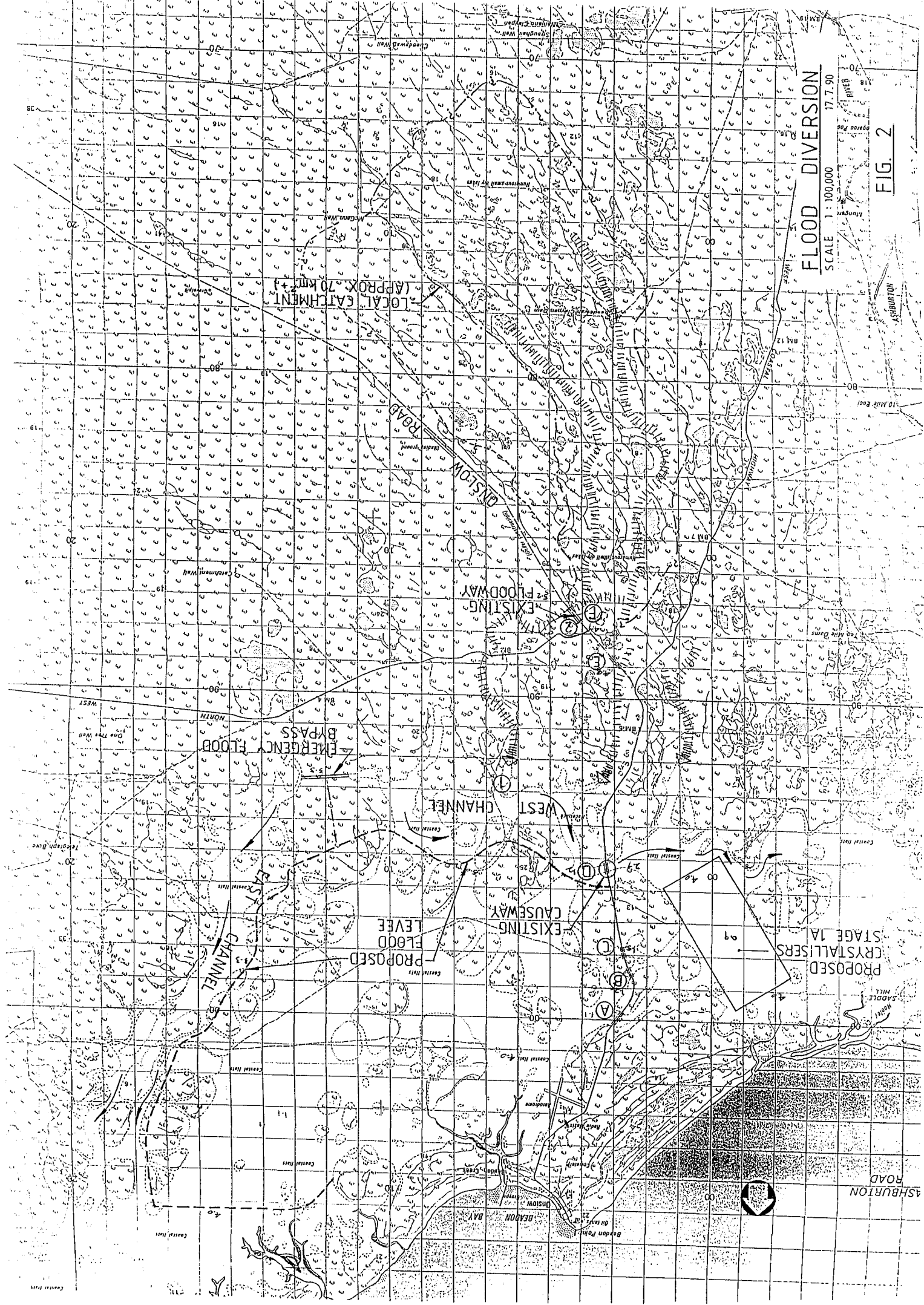
The Company will consider in conjunction with the EPA the possibility of specific works such as local bunds, walls or double glazing to satisfy affected residents who are proven to suffer injurious affect.

We trust that these commitments will clarify what we had in mind. If any additions or amendments are required please advise.

Yours sincerely,
GULF HOLDINGS PTY LTD



JOHN LEWIS
DIRECTOR



FLOOD DIVERSION
 SCALE 1 : 100,000
 17.7.90

FIG. 2

ATTACHMENT 3

EXPLANATORY NOTES ON CYCLONE SURGE

To hydraulic engineers what we have said in the ERMP is part of their training and axiomatic. However, we can see that various Respondents still have concerns and fears that the building of seawalls for the saltfield will cause higher surges in Beadon Creek. We now attempt to give a further explanation in semi lay terms.

Cyclone surge at Onslow is due to barometric pressure drop and wind driven forces in about equal proportions. The order of surges is about 0.5 m at 15 year frequency up to perhaps 1.5 m at 100 year frequency i.e. about half the spring tidal range in general terms.

At maximum surge height the current due to the barometric component must be very small being near the centre of the cyclone. The current at that time is mostly due to wind friction on the water surface over the previous few hours.

The duration of an intense cyclone surge is normally several hours, i.e. about one quarter of the tidal cycle, and the resulting high sea level depends on whether the surge occurs in a spring tide cycle and if it does, whether it coincides with high tide.

The movement of a cyclone surge is therefore like a tide and not a tidal wave. The surge currents at sea approaching the coast depend on the direction of travel of the cyclone and consequent direction of the wind. These surge currents towards the coast will be at right angles to the tide which is roughly parallel to the coast in the Onslow area. Therefore tide and surge velocities are not cumulative in this area.

The incoming velocity of the surge component of the water mass at right angles to the shore at Onslow during a high cyclonic surge is not more than 0.2 m/sec. This can be simply checked by calculating the volume change due to the surge at high water and dividing by the depth at various distances offshore which gives incoming velocities of the order 0.10 - 0.15 m/sec.

With these velocities it is a simple calculation to show that the conversion of kinetic energy of the water mass to static rise in seawater level is less than 1 cm. This would be the case if a dam were built across the entry to Beadon Creek for example, i.e. if Beadon Creek did not exist the surge levels off Onslow would not be changed. Conversely the amount of surge or tidal water flowing into Beadon Creek and out over the saltflats is so small compared to the volume change in the open sea, that the presence of Beadon Creek does not materially reduce oceanic surge levels.

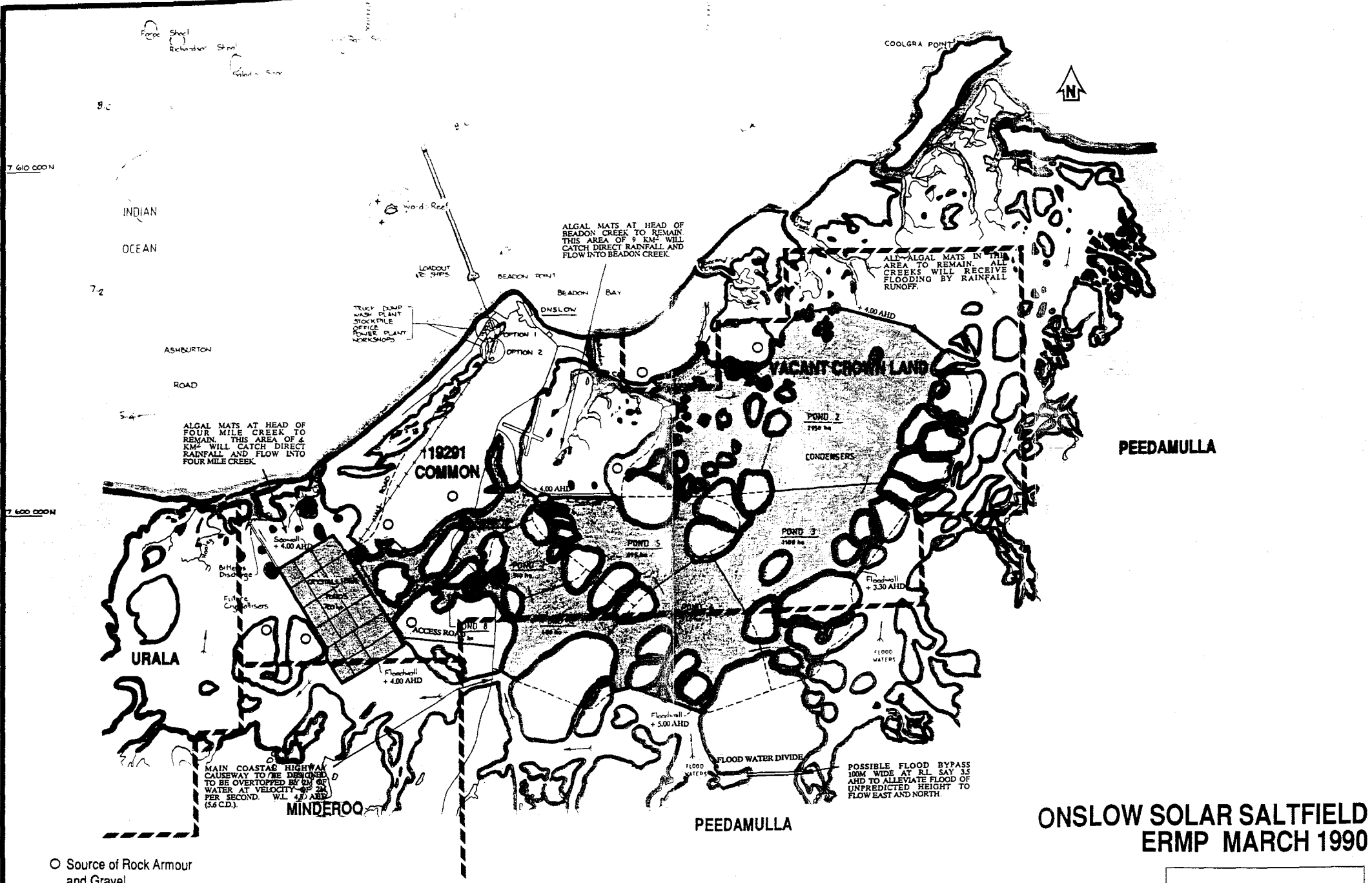
Within Beadon Creek or any local creek, velocities are governed by the rate at which water can enter or egress through the restricted creek entry and the shape of the water surface in the creek and eventually out over the supratidal flats. The geometry of some inlets from the sea makes them convergent with higher tides/or surges than in the open sea and some inlets are divergent with lower tides or surges than the open sea. The open water in Beadon Creek Harbour is neutral as the tidal ranges are very similar to the open sea ranges on the old jetty.

The velocity of flow of shallow surge water across the supratidal flats is low and largely a function of wind as can be seen in the salt ponds themselves. The constraint of pond walls causes local changes in water surface slope and level. With a northerly wind there would be a minor build-up in level against the condenser seawall. Any such build-up on the Onslow side of Beadon Creek requires an easterly wind in which case the project seawalls would improve the position, and the open sea surge will have had no wind component.

The concern of some people could be related to the well-documented tidal and cyclonic surges at the head of Exmouth Gulf. This is a classic example of a large inlet having unrestricted entry from the sea (not like Onslow creeks) and convergence both laterally and by shallowing sea bed.

Another concern could be confusion of cyclone surge with the devastating effects of tidal waves. These are in no way related as tidal waves are solitary real waves of great volume generated by earthquakes. They travel at great speed across oceans and are subject to quite different mathematics from tides and cyclonic surges.

One of the writers has had occasion on a recent overseas trip to review studies of the effect on tides of building tidal power barrages across very convergent estuaries with extreme tidal ranges. There would be no build up in tidal ranges at the Severn, Mersey (U.K.) and St. Malo (France) proposals and a minor build up of a fraction of a metre in the Bay of Fundy (Canada, U.S.). In these cases the tidal ranges are of the order 10 m at spring tide and resonance time of the basins (like water in a bath) was important.



○ Source of Rock Armour and Gravel.

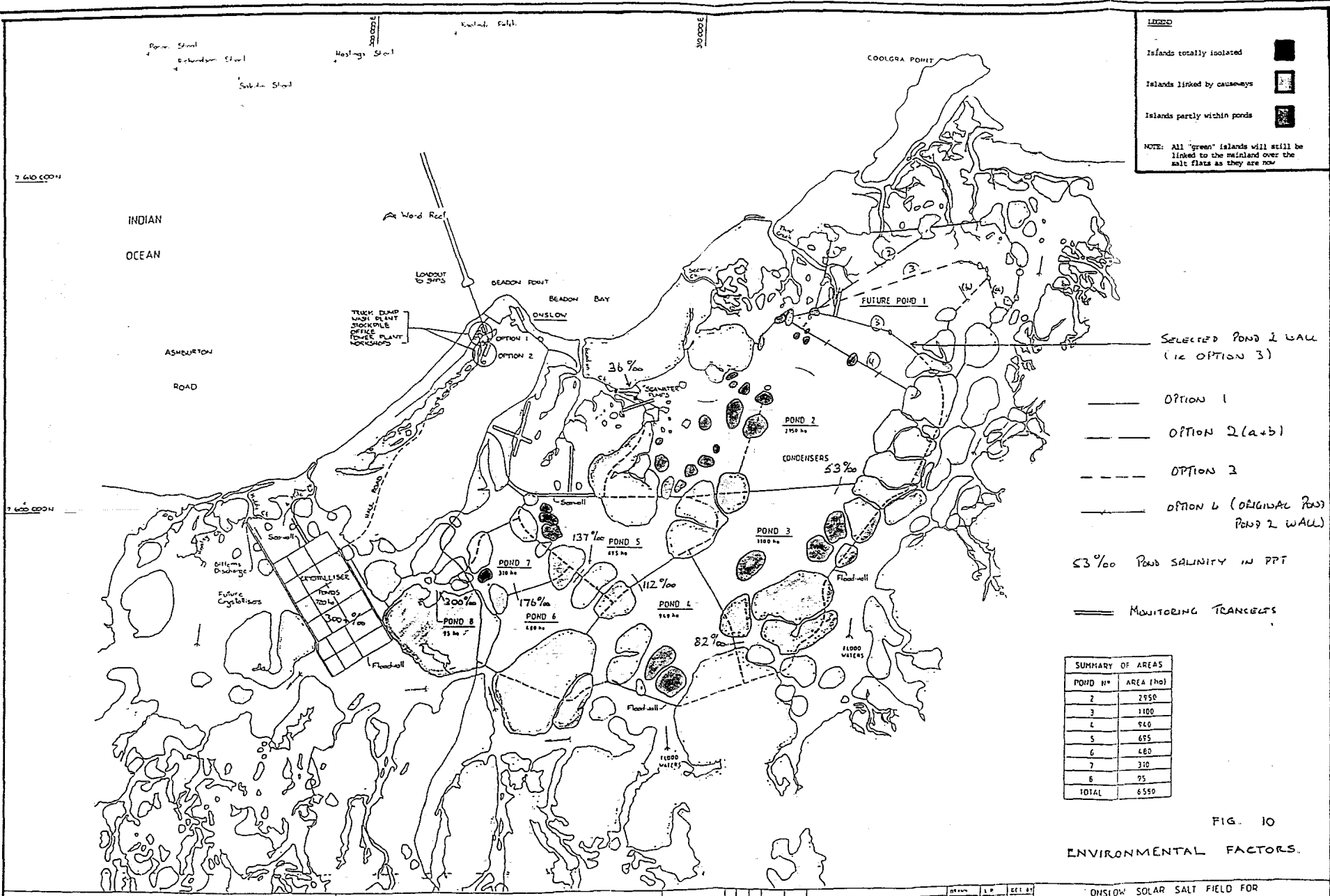
**ONslow SOLAR SALTFIELD
ERMP MARCH 1990**

**GULF HOLDINGS
PTY. LTD.**

LEGEND

- Islands totally isolated
- Islands linked by causeways
- Islands partly within ponds

NOTE: All "green" islands will still be linked to the mainland over the salt flats as they are now



- Selected POND 2 WALL (ie OPTION 3)
- Option 1
 - Option 2 (a+b)
 - Option 3
 - Option 4 (ORIGINAL POND POND 2 WALL)
- 53‰ Pond SALINITY IN PPT
- Monitoring TRANCECTS

SUMMARY OF AREAS	
POND N°	AREA (ha)
2	2950
3	1100
4	960
5	695
6	480
7	310
8	95
TOTAL	6550

FIG. 10
ENVIRONMENTAL FACTORS.

MANAGEMENT CONTRACTOR
TAYLOR WOODROW INTERNATIONAL

CONSULTANT
SAGAMORE PTY. LTD.
SALT INDUSTRY CONSULTANTS

DATE	BY	REVISED

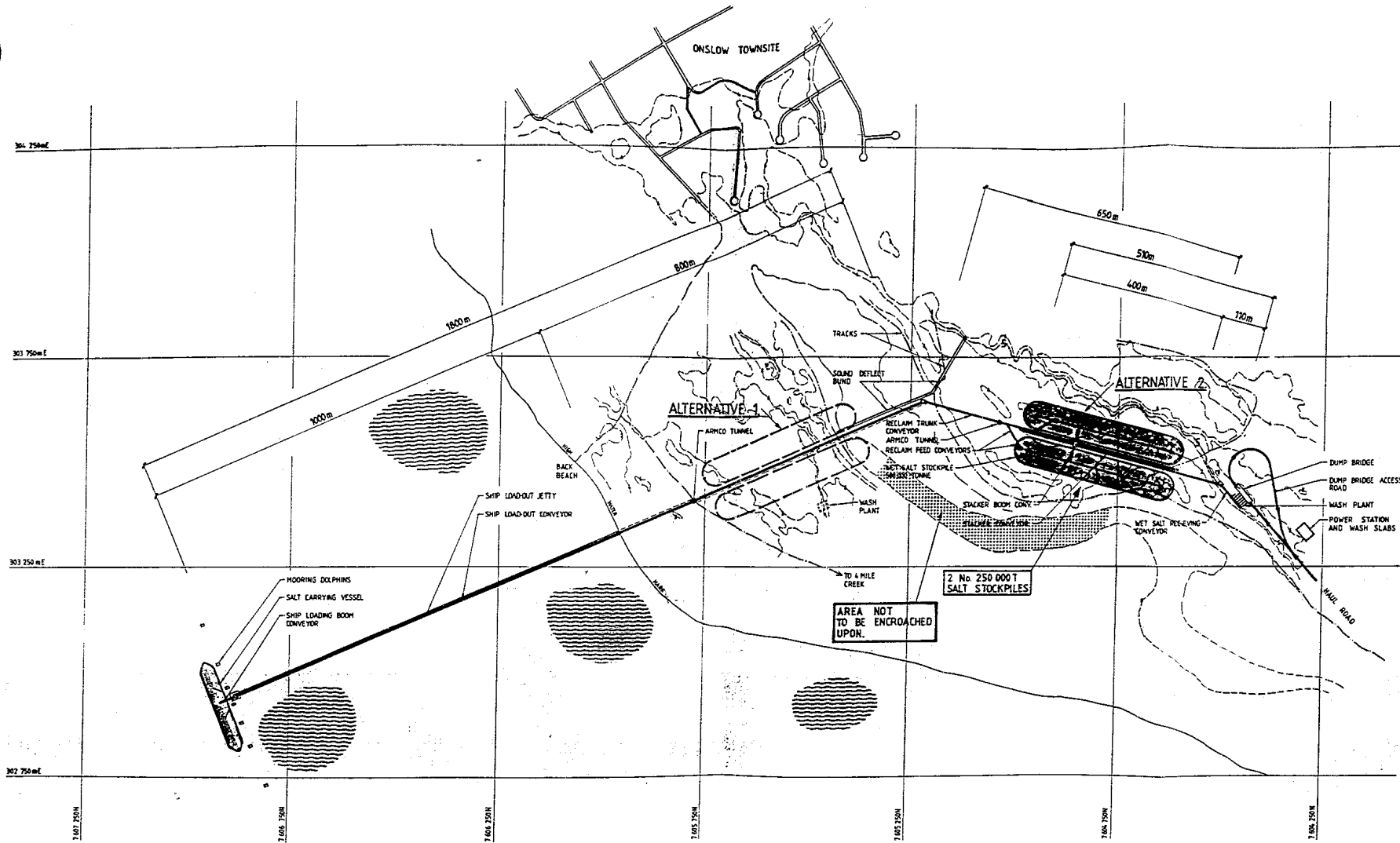
DESIGN
ENGINEER
DESIGNED
DESIGN
ENGINEER

DATE
A.P.
R.P.
OCT 87

PROJECT
ONSLOW SOLAR SALT FIELD FOR GULF HOLDINGS PTY LTD

GENERAL ADMINISTRATION

DATE 1.10.88



PLAN



NO.	DATE	REVISION	BY	APP'D
27-9		ALTERNATIVE 1, WASH PLANT AND WOODGILL NOTE ADDED		

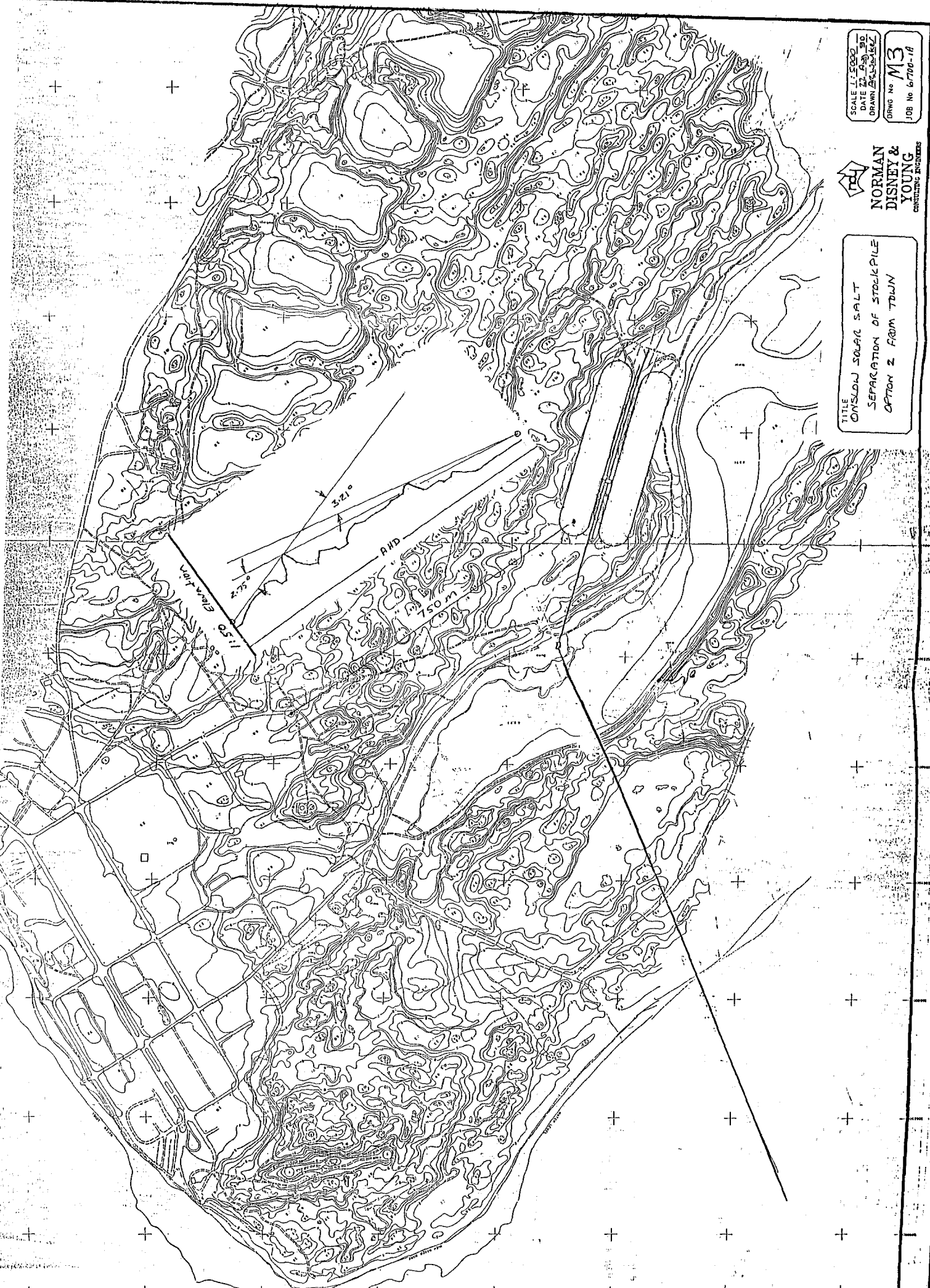
CLIENT
GULF HOLDINGS PTY LTD

Halpern Glick Maunsell
 CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS
 1 ORO STREET, WEST PERTH 6005
 Ph. (09) 321 4844 Fax. (09) 324 1079
 11 PRINSEP STREET BUNBURY 6230
 Ph. (09) 219876 Fax. (09) 219811
 19 DURLACHER STREET, GERALDTON 6530
 Ph. (09) 218289 Fax. (09) 217285
 MEMBER OF THE ASSOCIATION OF CONSULTING ENGINEERS AUSTRALIA

DESIGN: JG
 DRAWN: DS
 CHECKED:
 APPROVED:

PROJECT: **ONSLow SOLAR SALT**
 TITLE: **MECHANICAL PLANT PLAN GENERAL ARRANGEMENT**
 SURVEY INFORMATION: DATUM AHD

DRAWING No. **40-10-001**
M8701/001
 SCALE: 1:500
 DATE: _____
 REV: **A**



SCALE 1:5000
DATE 22.12.90
DRAWN 22.12.90
ORIG No M3
JOB No 6700-10


NORMAN
DISNEY &
YOUNG
CONSULTING ENGINEERS

TITLE
OWNSLOW SOLAR SALT
SEPARATION OF STOCKPILE
OPTION 2 FROM TOWN

Appendix 2

Proponent's responses to public submissions



GULF HOLDINGS PTY LTD.

Level 2/679 Murray Street
West Perth 6005
Western Australia 6005

Phone: (09) 322 4097
Fax: (09) 321 1491

JGL:VJN

30 August 1990

The Director
Evaluation Division
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Dear Sir,

ONSLow SALT - ERMP
REPLY TO SUBMISSIONS TO EPA

In answer to your letters of July 13, 18 and 31, 1990 summarising submissions made to the EPA, we submit our replies herewith:

During the formal submission period public responses dealing with a range of points arose. In general these fall under the following headings as outlined by the E.P.A. in your letters.

1. Floodwater Studies and Control
2. Storm Surge Studies and Integrity of Pond Structures
3. Groundwater Regimes
4. Impact on Algal Mat Mangrove Creek Coastal Ecosystems and how they relate to Prawn and Fishing Industries
5. Noise Level Studies from Salt Processing Facilities and their Location
6. Baseline Flora and Fauna Surveys on Islands and Flats
7. Social Impact Issues
8. Aboriginal Issues.

The attached Response provides answers to questions and comments grouped into these major categories. In general each section is preceded by an explanatory section in which more up to date data than was available at the time of the E.R.M.P. is presented.

As you are aware this project was significantly modified as a result of advice from consultants and comments from the public and Government agencies during the Environmental Assessment Process - for instance:

1. The pond layout was modified so that:
 - (a) No mangrove communities apart from those at the pump station will be directly affected by the project;
 - (b) Floodwaters will have access to the majority of the tidal creeks.
2. Where possible, the ponds have been located on supratidal flats to avoid active algal mat communities.
3. The bitterns discharge has been modified to avoid creeks with significant mangrove communities and recreation values.
4. The alignment of the jetty and conveyor system has been changed in order to accommodate the wishes of the Aboriginal community as originally expressed.
5. The stockpile and washplant complex was relocated, at significant cost to the project, in order to minimise its impact on the local community.

As a result we believe the major environmental (including social) issues and the potential major impacts associated with this project were addressed in the E.R.M.P. and that the inevitable minor impacts of a project of this size are not significant.

This opinion is supported by the knowledge that the other salt producers have been operating in similar coastal environments for the past 20 years without a demonstrable significant impact on the surrounding environment which in one case, is far more sensitive and significant than that in Onslow (e.g. Shark Bay). It is our view that there is no reason why the Onslow Salt Project will have any more impact than these operating projects. In fact, it will have significantly less impact due to the modifications set out above.

It was interesting to us that the Government Departments generally did not have any serious problems with the project or its impacts.

Yours sincerely,



JOHN LEWIS

ONSLow SALT PROJECT - ERMP

REPLY TO SUBMISSIONS TO ENVIRONMENTAL PROTECTION AUTHORITY

TABLE OF COMMENTS

	Page
1. PHYSICAL	
1.1 Diversion of Floodwaters Around the Condenser and Crystalliser Ponds	1
1.2 Storm Surge Levels in Onslow	7
1.3 Ground Water	10
2 BIOLOGICAL EFFECTS	
2.1 Loss of Mangroves and Algal Mat	14
2.2 Discharge of Bitterns	18
2.3 Pumping from Beadon Creek	21
2.4 Change in Distribution of Bird Species	23
2.5 Environment/Species Inventory	23
2.6 Ships' Ballast Water	24
2.7 Monitoring Impacts	24
2.8 Prawn Fishery	27
3. SOCIAL IMPACTS	
3.1 Noise from Processing Activities	28
3.2 Impacts on Beadon Creek & Beaches	34
3.3 Access	35
3.4 Insect Problem	36
4. ENGINEERING IMPACTS	
4.1 Coastal Processes and Dredging	37
4.2 Jetties, Ships	39
4.3 Piles into Seabed	41
4.4 Processing Plant and Services	41
4.5 Miscellaneous	43
5. MANAGEMENT	45
6. VIABILITY OF PROPOSAL	48
7. SOCIAL IMPACT ISSUES	
7.1 Location of Stockpile & Washplant	48
7.2 Public Consultation Process	49
7.3 Housing of Gulf Workers During Operation Phase	50
7.4 Housing of Workers During Construction Phase	50
7.5 Public Access to Jetty	51
7.6 Impact of Jetty on Back Beach	51
7.7 Marginalisation of Aboriginal Community	52

7.8 Local Employment Opportunities	52
7.9 Impact on Tourism	53
7.10 Medical and Public Health Services	53
7.11 Truck Routes	54
7.12 Impact on Beadon Creek's Recreational & Commercial Uses	54
7.13 Aboriginal Sites	54
7.14 Jetty Ownership	55
7.15 Community Benefits	55
7.16 Flooding of Roads	55
7.17 Loss of Income for Fishermen	56
7.18 Miscellaneous	56
8. ABORIGINAL COMMUNITY	
8.1 Background Comments	58
8.2 Replies to Specific Comments Made	59

LIST OF ATTACHMENTS

1. Biological Report by Dr. P. van der Moezel and Mr. E. Paling
2. Diversion of Floodwaters by Halpern Glick Maunsell
3. Notes on Cyclone Surge by Mr. J. G. Lewis

PLANS

1. Onslow Salt Field ERMP March 1990 (notes related to algal mats and floods added)
2. Onslow Salt Field Showing Island Accessibility for Fauna
3. General Arrangement showing Relocated Stockpile
4. Noise Attenuation Plan

RESPONSE TO SUBMISSIONS

1. **PHYSICAL**

1.1 DIVERSION OF FLOODWATERS AROUND THE CONDENSER AND CRYSTALLISER PONDS

1.1.1 General

The attached plan shows in greater detail than presented in the E.R.M.P. the catchment areas for creeks and floodways extending some 30 km south of Onslow and inland of the proposed salt field. Further calculations have been made and the area has been flown by helicopter to obtain a better appreciation of the catchments and run-off channels.

The ground levels and road formation levels of the realigned and now sealed main road into Onslow for a distance of 22 km out of Onslow have been obtained from the Main

The attached Halpern Glick Maunsell supplementary report (Attachment 2) presents the current drainage and flood assessment. The figures show that the claims made in the E.R.M.P. were in fact conservative. Consultation has taken place with engineers of the Main Roads Department to ascertain as much information as possible as to the sources of water draining across this area.

The old north-west coastal highway is a gravel road which crosses the Ashburton River by means of a high level bridge near Minderoo. When this highway was diverted inland nearly 20 years ago, a new branch was constructed from it into Onslow, which does not cross the Ashburton River but follows parallel to it some 30 km to the north-east.

The old coastal highway, which is still gravel, now serves as access to Onslow for the stations of Peedamulla, Minderoo and Urala. The junction of all these roads is some 16 km south of Onslow. The re-aligned access road was bitumenised in 1987, and a number of floodways and causeways exist on its approach into Onslow. One major floodway crosses the bitumen 800 m south of the junction with the Peedamulla turnoff, and continues on to cross the old gravel road 3 km to the east. Another floodway crosses the main road 1000 m to the north of this junction. Other small floodways cross the gravel road to Minderoo and Urala to the south-west of the junction of this road with the main road.

This confluence of roads and floodways exists 7 km to the south of the first causeway crossing the saltflats before coming to the proposed condenser walls and it is on much higher ground than the saltflats. The saltflats are at approximately 1.2 AHD whereas the ground level at the confluence ranges between 5.0 and 9.0 AHD.

This causeway, approximately 230 m wide, has a small culvert for minimal flows but acts as a floodway for large flows of water from the salt flats on either side. There is no definite direction of flow of flood waters at this point because this is entirely dependent on the wind direction.

There is no doubt that construction of the condenser boundary walls will result in flood water that crosses the floodways near the Peedamulla turnoff being diverted back to the west and across the main road causeway.

If the floods originate from the local catchment only, the estimated 1 in 100 year peak flow at the causeway is calculated to be 200 cubic metres per second corresponding to a depth of water over the road of less than 0.5 metres.

The length of time that this causeway would be untrafficable would be virtually the same as the time that the Peedamulla floodway was untrafficable. The significance of this is that flooding across the sealed and unsealed roads south of the confluence of roads is in no way influenced by the construction of the pond embankments.

The same logic holds if flooding were to occur as a result of an Ashburton River breakout at some point south of Minderoo Station. Such flood waters would not be cumulative to the local catchment floods and would in effect be several days later. Any cyclonic storm surge in water level on the salt flat drainage paths would also have dissipated. The flood flows have been estimated as a maximum of 800 cubic metres per second. Flood depth over the causeway would not exceed 1.65 m i.e. AHD 4.25 m.

The main concern is to establish the flood levee banks to the condenser ponds at a sufficiently high level not to be overtopped and also to ensure that the causeway floodway is suitably armoured and protected to eliminate scour damage by water flowing over it at a velocity in the order of 2 to 3 metres per second. These are engineering problems which can be accommodated and have already been allowed for in our cost estimates.

Any pasture land that would be flooded by water rising to a level of 4.65 AHD would not extend south from the salt flat by more than 2 or 3 km in the various gullies and it would be inundated for no more than 3 or 4 days. The water will be fresh and if anything, could be of benefit to pasture growth. It is not envisaged that any soil erosion will occur. Certainly it will not be exacerbated from what might presently occur from the gully outlets with sheet flooding.

In summary, there is no doubt that construction of the salt ponds will not affect in any way flooding conditions which will occur at the confluence of the bitumen highway and the Peedamulla and Urala access roads (i.e. the old north-west coastal highway). This applies equally to run off from local catchments or breakout from the Ashburton River.

The height of embankments ensures that they are not overtopped by the highest estimated flood level within the diversion channels. The causeway crossing will be suitably armoured to cater for the maximum flow velocities.

If the above two criteria are met, then the construction of the salt field will not result in any of the roads around Onslow being out of commission for any longer period of time than they would be at present.

1.1.2. Specific Items Listed

1.1.2.1 The ponds will block some of the overflow during floods of a major watercourse. This will restrict water movement and exacerbate flooding, erosion and waterlogging of pastures. These effects need to be quantified.

Reply: Covered in General above.

1.1.2.2 How much extra pasture will be affected and for how much longer?

Reply: Covered in General above.

1.1.2.3 What impact will there be as a result on the productivity of the affected pastoral leases (Peedamulla, Minderoo, Urala)?

Reply

We see no impact on the productivity of the surrounding pastoral leases as a result of the construction of the salt field. If anything, slight periodic backing up of floodwater on Peedamulla could be beneficial. There will be no backup onto Minderoo or Urala.

1.1.2.4 Appendix 4 of ERMP (Flood flows by Halpern, Glick, Maunsell) states that the findings are a desk study only and that field investigations will be required to verify various assumptions made. Have these been done?

If not, what level of confidence can be placed on the study? Much more detailed work is required on this. The study should use a 100 year return period because this is the level of safety required, especially as the project is expected to have a similar length of life

Reply

Collection of extra data and assessment thereof has been carried out and the conclusions are covered in General above. We now place a high level of confidence on our conclusions. See also Section 4.5.1.1 of this report and consultants further report attached.

- 1.1.2.5 Section 8.4.8 states that floodwater levels will be monitored and that the road will be modified if required. This is unsatisfactory. It should be possible to calculate runoff to resolve what is required to overcome flooding damage and to make a commitment on what is to be done.

Reply

The causeway at location D (see plan) will be modified and protected by suitable rock armour to withstand overtopping by floodwater flowing at a velocity of 2 to 3 metres per second. This will cater for the largest predicted flood whether arising from local catchments or a break out of the Ashburton River.

- 1.1.2.6 Effect of wetting up of the road structure on causeway sections of road passing through condensers. Also, wave action from the ponded water may also erode existing embankment.

Reply

The causeway sections of the main road have been wetted during floods and cyclone surges on previous occasions. The permanent water level in the condensers is less than this flood level so there should be no

settlement of the road. The shoulders of these causeways will be reinforced and armoured with stone pitching to protect them against long term wave action. There is sufficient freeboard on all the causeway sections.

- 1.1.2.7 Flooding has potential to render gas well heads inaccessible and reduce general access to gas field and pipeline routes (also station tracks and bores).

Reply

Flooding the access roads to Urala Station from the North West Coastal Highway is not influenced in any way whatsoever by construction of the salt field as described in General above.

The Tubridgi gas fields and pipeline routes are well to the south east of the Ashburton River.

- 1.1.2.8 Main Roads Department staff predict that flow through the causeway under the main road will be increased from the west channel and the existing causeway from 160 cubic metres per second to between 1000 and 1400 cubic metres per second. This will require major modifications to the causeway to ensure that the existing level of service is maintained.

Reply

Covered in General above. The estimate appears to be that of our consultants which has now been reduced.

- 1.1.2.9 The flood study in Appendix 4 indicates that a 50 year event flood could be accommodated in the waterways provided, without overtopping the flood walls (Section 3.7(d)). However, no such assurance is given for the 100 year event, which is the standard required.

What height is proposed for the flood walls? A contingency plan should be developed for when this flood level is exceeded.

Reply

The highest flood level predicted in the western channel east of causeway D is 4.65 m AHD. The flood walls (condenser pond embankments) in this location will be constructed to 5.0 m AHD (ERMP Fig. 2). This would cater for the so called 100 year event (i.e. a 1% chance of being exceeded in any one year) since there would be no wave problem at this time.

A contingency plan could be considered by cutting a saddle bypass at the base of the highland divide where shown on the drawing (1.5 km long x 100 m wide @ AHD +3.5 m).

- 1.1.2.10 Section 7.2.2 has ignored the effect that cessation of sediment flow over areas currently susceptible to overland flow might have on coastal processes.

Sediments will be diverted by the creation of the ponds, forcing floodwaters laden with silt to concentrate and disgorge elsewhere along the coast causing erosion in areas currently not susceptible.

Reply

There is no evidence of sand having been transported by sheet flooding across the salt flats. If it were, then it would be dropped in the deeper waters of the creeks. The coastal processes involve sand and there is no cut off of any source of this material. The gradients of floodwaters in this area are very low and the velocities of flow are only capable of transporting suspended fine silt and clay which is generally carried well out to sea. Only three creeks are cut off from flood waters - namely Beadon Creek east of Onslow and Four Mile Creek and Middle Creek west of Onslow. This represents a loss of coastline for flood drainage of 3 km in 40 km or approximately 7%, which is not going to cause a concentration of silt in any particular area.

- 1.1.2.11 In discussing impacts the proponent has not mentioned the effect of diversion of flood waters onto pastoral property. Is this likely to be beneficial or have a negative impact?

Reply

This question is raised and answered in 1.1.2.1, 1.1.2.2 and 1.1.2.3.

- 1.1.2.12 The flood frequency analysis for the Ashburton River appears to have used only flow data up to 1982 from the Water Authority gauging station 60 km upstream. This analysis should include all available information up to March 1990.

Reply

This comment is of little significance. It is demonstrated in the General section above that construction of the salt field levees will not influence the manner in which flood waters cross the highway into Onslow, even if they do originate from an Ashburton River breakout. There is considerable doubt as to whether the Ashburton River breaks out or not, but in any case flooding which could occur from such an event in the future will not be exacerbated by the presence of the salt ponds.

- 1.1.2.13 It appears likely that flood waters redirected west by the ponds would cause the Old Onslow Road to be rendered impassable for longer periods after heavy rains.

Has the proponent investigated whether this is in fact the case, and if so, how will it be dealt with?

Reply

This is a repeat of earlier questions raised and is answered in General and section 1.1.2.7 above. Specifically the Old Onslow Road is in no way affected.

1.2 STORM SURGE LEVELS IN ONSLOW

1.2.1 General

The comments received seem to suggest that many Respondents liken cyclone surge of the sea water level to that of a tidal wave. These 2 effects are quite different. A tidal wave is a solitary real wave generated by an earthquake and can be of great height and volume. It travels at high speed across thousands of kilometres of ocean. On reaching a coastline, it can have devastating effect.

Cyclone surge, on the other hand, results from the reduction in barometric pressure within the cyclonic vortex to that outside together with wind driven forces on the water surface. The surge travels with the cyclone very slowly compared to a tidal wave and is similar to a rise in tide. The extent of sea level rise depends on several factors.

The two pages of explanatory notes (Attachment 3) now provided demonstrate that blocking off Beadon Creek at its entry from the sea would not change the surge levels in the sea and therefore would not change the surge levels in Onslow. Blocking off Beadon Creek or any creek further inland cannot have a worse effect.

Construction of the embankments well inside the shore protection of sand dunes and mangroves and in the case of Onslow itself, 5 km inland, will have no effect whatsoever on the sea levels which can occur within the town and out at the airport.

The low areas in the town and at the airport have been inundated in the past, and there is no doubt that this will occur again in the future.

The main street and older houses are at a level of approximately +3.0 m chart datum and the airport is at +2.5 m chart datum.

1.2.2 Specific Items Listed

- 1.2.2.1 The new building level at 5.1 m has only been recently adopted. Section 3.7(d) must recognise that many homes are built below this, and address the lower level.

Will tidal surge be greater on either side of the pond development as a result of the 20 km long barrier created by the ponds along the coast? Will restrictions to tidal surge in the area of Beadon Creek increase the possibility for flooding of the Onslow airstrip?

Reply

The Ashburton Shire Council has recognised that new buildings in Onslow should be founded above the highest predicted flooding level. As stated in General above, such flooding originates from the sea and not from overland stormwater flooding. The new minimum building level of 5.1 m chart datum is some 1.5 m above the highest predicted cyclone surge level, which should be adequate. Old houses and buildings below this level and the airport will continue to be flooded occasionally, but in no way exacerbated by the construction of the salt field.

- 1.2.2.2 Section 5.3.4 shows cyclone frequency data for the Onslow area. However, monsoonal depressions (such as occurred earlier in 1990) are capable of causing worse flooding because of their greater length of duration and broader front. These have not been addressed in this section.

Reply

It is unfortunate that the Bureau of Meteorology does not recognise such occurrences in the same way as cyclones but the data can be researched. "Cyclone" Tina was in fact a very large tropical low with large diameter, long duration and constant fetch which caused a high surge of exceptionally long duration, i.e. exceeding 30 hours, extending over several high tides (Section 3.6(a) ERMP). Normal cyclones produce a peak surge for 2 or 3 hours only. The maximum level of +2.91 m (chart datum) recorded during Tina was taken from the recorder in Beadon Creek by the Marine & Harbours Department and occurred at a predicted high water spring tide.

We have checked debris levels on the various islands on the saltflats resulting from this surge. We believe one similar level has occurred in the last 30 years and that a particularly severe cyclone in 1934 (Prof. Martyn Webb, "Edge of Empire") reached a level of about 3.2 m judging by the debris from both the old and new jetties on islands in the Four Mile/Middle/ Hooley Creek area. As design levels are set at 4.5 m we believe that the impact of monsoonal lows will not impact the project.

Equally the project will not exacerbate the impact of the lows on the coast.

- 1.2.2.3 Section 3.7(c) discusses repair after extreme events. With regard to cyclone damage to sea walls it is noted that 100 year events are expected to overtop the walls if wave heights are greater than 0.5 m as expected. Is this good engineering design?

Reply

Our remarks in Section 3.7 (c) must have been misunderstood. The external banks will have sufficient free board to prevent overtopping. We consider the engineering design to be commensurate with other north-west salt fields in its margins for safety.

- 1.2.2.4 The Steedman flood survey in Appendix 7 states that it is a preliminary (draft) document (Section 1 and 2.1) and that an analysis of long-term tidal records is in progress. Where are these results and what are the conclusions?

The Steedman survey does not promote the 100 year return water levels as being reliable. In the light of the potentially long life of the proposed saltfield this is of concern. Further doubt on the reliability of this survey stems from the relative lack of actual measured tidal residuals (only 2 out of the 29 cyclones for which modelling was attempted). Further, the modelled data were "out" by a factor of 50% for the two known events.

If the modelling survey cannot be used as a reliable guide, we are left with anecdotal evidence which likewise needs to be treated with caution, especially as memories tend to become less accurate over the longer return periods sought. Similarly, with field evidence of tidal levels, it is unlikely that evidence of strand lines would remain *in situ* for more than a couple of decades.

Reply

Steedmans were unable to get enough information for long term tidal

It is correct to say that the modelling survey cannot be used as a reliable guide, and one must turn to known facts and local memories. We agree that memories are unreliable, perhaps more often too high than too low.

The best evidence comes from pieces of jetty timber and mangrove trees which will last for over 100 years.

There is evidence in the Hooley/Middle/Four Mile Creek area of debris from original jetties which we believe dates from the very large cyclone of 28th March 1934 as indicated in 1.2.2.2 above. The first sea jetty was built east of Old Onslow in 1896 and successive damage by cyclones since 1897 provides debris over a period of nearly 100 years.

This type of forecasting is of far more importance when considering the sea wall and jetty design and not the effect of flooding in the town of Onslow, which we have stated above will occur in the future and is not related to levee construction.

We have adopted a surge level 1.6 m higher than that recorded during "Tina" (i.e. 4.5 m) and this may be set at 2.1 m higher (+5.0 m) in the final design.

1.3 Ground Water

1.3.1 General

There are two basic regimes of groundwater:

- (a) The salt flats themselves, including tidal creeks along the seaward boundary.
- (b) Beneath the islands which support vegetation. The town of Onslow is located on one of these islands.

Section 7.2.4 in the ERMP relates to these two cases. The groundwater below the salt flats is generally 0.5 to 1.0 m below the surface and is of high salinity except in close proximity to the creeks. This was known by many sample holes throughout this area, and from backhoe pits along the water pipeline route across the condenser pond area. However, since the ERMP was published monitoring bores were set up by Dr. P. van der Moezel (see Attachment 1) and the water samples taken confirm these data. From the seaward edge of the algal mats the salinity is about 150 p.p.t. and higher inland beneath the flats.

Beneath the islands, certainly the sandy parts, there can exist a lens of brackish water above the saline ground water. This can rise as a shallow mound from the "beach" of the island towards the centre. This is only likely to occur where the soil is relatively clean sand as instanced by the difficulty of finding even brackish groundwater around Onslow. Where the soil on the islands is loamy sand (as in most cases) it is unlikely there will be any lens of brackish water overlying the regional brine base of the saltflats e.g. various borrow pits go straight into the brine.

The plants on the islands are generally growing on absorbed (or interstitial) water held in the soil above saline groundwater which is replenished by occasional direct rain.

The spasmodic sheet flooding of the flats would not penetrate far into these loamy soils in the short contact time available and in any event similar submergence by sea water during cyclones is equally frequent.

With construction of the condenser and crystalliser ponds, certainly the soil will be fully saturated and the static water level will rise about 600 mm above ground level. In the condenser ponds the water salinity will be considerably less than the present ground water whilst in the crystalliser ponds it will be slightly greater. Despite this the lenses of fresh water will still "float" on the saline groundwater beneath those islands capable of retaining a freshwater mound.

Because of the low gradient, and the soil type, leakage from ponds will be minimal (of the order 100 mm vertically per year) especially as the crystallisers will in fact seal themselves off with the building up of the permanent salt floor.

There are no islands contained within the crystalliser area and for those within the condenser area the water table will rise by approximately 1.5 m in the worst case. A new regime will establish itself beneath the islands and if at all, the salinities will be less than they are now.

As the islands rise steeply across the beach area from the saltflat, only a very narrow margin of growth a few metres wide around the perimeter of each island will be lost. Inspection of the shore around the bitterns pond at Dampier Salt confirms that vegetation grows right to the edge of the shoreline.

Onslow itself is 5 km from the nearest condenser pond and 8 km from the nearest crystalliser pond. The total circumference of the Onslow Island is about 24 km of which only 5 km is contacted by the condenser ponds. There is no contact with the crystalliser ponds but there is contact with 12 km of seawater. There is a large land mass comprising clay and gravel between Onslow and the condenser ponds. There is no direct line of percolation between the condenser ponds and the town. It is therefore impossible for water to flow from the salt ponds to Onslow townsite.

There is a 6 km long land locked depression parallel to the coast and immediately south west of the town. Ground water in this depression is at salting point and in dry weather salt crystals exist on the ground surface. Adjacent to this depression near the town are several large tamarisk trees and even several very healthy eucalyptus. The direct flow path from the ponds to this depression is half that to the town, and water would seep in the direction of the depression, if at all. This is another reason why it is impossible for water to flow from the salt ponds to Onslow townsite.

The brackish water obtained from bores in the sand dunes west of Beadon Point was once the water source for Onslow and this could only have been recharged by direct

rainfall to the sand dunes. Exhaustive exploration by the Public Works Department over a period of 40 years never located any other worthwhile lens of brackish water.

The plants and trees in Onslow are supported by imported water from the Cane River together with increased percolation by runoff from roofs and bitumen roads in addition to what water is available from the brackish lens and natural absorbed interstitial water in the soil. Despite the proximity of this saline flat and the ocean, both of which are much closer than any condenser pond, trees and gardens grow at Onslow.

1.3.2 Specific Items Listed

1.3.2.1 There is the potential for changes to the groundwater regime in the vicinity of the ponds and downstream from them as a result of an extra 600 mm head of water in the proposed ponds. The possibility of leakage is high in the early months of the project, before a suitable sealed bed is deposited in the ponds.

The effects are likely to include a rise in the levels of saline groundwater which would displace fresher lenses of groundwater sitting on top. The sandy nature of the islands means that saltwater can readily percolate laterally and migrate upward by capillary action. This has the potential to compromise the root systems of plants on these islands, including the one on which Onslow is built. There could be a major impact on trees, deeper rooted shrubs and possibly all the vegetation in the town's gardens. The Proponent has advanced no scientifically based information on which to assess the risk of these occurrences (there is no hydrogeology section in the ERMP).

The personal reference by Mr. Lewis relating to groundwater salinities seems unusually high and is likely to be regionally incorrect and representative of only a small area at which the test was conducted.

Rigorous and extensive groundwater studies should be done by independent consultants. These should address groundwater location and salinities at several sites, to establish what aquifers exist and their salinity. A study based on this data and underground flow tests should be carried out to assess the consequences of leakages on mangroves and Onslow and the other islands. The studies would need to collect data during dry periods as well as those immediately following heavy rains in order to obtain a representative picture. Only then would it be possible to predict with any confidence the likely effects of the proposal.

Reply

The theme of this comment is addressed in General above. We consider the hydrogeology to be very simple and do not concede that a "rigorous and extensive groundwater study should be done by independent consultants". The effect on islands of similar nature at Dampier and Leslie demonstrates that the effect on vegetation is very minor. Our consulting botanists are confident that Onslow town gardens will not be effected by the saltfield.

Monitoring of bores and collection of base line data near Beadon Creek and Middle Creek has commenced and supports the statements in the ERMP and the personal reference by Mr. Lewis in relation to the very high salinities being of regional significance. The assertion that the ground water samples taken are likely to be incorrect and not representative is shown to be totally untrue.

1.3.2.2 The Proponent has stated that the haul road will be dust-free but not sealed. This will require the almost constant (in summer) wetting of the road, using (presumably) salt water. This is likely to have a contaminating effect on the freshwater lens which nourishes the gardens of Onslow, downstream from the haul road.

Can the proponent be confident that this effect will not be noticeable, even in the longer term? If not, bearing in mind that the road must be maintained dust-free, will the proponent undertake to seal the haul road?

Reply

The road surface becomes salt stabilised very quickly and requires only a minimum of maintenance "wetting". Run off has no affect on the basic groundwater. We see no necessity to seal the haul road but would do

The nearest loop of the haul road is over 1 km from the residential area of Onslow. In contrast the linear saltflat approaches to within 300 m of the nearest houses. Despite this, tamarisks grow close by and the gardens of Onslow survive. On this basis it is concluded that watering this road will certainly not affect the fresh water lens underlying the town.

Experience at both Dampier and Lake MacLeod shows that natural vegetation is only affected within 20 m of the road.

- 1.3.2 3 Will the Company make a written commitment to adequately compensate all affected parties from the effects of rising salinity, which may include loss of gardens, reduction in quality of lifestyle, increased skin cancer incidence and reduced real estate values? The further effects are likely to include soil loss if vegetation is killed, leading to silting of creeks and increased dust levels in Onslow.

Reply

These are intangible issues which we believe will not arise as a result of construction of the salt field and any remedial measures that could be undertaken.

However, should such events occur and it is subsequently shown that any of these were a consequence of Onslow Salt operations then we would honour our obligation as required by the law.

2. BIOLOGICAL IMPACTS

2.1 LOSS OF MANGROVE AND ALGAL MAT

2.1.1 General

Since the publication of the ERMP, further site work has been carried out by Dr. Paul van der Moezel of the Department of Botany, University of Western Australia and written reply has been made by Dr. van der Moezel and Mr. E. Paling related to relevant sections of the ERMP.

Their report is attached hereto (Attachment 1) and answers the issues raised in submissions to the Environmental Protection Authority. This report substantiates statements and opinions expressed in the ERMP and records the monitoring groundwater bores which have been established.

2.1.2 Specific Items Listed

- 2.1.2.1 The proponent claims that there would be direct losses of 235 ha of mangroves and algal mats as a result of the proposal. Although only 1 ha of mangrove will be directly impacted by the proposal (P12) Paling in Appendix 3 of the report indicates that indirect impacts are likely to be much more substantial. Similarly the 11% of directly impacted algal mats leads on to a greater percentage of indirect impacts to them.

What is the total significance of these losses and changes to the rest of the ecosystem, particularly on the creek systems, their flora, fauna and importance to prawn and fish nurseries?

Will the loss of nutrients to the algal mats in the Beadon Creek system lead to loss of more algal mat area, leading in time to sediment losses into Beadon Creek and impacts on the mangroves?

Given that the mangrove communities are well adapted in an area of high variability between seasons, signs of chronic stress are likely to take years to manifest. It is unlikely that alterations to the project at that late stage would be contemplated, for economic reasons. Therefore it is extremely important to know the likely effects prior to construction.

Reply

Paling's statement on page 12 Appendix 3 of Volume II of the ERMP relates to dust and clearly states that mangroves are only affected when the dust source is persistent, and that in the case of road and bund wall construction it will only be short term, if at all. In any case the proportion of mangroves to the total coastal community which are in close proximity to construction works is negligible.

Inspection of the Dampier and Leslie saltfields shows that brine and bittern ponding has no effect on mangroves or algal mats beyond the containing levee banks. In fact at Port Hedland mangroves are recolonising headwaters of tidal creeks upstream of the culverts beneath the main road into Hedland where pre-existing stands died as a result of changed flooding regime after construction of the road and salt ponds.

Clearly this demonstrates that despite massive direct changes in this area mangroves will still survive right up to the road on the seaward side while upstream of the road they are recolonising.

Apart from the pump station site no mangroves will be directly affected at Onslow. The experience from elsewhere suggests therefore that indirect impacts have not been detectable over 20 years. There is no reason why this should not be the case also at Onslow.

The remainder of this comment is answered in the ERMP or General above and Attachment 1.

- 2.1.2.2 Section 7.3.1.2(IV) claims it is generally considered that an arid coast's mangroves derive most nutrients from marine sources. However, in Appendix 3 Paling describes a straight line relationship between mangrove productivity and loss of nutrient input via fresh water run off which appears to contradict this statement.

Reply

This comment is addressed in Attachment 1. It is estimated that the volume change of water in the creeks, which directly relate to the mangroves growth and nutrition is 100 to 1 for sea water tide versus flooding from on shore. Four Mile Creek and Middle Creek are the only two creeks which will be precluded from on shore flooding.

- 2.1.2.3 Section 7.3.4.1, in describing impacts of the proposal on mangroves claims that a breach of bund walls resulting in a short term flow of highly saline water into the creeks is unlikely to cause permanent damage. However, prawns in particular can be seriously affected by discrete events and may take years to regain original population levels.

Reply

Agree. Taking years to recover is not permanent. In any event, the only two creeks which could be affected by such an event would be Beadon Creek and Four Mile Creek which represent a very small percentage of the total creek volume along the eastern shore of Exmouth Gulf. A breach in the walls at Leslie about 10 years ago is not believed to have caused a problem.

- 2.1.2.4 Section 7.5 summarises impacts as seen by the proponents. I would like to comment on several statements made in it:

- "biological impacts are likely to be insignificant". I would submit that these impacts are still largely unknown as a result of the proponent's failure to come to grips with studies into:
 - the flora and fauna of the terrestrial islands, mud flats and creek systems;
 - the impact upon these ecosystems of changing floodwater levels and routes, nutrient and silt levels and groundwater regimes;
 - the added impacts of bitterns discharges and sea water pumping.
- What is the proponent's source of information for the statement that the offshore environment is extensively modified? What surveys have been done to establish this as fact?

- There is no indication of where the seabed investigations were carried out.
- Comparisons with "elsewhere" are not valid as the environments are not directly comparable.
- Monitoring programmes to assess indirect impacts are OK but there must be a further indication of how impacts will be fixed if they are discovered by the monitoring.

Reply

These comments ignore the intent of the Environmental Protection Authority guidelines that the appraisal of the systems likely to be affected by the project "should concentrate on the significant aspects of the environment subject to potential impact from the development". The ERMP therefore concentrates on those environments that were in the opinion of the Proponent and its consultants likely to experience significant impact. These opinions were based upon knowledge of the operation of the other saltworks along the West Australian coast.

With regard to the islands the Proponent and consultants are of the opinion that there will be very little change to this environment and hence have not carried out baseline surveys. This opinion is based on a study of the shoreline around the Dampier salt ponds.

It is not true to say that the mudflats and tidal creek environments have not been addressed. These environments were regarded as potentially subject to impact and hence this aspect has been addressed in Appendix 3. In fact a major rearrangement of the pond layout has occurred in order to avoid this environment.

It is also not true to say that the flooding regime has not been addressed. Appendix 3 deals with the impact on these ecosystems of changes and flooding regime which was also regarded as a potential side effect. The issue of bitterns has been addressed in Appendix 3 and elsewhere in the ERMP. Again it is the opinion of the Proponent and consultants that there is no demonstrable evidence from Shark Bay, Dampier or Leslie Salt that bitterns discharge has had a significant deleterious impact on the environment (see 2.2 below). To say this issue was not addressed is also untrue.

Local fisherman advise that the offshore area had been dragged. Diving locations are shown in Figure 3 of Appendix 3. Until impacts are known there can be no recipe for fixing them. A discussion of the reason for comparisons elsewhere is contained in Attachment 1.

In any new project there must be an impact of one sort or another. In many cases it is a matter of risk assessment because the final outcome of any change is never certain.

In this proposed project, because of the investigation and design which has already been carried out and which formed the basis of the ERMP and from what can be observed from four other salt fields on the north west coast which are both north and south of Onslow, it must be conceded that environmental risks are low and pose no major problems.

The fact that other saltworks have been operating for many years (some in very sensitive environments e.g. Shark Bay) and that the proposed expansion of these existing works has attracted low levels of assessment by the Environmental Protection Authority leads to the conclusion that as an industry environmental side effects are low and there is no reason to suppose that there will be any new or unusual problems at Onslow.

This series of submissions is also addressed in Attachment 1.

2.2 DISCHARGE OF BITTERNS

2.2.1 General

It is realised that the discharge of bitterns is a most important and highly contentious environmental issue. This matter has been very fully considered and compared with the facts known about the discharge from other salt fields in a very similar situation. There is recognition by the Proponent of the necessity to manage correctly the bitterns discharge both to its own satisfaction and to the satisfaction of the E.P.A. A detailed programme will be submitted before any discharges are made in accordance with proposals in the ERMP and practices at other saltfields.

2.2.2 Specific Items Listed

2.2.2.1 The tidal range at Onslow is less than half that at Dampier. Are comparisons between the two areas valid?

Reply

Refer to Attachment 1. Added to this it should be noted that even Onslow is in a useful tidal range.

The proposed Onslow discharge is into an established creek along an unconfined coastline whereas Dampier discharges into the confined area of Nickol Bay via a discharge channel which is effectively stabilising as a tidal creek.

Middle Creek was chosen for a number of reasons, one being that it was short and relatively poorly colonised by mangroves. Hence this creek is probably the least productive and thus a better site for discharge than some of the other creeks.

It should also be appreciated that mangroves colonise right up to the bitterns pond retaining wall at Dampier and that the banks of the bitterns channel are being colonised by mangroves. At Shark Bay, bitterns discharge direct into a protected bay where seabed is colonised by seagrass. Despite a lower tidal regime (1.2 m) than at Onslow (1.8 m) and lack of wind driven or tidal mixing, the bitterns discharge has had only a very localised impact on the seagrass community close to the shore. The discharge at Leslie Salt is into a rather narrow creek and no serious problems have emerged. Given the evidence, it does not seem unreasonable to conclude that while change is likely to occur in Middle Creek it is not likely to be catastrophic to the regional ecosystem.

2.2.2.2 What is the biomass of fish, crabs and prawns in the creeks? What is their significance? How will they be affected by bitterns discharge proposals? If discharge into the creek system is to be allowed ongoing monitoring will almost certainly be required.

In Appendix 3, Section 6a the first sentence mentions changes to the faunal composition of mangrove stands. However, there is no reference to what these changes may be. Has the proponent done a survey of the fauna (and their significance) in the water and bottom sediments in Middle Creek? What will be the impacts to them from the discharging of bitterns?

Reply

Agree. The Proponent has committed to monitoring Middle Creek (ERMP 8.4.5).

A biological study will be undertaken before the project goes ahead as a matter of record followed by ongoing monitoring. The acceptance of a change in regime of fauna in Middle Creek must be recognised. In a regional sense this change will be minuscule.

The sentence in Appendix 3 (6a) refers to changes in faunal composition within - not of - mangroves.

The sense of the sentence is that if there is any unexpected change to the mangroves caused by raised salinity levels, then faunal changes will

probably occur first. However, such changes are not expected but this is what would happen if they did.

- 2.2.2.3 On what basis can it be concluded that results derived from Dampier Salt's discharge into Nickol Bay are comparable to the proposed bitterns discharge into Middle Creek, which is a far more restricted system? Have the Proponents considered direct discharge into the sea?

On page 18 of Appendix 3 there is reference to monitoring some of the intertidal invertebrates in front of Dampier Salt's bitterns discharge plume at Nickol Bay where discharge concentrations are presumably at 42‰. Discharge into Middle Creek may go as high as 340‰.

Reply

Refer to Attachment 1. We do not acknowledge that Onslow Salt's proposed discharge into Middle Creek is more restricted than Dampier's into Nickol Bay. In fact ours is considered to be less restricted. Note also that Leslie Salt discharges into a mangrove lined tidal creek without any apparent significant deleterious side effects to the mangroves etc. Leslie Salt would be more restricted than Middle Creek and there are no ill effects to our knowledge. We certainly do not consider direct discharge via pipeline into the sea as being necessary.

- 2.2.2.4 The volume of discharge of 25000 m³/year is questioned. The production of such amounts should result in the annual production of some 4 million tonnes of salt at least.

Reply

Section 7.3.3.1 page 97 of the ERMP reads: "The volume of bitterns discharged will be around 25,000 m³/day." The production of 1.5 MTPA of salt will result in 2,100,000 m³ of bitterns per year which gives a daily average of say 7000 m³. Because the bitterns will not be flowing continually because of tidal cycles and because of seasonal effects, the figure above has been adopted. Dampier Salt is reported to have discharged between 7000 and 20,000 m³ of bitterns per day at a salinity of 274-298 ppt into Nickol Bay in 1982. This would be commensurate with our predictions.

- 2.2.2.5 The mechanisms area and speed with which the daily proposed bitterns discharge will be diluted and disposed are not discussed, nor matched against pertinent hydrographic data for this coastal area.

Reply

Notwithstanding that the Proponent will formulate a fully detailed bitterns discharge management programme to the satisfaction of the E.P.A. the intentions and prognosis of discharge as outlined in section 7.3.3.1 of the ERMP submission are considered to be adequate at this juncture.

- 2.2.2.6 Alternatives to creek discharge, such as offshore outfall, sea water pre-dilution, recycling for increased salt and potash output, or injection into highly saline groundwater, have not been evaluated.

Reply

We have considered these various options listed and least of all favour a pipeline outfall. Groundwater injection would not work with the volume involved.

We are not interested in bitterns redissolution at this stage. If there are unexpected problems we could consider seawater predilution.

- 2.3 PUMPING FROM BEADON CREEK

2.3.1 General

Beadon Creek has one channel entering from the sea which is approximately 1 km long. It then broadens out into a circular basin over 0.5 km across, off which 3 separate arms branch. One of these flows in from the west near the airport, another flows in from the south also past the airport and the third flows in from the salt flats to the east. It is on the upper reaches of this eastern arm that it is proposed to site the pump station. It is the flow in this arm to which the pumping rates and program are geared.

The commercial ship wharfage and anchorage area is located in the main inlet channel some 2 km downstream of the pumps. The maximum velocity of creek flow due to pumping in this region is less than 0.01 m/sec which is negligible.

2.3.2 Specific Items Listed

2.3.2.1 The proposal is to pump at the rate of 12 m³/sec. from an arm of Beadon Creek increasing to 20m³/sec. when a further two pumps are installed

At what stage is this proposed and how will it relate to the expansion proposals?

Reply

More refined calculation of the brine mass balance shows that for a production of 1.5 MTPA the peak summer flow rate required from Beadon Creek is 21,600 m³/hour. This can be comfortably achieved by two pumps delivering at 4 m³/sec.

The statement that 3 pumps would be initially installed catered for one standby unit. Once the field settles down and initial leakages become sealed, the field capacity is likely to increase. In this instance a fourth pump will probably be installed. Such a pump would be used at peak tidal pumping opportunities to offset lower efficiency of three pumps working at less opportune tidal ranges. It is most unlikely that a fifth pump will ever be required, but provision for such will be made in the forebay structure.

2.3.2.2 The cross section of Beadon Creek at the pump intake point is 20 m² at high water neap tide (section 7.2.2.1). Given this, the average velocity of inflowing water up this arm of the creek will need to be 1 m/sec (3.6 km/hr) when all 5 pumps are installed.

This would be superimposed on the velocity of the incoming tide. The impacts of such high intake velocities have not been addressed. It is likely that:

- very little water would flow past the pump station;
- scouring of the creek banks may occur;
- creek water may be diverted from other arms of Beadon Creek.

Reply

Section 7.2.2.1 of the ERMP has been misquoted in the comment above. It should read "The cross section of Beadon Creek at the pump intake point is 20 m² at mean sea level." High water neap tide is some 0.5 m above this level. The realistic velocity in the creek is less than 1 m/sec (0.4 m/sec. with two pumps at mean sea level). At cut off level little water will flow to the upper reaches of the creek but water will remain in it at that level. Scouring of the banks cannot occur at this velocity. No water will be diverted from other arms of the creek.

2.3.2.3 No data are provided to indicate the effects of high numbers of fish eggs, prawn larvae etc. being sucked up by the pumps and effectively isolated from the Beadon Creek ecosystem.

Reply

Refer to Attachment 1. As with other matters associated with the creeks, on a regional basis the possible impact is extremely small.

2.3.2.4 Will the drop in water level in Beadon Creek reduce its present ability to provide safe upstream anchorage points during cyclonic conditions?

Reply

No. Pumping has no effect on water levels at the anchorage sites. Cyclones create a surge in tidal level anyway.

2.4 CHANGE IN DISTRIBUTION OF BIRD SPECIES

Section 2.6.3 discusses the extensive environment suitable for wading birds which would be created by the proposal. While this appears to have happened at other salt fields there is no discussion of the species (not only birds) displaced by the creation of these ponds.

Reply

Refer to Attachment 1. If there happen to be birds other than wading birds which inhabit the proposed pond area, then there are still many hundreds of square kilometres of saltflats both north and south of Onslow which are left untouched for them to occupy.

2.5 ENVIRONMENT/SPECIES INVENTORY

Sections 5.4, 7.3.5 and Appendix 3 omit any discussion on species of migratory wading birds, which have been observed on the Onslow mudflats. Australia is signatory to a number of international agreements with China and Japan to protect their habitats. How significant will the change of habitat be to these birds and what species are affected? There is no species inventory for flora and fauna (nor discussion of their significance) in the creek systems, despite the fact that these are probably the most likely to be threatened by this proposal. One must know what exists in these ecosystems before any changes to the environment are allowed for follow-up monitoring to have any use.

Similarly the discussion (Section 5.4.2.3) on the flora and fauna of the salt flat islands is insufficiently detailed and will require further field surveys (including trapping) to adequately describe.

Reply

This question is linked to 2.4. Both C.A.L.M. and the Museum have stated that there are no recorded rare or endangered species in the area. No species inventory of fauna and flora in creeks and islands has been made (see 2.1.2.4), apart from that undertaken to demonstrate that these environments are not unique to Onslow. It is proposed to carry out a flora and fauna inventory on the salt flat islands which will become isolated.

2.6 SHIP'S BALLAST WATER

The issue of ballast water discharge from salt carriers needs to be addressed (The Department of Agriculture Quarantine Services is co-ordinating the matter in this State and the Proponent should make contact with them).

Reply

Onslow Salt will be required to conform to statutory regulations as set down by the Department of Agriculture Quarantine Services.

2.7 MONITORING IMPACTS

2.7.1 General

The impacts to any change to a regime are related to risk. If the risk is high, then the formulation of an acceptable contingency plan is more imperative. Despite all theory the impact is not known until it actually happens and before such an event questions and answers are largely hypothetical. In the case of the Onslow Salt field our studies to date see all the risks as extremely low, especially in the biological category.

2.7.2 Specific Questions Raised

2.7.2.1 In Section 7.2.2 it is proposed that monitoring will clarify the nature of any change in tidal flushing in Beadon Creek. However, there is no statement made anywhere in the report as to what could or would be done to fix any impacts identified by monitoring.

This creek is an extremely important focus of attention for the community, and impacts need to be known in advance so that a judgement can be made whether they are acceptable, environmentally and socially.

Reply

Pumping of sea water takes place in the upper reaches of the eastern arm of Beadon Creek, upstream of a rock bar. This location is nearly 2 km from the main channel of Beadon Creek which you state as being the important focus of attention for the community. We see no impact whatsoever in this section of Beadon Creek and are yet to be convinced that a survey will provide any meaningful data. In any event the impact of the salt project is likely to be minor in comparison to that associated with boating activity near its mouth.

2.7.2.2 In monitoring of impacts on mangroves (Sections 7.3.1.2 and 8.4.5) there is no statement as to how or what will be done if negative impacts are indicated. What action could be taken to rectify problems identified?

Reply

As stated in Section 2.1 experience observed from other salt fields indicates that no negative impact will occur to the mangroves. Even if it does, the number of mangrove trees in this area are infinitesimal. No impact has been identified by anyone which would be unique to the Onslow saltfield.

2.7.2.3 The commitment to monitor the effects of dust on adjacent mangroves in Section 8.4.2 is unlikely to produce new data. It is known from programmes elsewhere in the region (i.e. at Leslie Salt and on Varanus Island) that mangroves have limited tolerance to dust. What is more important is how this impact will be managed.

Reply

In ERMP 7.3.1.2. (i) there is a discussion on the potential of construction to affect mangroves. As the only mangroves anywhere near a construction site are those around the pump station, only these could possibly be affected. If they are for any reason affected - and there is little likelihood of this as the majority of the material will be moist - the impact will only be short term and probably insignificant in relation to the normal dust fallout generated by the supratidal flats.

If dust in the area does become a problem (and the risk is very small) it is known that the duration of the dust problem will only be for several months.

The construction materials are largely moist and the area possibly affected near the pump station is very small. Consequently we see no need to provide for such a plan.

Despite all this the Proponent has agreed to monitor the mangroves here to see if there is any discernible impact. If dust generated during construction is obviously affecting these mangroves then dampening of construction material will be undertaken.

2.7.2.4 The groundwater monitoring outlined in Section 8.4.5 will need a control area, located sufficiently far away from the proposed site of any construction that it will not be affected by any changes arising from the proposal. This site needs to be canvassed for suitability

Reply

A suitable control area for groundwater monitoring will be selected and established (see Attachment 1).

- 2.7.2.5 It is intended that the tree planting programme (Section 8.4.6) will be monitored. Does the proponent intend to make good any failures or problems which the monitoring might highlight?

Reply

The proponent undertakes to make good any failures or problems arising from the tree planting programme provided the failure is the result of the company's mismanagement.

- 2.7.2.6 High resolution aerial photography should be part of the annual monitoring programme commitment for mangrove and other coastal communities. These photos should be provided to the Environmental Protection Authority to allow independent interpretations

Reply

We are prepared to utilise high resolution aerial photography as a monitoring aid to the same degree as other companies are required to do.

2.8 PRAWN FISHERY

2.8.1 Specific Items Raised

- 2.8.1.1 The ERMP has not assessed the importance of inshore areas near Onslow including the role of tidal creeks) as nursery areas for prawn populations. This is seen as a major omission in this report.

Reply

This was not requested in the guidelines provided by the Environmental Protection Authority. Refer to Attachment 1.

On a regional basis, the proportion of coastline influenced by the Onslow Salt project is small and risk to the prawn nursery areas and populations is low.

This is not a prime prawning area since it only produces about 100 T/year from both inshore and offshore, barely supporting a few part time boats.

- 2.8.1.2 The standard of the maps and diagrams presented makes it difficult to gauge the present location and extent of the nutrient-providing algal mats in the area.

It is also difficult to assess how many will be lost within the proposed ponds and how much will be modified indirectly by changes to the groundwater regime or by diverted floodwaters.

Reply

The ERMP gives the respective areas and percentages lost quite clearly. Figures 4, 5 and 6 are as clear as we could make them without using colour.

There will be little or no changes to the groundwater regime. The possible changes due to diverted floodwaters have been dealt with in 2.1.

The loss of algal mats is the only uncertain reduction to the nutrient provision for prawn larvae.

The largest area of algal mat to be lost is in the crystalliser area feeding into Middle Creek and Four Mile Creek which is a small proportion of the area of mats in the region.

Four Mile Creek still has some 4 square kilometres of algal mat surrounding it.

2.9 SALT MAKING PROCESS

2.9.1 Specific Items Raised

Will fertilisers or other turbidity enhancers such as artificial dyes be added to the pond water?

Reply: No.

3. **SOCIAL IMPACTS**

3.1 NOISE FROM PROCESSING ACTIVITIES

3.1.1 Answers to Specific Items Raised

3.1.1.1 "It is possible that under certain, calm, hot and humid conditions noise levels during ship loading will exceed the limits. These conditions are not expected more than 3 times per year" (Section 5.1).

Would the Proponent indicate specifically the temperatures, humidity and wind speed under which these assumptions were made? What does the community feel about this?

Response

A detailed analysis of temperature inversions is not immediately available for the Onslow area and "three times per year" is an estimate based on experience of similar conditions.

In support of this estimate, we submit that the proposed production rate and loading rate results in ships being loaded for approximately 13% of the time.

Bureau of Meteorology data for Onslow indicates that the calm conditions (less than 1km/hr) which are likely to create temperature inversions can be expected on approximately 8% of the nights. On this basis, an adverse effect from temperature inversion on 3 days per year is a reasonable estimate.

3.1.1.2 How will the presence of large volumes of warm water in the condenser and crystalliser ponds affect local climate in Onslow, and is the number of the above nights expected to increase as a result?

Response

The general effect of flooding the present salt pans to form condenser and crystalliser ponds will, in theory, be beneficial. It is likely, however, that the benefit will be so slight as to go unnoticed.

Some evaporative cooling effect must occur with "off shore" breezes in the hotter weather and the thermal storage provided by large volumes of contained water must also warm the cooler morning breezes. This warming effect will also reduce the occurrence of "temperature inversions".

3.1.1.3 Statutory levels for noise mentioned in Section 7.2.7.1 should be explained. Whose levels are these and for what setting? When does the "night time" lower level start?

Response

The acoustic appraisal demonstrates that the facility can be managed to operate within the Noise Abatement (Neighbourhood Annoyance) Regulations 1979 and, in particular, the assigned outdoor noise levels scheduled in Table 1 (Category A2) for residential, domestic or private recreational premises in a neighbourhood of predominantly residences with infrequent transportation.

3.1.1.4 The noise survey in Appendix 5 accounts for one tracked vehicle only. However, there are references in the text (Section 7.2.7.1) to "tracked vehicles". If more than one is operating at a time the predicted noise levels will be exceeded. This point needs to be clarified.

Response

Although two tracked vehicles will be in operation on the site, it is not necessary for both to operate at the top of the stockpile during normal day operation nor near the top of stockpiles at all during night time operation.

At final design, operating procedures will be established to ensure that barrier attenuation will be maintained so that the operation of the second machine will not increase the resulting sound pressure levels in residential areas.

- 3.1.1.5 Tracked vehicles working in salt develop excessive high frequency squeaking noises. The frequency spectrum shown in Appendix 5 does not cover this noise as measurements shown only extend up to 4000 hertz. This squeaking has the potential to be very irritating and penetrative and a more comprehensive analysis should be developed (with a real-life squeaking bulldozer) to address this problem.

Response

The frequency spectrum does cover the high frequency noise which can be expected from tracked vehicles operating on salt. The measurements used to derive a frequency spectrum in the initial calculation were taken from a machine which the operators (Bellway) considered representative of the operating condition of similar machines operating at other salt stockpiles.

It will be seen that major high frequency noise levels are caused by the clatter which occurs when such machines are operated in reverse and this derived spectrum with a 1 dB addition for compliance with AS 2436 has been used in the subsequent calculations.

- 3.1.1.6 The strategy for tracked vehicles working below the eastern-most stockpile crest is inappropriate for Location Option 2, given the orientation of the stockpiles with respect to Onslow. Therefore the up to 13 dB attenuation mentioned is lost.

Response

For Location Option 2, the separation from residential areas increases from 580 m to 750 m to give an additional 2 dB reduction. Our earlier assessment was based on a more remote location.

The accompanying sketch M3 has been prepared to illustrate the separation between the stockpile and nearest residential area under Option 2 over the Option 1 predictions (see sketch M3).

In the event that final design considerations require machines to work on the remote side of the stockpile to maintain adequate noise attenuation, any change in barrier length which will result from the revised orientation under Option 2 can be compensated for by increased barrier height. Operating procedures established at that stage will be formulated to ensure compliance with regulations under the Act.

- 3.1.1.7 The generator sound output has not been added to the overall sound levels for daytime operations. Neither has account been taken of noise generated by the washing plant. How much extra noise will be generated, and will it exceed the statutory limits quoted for day or night operations?

Response

The noise resulting from the operation of generators and washing plant will be substantially less than that from the tractor. The night operation is not expected to include washing plant and the presentation in Appendix 3 of our report makes allowance for generator noise. As can be seen, the higher sand dunes in this direction will improve the barrier attenuation. With the increased separation of generators and washing

plant combined with the barrier attenuation provided by stockpiles, it is not expected that these items will cause any problem.

- 3.1.1.8 The conveyor type, chosen route, adjacent sound levels and prediction of degree of attenuation at the townsite have been ignored. Given its higher position, and closer distances to Onslow and the recreational beach areas this appears to be a major omission.

Response

Typical conveyors of the size required for this project operate at sound pressure levels of 80 dB at 1 m. This is so far below the tracked vehicle level of 108 dBA that no detailed analysis is considered to be necessary prior to the design development phase of the project. Conveyor transfer points and drives are capable of attenuation back to similarly low noise levels and actual requirements will be determined by detailed analysis at the design stage.

In particular, the change in direction between "stockpile" and "wharf" conveyors is expected to need some form of encasement to ensure acceptable performance in an easterly direction.

- 3.1.1.9 The barrier attenuation claimed for night time operation is a complex question involving barrier heights, widths, lateral location and climatic and wind factors. It requires a more detailed analysis to enable confidence to be placed in the levels achieved.

Response

We have, over many years, found that predictions based on the calculation techniques which we have used in this exercise to be acceptably accurate.

- 3.1.1.10 No details of road transport noises are provided (except that trucks are generally >3 dB quieter than tracked vehicles). On this basis trucks are capable of adding up to approximately 2 dB to the overall sound levels. Will the trucks be working at night?

It is claimed that barrier attenuation from natural contours (Appendix 5) will be sufficient to keep levels adequately low. However, as mentioned above, there is no detailed map showing haul road loop and hopper with respect to the natural landforms or contours.

Response

Road transport from the salt fields to stockpiles is not expected to operate at night. For day operation, increased separation between haul road and residential areas and barrier attenuation from stockpiles or natural contours will be quite effective. A contour map is available to demonstrate this.

- 3.1.1.11 There is no apparent account taken of the wind factor in any of the calculations. As most of Onslow is downwind from the site and conveyor it would be appropriate for this to be considered.

Response

Reference material indicates that the significant influence of wind on noise is the effect of downwind propagation on barrier attenuation. Our calculation of day time noise assumes that there will be no barrier attenuation and therefore no wind influence.

For night time operation, weather data indicates that light winds from the west would have an influence on OPTION 1 location for about 5% of the time. Similar light winds from the south west would affect the OPTION 2 location for about 10% of the time.

However, the significant barrier attenuation at night time is provided by the stockpile crest at a proposed angle of 14° and reference material

indicates that problems are only likely to occur when this angle is 2° or less.

- 3.1.1.12 The output levels for truck and dozer beepers should be given. The Department of Safety and Health recommend that reversing beepers are set to operate at approximately 10 dB above background levels. Clearly this would require consideration in the analysis - especially at night time.

Response

Trucks will be pulling trailers through the unloading facility and the arrangement will not permit operation in reverse.

Tractors make a distinctly different noise when operating in reverse and this higher level has been used in our assessment. DOSHWA have, in the past, accepted reduced noise levels from beepers on these machines because of the pronounced frequency change between forward and reverse operation.

- 3.1.1.13 Chart 1 in Appendix 5 shows sound attenuation inside a "domestic dwelling". The type of building is not specified. Is it double brick or asbestos, what is the roof medium, and are windows open, closed, curtained or double glazed? Is the assumption used appropriate for Onslow's houses?

Response

The presentation of predicted sound levels on a family of NC curves was intended to give some idea of where the predictions stood with respect to identifiable situations.

The attenuation figures used were taken from an old PWD data set for closed timber framed windows. We have not made a specific study of housing construction in Onslow and the plots are only estimated approximations.

- 3.1.1.14 The use of a 5 dB reduction in discussing differences between noise levels from Site 1 to Site 2 is too simplistic. Option 2 could even prove to be a noisier site for residents.

Response: See Response 3.1.1.6.

- 3.1.1.15 The strategy adopted by the Proponent where "noise emissions are not expected to result in any significant impact. If they do the Proponent undertakes to take whatever action is necessary..." (Section 7.2.7.1) does not instil confidence in the sound analysis as presented. The purpose of such a study should be to establish prior to operation whether there will be problems.

Response

The purpose of the presentation has been to demonstrate that acceptable acoustic criteria can be achieved. Undulating scrub covered hills will separate the stockpile facility from the town and its future extensions. This is particularly so for Option 2 as has now been illustrated. We are confident that due consideration to acoustic requirements during the design phase of the project will allow the facility to be operated without undue restraint on work practices.

3.2 IMPACTS ON BEADON CREEK & BEACHES

The importance of Beadon Creek and the town's beach areas to the community have not been recognised in the ERMP. The creek is the focal point for much Aboriginal activity, and the beaches also supply considerable public recreation value. Much of the attraction of Onslow derives from the opportunity it presents to walk, swim, collect shells, fish, dive and bird watch along its coast. These assets are worth preserving. The potential impacts on recreational fishing in Beadon Creek and Four Mile Creek have been ignored. Loss of nutrient input to these systems would be expected from diversion of flood waters.

Reply

We agree with the comment made except for the statement that the ERMP has not addressed this issue. It has. Our offer to contribute towards community projects relates to our genuine desire to improve and foster the various activities enjoyed by the public, whether local residents or tourists. There will be no negative impact on recreational fishing in Beadon Creek or Four Mile Creek. These creeks will not be subjected to any significant loss of nutrients by a diversion of floodwaters as stated in various sections above (esp. 2.1). Such floodwaters are spasmodic and flow from relatively barren catchments. Possible access to the jetty will provide better facilities for fishing and diving.

3.3 ACCESS

3.3.1 Specific Items Listed

- 3.3.1.1 There are claims of poor liaison with pastoralists, indeed the Proponent has never consulted with the Minderoo Station Manager, despite the fact that part of the crystalliser ponds lie on his lease.

Reply

These claims are untrue. We have informed the three pastoralists adjacent to our project, namely Urala, Minderoo and Peedamulla of details as the project has developed. Correspondence was sent to the manager of Minderoo Station including a complimentary copy of the ERMP documents. Council meetings were addressed by members of the company and a public workshop was held in Onslow, specifically related to the development prior to the closing date of submission for the ERMP.

- 3.3.1.2 The matter of public access to the jetty should be resolved. It is noted that other industrial concerns do not allow public access to similar facilities, and it is considered highly unlikely that Gulf would obtain the necessary public liability clearance.

Reply

Public Liability insurance may be obtained for access to the jetty, and within the limits stated in the ERMP, the company still offers this facility as a possible contribution to the community. Other companies' policies are not a concern of ours.

- 3.3.1.3 In Section 7.3.2.2 any increase in access to the algal mats is to be monitored to ensure that large scale damage does not occur. Access will need to be controlled to ensure this.

Reply

We do not wish to create access to algal mat areas. In fact we are looking at ways and means to reduce or completely prevent it.

- 3.3.1.4 Concerns have been expressed about the amount of commonage which would be lost to the proposal. Will the haul road, which is proposed to cross the commonage, be fenced off, effectively dividing this area into two?

Reply

We see no need to fence the haul road unless the Shire requests it. The haul road easement would be included within the mining lease with no public access allowed. To the best of our knowledge, the Dampier and Cuvier haul roads are not fenced. There is no stock and few kangaroos on the Onslow Island. The haul road does not cross any public roads.

- 3.3.1.5 How much ground will be required for borrow pits, and what is the quantity of material which will be extracted?

Reply

The total material involved including rip rap is about 1 million cubic metres, most of which can be won from the salt flat itself. Eventually such pits will be covered with pond water. Material occurring on the various islands is generally sandy pindan soil which is not satisfactory for bank building and we do not see any extensive borrow pits established on the islands for this purpose. However, a number of rock and gravel quarries will be opened up on the islands but these will be quite small. The gross area of borrow pits is unlikely to exceed a total of 20 hectares in small areas and reinstatement procedures will be carried out (See Sections 8.3.2.5 and 8.4.6 of the ERMP).

- 3.3.1.6 Rehabilitation of the salt ponds and processing site should be a commitment given by the Proponent in the event that the project is shut down.

Reply

The processing site is covered by the ERMP Section 3.9.2. We do not see the need to rehabilitate the salt ponds in any other way than we have described.

3.4 INSECT PROBLEM

The discussion of insect pests (Section 7.4.2.11) has ignored the problems faced in other areas, where mosquitoes are only kept controlled as a result of substantial mosquito control programmes.

While the ponds themselves may not create a problem in Onslow, other aspects of the operation (such as standing water around the processing site) will need to be carefully controlled

Reply

Standing water will be adequately drained wherever possible from around operational areas. Mosquito breeding on any standing water that would affect the Town of Onslow will be carefully controlled.

4. ENGINEERING IMPACTS

4.1 COASTAL PROCESSES AND DREDGING

4.1.1 Specific Items Raised

- 4.1.1.1 It is mentioned in Section 3.2.8.1 that, at some later stage, ships up to 40,000 tonnes may have to be accommodated, requiring the further dredging of 6 km of channel extra and a total of 2 million m³ of spoil. What will be the potential impacts of this operation?

Reply

The impacts of dredging for larger ships will be similar to those associated with the current proposal. The extended channel does not impact on any other coral reefs, such as Wards Reef. By this time we will have had experience of the impacts from the initial stage.

- 4.1.1.2 In Section 7.2.2 it is claimed that the dredged channel and spoil bank is not anticipated to have any affect on normal coastal processes. What is the basis for this statement?

Reply

The basis for this comment is our knowledge of coastal engineering and the study of tides and currents available to us. The dredged channel and spoil bank is far removed from the normal processes along the coast itself.

The net movement along the coast over a long period is from west to east including the effects of littoral drift and storms. At the berth itself, some 1000 m offshore, the situation is reversed due to the different tidal currents and much lesser effect of storms.

- 4.1.1.3 Comment is made in Section 7.2.7.4 that if the dredge plume moves toward Wards Reef the pipeline disposal point will be moved. It should be known from the studies undertaken whether/when tidal drift is likely to carry spoil toward the reef, and plans set accordingly.

Reply

We agree and plans will be set accordingly.

- 4.1.1.4 In Section 8.3.2.3 the proponent anticipates that dredging will be required every 10 years or so to keep the shipping channel clear. What is the basis for this estimate? Some sources estimate that the frequency will need to be much higher. What are the anticipated environmental impacts from this work?

Reply

We are relying on experience of other channels in the north west with similar exposure and soil types. One Respondent thought the frequency of maintenance dredging would be much higher than our estimate, but this Respondent also thought that Beadon Creek was frequently dredged, whereas this has never been dredged since the construction of the breakwater in the mid 1970's. Any maintenance dredging from time to time involves a small volume compared to the original cut.

- 4.1.1.5 Information is sought on the size of the exclusion zone around the dredged channel.

Reply

The exclusion zone related to the shipping channel, jetty berth and navigational aids we believe is governed by Marine and Harbours Department regulations.

- 4.1.1.6 Can the spoil be stabilised to allow future prawn trawling? If not, what other measures are proposed to offset the effect of areas lost?

Reply

The dredged channel and spoil banks are located in close proximity to the Onslow Fishery Zone boundary. The spoil banks will stabilise, but they will not be flat on the natural seabed.

Subject to access as above we have no objections to fishermen trawling in this area.

- 4.1.1.7 The impression is gained that inadequate assessment of coastal processes and their relation to the proposed offshore engineering has been done. Considering the vulnerability of Onslow to any change in coastal configuration this is considered to be a weakness in the ERMP and will lead to a lack of support from some involved government agencies unless the requirement is adequately addressed.

Reply

This comment originally emanated from the Department of Urban Planning and not the Department of Marine and Harbours.

We realise that final approvals will need to be obtained from the various departments which have responded to our ERMP. We do not anticipate any major problems with this process once the detailed engineering design is being carried out.

4.2 JETTIES, SHIPS

4.2.1 Specific Items Raised

- 4.2.1.1 The dredged channel will permit carriers up to 28,000 tonnes to enter or exit only at half tide or above. This is of concern because it is most likely that from time to time ships would need to leave port quickly because of approaching bad weather or other emergencies.

The probability of severe summer storms or cyclones in this area is a real one. The channel should be dredged deeper so that ships could come and go irrespective of the tide.

Reply

We do not agree with this proposition, firstly, because ships would not be entering the channel with a cyclone threat pending. Secondly, it is most unlikely that a loaded ship would have to leave the berth at less than six hours' notice.

The loading rate is 1300 tonnes per hour, equivalent to 7,800 tonnes in six hours, which equals 25% of the load. If a ship is three-quarters loaded and there is a real cyclone danger, it should leave at this juncture.

- 4.2.1.2 It is of concern that the proponent has not detailed navigational hazards, and assessed the risks inherent in ships using these waters at times of higher risk, such as at night. This could perhaps become a part of the Oilspill Contingency Plan referred to below.

Reply

Navigational hazards, particularly at night, are part of a normal shipping operation without any unusual aspects.

- 4.2.1.3 An oilspill contingency plan should also be prepared against the event of accidents leading to spills, both on the carrier ship and the jetty facilities.

The fuel line along the jetty should be equipped with stop valves on the landward end of the jetty and be filled with seawater (except when in use) in order to prevent fuel spills into the sea in the event of the line being ruptured.

These considerations were not addressed by the Company and require commitments to cover these risks.

Reply

There will be an Oilspill Contingency Plan, just as there will be a ballast plan for shipping. No ship should be permitted to use the jetty until such plans are in place and approved. Guidelines for plans of this nature are undergoing considerable change at present and any submission now will be out of date in two years' time when it is anticipated that the berth will first come into use. We will conform in both design and operation with whatever statutory regulations are in force at the time.

- 4.2.1.4 Elsewhere in the Pilbara salt-carrying vessels have been overloaded or incorrectly loaded and have had to dump salt close to the port over the side of the vessel because no facilities were available for off-loading back onto the jetty. How does the Proponent intend to manage this situation?

Reply

Onslow Salt currently proposes to contract a marine surveyor to remain on board during the loading period, thus ensuring as best as possible that loading is carried out correctly.

(We believe that full time loading surveillance is not conducted by other salt fields). However, should an overload unfortunately occur, we will follow Environmental Protection Authority guidelines.

The mechanics of discharge will depend on the nature of the overloading, ships gear, and available outside equipment.

- 4.3 PILES INTO SEABED

What are the possible implications for piling design if the preliminary jet probe survey (Section 3.2.7.5) data is found to be inaccurate?

Detailed work by nearby oil companies resulted in gross under-estimation of substrate hardness and thickness.

Reply

The jet probe survey done to date was carried out with the aim of assessing the dredgeability of the seabed material. Oil companies have found weak calcareous sediments in other areas well offshore during major platform construction. Our jetty structure is quite different to

A check with Marine and Harbours revealed that no difficulties were experienced with pile driving at the old jetty site. We expect that much of the proposed jetty and berth will be founded in lightly cemented reef and stiff red clay.

All piles will be driven to refusal which from experience should be to a depth of 8 to 12 metres. This will be proved before final documentation by considerably more seabed drilling which determines the exact type of pile to be used and method of driving.

4.4 PROCESSING PLANT AND SERVICES

4.4.1 Specific Items Raised

- 4.4.1.1 Section 3.2.5 discusses water drainage from the washplant floor. This is engineered to redirect brines to the crystallisers. However, it is unlikely that rainwater run-off would be treated in a similar manner.

How is it proposed to deal with salt-contaminated rainwater draining off work areas?

Reply

Drainage from stockpile areas, whether brine or rainfall, will be collected in a compensating pond and together with washplant settling pond overflow (including washplant drainage), be pumped to an evaporating pond upstream of the crystallisers. In this manner all washplant and stockpile salt losses will be recovered with ultimate crystallisation.

- 4.4.1.2 The location of the stockpile has been of concern to many residents. It is believed that few people appear to know the actual location of the proposed site.

There is no detailed map in the ERMP which shows the processing plant and stockpile with respect to landforms and topography, as the drawing numbered M1 in Appendix 5 relates to Location Option 1.

Reply

Figure 7 in the ERMP Volume I shows exactly where the stockpile is proposed in relation to the town, landforms and topography. A further larger scale drawing No. 40-10-001 (M8701/001) is enclosed for your information.

Drawing M1 in Appendix 5 does show the stockpile in the original location No. 1, but this was related to the noise assessment.

The matter of noise has been reassessed for the stockpile No. 2 location and is the subject of Section 3.1 of this report.

- 4.4.1.3 The ERMP does not appear to identify the site of the proposed power station and switchyard. Their location should be clarified. Will the power generated be integrated into the SECWA grid?

Reply

The power station and switchyard will be near the washplant and on the side of it remote from the town. The workshop and fuelling point will also be in this location which is over 1.5 km from Clarke Place. Power will not be integrated with the SECWA grid.

- 4.4.1.4 The location of a septic disposal site for the project will require an investigation in liaison with the Water Authority of WA, because of the high groundwater levels in the vicinity.

Reply

This will certainly be done.

- 4.4.1.5 The ERMP is inaccurate when it describes Site Option 2 as being 1 km further from town - it is only 500 m on Figure 7.

Reply

The ERMP Section 4.2.8 on page 53 clearly states that the plant has been relocated approximately 1 km to the south. It does not say 1 km further from the town.

The truck dump bridge, washplant and most active part of the stockpile are in fact 1.4 km south west of Clarke Place, which is further from the town than the present power station and shielded by undulating scrub covered hills in between.

4.5 MISCELLANEOUS

4.5.1 Specific Items Raised

- 4.5.1.1 Design levels should be for 100 year events, not 50 for flood levees and sea walls.

- 4.5.1.3 Section 3.2.1 mentions that there would be provision at the pump site on Beadon Creek for 2 additional pumps for Stage 1. Is this expansion part of a proposal to create pond 1 in the future? What are the impacts associated with 67% more water intake?

Reply

This has been addressed in Section 2.3 of this report.

- 4.5.1.4 With regard to fuel storage (Section 3.2.10.6; 8.3.2.8) the type and thickness of lining for the bunds should be specified.

Reply

The design of fuel storage installations is required to conform to various statutory regulations. Leakage into the soil or groundwater will not be permitted. Final documentation will cover this issue.

- 4.5.1.5 Given that the bitterns channel may suffer erosion of its walls unless supported, does the company intend to do so? (Section 7.3.2.2).

Reply

The upstream part of the bitterns channel will be excavated in hard limestone nodules embedded in a clay matrix which is not expected to scour. The downstream part excavated in the marine muds will be protected by an access road on the eastern side. The southern side will be stabilised and armoured as required by site conditions. This is a small channel with flow capacity of about 0.3 m³/sec. (max. in summer). It will not be allowed to develop as a creek draining tidal water.

5. **MANAGEMENT**

5.1.1 Specific Items Raised

- 5.1.1.1 There are concerns that environmental personnel will be hired as required (Section 3.3.1). The construction and early operational phases of this project would require almost constant supervision by competent environmental personnel, and on-going monitoring commitments could easily justify the full-time employment of an appropriate staff member.

Reply

The company is giving this matter due consideration. Employment of independent consultants as currently committed in the ERMP would give more expert advice but is probably more expensive.

5.1.1.2 A further requirement for this person would be for the comprehensive environmental induction of all construction and operations work force members. Without an appropriate programme the good intentions of the Proponent are likely to be wasted.

Reference in Section 3.10 to a tug/workboat and the management of fuel spills requires that a workable oilspill contingency plan is available when needed, and that the boat's personnel are adequately trained in the deployment of the appropriate equipment. These details should be clearly described in the Oilspill Contingency Plan.

Reply

We agree with the suggestion in the first paragraph.

Reference to an Oilspill Contingency Plan is covered in Section 4.2.1.3 of this report.

5.1.1.3 Borrow pits should be rehabilitated as soon as they are no longer required, rather than at the completion of construction. This ensures that stockpiled topsoil is replaced as soon as possible, without an unnecessary loss in contained seed viability.

The commitment to "tidy up" pits and quarries (Section 3.5d) should be clarified to specify recontouring, ripping and battering as necessary.

Reply

We agree with these comments (see ERMP 8.3.2.5).

5.1.1.4 Section 5.3.3 discusses tides and seawater pumping cut-off at low tide. Will this be achieved automatically or manually?

Reply

The control will be automatic.

5.1.1.5 A commitment is sought from the Proponent that rehabilitation of areas disturbed during construction (Section 8.3.2.5) will be to a standard satisfactory to the Shire and to the Environmental Protection Authority.

Reply

We agree that the standard of rehabilitation of disturbed areas will be as mutually agreed with the Shire and the Environmental Protection Authority.

5.1.1.6 The Proponent must commit to eradicating all weed and feral animal species which may be introduced to the islands following initiation of the project. This may require hand weeding, careful applications of herbicides and selective baiting or trapping.

Reply

There is presently sufficient access to these islands across the saltflats and on various tracks to allow humans, vehicles, animals (and hence seeds and plant matter to be transported) to allow introduction of weeds and feral species.

Surrounding some of the islands with water will isolate them from this danger. The other islands will still be open to access as they are now across the flats.

5.1.1.7 There is the strong implication in Section 8.4.11 that the Proponent intends to relinquish responsibility for the project soon after approval is given in the comment "The proponent and his successor....".

This is cause for concern because of the unknown status of this successor and requires clarification.

Reply

The Proponent is Gulf Holdings Pty. Ltd. It is inevitable that the personnel of Gulf will pass on responsibility to manage and operate the

project to an operating company and it is also likely that other partners may join the project.

As stated in the ERMP, a Management Company will be formed and this company will be bound by all the conditions entered into by the Proponent.

6. VIABILITY OF PROPOSAL

The Proponent should demonstrate that the proposed Stage 1 is viable as a stand-alone project without requiring Stage 2 expansion to deliver economies of scale.

Reply

We have demonstrated this for Stage 1 to the Resources Department by medium of potential production, cost of production, sales arrangements and cash flows (profitability). The figures are however confidential commercial information which we do not wish to be made public.

7. SOCIAL IMPACT ISSUES

7.1 LOCATION OF STOCKPILE AND WASHPLANT

7.1.1 General

These matters have been addressed in the ERMP and in Section 4.4 of this report.

7.1.2 Specific Items Raised

7.1.2.1 What distance is the Site 2 stockpile from the nearest residences? How far away would the washplant be from residences? A map should be provided showing the proposed location of the stockpile and washplant and indicating the contour of the land on and around the site.

Reply

Figure 7 in the ERMP showed all of these figures to scale. The attached plan entitled Mechanical Plant - Plan General Arrangement No. 40-10-001; M8701/001 shows in more detail the location of the washplant and stockpile, relative to the town to scale.

The closest distance of the stockpile at the proposed Site 2 from the residences is 700 m across undulating scrub covered hills. Clarke Place is 900 m away not on a direct line of sight. The washplant is 1200 m from the nearest residences and Clarke Place is 1400 m away.

7.1.2.2 How will the noise and visual impacts be managed?

Reply

The matter of noise is further addressed in Section 3.1 of this report.

The visual impact is managed by excavating the base of the stockpile to R.L.2.5 AHD between two sand ridges.

The stockpiles will not be visible from the town or the beaches. The highest residences in the nearest cul-de-sacs (not Clarke Place) will see perhaps the top 10 m of the peak of the stockpiles when full.

7.1.2.3 What alternative sites were considered and why were they rejected?

Reply

Five alternative sites were considered. Refer to ERMP Sections 4.2.8, 4.2.8.1, 4.2.1.2(a), (b), (c) and (d).

The location of the washplant and stockpile is linked very closely to the location of the jetty, for economic and operational reasons. The ERMP deals carefully with the reasons why the jetty cannot be repositioned and these all relate back to the exceptionally large cost involved in other sites (see ERMP Table I at end).

7.1.2.4 Will Site 2 conflict with future residential development?

Reply

We do not believe that this will be so. Future development will most probably be further away than the nearest existing development.

Onslow is on a very large island and plans available to us show provision for 5,000 population on a small portion of it and not coming in the direction of Site 2 stockpiles.

7.2 PUBLIC CONSULTATION PROCESS

7.2.1 General

The statements made in the preamble are false and misleading.

The Aboriginal Community and the local pastoralists including Minderoo were kept fully informed of our progressive development by numerous visits to Onslow by directors of the company and by correspondence (see ERMP Volume I Section 6 and Volume II Appendix 2).

The Onslow Residents Liaison Group was a self-appointed body and we would be unaware if it was representative or not. However, we always believed that it was. The ERMP Volumes I and II were available in the public libraries of Onslow, Tom Price and Paraburdoo, as well as sending complimentary copies to all Shire Councillors. A public workshop was held in Onslow on 21st May with plans, maps, charts and photos to inform any parties interested to attend.

7.2.2 How will the company ensure that there is ongoing dialogue with the community?

Reply

The company is very aware of the social impacts of a new venture such as this on Onslow.

Section 7.4.2.10 of the ERMP refers to a liaison officer whose duty will include ongoing dialogue with the community.

7.3 HOUSING OF GULF WORKERS DURING OPERATIONS PHASE

The last thing that Gulf wants to do is to create a company ghetto. Company employees will have to live in the town - hopefully for long durations. For this reason we wish for a truly integrated community.

7.3.1 How will Gulf Holdings address the above issues of worker accommodation during the operations phase of the project?

Reply

We believe that this question is adequately answered in Section 3.2.10.5 of the ERMP Volume I.

7.4 HOUSING OF WORKERS DURING CONSTRUCTION PHASE

7.4.1 Specific Items Raised

7.4.1.1 Where will the construction camp be located and who will operate it?

Reply

We will not be establishing a construction camp of our own. The present caravan site owner believes that he can accommodate any constructional workforce adequately. If this is not the case then a temporary park can be established on the site of the WAPET construction camp.

7.4.1.2 Who will be responsible for ensuring that construction workers and their dependents conduct themselves in an appropriate manner?

Reply

This is a civil matter and any misconduct or law breaking would be a matter for the police. The Construction Manager will endeavour to preserve good relations with the local community.

From our enquiries the presence of the WAPET camp did not cause the town undue concern.

7.5 PUBLIC ACCESS TO JETTY

Will the company allow public use of the jetty?

Reply: Yes (Refer ERMP and Section 3.3.1.2 of this report).

7.6 IMPACT OF JETTY ON BACKBEACH

What steps will Gulf Holdings take to ensure that the jetty does not reduce the community's use and enjoyment of the backbeach area?

Reply

The jetty is located 200 m south west of the backbeach car park. It is a steel piled structure coming from the sea, across the beach and into the foredunes. There are only two piles per bent and these bents are spaced at 25 m centres. These can be located to straddle the beach area giving an uninterrupted shore line. The deck will be 7 or 8 m above the beach level.

7.7 MARGINALISATION OF ABORIGINAL COMMUNITY

How will the company manage the potential marginalisation of Aboriginal people?

Reply

The creation of new jobs which will be available to Aboriginals as well as whites will help to reduce the marginalisation of the Aboriginal people despite an increase in the number of non-Aboriginals living in the town.

7.8 LOCAL EMPLOYMENT OPPORTUNITIES

7.8.1 Specific Items Raised

7.8.1.1 How many jobs will the project create during the construction and operations phases?

Reply

Refer to clauses 3.2.10.5 and 7.4.2.10 in the ERMP. Construction phase approximately 100 at peak times. Operational phase approximately 60.

7.8.1.2 Will Gulf Holdings be an equal opportunity employer? How will local employment on the project be encouraged during both the construction and operations phases?

Reply

Yes. The employment of staff will be the responsibility of the management company as detailed in the ERMP 7.4.2.10.

7.8.1.3 Will there be a sub-contracted workforce?

Reply

Yes.

7.8.1.4 How will contractors be selected and will any conditions be placed on contractors by the Proponent?

Reply

Contractors will be selected by public or invited tendering.

The general conditions of contract will have special conditions imposed upon them by the company.

7.8.1.5 What economic spinoffs are anticipated in Onslow as a result of the salt project?

Reply

See ERMP Sections 2.2, 2.4 and 2.6. Apart from the cash contribution of \$500,000 towards commercial facilities, the opportunity will be provided for increased business in the town from company expenditure and possibly the spending from an increasing number of tourists.

7.9 IMPACT ON TOURISM

How will Gulf Holdings monitor and manage the impacts of its project on tourism?

Reply

We believe that the project will enhance tourism (see ERMP Section 7.4.1.4).

It is not the company's intention or responsibility to manage it, but the company will co-operate with tourism development if promoted by others.

7.10 MEDICAL AND PUBLIC HEALTH SERVICES

What is the company's responsibility to medical and public health services in Onslow?

Reply

The company has no responsibility to provide medical and other public health services in Onslow. However, the increased population will provide a stronger case for provision of improved services (see ERMP Sections 2.3, 2.6.1).

7.11 TRUCK ROUTES

7.11.1 Would trucks or other heavy machinery from the salt project go into Onslow?

Reply: No.

7.11.2 How would construction materials for the jetty and other facilities be transported to the site?

Reply

Construction materials for the jetty would be trucked via a bypass road off the North West Coastal Highway.

7.12 IMPACT ON BEADON CREEK'S RECREATIONAL AND COMMERCIAL USES

7.12.1 How would the commercial and recreational users of Beadon Creek be affected by the project? How will impacts be managed and monitored?

Reply

They will not be affected at all by the Onslow Salt Project. There will be no impacts on them to be managed and monitored.

7.13 ABORIGINAL SITES

7.13.1 Specific Items Raised

7.13.1.1 What did Rory O'Connor's survey of Aboriginal Sites say about Site 2?

Reply

Plant Site No. 2 does not encroach upon any Aboriginal Sites.

7.13.1.2 Which Aboriginal elders were consulted in the assessment of Aboriginal sites?

Reply

The Aboriginal elders consulted in the assessment of the Aboriginal sites were Mr. Mick Fazeldean and Mr. Mibben Lowe.

Other Aboriginal members consulted were Messrs. Norman James; Trevor Hicks; Claude Butler; Douglas Fazeldean; Slim Parker; Guy Parker.

7.14 JETTY OWNERSHIP

7.14.1. Is Gulf Holdings committed to removing the jetty at the end of the lease if the State does not wish to accept it?

Reply: Yes:

7.15 COMMUNITY BENEFITS

7.15.1. What was the intent behind the \$500 000 offer, how will the money be used, and who will decide how it is allotted?

Reply

The money is offered as a contribution for communal facilities in the town of Onslow.

The allocation of funds to projects will be decided in consultation with the Shire.

7.16 FLOODING OF ROADS

Will access to Onslow and local stations be restricted further during flood conditions as a result of the salt project and if so how will this be managed?

Reply

No. The matter of floods is further discussed in great detail in Section 1.1 of this report.

7.17 LOSS OF INCOME FOR FISHERMEN

7.17.1. How has the issue of impact on the local fishing industry been addressed? How will impacts be monitored and managed?

Reply

This matter is addressed in the ERMP Section 7.3.6 and Section 2.8 of this report.

7.18 MISCELLANEOUS

7.18.1 Items Raised

7.18.1.1 The establishment of the salt project would deter other projects from coming to Onslow

Reply: We do not support this opinion.

7.18.1.2 There was a vagueness in the overall description of the land and maps which did not clarify whether it was public land, pastoral lease land, or other.

Reply: Figure 1 of the ERMP clearly shows these demarcations.

7.18.1.3 Houses in Port Hedland and Dampier had suffered corrosion due to dust salt from the salt projects. This would happen in Onslow as well.

Reply

We are unaware of corrosion of houses in Port Hedland and Dampier solely as a result of the salt projects. Windborne marine salt maybe. Onslow is similar. The salt project will not exacerbate this situation.

7.18.1.4 The staff maintained by Western Mining, Hadson Energy and WAPET were considerably greater than indicated in the ERMP.

Reply

If this is true, then the impact of these forces in Onslow was less than we have indicated.

7.18.1.5 The salt ponds would be highly visible and to pretend otherwise was invalid.

Reply

The salt ponds will not be visible from any location in Onslow. Part of the ponds will be visible from the North West Coastal Highway from causeways south of Onslow.

- 7.18.1.6 Section 3.2.4 talked about public roads but there was no map in the ERMP indicating the height above sea level, public roads and access ways, land tenure and the like.

Reply

Section 3.2.4 relates to the salt haul road.

Our project does not impact on public roads other than the North West Coastal Highway as discussed in Section 1.1 of this report. Fig. 1 in the ERMP was clear on land tenure and roads.

- 7.18.1.7 Would any historic sites be affected by the salt project?

Reply

With the present design, no.

- 7.18.1.8 The ERMP discussed fencing off access points to the coast but if the coast was Vacant Crown Land, could the proponent prevent public access?

Reply

Land granted under mining lease will have restricted access. The coastal land east of Beadon Creek is pastoral lease and the offer to fence off access points created by the project was made with a view to minimising potential coastal management costs. No current access will be closed.

- 7.18.1.9 Section 7.4.2.4 talked about educating newcomers to Onslow but no cross education of Onslow to the newcomers was undertaken.

Reply

Good point. A good public relations exercise.

- 7.18.1.10 The improved community services (eg medical, education, etc.) predicted in the ERMP would not be realised.

Reply

Nothing is certain, but there will be an improved commercial environment and opportunity for this to occur.

- 7.18.1.11 Fifty percent of the project's profits should go to Onslow.

Reply

"Onslow" being whom? If "Onslow" contributes 50% of the project cost this would be a fair and reasonable statement.

- 7.18.1.12 Would Gulf Holdings indemnify Onslow residents for flood damage due to the project?

Reply

If flood damage to residents was due to project causes, then indemnity would be applicable under law.

8. ABORIGINAL COMMUNITY

8.1. BACKGROUND COMMENTS

We acknowledge the association of Aboriginal people with the town of Onslow as expressed in the ERMP Volume I and Volume II Appendix 2 and earlier sections of this report. Our desire is to foster a project which will improve living conditions in Onslow for both Aboriginal and non-Aboriginal people alike.

The 1986 Australian Bureau of Statistics figures for Onslow list 197 Aboriginal and 327 non-Aboriginal people. It may well be that the number of Aboriginal people today is in the vicinity of 300.

8 2 SPECIFIC COMMENTS MADE

8.2.1 A major issue is employment discussed in Volume 1 Sections 3.4.2, 6.3.2.4, 7.4.2.10, 8.3.2.9. The only firm commitment made by the company is to train 2 unskilled workers (the other 2 undertakings are vague). We want a commitment from Gulf Holdings Pty. Ltd. that:

The company should undertake a firm commitment to employ 25% of its workforce from local aboriginal people by the end of stage one. This to include both skilled and unskilled workers. Should an aboriginal employee resign or be dismissed the replacement be recruited from local aboriginal people.

Initial training for jobs to occur before the saltworks become operational, followed by on the job training. D.E.E.T. to establish training programmes in Onslow or Peedamulla Station, including a plant operators course.

Reply

These 3 commitments were made after numerous consultations with DEET and DET. The commitment is to train at least 2 unskilled workers on a continual basis. That is when workers under training graduate into the workforce, new trainees will be appointed.

The trainees will be from Onslow residents, if available, from both Aboriginal and non-Aboriginal people.

We are aware of the achievement of the saltworks at Port Hedland in employing Aboriginal people but this took many years to achieve.

The company cannot make a firm commitment to employ 25% of its workforce from local Aboriginal people by the end of stage one. This number is possible, but it depends on the availability of persons for recruitment.

Training would be for persons to become company employees, not general district employees. However, if an employee resigned, then his or her training may possibly benefit other employers in the district or elsewhere.

8.2.2 Another important concern is the potential for devastating flooding. We do not think the Report discusses the dangers fully. See Volume 1 Sections 2.6.2(v), 3.2.2, 3.6(a) & (d).

We request an independent engineering consultant carry out a survey on flooding, as the current Report does not cover the issue satisfactorily.

Reply

This matter has been further addressed in Section 1.1 of this report. The statements made are based on studies and calculations by an independent consultant, namely Halpern Glick Maunsell.

8.2.3 Public access to the proposed jetty. See Volume 1 Sections 2.6.1(vi)(a), 3.2.7, 6.3.2.5.

We request a commitment from Gulf Holdings to establish 3 fishing platforms along the jetty with independent public access.

Reply

The Proponent has indicated that, subject to the resolution of concerns related to public liability, insurance and other matters referred to in the ERMP, it is prepared to erect one fishing platform on the jetty as part of its contribution to services and facilities to be provided for the community. Ultimately, the decisions required to endorse this proposal will have to be made by the Shire of Ashburton.

8.2.4 Aboriginal Sites. See Volume 1 Sections 4.2.8, 4.2.8.1, 5.5.9. We are concerned that Aboriginal sites identified during the ERMP will be disturbed by the saltworks. There should be no work within 300 m of the sites, nor any work above them.

Mr. Russell Halpern made a verbal agreement that 2 Aboriginal consultants would be employed during the construction phase to ensure Aboriginal sites are not damaged. This verbal agreement should be confirmed in writing.

Aboriginal traditional owners must be consulted before any siteworks are undertaken to ensure Aboriginal sites are not disturbed.

Reply

Aboriginal traditional owners were consulted in relation to Ethnographic Sites. The mythological site B..... was pegged by them and surveyed. It was stated at the time that the Aboriginal community had no objection to works being conducted provided those works did not penetrate the surface of the lake identified as the site.

Detailed discussions related to a second option to bridge the site included permission from traditional owners to erect appropriate structures at the edge of the site to enable a bridge to be constructed.

The first option of the Aboriginal community was that conveyors be constructed to pass around the site and the appropriate location of conveyors was made clear and agreed at that time. At no time during those discussions or since was any mention made of a 300 m setback.

Our present plans do not necessitate crossing Burubarladji. A copy of these plans and relevant aerial photographs were agreed with and given to one of the eight Aboriginal members originally consulted.

We agree to have 2 Aboriginal consultants employed at \$80.00 per day plus \$20.00 expenses to supervise construction activities associated with any structures to be built on the perimeter of the site Burubarladji. It was agreed that the Aboriginal community would nominate the 2 parties and would be advised prior to construction by the company (see ERMP 8.3.1.6).

8.2.5 Water. See Volume 1 Sections 3.2.10.2, 7.2.4. We are concerned about how increased demand for water in the new subdivision will affect the water table, especially on Peedamulla station which is already affected by the town's water demands.

We want a survey of the effects of the development on scarce water sources. If a survey has already been undertaken it should be made public, if not, one should be carried out.

The Aboriginal community is particularly concerned about how the water supply of Peedamulla station will be affected.

Reply

The project will not use fresh water from the Onslow Town water supply for industrial purposes.

The extra demand will be for permanent residents living in houses in Onslow. The Water Authority has confirmed that such a demand will present no supply problem. The system has already been put to the test by having some 200 construction workers living in the WAPET camp - near Beadon Creek.

8.2.6 Community facilities. See Summary 53, Volume 1 Section 6.3.2.6.

The Aboriginal community owns land in the main street of Onslow and would like to establish a sporting and community complex for the whole Onslow community on it. Some of the funds promised by Gulf Holdings could be used on this project.

The \$500 000 proposed as a contribution by Gulf Holdings to community facilities be spent on facilities in Onslow and not the Shire generally. A local Onslow committee be established with 50% Aboriginal representation to decide what facilities should be provided.

Reply

This matter is addressed in Section 7.15 of this report. If the Aboriginal community has land it wishes to develop as a sporting and community complex, then this would be one of the options to be considered with the Shire.

8.2.7 Location of the Jetty, Stockpile, etc. See Summary 5.3.

We support the Shire's submission that the jetty and stockpile be relocated 3 km from Clarke Place in support of the general wellbeing of the Onslow community.

Reply

The matter of the jetty and stockpile location is further addressed in Sections 4.4 and 7.1 of this report.

The Shire had given written approval for the location we adopted as indicated in the ERMP.

In all the discussions we have had with Aboriginal groups they have never expressed any concern provided we did not intrude on any of their sites.

8.2.8 Liaison Officer. See Summary 5.3.

The community worker appointed to integrate the new population with the town should be an Aboriginal person, or a separate Aboriginal liaison officer should be appointed to tell the new people about Aboriginal culture and ways of communicating.

Reply

This matter is of importance, and the company will carry out whatever is necessary to achieve the necessary liaison in conjunction with D.E.T. and the Social Impact Unit.

8.2.9 Resolution/Conclusion.

It is essential that the West Australian Government demonstrate their support for the Aboriginal peoples equity in employment and development by supporting this resolution thus avoiding another Roebourne or Port Hedland where the concerns of the aboriginal were disregarded.

Reply

We support this expression of concern. However, the issue of a buffer zone referred to in Items 8.2.4 and 8.2.7 constitutes a position which is out of character with the goodwill that has been established and inconsistent with previous advices agreed to by all parties on site. It also makes construction of a solar salt field in Onslow improbable and would therefore not give the West Australian Government the opportunity to demonstrate their support for Aboriginal people's equity in employment and development in Onslow. At this time, further discussions are scheduled to endeavour to arrive at a satisfactory conclusion to this issue with various Government departments and the Aboriginal community of Onslow.

LIST OF ATTACHMENTS

1. Biological Report on Environmental Protection Authority Summary of Submissions by Dr P. van der Moezel and Mr. E. Paling
2. Report on Effect of Proposed Salt Pond Flood Levee, on Flood Flows by Halpern Glick Maunsell
3. Notes on Cyclone Surge - J. G. Lewis

ATTACHMENT 1

Biological Report on EPA Summary of Submissions

by Dr Paul van der Moezel and Mr Eric Paling 11-7-90

The following report contains comments on various biological aspects of the EPA Summary of Submissions for the Onslow Solar Salt ERMP. The report contains comments on specific points concerning biological issues in the ERMP, provides new information on on-going monitoring programmes and proposes possible management strategies for dealing with primary issues.

1. PHYSICAL

Groundwater (3rd paragraph)

A series of groundwater monitoring bores was set up at Onslow during June 1990. Twenty permanent bores were set up in the Beadon Creek and Middle Creek areas (Figure 1). Groundwater depth and salinity were sampled with the results presented in Table 1. One site will be continually sampled by salinity and depth probes attached to a data logger and the other sites will be monitored bi-monthly. Groundwater salinities under *Avicennia* mangroves ranged from 39-58 ppt and increased to 54-65 ppt only 1m from the edge of the mangrove. Groundwater salinity increased dramatically under algal mats with a range of 136-193 ppt at depths of 44-58 cm below the surface. At one sample site in the mangroves two bores were set up to detect the presence of separate aquifers. At the time of sampling in June there were no observably different groundwater horizons.

2. BIOLOGICAL IMPACTS

Loss of Mangroves and Algal Mats

1. The ERMP claims that there would be a direct loss of 235 ha of mangroves and algal mat area. Only about 1 ha of this total is mangrove which represents 0.16% of the mangroves in the Onslow area and 0.67% of mangroves in Beadon Creek. The loss of algal mat will not lead to further algal mat degradation because algal mats receive most of their nutrients from tidal water and are able to recycle nutrients and fix their own nitrogen *in situ*. Similarly, erosion of algal mats will not occur. This is because all algal mat loss is at the distal end of the system i.e. towards the salt flats and not between tidal creeks and non-affected mats. Most of the algal mat loss will be caused

by the Crystallizer Ponds above Middle Creek and 4 Mile Creek both of which have a small proportion of mangroves.

2. Mangroves receive their water-borne nutrients from tides, rivers, overland sheet flow and direct rainfall. The relative importance of each of these sources is dependent upon the climatic environment and the surrounding vegetation. As was pointed out in page 5 of Appendix 3, mangroves in arid areas are thought to receive the bulk of their nutrients from tidal sources. Onslow receives 343 mm rainfall per annum and is classified as arid. The comment on page 15 Appendix 3 referred to the work of Lugo and Snedaker (1974) who did their work on mangroves in South Florida with a tropical humid environment (1500 mm rainfall per annum) and surrounded by a swampland which provides the nutrient supply. This reference was included to point out that there is a relationship between the nutrient source and mangrove productivity. The reason Lugo and Snedakers observations were included were a). to illustrate this fact, hence the suggestion for monitoring, and b). their work is one of the only long term monitoring studies available on this topic.

3. (See section on 'Prawn Fishery' below)

4.1. The proponent has commissioned a flora and fauna survey which will provide information on the following:

- a vegetation survey of salt flat islands and adjacent mainland regions
- fauna survey, particularly reptiles and mammals, of salt flat islands and adjacent mainland regions.
- vegetation survey of rock quarry sites.
- list of deep-rooted plant species on salt flat islands
- an indication of the impact of salt flat island isolation on migratory land-dwelling animals.

4.2. Trawlers operate on flat, sandy, homogeneous seabeds. Although no formal survey was done, local fishermen and the Western Australian Fisheries Department both admit that drag chains may be used to clear trawling grounds of rocks thus modifying the benthic environment.

4.3. Comparisons with 'elsewhere' are particularly relevant for Dampier which, although not exactly the same, has a similar arid climate to Onslow and is close geographically. This comparison is much preferred than comparisons with overseas work.

4.4. It is difficult to comment on how impacts will be fixed until they are discovered. However the proponent will carry out the necessary repair of ecosystems in the area if they are found to be impacted adversely. A programme or research into mangrove biology and establishment techniques is one possible line of on-going research.

Discharge of Bitterns

1. As stated earlier it is believed that comparisons between Dampier and Onslow are valid, despite the difference in tide ranges. It is viewed that it is more acceptable to compare two areas that are close geographically (i.e. same climate etc.) than two geographically distinct areas (and therefore climatically distinct) that only share common tide heights.

2. The proponent will begin monitoring fauna in the creeks if and when the project gets the go-ahead. Middle Creek is not used extensively for fishing because it is shallow and inaccessible to boats and is difficult to walk to. The small amount of mangroves in Middle Creek means that if any fauna or flora is lost due to bitterns discharge it would be a small proportion in a regional sense.

Dampier Salt Operations discharged between 7000 - 20000 cubic metres per day of bitterns with a salinity range of 274 - 298 ppt during 1979-1982 into Nickol Bay with no deleterious effects on juvenile prawn numbers.

3. Although bitterns discharge into Nickol Bay and Middle Creek are different systems, both discharge bitterns of similar high salinity into seawater. Brine will not enter the crystallizer ponds for around 8 months after pumping starts and bitterns discharge will initially be used in the first few years to build up the floors of the crystallizer ponds. Therefore there is adequate time to obtain information on the fauna of Middle Creek before bitterns discharge takes place.

The ERMP section 7.3.3.1 states that bitterns discharge concentration at Dampier was diluted to 42 ppt from a concentration of 340 ppt. Bitterns discharge concentrations at Dampier during 1982 were in the range 274-298 ppt.

Pumping from Beadon Creek

3. There are currently no data available on the density of fish eggs and prawn larvae in Beadon Creek. Therefore a definitive statement on the effect of removing stocks of these propagules cannot be made. However, pumping occurs from a tributary of the Beadon Creek system, not the whole creek. So if all propagules were removed (which is unlikely) from this arm of the creek, recruitment can still take place from other arms of Beadon Creek. In addition, it is not suspected that Beadon Creek supplies all propagules to the Onslow area. There are other creeks in the area which will contribute to propagule supply.

Environment/Species Inventory/Change of Distribution of Bird Species

Flora and fauna of salt flat islands and the ^{Middle} creek system fauna will be surveyed upon the project receiving the go-ahead.

There is hardly any direct effect of the project on mudflats i.e. mangroves, and therefore no change in that habitat for any wading birds. If the EPA Summary meant loss of salt flats and algal mats then on regional basis 96% of tidal and supratidal ecosystems will be unaffected and wading birds don't use salt flats a great deal.

Monitoring of Impacts

4. It is agreed that a groundwater monitoring control area will need to be located away from the proposed site. A site east of Coolgra Point or near Cane River would be suitable.

6. Aerial photography monitoring of mangrove and coastal communities can be included in the on-going monitoring programme.

Prawn Fishery

1. The offshore 1989 prawn harvest at Onslow consisted mostly of banana prawns (47 tonnes) king prawns (19t) tiger prawns (9t) and endeavour prawns (5.5t). The inshore area near the Ashburton yielded 18t tiger, 6.5t king, 5.5t endeavour and less than 1t banana prawns (Fisheries Department statistics).

The larvae of penaeid prawns which includes all these four species can utilise channels, creeks and mud flats as nursery areas with particular habitat preference dependent upon the species concerned. Emmigration of juvenile prawns back into deeper waters occurs between December and March. Although the movement of banana prawns is often related to cyclonic river flooding, normal recruitment can occur without such flushing (White, 1980 - Prawns of the Dampier Region).

It is agreed that monitoring of juvenile prawn numbers would aid in determining the potential effects of this proposal on the prawn fishery. As stated a survey of creek fauna will be conducted after the go-ahead is received.

2. Agree.

Insect Problem

Standing water will be adequately drained from around operations. The sandy soil will not make this a difficult task.

5. MANAGEMENT

1. We recommend that a full-time environmental officer be employed by the company to undertake monitoring commitments and environmental education of employees. An independent consultant should supervise and assess the monitoring programme.

Table 1. Groundwater salinity and depths at Onslow during June 1990

Bore	Surface Cover	Water Depth (cm)	Water Salinity (ppt)
MC6	Mangrove	20	47
EB5	Mangrove	77	58
EB6	Mangrove	76	48
EB9	Mangrove	67	57
SB5	Mangrove	54	44
EB7	Mangrove	18	39
MC5	Mangrove roots only	24	51
SB4	Mangrove roots only	76	48
EB8	Mangrove roots only	26	45
MC4	Bare 1 m from mangroves	28	54
EB3	Bare 1 m from mangroves	68	61
EB4	Bare 1 m from mangroves	43	65
EB2	Bare 40m from mangroves	47	98
MC1	Algal Mat	58	187
MC2	Algal Mat	44	193
MC3	Algal Mat	46	136
EB1	Algal Mat	58	155
SB2	Algal Mat	52	159

All other bores were dry

MC = Middle Creek location

EB = East Beach Creek location

SB = South Beach Creek location

OCEAN



BEADON CREEK

PUMP STATION SITE.

EB8

EB9

EB6

EB7

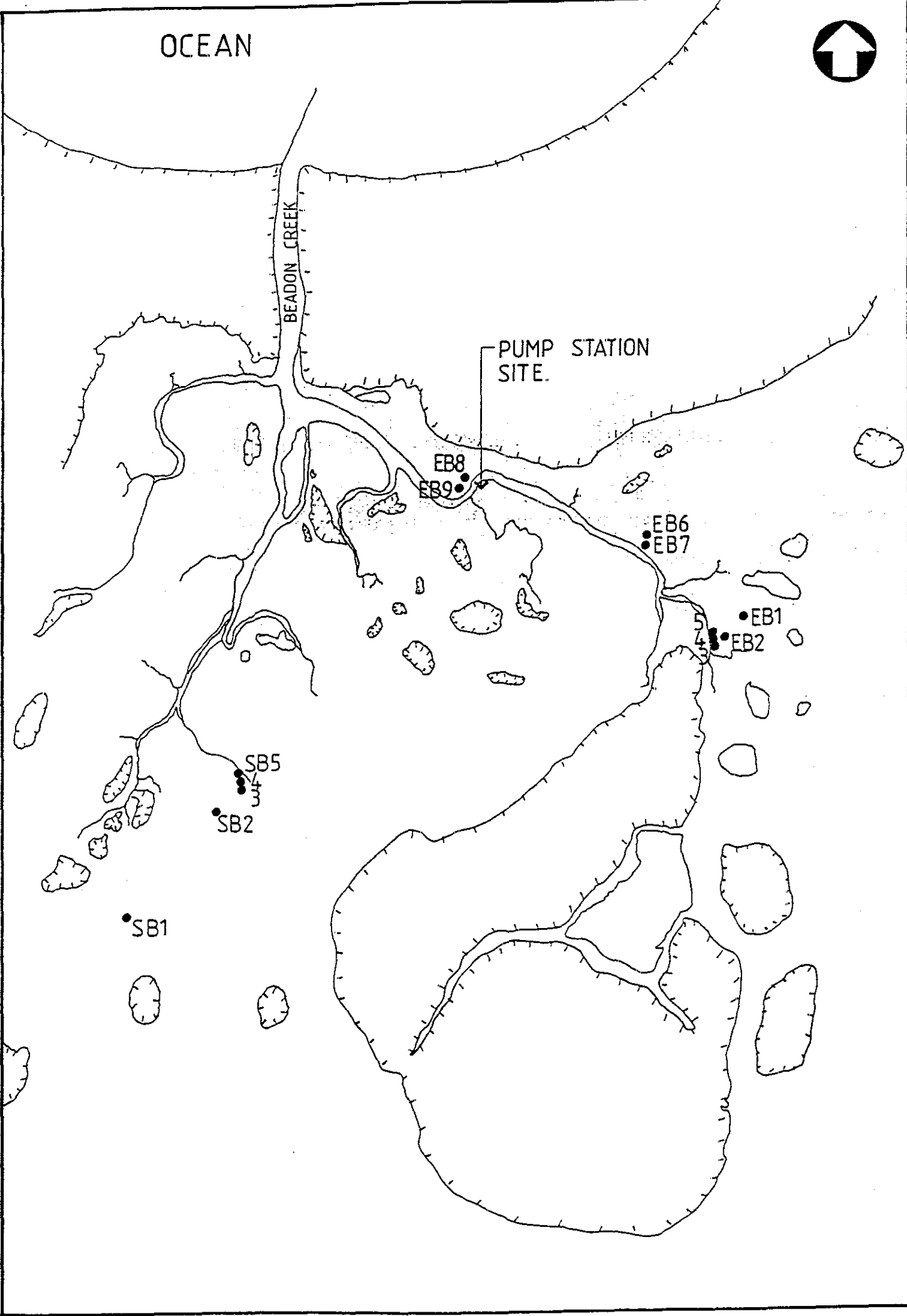
EB1

EB2

SB5

SB2

SB1





OCEAN

4 MILE CREEK

MIDDLE CREEK

6
5
MC4

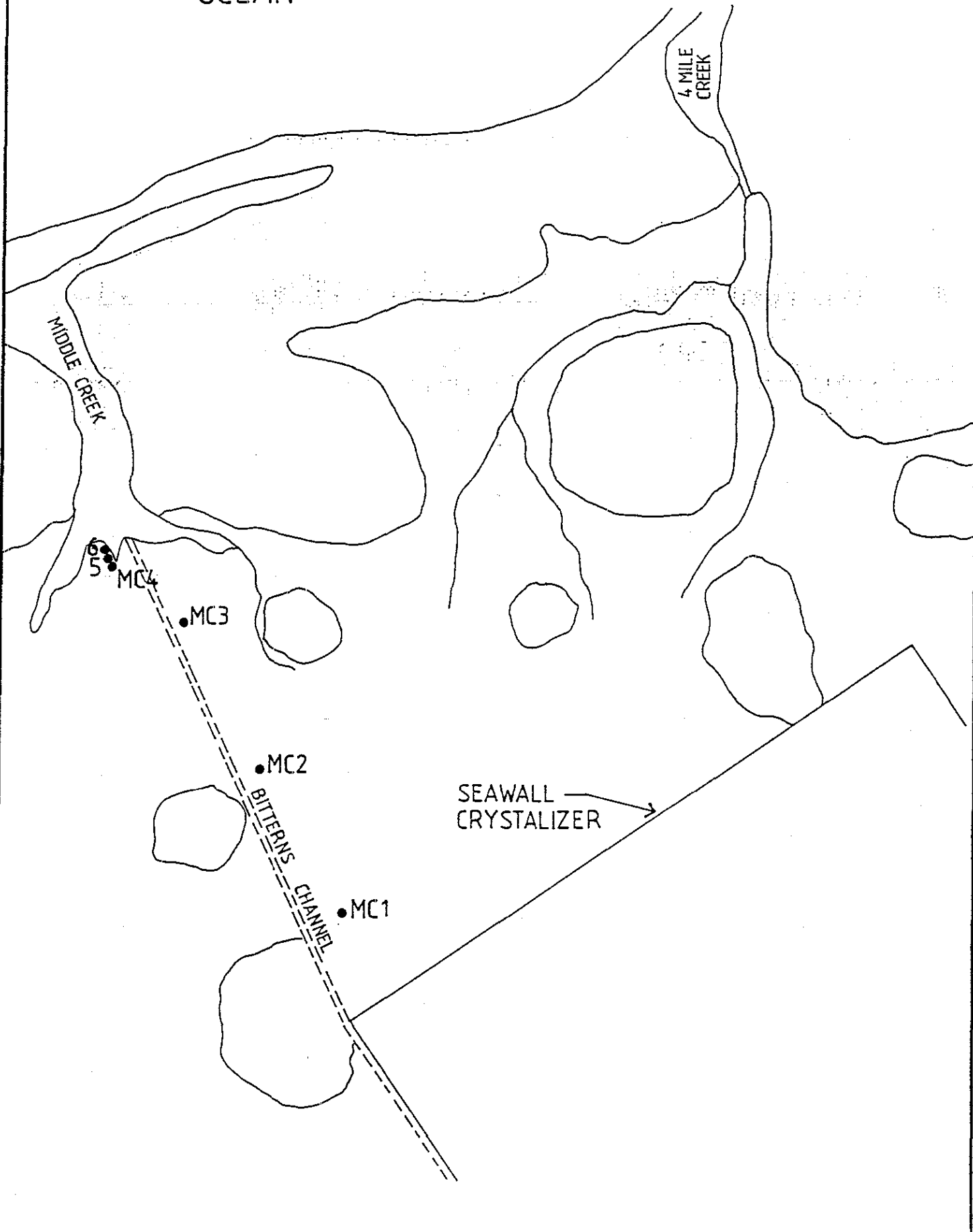
•MC3

•MC2

BITTERN'S CHANNEL

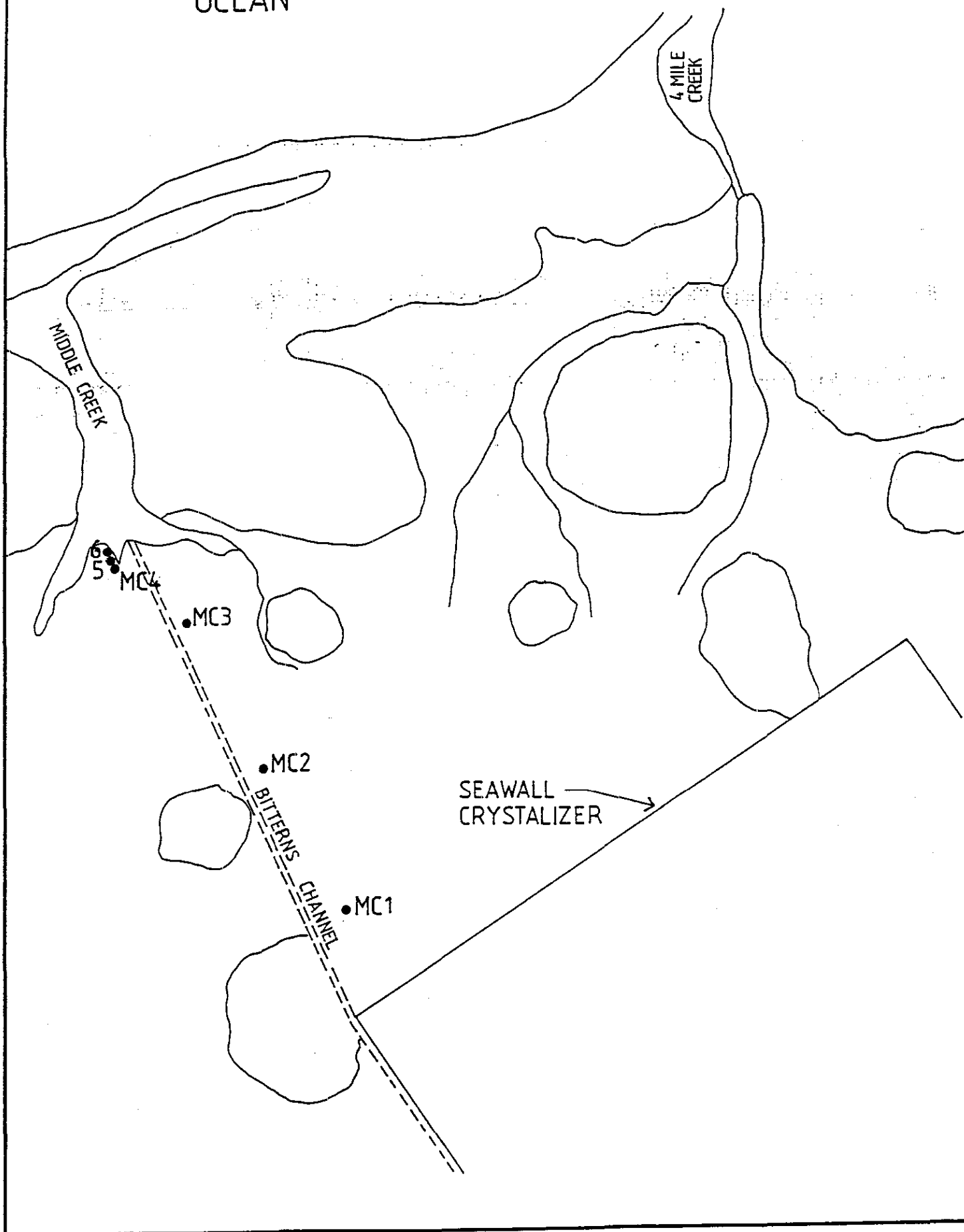
•MC1

SEAWALL
CRYSTALIZER





OCEAN



ATTACHMENT 2

DIVERSION OF FLOODWATERS - ONSLOW SALT PROJECT

Summary of Results of Updated Flood Flow Calculations - 30 August 1990

1.0 INTRODUCTION

Subsequent to the Halpern Glick Maunsell January 1990 report on flood flows, further refinement of the flood flow estimates has been undertaken in the light of recent field investigations and receipt of additional information related to existing floodway levels.

This report summarises the results of these recent calculations and comments on the effect of the diverted floodwaters on flooding of pastures, backup of inland floodwater levels and scouring.

Figure 2 outlines the location of the proposed flood diversion walls along the perimeter of the salt ponds and indicates the outfall routes of floodwaters diverted to the east and west extremes of the salt pond system via the "east" channel and "west" channel created by the floodwalls.

2.0 WEST CHANNEL

The January 1990 report on floodwaters stated that the sources of floodwaters in the west channel were the local catchment south of the channel, and, possibly, a breakout flow from the Ashburton River.

Field inspection of the general salt field site and helicopter inspection of the area between Minderoo Station and the main causeway crossing of the salt flats near Onslow Townsite was performed in May 1990.

The specific aim of the helicopter inspection was to assess the general nature of the catchment above the main floodway crossing of the Onslow Road (point (2), Figure 2), and to trace obvious water courses or flood paths to their upstream origin.

The aerial inspection traced the route of two major watercourses to approximately 12 to 15 kilometres upstream of the floodway crossing at which point the flow paths were no longer obvious (refer Figure 2). No signs of a flow path between the Ashburton River and the floodway crossing were apparent.

Hydraulic analysis of the main watercourses observed above the Onslow Road floodway indicate that the average major flood flow velocity is probably 0.6 to 0.8 metres per second rather than the conservative 1.0 metre per second assumed for the January 1990 desk study. The revised velocity range together with witness reports of peak flow depth and width at the floodway during the June 1980 flooding combine to indicate a peak flow range of approximately 400 to 550 cubic metres per second compared to the previous estimated range of 750 to 1,000 cubic metres per second for the June 1980 event.

As a result the predicted 1 in 50 year flow at the floodway crossing reduces to 550 to 750 cubic metres per second in lieu of the previous estimate of 1,000 to 1,400 cubic metres per second. The 1 in 100 year flow is estimated at 700 - 1,000 cubic metres per second at this point.

The 'obvious' local catchment above the Onslow Road floodway covers an estimated area of at least 60 to 70 square kilometres, a significant proportion of which is claypan. Preliminary estimates indicate that peak flow rates from this local catchment range between 400 and 800 cubic metres per second for a 1 in 50 year event, but may be higher if the claypans are near full at the commencement of the storm as was probably the case in June 1980 (average catchment rainfall approximately 45 mm over 2 days one week prior to average 140 mm 2 day rainfall in June 1980). The local catchment is therefore considered to be capable of generating the observed June 1980 flood peak flow from the recorded rainfall without contribution from the Ashburton River.

Notwithstanding, the field observations and subsequent estimates of peak runoff flow rates from the observed local catchment do not preclude the periodic breakout of the Ashburton River and the outlet of a portion of the river flow over the Onslow Road floodway, but the initial field observations have not found any obvious evidence in support of the 'breakout'.

If the peak flow at the Onslow Road floodway derives from the local catchment and not the Ashburton River the total flood volume will be considerably less than that from the Ashburton, and the attenuating effect of the west channel storage could be expected to reduce the 1 in 100 year peak flow rate at the existing causeway to approximately 200 cubic metres per second. The maximum water level associated with a peak flow of this order is approximately 3.2 metres A.H.D. at the causeway and 3.4 A.H.D. at the upstream limit of the west channel.

If some major flood flows do originate from the Ashburton River, the total flood flow volume will be significantly greater than a flood from the local catchment, and the attenuation effect of the west channel storage on the flood peak flow will be much less. For a 1 in 100 year peak flow at the floodway of 700 to 1,000 cubic metres per second, the 'Ashburton' flow peak at the downstream causeway is estimated to be 550 to 750 cubic metres per second. At these flow rates, the peak water level immediately upstream of the causeway will be 3.9 to 4.25 A.H.D. relative to an average causeway top level of about 2.75 A.H.D. Average velocities at peak flow will be approximately 0.9 to 1.1 metres/second. Maximum upstream flood levels are estimated to be 4.3 to 4.65 A.H.D. in the west channel.

3.0 EAST CHANNEL

Flows into the east channel derive from the local plateau catchment south of the channel as described in the January 1990 report.

The estimated 1 in 100 year peak flood flow into the channel is conservatively estimated at a total of 1,000 cubic metres per second, which reduces to approximately 500 cubic metres per second at the channel outlet due to channel storage effects. Analysis of peak water levels assuming inflow at several locations along the length of the channel to reflect the actual field flow conditions yielded a conservative maximum water level (1 in 100 year) at the west end of the channel of 3.5 A.H.D. Maximum velocities during this event are estimated at 0.35 metres per second.

4.0 DISCUSSION

Hydraulic calculations show that the 1 in 100 year peak water level of 4.3 to 4.65 A.H.D. at point (1) will not cause a backup in the natural flood flow across the plain upstream of point (1) because the water level in the west channel will be significantly below the water level of the plain flood flow. As a result, the spreading outflow from the plain flood flow into the west channel will cause a drawdown in the plain flood level rather than a backup, as presently occurs. The 1 in 100 year peak flow level in the west channel of approximately 4.3 to 4.65 A.H.D., and in the east channel of approximately 3.5 A.H.D., will not flood back onto pastures on the plain to the south because the peak channel water levels are generally below ground levels along the northern edge of the plain.

Flooding of small areas of the plain adjacent to the west channel may occur where plain ground level is below the general level of 5 to 6 metres A.H.D., but the duration is likely to be only about one day during the passage of the flood peak, and the effect on pasture and pastoral lease production will be insignificant.

Short duration inundation of west and east channel sides will occur for several days during the passage of a major flood, but this will not cause erosion or result in degradation of what little pasture exists on these steep slopes.

As a result of field follow-up of the earlier desk study and subsequent re-assessment of average flow velocities and allowance for storage attenuation of peak flood flow rates, the following conclusions can be made with a reasonable degree of confidence.

- (a) The estimated 1 in 100 year peak flow in the west channel is unlikely to exceed 1,000 cubic metres per second, and the attenuated flow at the causeway should not exceed 750 cubic metres per second or a water level of 4.25 metres A.H.D. It is likely that the peak flows and maximum water levels will be significantly less than these values.

- (b) Flooding of pasture and backup of flood flows on the plain during major floods will not result from construction of the proposed salt field flood walls even when the upper limit of flows and water levels are considered. At most an insignificant area of low plain pasture may be flooded adjacent to the south side of the west channel.
- (c) Average flow velocities in the proposed east and west channels during passage of the peak 1 in 50 year and 1 in 100 year flows should not cause scour. Minor localised scour may occur in some areas during extreme event flooding.

Further field survey and investigation will be necessary at the time of final design to refine design flows, flood levee levels and confirm or disprove the Ashburton breakout flow. However, until such further refinement can be justified, it is considered that the preliminary adopted flow rates and channel water levels are conservative.