ROC OIL PTY LIMITED

CLIFF HEAD PIPELINE

REVISED
REHABILITATION PLAN

October 2013
DOCUMENT REVISION HISTORY

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<th>Revision</th>
<th>Description</th>
<th>Originator</th>
<th>Internal Reviewer</th>
<th>Internal Review Date</th>
<th>Client Reviewer</th>
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<td>GW</td>
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<td>2</td>
<td>Revised to include maintenance activities</td>
<td>GW</td>
<td>DW</td>
<td>24-09-13</td>
<td>Andrea Wills</td>
<td>1-10-13</td>
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<td>1-10-13</td>
<td>Andrea Wills</td>
<td>28-10-13</td>
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<tr>
<td>4</td>
<td>Final with Completion Criteria amended</td>
<td>GW</td>
<td>CG</td>
<td>29</td>
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<td>29-10-2013</td>
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Report Number: ROC04-48-01

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## CONTENTS

1 INTRODUCTION .................................................................................................................. 1
2 EXISTING VEGETATION ..................................................................................................... 1
3 REHABILITATION OBJECTIVES ......................................................................................... 3
4 REHABILITATION STRATEGY ............................................................................................. 3
   4.1 BEST PRACTICE BENCHMARK .................................................................................. 4
       4.1.1 Review of Methods .............................................................................................. 4
       4.1.2 Successful Methods ............................................................................................. 8
5 REHABILITATION METHODS ............................................................................................. 10
   5.1 WEED MANAGEMENT .................................................................................................. 10
   5.2 DIEBACK (PHYTOPHTHORA CINNAOMO) MANAGEMENT ......................................... 10
   5.3 RESOURCE MANAGEMENT ....................................................................................... 11
   5.4 SOIL PROFILE AND LANDFORM ............................................................................... 11
   5.5 ESTABLISHMENT OF NATIVE VEGETATION .......................................................... 12
6 COMPLETION CRITERIA ...................................................................................................... 12
   6.1 CRITERIA DEVELOPMENT ......................................................................................... 13
       6.1.1 Landform (Soil Stability) Criteria ........................................................................ 13
       6.1.2 Vegetation (Weed and Phytophthora Disease) Criteria ....................................... 13
       6.1.3 Vegetation Criteria .............................................................................................. 13
   6.2 COMPLETION CRITERIA ............................................................................................. 15
7 MONITORING PROGRAM ................................................................................................... 18
8 REPORTING AND AUDITING ARRANGEMENTS ............................................................. 19
9 BIBLIOGRAPHY ................................................................................................................ 20

### APPENDICES

Appendix A: Proposed Species for Seeding of Dunal and Heath Communities
Appendix B: Brush Harvesting Procedure (Enesar Consulting 2006)
1 INTRODUCTION

The ROC Oil pipeline project area is located within the Beekeepers Nature Reserve, approximately 20 kilometres south of Dongara in the Northern Sandplain region of Western Australia. Two pipelines transport oil from the Cliff Head oil field offshore to ROC Oil’s processing plant located immediately to the east of the Beekeepers Nature Reserve and injection water back to the offshore platform.

The pipelines were constructed and installed between the onshore plant site and the offshore production facility during 2005 and 2006. The pipeline was constructed and buried in a trench between the plant and a point approximately 400m east of the Indian Ocean high tide mark. This point is located behind the frontal dune system and was the position from which the pipelines were installed using directional drilling to achieve a shore crossing without impacting on the shoreline. This point was cleared (the Horizontal Directional Drilling (HDD) pad) to accommodate the drilling rig.

The pipeline easement is 50m wide with the clear and grade operation for pipeline construction comprising 20m Right Of Way (ROW) clearance along the pipeline on level ground, and approximately 36m width including batters to allow for excavation through the highest dune. In addition to the ROW for the pipeline construction and installation, an additional area of clearing was required to transport lengths of pre-welded high density polyethylene pipe from the ROW to the beach. This pipe was inserted back into the directionally drilled hole to act as a liner and allow the oil pipeline to be inserted safely beneath the frontal dunes.

Since construction of the pipelines, a need for maintenance activities has been identified. These activities may involve excavation to expose the pipe in discrete locations to enable repair works or replacement of pipe sections. Other activities and investigations, such as geotechnical investigations, may also be required to inform planning of repair works.

The pipeline traverses the Beekeepers Nature Reserve (vested for the purpose of conservation) and as such the project seeks to re-establish native vegetation over the pipeline easement following installation of the pipe and any maintenance or related works. This document addresses the requirement to produce a rehabilitation plan for the project and supersedes the original report released in 2006.

2 EXISTING VEGETATION

The pipeline corridor for the Cliff Head project runs east to west through the Beekeepers Nature Reserve, traversing two main plant communities as described by Woodman Environmental Consulting Pty Ltd (2003). These are:

T2: Thicket of *Melaleuca huegelii* subsp. *huegelii* and *Melaleuca cardiophylla* over *Acanthocarpus preissii* over mixed low shrubs and daisies on grey sand on dune crests

Plant community T2 was mapped on the crests of several narrow dunes within the proposed pipeline corridor. The cover of the vegetation was lower than in
surrounding areas due to wind exposure. These crests run into a large mobile dune north of the project area.

H1: Heath dominated by Melaleuca 'leuropoma and Melaleuca huegelii subsp. huegelii over a herb layer dominated by sedge and daisy species on grey sand with limestone outcropping

This plant community was mapped over the majority of the pipeline corridor on the plains between the dune systems. It was generally very uniform in cover and height although small patches of emergent Allocasuarina lehmanniana subsp. lehmanniana were present. Common understorey species included Baumea juncea, Lepidosperma pubisquameum and Rhodanthe citrina. It was the most diverse plant community mapped within the project area, with 64 species recorded.

An additional heath community is present behind the frontal dune that may require some rehabilitation effort as a result of the HDD liner pull operation, or should maintenance activities be required for this section of the pipe. This community is:

H2: Dense Heath dominated by Lepidosperma gladiatum, Scaevola crassifolia and Zygophyllum ?fruticulosum, with occasional taller shrubs, over herbs on white sand

Plant community H2 was mapped on the plain behind the foredune. It differed structurally from the heaths on the plains further from the beach. The plants here were shorter, probably due to greater exposure to wind. Occasional taller shrubs were present, including Acacia rostellifer x xanthina, Santalum acuminatum and Allocasuarina lehmanniana subsp. lehmanniana. This plant community was in excellent condition with a total of 37 species recorded.

H3: Low Heath dominated by Scaevola crassifolia, *Tetragonia decumbens and Myoporum insulare on white sand

This plant community was mapped in a very narrow strip on the ocean side of the foredune. Vegetation cover was low and sparse, with some weeds present. Only nine plant species were recorded.

Others
T2/H1: Mosaic of plant communities T2 and H1 on dune crests and swales

An area located between plant communities H2 and H1 was mapped as a mosaic unit. It was situated in an area of high topographical relief where the vegetation on the dunes and swales could not be separated. This area contained both plant community T2 and plant community H1 in small merging patches.

No Declared Rare Flora (DRF), Priority Listed flora species or Threatened Ecological Communities (TEC) were identified during the baseline studies for this project.

Introduced species were identified during baseline studies and areas of significant weed cover were recorded to ensure that appropriate weed hygiene measures could be implemented to protect the vegetation of the Nature Reserve. Remnant vegetation
between the plant site and the first dune system was identified as severely weed infested and worthy of quarantine and hygiene measures. Also, the fishing track that bisects the ROW at the HDD pad location was also identified as weed infested and requiring hygiene.

3 REHABILITATION OBJECTIVES

The following rehabilitation objectives have been set for this project based on the location of the project within Conservation Estate, the existing environment of the project area and the nature of the impact.

The following key objectives have been identified for the rehabilitation process:

1. Provide a stable soil profile that is the same as the pre-existing land surface, will not erode and will not impede surface water flows;
2. Provide a cover of indigenous plant species that is consistent with the vegetation immediately adjacent to the clearing and that provides for stabilisation of the soil surface and provision of habitat for fauna and flora species; and
3. Provide a cover of indigenous species that has weed species covers that are similar or less than surrounding areas.

4 REHABILITATION STRATEGY

The rehabilitation strategy for the pipeline corridor is as follows:

1. Conduct a benchmarking exercise to identify best practice methods for re-establishing coastal dune environments.
2. Prepare a rehabilitation plan.
3. Clear and stockpile vegetation and topsoil from the corridor separately.
4. On completion of pipe laying and backfilling, rip compacted work surfaces to 20-40cm depth.
5. Rehabilitate the corridor sequentially from the HDD pad back toward the plant site to avoid weed issues on machinery.
6. Rehabilitate areas where maintenance activities have been undertaken.
7. Re-construct dunes and contour corridor.
8. Respread topsoil over the cleared corridor.
9. Respread cleared vegetation over the cleared corridor.
10. Hand seed additional native species from the appropriate communities to improve early plant establishment.
11. Hand cut additional brush material from local Acacias and Melaleucas on adjacent private property and apply to the dunal areas utilising appropriate weed hygiene measures (Appendix B).
12. Do not apply fertiliser to reduce the establishment of weeds.
13. Complete earthworks prior to end April and seed and brush immediately.
14. Minor disturbances from the HDD liner pull operation and associated drilling areas will be addressed using rakes, brush matting and where required some broadcast seed.
15. Monitor all rehabilitation areas during the first spring post rehabilitation and annually until three years old at which point an assessment will be made of whether completion criteria have been met and whether additional remediation measures are required and also further monitoring that may be required.

16. Infill gaps with planted seedlings during early winter, with tree guards to be installed to protect from rabbits and desiccation.

17. Conduct weed control as required each winter/spring.

The use of brushing using local native material, especially Acacias has proven an effective technique for dune stabilisation. The brush matting can withstand strong winds and traps windblown sand which protects the seeds and seedlings, minimizes wind erosion, and creates a microclimate. Brushing has been used successfully in many coastal dune environments including in the dunes extending from White Hills to Tim’s Thicket, at Halls Head, Sorrento Beach etc.

4.1 Best Practise Benchmark

The techniques used to stabilise dune environments can involve a combination of engineering and natural solutions. The aim of this review is to outline the techniques that are currently being applied in dune restoration and to determine the best practice processes and methods for this site.

4.1.1 Review of Methods

Case study 1:
Dune restoration - White Hills to Tim’s Thicket. (Murray Love, Senior Operations Officer, Department of Conservation and Land Management, May 2005).

Procedures for restoring dunes:

- Development of a management/rehabilitation plan for the area
- Reinstate dunes and berms
- Brushing: this technique is an essential part of dune restoration but the hardest because large amounts of brush are required to stabilise the dune surface, and the brush is not always readily available near the source. Brushing was used on bare surfaces, on areas that are being eroded by wind or on dunes that are actively moving. The purpose of brushing is to break up the strength of the wind and to trap sand movement thereby stabilizing the dune. Only brush from native species is used, to prevent the potential spread of introduced species. *Acacia rostellifera* is an ideal species to use as it holds together well, it regenerates readily, is a small shrub, and it won’t flatten out (i.e. it stands up once laid and traps sand and breaks up wind). Brush of approximately 2 metres long is used. Brushing can be done at any time of year. Jute matting is effective and can be used, particularly on frontal approach near the beach. Seaweed is also a very effective brushing material.
- Planting: primary dunal species and secondary dunal species were used appropriately on dunes. Planting was carried out once the sand on the dune was saturated. Native seedlings that were purchased and grown by Men of the Trees were planted on the dunes.
- Sites are revisited for many years to come, with infilling of plants undertaken if required, rebrushing may be needed or a berm may need to be rebuilt with machinery.
- Weeds are not normally a major problem, and the weeds that are there act as a stabilizer for the dunes.
- Rabbits are often a major problem and 1080 is used to control them. Tree guards have not been used because in such hostile environments their effectiveness is not guaranteed to work effectively, and are very expensive.
- Process of dune restoration is very expensive. Up to $10,000 per hectare to rehabilitate.

Case study 2:
Dune restoration - Town of Cambridge comprising Floreat Beach, City Beach, Swanbourne Beach and Scarborough Beach. (David Merritt, Botanic Parks and Garden Authority, May 2005).

Procedures for restoring dunes:

- Weed control: For woody weeds such as Victorian Tea Tree chainsaws and saws were used to cut them out, and herbaceous annuals and perennials are sprayed with herbicide. Weed control is generally carried out in May, before the rains and before planting commences.
- Stabilisation: The dunes were protected from wind erosion by using jute matting (comprised of coconut fibres). The matting, which traps sand and keeps some of the weeds from invading, is rolled onto the dunes. The matting degrades over a period of 2-3 years and the plants can be planted through the matting. The Coast Care group avoids using brushing on the dunes and discourages its use because it ends up as a dumping ground and the wood doesn’t break down because the sand is so sterile, and it doesn’t stabilize the dunes that well.
- Planting: The dunes were planted using local provenance species. The group collects their own seed in Nov-Dec as well as propagating by cuttings and have plants grown up in a nursery. Approximately 12 000-14 000 plants per year are planted comprising about 15 species over 3-4 dunes that measure approximately 30x30 square metres. Planting is carried out in early June, and is not usually followed up with irrigating as it is too expensive. A 40-50% survival rate is achieved without irrigation. Direct seeding has not been used because they have found that the broadcast success is low (approximately 10–15 % survival). Green stock of plants that are about 6 months old is used.
- Rabbits are a major problem and the Coast Care group is currently involved in some baiting trials. Tree guards could be installed around each plant but this greatly increases the amount of time it takes to plant and being a community group with volunteers the resources aren’t available.

Case study 3:
Cable Sands Minninup Sand Mining Proposal – mining of beach and primary dune.

Procedures for restoring dunes:

- Dunes to be stabilized by replacing topsoil, plant debris and brush matting. Vegetation and topsoil (15-20cm) removed from mine path and re-spread over
the rebuilt dune immediately. The vegetation is replaced as a layer of bushes, branches and debris, forming a wind barrier over the soil surface.

- Brushing: Additional brushing if required will be cut on-site, pine cuttings may be used.
- Planting: Most plants will regenerate from seed contained in the topsoil, but there will be supplementary hand seeding. Hand planting of seedlings and cuttings is undertaken, at a density of approximately 3 plants per 10 square metres, and runners of native dune grasses collected prior to mining will be hand planted.
- Straw bales have been used to reduce windspeeds at the dune surface, however this is not recommended as weed infestations result.
- Use of fertilisers to promote early growth.

Rehabilitation monitoring by Cable Sands in secondary dunes have found that the majority of rehabilitation is successful with the replacement of topsoil and no other action. Planting of seedlings enhances rehabilitation and can be used to ‘fill in’ gaps in natural regeneration. Hand planting of trees has a high success rate and applying fertilisers is advantageous as it promotes growth of seedlings.

Case study 4:

Mineral sands mining at Eneabba (RGC Mineral Sands and Iluka Resources Pty Ltd)
– Mining and rehabilitation of Kwongan plant communities on Aeolian Dunes on ancient beach deposits (not currently coastal).

Procedures for restoring dunes:
- The topsoil is stripped from the mining path and spread onto the contoured tailings. This task is completed by the end of April to allow time to mulch and seed (using native seed) before the break of the winter season at the end of May. Studies indicate that the topsoil contributes significantly to plant densities and species diversity.
- Mulching: The mulched vegetation is then collected and spread onto areas where the topsoil has been spread. Mulching provides a seed source and assists in the stabilization of the soil surface. Studies indicate that mulching adds to plant density and species diversity but returns a different suite of species in contrast to the topsoil.
- A cover crop of sterile oats is sown using a seed drill and a fertiliser applied.
- A seed mix of native species is broadcast with additional fertiliser, and spot seeding using the Leggate spear is used to selectively sow larger seeded species. Studies have indicated that the best results are achieved when all seed is sown by end of May. Bradysporous species regenerating from mulch and direct seeding dominate in the first couple of years, and easily germinate in the rehabilitated areas. Trials undertaken on collected native seed confirms that many of the soil-stored species do not readily germinate. Seed that is broadcast contributes to species diversity but does not significantly affect plant density.
- Densities of Restionaceae and Cyperaceae are significant in the native vegetation but don’t return in sufficient numbers in rehabilitated areas. Research into this was undertaken focusing on *Ecedeiocolea monostachya*, *Lepidobolus chaetocephalus*, *Restio sphacellatus*, and *Mesomelaena*
pseudostygia. Results indicated that total seed production and quality of seed is poor for these families, and that unfavorable weather conditions resulted in further decline of the total number of seeds.

Case study 5:
North Stradbroke Island (AMC) aeolian high dunes of sclerophyllous heath, scrub and forest vegetation and extensive frontal dune system.

Procedures for restoring dunes:

- The topsoil was spread onto the recreated landform.
- Planting of a cover crop and native seed mix, which was determined by pre-mining densities, seed variability, seed size and seasonal establishment rates. Seed is usually broadcast on the surface. Supplementary seeding carried out where necessary by ‘spot-seeding’ technique. Direct seeding techniques proven so successful in rehabilitated areas that the use of nursery stock has been reduced to a back-up activity. It was found that the majority of shrubs and ground cover species regenerated from topsoil. The seeds of large shrubs and tree species failed to survive and needed to be collected for direct seeding or to raise nursery stock. Studies indicated that Autumn sowings were the most successful.
- Post-mining rehab of frontal dunes based on direct seeding of sand spinifex grass. Up to 15000 kg of sand spinifex grass seedheads were hand harvested and threshed annually with seed sown in rows approx 1m apart and 10 cm deep at rates of approx 50 kg/ha.
- Fertilise for the first two years for rapid establishment. Hand picked seeds of Acacia sophorae and minor herb species broadcast. To break up the pods of the Acacia seeds they were threshed through a hammer mill, sieved and floated, treated with boiling water. Fleshy fruited species including pigface and fanflower, fruits were crushed and fermented in water. Seed was then washed and dried prior to storage.

Direct seeding was favored over planting nursery stock because: more natural spatial distribution of seedlings; more natural root development leading to better seedling growth; better seedling survival under harsh conditions; and more economically viable.

Case study 6:
Rehabilitation in the high dunes at Bridge Hill Ridge, central coast of New South Wales, J.W. Lewis (1986).

Mineral sands mining commenced in the Myall Lakes region in 1974. The site comprised a forested dune up to 120 metres high and extended 12 kilometres.

Procedures for restoring dunes:

- Prior to the mining operation commencing, seed was collected from all tree species and some understory species in the mining path. It was later used for direct seeding and nursery stock.
- The vegetation was cleared, heaped and burnt, and the topsoil removed ready for use on the mined areas.
- To recreate the dunes after being mined, excess water from the tailings sand was drained and contoured by a bulldozer to pre-mining dune heights. It was not considered possible to restore dune slopes greater than 25 degrees. A series of bores were installed near the bottom of the dune to eliminate the risk of tailings slumping and eroding. The water was extracted and pumped away.
- The topsoil was spread onto the newly recreated dunes.
- A cover crop of sterile hybrid sorghum was planted initially on the replaced topsoil. This reduced solar radiation and wind velocity at soil surface thereby allowing the native plants to emerge. A fertiliser mix (comprising 10.5% N, 3.9% P, 3.7% K and the trace elements copper, zinc and molybdenum) was applied at rate of 400 kg/ha.
- The majority of understorey species germinated rapidly and naturally from the seed in the topsoil. The densities of understorey species varied annually, with some declining due to conditions of rehabilitation being unfavourable (ie. high solar radiation levels and surface temperatures and periods of drought). The seeds of species that were known to not germinate readily from the topsoil as well as some selected understorey species were broadcast. Some seeds were planted individually.
- Mulching: The mulched native vegetation was spread onto the crest of the dune and on some of the rehabilitation areas cut branches with seed capsules of tree species were spread. The fleshy roots of Macrozamia were planted.
- Planting: In the first Autumn after 12 months had past since the topsoil was spread, nursery stock of tree species were planted on rehabilitated areas to supplement plants that had established naturally and to take advantage of favorable growing conditions. Supplementary plantings were made at the appropriate time of year where deficiencies in densities were indicated by monitoring.
- Wind erosion was found to be a problem due to the height of the dune, and to control this temporary plastic weldmesh fences were assembled on the newly planted areas to protect the young growth in the early years of rehabilitation.
- Weeds were controlled by spot spraying and regular hand-pulling for coastal weeds such as bitou bush, and the number of weeds such as flatweed were found to decline in numbers as the fertility levels in the topsoil returned to natural levels.
- Samples of the topsoil were collected nearly 20 years post-mining and indicated a total phosphorus range of 11-26.5 ug/g, compared to pre-mining range of 11-28 ug/g.

4.1.2 Successful Methods
Techniques for dune stabilization and restoration that have not proven successful include the use of hay bales at the Minninup Beach mineral sands mine. However, this review has identified methods that have proven useful in stabilizing and regenerating dunal environments in a range of locations. The following recommendations comprise “Best Practise” in current dunal rehabilitation in Australia.
Pre-mining or excavation
Prior to the dunes being excavated, the existing vegetation should be removed and
stockpiled, and the topsoil should be stripped to a depth of 10cm for use in
rehabilitation of the dunes once they have been recreated. These materials should be
re-spread as soon as possible in order to maintain seed viability and soil fertility.

Recreating the dune
The three dunes will need to be recreated by replacing the sand back into the dune
void. The seaward face of rebuilt dunes should not exceed 25 degrees (unless the
natural face is steeper than this) otherwise the dune face becomes more prone to wind
erosion, slumping, and maintaining the vegetation will be more difficult.

Use of topsoil
It is recommended that the topsoil stockpiled from the excavated dunes be re-spread
onto them as soon as possible once recreated. This task should be completed by the
end of April to allow time to spread the vegetation and plant in time for the winter
season. The existing vegetation cleared from the excavation pathway should also be
spread onto the dune after the topsoil has been spread.

Stabilisation
The dune surface should be stabilised as quickly as possible after recreating the dune.
It is recommended that brushing be used to stabilize the dune, using the locally
occurring native species Acacia rostellifera, Melaleuca cardiophylla and Melaleuca
huegelii subsp. huegelii. These are ideal species to use because they occur locally and
are very common, they hold together well, they regenerate readily, and the mulch
material stands up once laid thereby trapping sand and acting as an effective
windbreak. These species are found on all dunes in the area and are a local source of
seed in the dunes. The brush matting can withstand strong winds and traps
windblown sand which protects the seeds and seedlings, and creates a microclimate
therefore making it an ideal technique for dune stabilisation. Brush material of
approximately 2 metres long is recommended. Brushing can be done at any time of
year. An additional benefit of brushing is that it provides habitat for fauna.

Planting
The rehabilitation of the dunes should only use locally occurring native species.
Planting should only be carried out if regeneration from topsoil, mulch and seeding
does not provide adequate plant densities. Planting should be carried out when the
sands are saturated, usually in early June. To supplement plants that establish
naturally from the topsoil, nursery stock of tree species should be planted on the
rehabilitated areas in Autumn. In-fill planting will not occur without prior
consultation and agreement with the Department of Parks and Wildlife (DPaW).
Investigation into the soil conditions prior to planting will be conducted following
failure of seedling plantings on the eastern end of the ROW in 2012 where non-
wetting conditions were thought to have caused the deaths.

Feral animal control
Rabbits are likely to be a problem at the site and it is recommended that tree guards to
a height of one metre be installed around each planted seedling to assist their survival.
Fertilising
Fertiliser will only be applied to planted seedlings in the form of a DAP pellet buried under the seedling. This will reduce competition from weeds.

Irrigation
Irrigation will not be used to establish the rehabilitation. Plants grown from seed without the aid of fertilizer or irrigation develop better root systems and survive better in the long term without such aids.

5 REHABILITATION METHODS

Rehabilitation of the pipeline ROW will be integrated with all project activities and objectives.

5.1 Weed Management
Weed infested areas have been mapped and a weed hygiene protocol established for the operation that identifies hygiene points designed to minimise the introduction of weeds from the pipeline construction, maintenance and operations.

Weed covers and species will be included in rehabilitation monitoring to facilitate management of weed issues following completion of the rehabilitation. Annual monitoring results will be used to develop weed management programs in consultation with DPaW.

Weed hygiene will be implemented during all operations in accordance with the Weed Hygiene Protocol in the Environmental Management Plan (EMP) for the operation.

5.2 Dieback (*Phytophthora cinnamomi*) Management
The project area was surveyed by two experienced interpreters for the presence of symptoms of plant disease caused by *P. cinnamomi* during October 2003.

The survey focused on areas that were most at risk of containing the pathogen through a history of human access such as tracks and previous operational areas. These areas were inspected on foot for symptoms of plant disease and samples of soil and plant material collected for analysis. Four samples were collected within the project area and analysed for the presence of *P. cinnamomi* by the Vegetation Health Service laboratory at the Department of Conservation and Land Management (now DPaW). The project area was found to be uninterpretable for the presence of *P. cinnamomi* as a result of the coastal soil type and lack of indicator species in the plant communities (Woodman Environmental Consulting Pty Ltd 2003).

Interpretation of the corridor and assessment of the values of the project area indicated that the project area should be treated as a Protectable area (Department of Conservation and Land Management 2003b). Therefore, hygiene management will be in accordance with the Dieback Hygiene Protocol for the project and will include the following provisions:

1. All vehicles and machinery will arrive at the project area in a clean state free from soil, mud, soil slurry and vegetation material.
2. Soil and vegetation stripped from the ROW will be stored immediately adjacent to the site where it originated.
3. No soil or vegetation material will be transported along the corridor.
4. Any material to be imported to the pipeline ROW, eg. Pipe padding, must be certified to be free from *P. cinnamomi* to the satisfaction of DPaW.
5. Hydrotest water will not be released to the ROW, but disposed of in a manner acceptable to DPaW and in a location that will not compromise the hygiene status of remnant native vegetation.

5.3 **Resource Management**

Native vegetation on the easement is a valuable resource for the rehabilitation process in that it provides seed, carbon material, stabilises the soil surface, cools the soil surface, provides habitat for fauna and provides micro habitats for capturing additional seed dispersing from adjacent vegetation.

Vegetation will be cleared and stored in a windrow adjacent to the ROW or work area and immediately adjacent to where it was cleared from. This will ensure that respread vegetation will be located in the appropriate vegetation type and position in the landscape to make best use of any remaining seed stored on the stems.

Topsoil is an essential component of a successful rehabilitation program as it contains the majority of the naturally stored seed for the existing vegetation that propagate using seed as their prime strategy. Topsoil will be removed using a grader that will cut the top 50 to 100mm of soil and store it in a windrow on the ROW edge immediately adjacent to where it was removed from. For areas of excavation associated with maintenance activities the topsoil will be removed to 100mm depth utilising machinery best suited to the topography and working area size. Machinery and methods will be documented and discussed with the DPaW prior to commencing works. This will ensure that topsoil is respread within the appropriate position in the landscape and vegetation type. Topsoil will not be picked up and moved along the easement. Topsoil will not be used for padding in the pipe trench. Topsoil will not be driven on or disturbed in any way prior to being respread on the ROW. During maintenance activities, the requirement for clearing of topsoil will be assessed on a case by case basis. If topsoil removal is required it will be stockpiled adjacent to the work area.

5.4 **Soil Profile and Landform**

Trench spoil will be removed and stored in a windrow adjacent to the trench. Following installation of the pipe, the trench will be backfilled and compacted. The surface of the ROW will then be graded to original surface contours and lightly ripped to a depth of 40cm to alleviate any compaction from vehicle and machinery movement. Ripping on contour will not be possible due to the constrained width of the ROW, however shallow ripping with narrow tines should not result in the generation of deep furrows and a light drag bar will be utilised behind the machine to smooth the final surface.

Topsoil will be graded evenly back over the ROW following ripping, ensuring that topsoil is not transported along the easement.
5.5 Establishment of Native Vegetation

Native vegetation will be established on the easement utilising the following methods:

1. From the topsoil seedbank (geospores).
2. From plant stored seed (bradyospores).
3. From applied seed.

Additional brush material in the form of *Acacia rostellifera*, *Melaleuca cardiophylla* and *Melaleuca huegelii* subsp. *huegelii* harvested from adjacent private property or firebreaks will be used to provide additional stabilisation and seed on all dune areas. Brush material will be hand cut and placed on the rehabilitated dune fronts, crests and steep slopes on the ROW and liner pull areas immediately after completion of topsoil replacement and mulched vegetation return. Appendix B contains the brush harvesting procedure developed for this project by Enesar Consulting in consultation with Woodman Environmental.

Species lists have been compiled from the ROW studies to generate seed mixes for application to the woodland sections of the easement. Trees are considered a threat to the integrity of the pipeline. Seed for these mixes must be collected from the communities immediately adjacent to the project area to ensure correct provenance.

The proposed seed mix for each area is presented in Appendix A. The seed mixes will be applied at a rate of 5kg/ha to promote a high initial establishment rate.

Seed will be spread on all disturbed areas including the ROW, the HDD pad and the liner pull tracks. Seed mixes will be spread in accordance with the vegetation map presented in Woodman Environmental Consulting Pty Ltd (2003).

6 COMPLETION CRITERIA

Completion Criteria for the pipeline corridor addresses a wide range of issues including soil stability, weeds, disease, and plant regeneration. The criteria do not address the issue of biodiversity on the corridor as it:

i. is narrow;
ii. does not reduce the distribution of native vegetation;
iii. does not reduce the distribution of any of the species in the area; and
iv. does not directly pose a threat to biodiversity in the Nature Reserve.

The primary issue relating to the corridor is unsatisfactory regeneration, indirectly resulting in habitat fragmentation, or introduction of weeds or disease. Therefore the completion criteria for plant regeneration focuses on replacing live native plant cover to reduce risks of weed invasion, third party access and habitat fragmentation. Regeneration of the corridor should allow the previously dominant species of each affected plant community to re-establish and provide suitable cover to reduce the risks mentioned above and to provide the habitat necessary for the full biodiversity of each community to return on the affected area.
Keystone species are those that provide the greatest proportion of cover and are the most common within a plant community. These species form the structural basis for the community and the habitat it provides. This report primarily addresses the development of completion criteria relating to the regeneration of keystone species on the corridor and also identifies completion criteria for the functional aspects of the project along with a monitoring program.

6.1 CRITERIA DEVELOPMENT

6.1.1 Landform (Soil Stability) Criteria

Areas within the pipeline corridor boundary contain soils prone to erosion from wind and water. Excavation of the north to south running sand dunes for pipeline installation will create areas prone to erosional forces.

Soil stability is determined by many factors including soil type, slope length, exposure to eroding forces (wind and water) and vegetation cover, therefore regeneration is critical to the long term stability of the soils in the area. Completion criteria for soil stability focus on areas at risk of erosion, primarily sandy soils on slopes. The criteria include targets for maximum length of bare patches and width and length of rills in erosion prone areas.

6.1.2 Vegetation (Weed and Phytophthora Disease) Criteria

Woodman Environmental have mapped the areas of weed infestation within nature reserve inside the project area, and this map forms the basis of completion criteria in future monitoring. Phytophthora disease has not been observed in the project area. There will not be active monitoring of this aspect, however, should symptoms of Phytophthora disease be observed during monitoring of other completion criteria such as vegetation regeneration, samples will be collected and analysed by an appropriately qualified person and the source of disease introduction identified where possible. Monitoring of weed management criteria will focus on sites susceptible to weed invasion. Monitoring will involve a visual assessment of weed cover.

6.1.3 Vegetation Criteria

Keystone species for plant communities to be cleared are based on data collected during the plant community mapping of the project area. Descriptions of species dominance, strata, soils, slope and fire history have been recorded for each site in each plant community.

Site data was analysed to identify the average percentage foliage cover and frequency of recording for each species in each plant community. This data was then collated to identify those species in each plant community that contribute the greatest average percentage foliage cover for each community and were found to be present at greater than 50% of sites assessed in each community. From each plant community between 4 and 7 species that conformed to the above criteria were selected and are presented in Table 1.
Table 1: Keystone Species for Plant Communities

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Keystone Species</th>
</tr>
</thead>
</table>
| T2: Thicket of *Melaleuca huegelii* subsp. *huegelii* and *Melaleuca cardiophylla* over *Acanthocarpus preissii* over mixed low shrubs and daisies on grey sand on dune crests | *Melaleuca cardiophylla*  
*Melaleuca huegelii* subsp. *huegelii*  
*Acacia rostellifera*  
*Conostylis candidans* subsp. *calcicola*  
*Acanthocarpus preissii*  
*Melaleuca systena* |
| H1: Heath dominated by *Melaleuca ?leuropoma* and *Melaleuca huegelii* subsp. *huegelii* over a herb layer dominated by sedge and daisy species on grey sand with limestone outcropping | *Melaleuca leuropoma*  
*Melaleuca systena*  
*Melaleuca huegelii* subsp. *huegelii*  
*Allocasuarina lehmanniana*  
*Acacia pulchella* var. *pulchella*  
*Acacia rostellifera*  
*Desmocladus asper* |
| H2: Dense Heath dominated by *Lepidosperma gladiatum*, *Scaevola crassifolia* and *Zygophyllum ?fruticulosum*, with occasional taller shrubs, over herbs on white sand | *Allocasuarina lehmanniana* subsp. *lehmanniana*  
*Lepidosperma gladiatum*  
*Santalum acuminatum*  
*Melaleuca huegelii* subsp. *huegelii*  
*Melaleuca systena*  
*Scaevola crassifolia*  
*Zygophyllum ?fruticulosum* |
| H3: Low Heath dominated by *Scaevola crassifolia*, *Tetragonia decumbens* and *Myoporum insulare* on white sand | *Spinifex longifolius*  
*Atriplex cinerea*  
*Scaevola crassifolia*  
*Myoporum insulare*  
*Olearia axillaris* |

6.1.3.1 Foliage Covers and Keystone Species at 3 Years

Three years was selected as an appropriate milestone at which regeneration of the corridor or areas disturbed during maintenance activities should be assessed for initial success. At this time, agreement could be reached on future management of the corridor with respect to applying active rehabilitation techniques. Three year old regenerated seismic lines currently exist within the Beekeepers Nature Reserve, and these have been used to develop appropriate completion criteria for 3 year old regenerated lines from the Denison 3D Seismic Survey (Woodman Environmental Consulting Pty Ltd 2004). That data has been used to provide a baseline for the rehabilitation of this pipeline corridor.

Quadrats measuring 2m x 2m were established along regenerating seismic lines within the plant communities rolled for the Denison 3D Seismic Survey. Twenty quadrats were established within each plant community and percentage foliage cover of all species and also combined keystone species recorded.

Individual species criteria will not be utilised, as it is unrealistic to set goals for specific species where knowledge of the vegetation establishment and recovery processes is limited. Therefore, in line with the objective of the regeneration process...
to provide closure of the lines and vegetation cover including keystone species for each community, the completion criteria assign foliage cover targets for total native species with representation of a bulked mixture of identified keystone species for each community.

Collection of data on three year old regenerating seismic lines identified several communities that may benefit from additional rehabilitation effort.

### 6.2 COMPLETION CRITERIA

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Objective</th>
<th>Criteria</th>
<th>Assessment method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operations</strong></td>
<td>To ensure that the key commitments that will influence success of the rehabilitation are implemented during field operations</td>
<td>100% compliance with the weed hygiene protocol</td>
<td>Audit during the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100% compliance with the dieback hygiene protocol</td>
<td>Audit during the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Width of clearing as per project approval.</td>
<td>Audit during the project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All vegetation and topsoil handling processes are complied with.</td>
<td>Audit during the project</td>
</tr>
<tr>
<td><strong>Decommissioning</strong></td>
<td>To ensure that all visual disturbances are removed by immediate remedial action to the greatest extent practicable</td>
<td>No litter or other project related materials remain in the project area</td>
<td>Audit on completion of the project construction and rehabilitation works Visual inspection</td>
</tr>
<tr>
<td><strong>Landform</strong></td>
<td>To reinstate the land to provide suitable conditions for natural recolonisation of native vegetation</td>
<td>Natural contours should be re-instated to pre-disturbance conditions</td>
<td>Audit on completion of the project construction and rehabilitation works Visual inspection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There should be no active erosion rills greater than 10m x 0.1m</td>
<td>GPS record and physical measurement of any points of erosion to be monitored after winter rains annually until year 3</td>
</tr>
<tr>
<td>Aspect</td>
<td>Objective</td>
<td>Criteria</td>
<td>Assessment method</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Vegetation</td>
<td>To facilitate the regeneration of dominant plant species within each vegetation type</td>
<td>There should be no bare patches larger than 10m x 2m after 12 months</td>
<td>Visual assessment, with particular emphasis in erosion prone areas – monitored annually</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The foliage cover of environmental weeds on rehabilitated areas should</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>be similar to surrounding undisturbed areas after year 3, with no Declared weed species present</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total vegetation percentage cover should be 10% after 3 years (refer to table 3)</td>
<td>Plot assessment of a representative number of sites within each vegetation type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Keystone species within each vegetation type should be represented in &gt; 90% of monitoring plots (frequency) within three years (refer to table 3)</td>
<td>Plot assessment of a representative number of sites within each vegetation type</td>
</tr>
</tbody>
</table>

Table 3 presents vegetation completion criteria applicable to each plant community at 3 years old. No seismic lines through communities H2 and H3 were assessed in developing these completion criteria and as such rehabilitation of these communities will be managed using the same completion criteria as presented in Table 3. Monitoring of rehabilitation success will identify where additional remedial activities are required.
Table 3: Plant Community Specific Completion Criteria

<table>
<thead>
<tr>
<th>Plant Community</th>
<th>Average Foliage Cover*1 (%)</th>
<th>Frequency of Keystone Species (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Field Data</td>
<td>Proposed Criteria</td>
<td>Field Data</td>
</tr>
<tr>
<td>T2</td>
<td>11.9</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>H1</td>
<td>14.8</td>
<td>10</td>
<td>100</td>
</tr>
</tbody>
</table>

*1 Total cover of native species averaged across all quadrats in that community.
7 MONITORING PROGRAM

Table 4 presents the proposed monitoring/audit program and schedule for completion criteria.

Table 4: Monitoring Program

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Assessment Method</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LANDFORM</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural contours should be re-instated to pre-disturbance conditions</td>
<td>Visual inspection of survey lines</td>
<td>Final audit on completion of field operations with results included in close-out report.</td>
</tr>
<tr>
<td>There should be no active erosion rills greater than 10m x 0.1m</td>
<td>GPS record of locations and physical measurement (regular monitoring) of any points of erosion</td>
<td>Visual inspection of erosion prone areas in winter following re-instatement. Results to be reported to DPaW/DER in annual environmental report.</td>
</tr>
<tr>
<td>All entrances to pipeline corridor should be disguised towards deterring third party access</td>
<td>Visual inspection</td>
<td>Visual inspection adjacent to public access. Results to be reported to DPaW/DER in annual environmental report.</td>
</tr>
<tr>
<td><strong>VEGETATION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There should be no bare patches larger than 10m x 2m after 12 months</td>
<td>Visual assessment</td>
<td>Visual inspection of erosion prone areas in winter following re-instatement. Results to be reported to DPaW/DER in annual environmental report.</td>
</tr>
<tr>
<td>Foliage cover of declared and environmental weeds on rehabilitated seismic lines should be similar to undisturbed areas</td>
<td>Visual assessment of weed species presence and percentage cover</td>
<td>Visual inspection of weed prone areas in winter following re-instatement. Results to be reported to DPaW/DER in annual environmental report.</td>
</tr>
<tr>
<td>Total vegetation percentage cover should be 10% after 3 years (refer to table 3)</td>
<td>Plot assessment of a representative number of sites within each vegetation type</td>
<td>Establishment of plots in Spring following re-instatement. Plots to be monitored annually in spring with results reported to DPaW/DER in annual environmental report. Annual environmental report 3 years following re-instatement to include an assessment of completion criteria and recommendations for areas not meeting criteria.</td>
</tr>
<tr>
<td>Keystone species should be represented in &gt; 90% of monitoring plots within each vegetation type within three years (refer to table 3)</td>
<td>Plot assessment of a representative number of sites within each vegetation type</td>
<td>Establishment of plots in Spring following re-instatement. Plots to be monitored annually in spring with results reported to DPaW/DER in annual environmental report. Annual environmental report 3 years following re-instatement to include an assessment of completion criteria and recommendations for areas not meeting criteria.</td>
</tr>
</tbody>
</table>
8 REPORTING AND AUDITING ARRANGEMENTS

All results of the monitoring program detailed in Table 4 will be reported to DPaW Department of Mines and Petroleum, Environmental Protection Authority and the Department of Environment Regulation (DER) in Annual Environmental Reports (AER). The commitments in this document will be included in the Commitments Register for the Cliff Head Project and then reported against (audited) in each AER.
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Appendix A  Proposed Species for Seeding of Dunal and Heath Communities

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>DUNAL COMMUNITY</th>
<th>HEATH COMMUNITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acanthocarpus preissii</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Allocasuarina lehmanniana subsp. lehmanniana</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Santalum acuminatum</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Muehlenbeckia adpressa</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Rhagodia baccata</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Threlkeldia diffusa</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Gyrostemon ramulosus</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Clematis linearifolia</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Acacia cyclops</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Acacia pulchella</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Acacia rostellifera</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Acacia rostellifera x xanthina</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Gompholobium tomentosum</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Hardenbergia comptoniana</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Nemcia pauciflora</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Zygophyllum billardierei</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Zygophyllum fruticulosum</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Comesperma confertum</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Spyridium globulosum</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Hibbertia subvaginata</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Melaleuca cardiophylla</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Melaleuca huegelii subsp. huegelii</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Melaleuca systena</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Hemiandra pungens</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Anthocercis littorea</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Myoporum insulare</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>Myoporum tetrandrum</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Goodenia berardiana</td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

The above species list was compiled from species recorded in the communities along the ROW and adjacent vegetation. Seed for all species on this list may not be available.
Appendix B  Brush Harvesting Procedure (Enesar Consulting 2006)

The project area for the Roc Oil Cliff Head Development is located approximately 20km south of Dongara, Western Australia, and stretches inland from the coast for approximately 3.5km (see Figure 1). The project involved the construction of a new oil processing plant within an area previously used for the processing of lime sand by WestLime (WA). An oil pipeline was also constructed to transport oil from Roc Oil’s oilfields off the coast of Dongara to the new onshore processing facility.

The project area is located within the Northern Sand Plain Region, Irwin Botanical District, as described by Beard (1990). The vegetation is characterised by a mosaic of *Acacia rostellifera* thickets on the sand ridges and low heath communities of *Acacia* and *Melaleuca* species on the flats (Beard 1979). Vegetation survey conducted by Woodman Environmental in the spring of 2003 further classified the area into eight vegetation types; six plant communities, one mosaic unit and one disturbance unit. Details of these classifications are given in Figure 1.

More specifically, the area in which clearing will take place is identified on Figure 1. The plant community in this area is characterised by thickets of *Acacia rostellifera*, *Acacia rostellifera x xanthina* and *Melaleuca* species over mixed shrubs on grey sand with occasional limestone outcropping. The area where the proposed clearing will take place has been modified by grazing and human activities. Compared to adjacent, relatively pristine, areas (marked as unit T1 on Figure 1) the area in which clearing is proposed has a greatly modified understorey with high weed cover.
Because of the nature of the clearing, only pruning for brush collection is required as opposed to broad scale clearing (see section 3.2), it is hard to provide an estimate of the area of clearing proposed. It is anticipated that a 1:1 ratio of clearing to rehabilitation area will be sufficient to supply the brush required.
Method of clearing and proposed disposal of vegetation

Clear felling is not required as the clearing proposed is for the purpose of providing brush for dune rehabilitation of the ROW or areas disturbed during pipeline maintenance activities. A limited number of plant species will be targeted for pruning to supply this brush; *Acacia rostellifera*, *Melaleuca huegelii* and *Melaleuca cardiophylla*. These species are common to this area and are resilient to perturbation.

Clearing will be carried out on foot using hand-saws and secateurs. Only branches will be taken from each individual and it is anticipated that not more than 10% of the canopy of any individual will be removed. Clearing will be undertaken in a manner that avoids the decimation of any individual plant. Clearing will be avoided in areas that are sensitive to erosion, such as the dune faces. In addition pruning of obviously stressed individuals will be avoided.

One of the major concerns is preventing the spread of weeds from the area where brush will be collected into Beekeeper’s Nature Reserve. In order to prevent the spread of weeds, cut brush will not be allowed to touch the ground at any stage until it is applied to the dunes to be rehabilitated. Weed hygiene both for vehicles and people will be carried out according to standard practices, as detailed later in this procedure.

On the job training in pruning methods, weed hygiene and species identification will be carried out by experienced personnel.

Purpose of Clearing

The purpose of this clearing is to provide additional vegetative matter to assist in the rehabilitation of dune faces disturbed during pipeline laying or disturbance associated with maintenance of the pipeline for the Cliff Head development. The vegetation cleared during pipeline laying has been returned to the dunes. Figures 2 to 4 show the pipeline easement after initial remediation. Note that the dune faces have little to no vegetation coverage. The flat, inter-dunal area does have some coverage however this is not thought to be adequate to prevent wind erosion.
Photos of Pipeline easement to be rehabilitated
The following photographs show the areas of pipeline easement that require further brush.

![Figure 2: Pipeline easement showing rehabilitation attempts. Note the lack of vegetation spread on the dune face at the end of the easement view.](image1.jpg)

![Figure 3: View of pipeline easement from track looking towards the coast](image2.jpg)
Weed Management Guidelines for Dune Rehabilitation Brush Cutting
Control of weeds is based on the prevention of weeds entering unaffected areas. This control is particularly important for the current rehabilitation exercise as additional vegetative material is being collected from an area of known weed infestation and will be placed in an unaffected area. To prevent the spread of weeds there are three main areas of focus:

- Preventing branches from picking up weed seeds from the collection area
- Ensuring that vehicles used are weed free before entering unaffected areas
- Ensuring workers are weed free before entering unaffected areas.

All crew are to be advised of the importance of weed control and the procedures to be implemented for weed control in this instance prior to undertaking any clearing. To ensure that the branches used for the rehabilitation works are not a source of weeds no branches will be allowed to touch the ground during collection. Branches will be cut and then placed directly onto the vehicle used to transport the branches. This vehicle will be thoroughly cleaned before its use for this purpose.

All vehicles will be subject to wash down on the hardstand area designated for this purpose before they travel east of the staging area, into the area to be rehabilitated. This
cleaning process is to remove all plant and soil material. Vehicle wash down will follow Roc Oil standard operating procedures for the wash down area. All crew are to ensure that clothing and footwear are free of seeds or any other plant or soil material prior to entering the area to be rehabilitated.