Barrow Island - WA Oil Prescription for the Rehabilitation of Disturbed Areas

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Barrow Island - WA Oil

Prescription for the Rehabilitation of Disturbed Areas

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1 Introduction

Chevron Australia Pty Ltd (Chevron) is the Operator of the Barrow Island (BWI) oil and gas operations on behalf of the Barrow Island Joint Venture (BWI JV). BWI is located off the north-west coast of Western Australia and has supported oil production facilities since 1967. Past and current activities on BWI have disturbed areas to varying degrees, ranging from driving over vegetation, to clearing of vegetation and excavation of the soil profile. Disturbed areas that are no longer required for operational activities (termed “legacy” sites) will be progressively rehabilitated. An area is deemed to be disturbed if anthropogenic activities have directly, or indirectly resulted in the loss, or reduction in extent of vegetation within an area.

1.1 Purpose

This prescription addresses rehabilitation activities that follow decommissioning and site remediation. It sets out a detailed process for assessing and rehabilitating disturbed sites on BWI. This rehabilitation prescription:

- Outlines the principles considered important in promoting the development of a sustainable rehabilitated landscape and associated ecosystem on BWI
- Describes the objectives for rehabilitation on BWI
- Details methodologies for rehabilitation works to be considered in the development of specific site rehabilitation plans
- Describes the monitoring program to assess the development of the rehabilitation
- Provides Completion Criteria against which rehabilitated areas will be compared for sign off as ‘completed’.

2 Background

2.1 Barrow Island Environment

Areas to be rehabilitated associated with the oil and gas operations of the BWI JV lie within the Barrow Island Nature Reserve (BINR). Key values of the BINR that are relevant to this prescription for rehabilitation of disturbed lands include the following:

- A high number of fauna species with conservation value, some of which are extinct or near extinction on the mainland
- Flora species that may be restricted within the area, or are at or near the limits of their range, as well as priority-listed species and communities
- BWI is an important site of biological refuge because of its isolation from threatening processes, for example there are low levels of non-indigenous flora and no non-indigenous vertebrates.

2.2 Climate

The climate of BWI is classified as arid subtropical due to its very hot summers and moderate winters. Summer is typified by its high temperatures of 20ºC to 34ºC and high humidity, while winter is characterised by moderate temperatures of 17ºC to 26ºC and strong north-east to south-east winds.

The average annual rainfall for BWI is 320 mm but can vary significantly from year to year. An average of two cyclones per year will have some impact on BWI. These summer weather events can bring up to 300 mm of rainfall and are usually responsible for higher than average rainfall years. Conversely, very low summer rainfall is not uncommon, and can impact on rehabilitation outcomes. In winter, frontal systems passing to the south can bring in excess of 50 mm of rain and, in typical years, can account for up to 35 per cent of yearly rainfall. The variability in rainfall has an overriding impact on plant establishment and growth, and on the overall success of rehabilitation on BWI.

In addition to the existing variability in rainfall on BWI, climate change is considered to be a factor that is likely to affect biodiversity in the long term (Ref.2). As discussed above, ecosystems on BWI are adapted to a climate of episodic rainfall events alternating with long periods of extreme dryness. Within the context of this extreme climatic variability, variation due specifically to climate change is not considered to be a factor that can be anticipated in this Prescription. However, this Prescription is based on an adaptive management approach — outcomes from monitoring will be reviewed routinely and will form the basis for management decisions.

2.3 Geology and Soils

As described in the BWIJV Environment Plan (EP), BWI is a geological extension of the Cape Range Peninsula, which became separated from mainland Australia by rising sea levels between 6,000 and 8,000 years ago. The Island is composed of coastal limestone deposits overlying tectonically folded limestone. For the purpose of rehabilitation, three broad landscapes have been identified, based on Mattiske and Associates definitions (Ref.3):

- Limestone Uplands ('Limestone' (L vegetation types) and 'Valley slopes and escarpments' (V vegetation types))
- Drainage Lines and Flats ('Drainage and creek line' communities (D vegetation types) and 'Flats' communities (F vegetation types))
- Coastal dunes.

Typically, topsoil on Limestone Uplands is limited and is a constraint for BWI rehabilitation. The soils of BWI as described as varying from duplex to coarse textural uniform, depending upon their topographic position and geological parent rock (Ref.4):

- On the western side of the island, soil texture is influenced by Tertiary limestone and is typically silty clay with alluvial watersheds dominated by silty clays and clayey loam textures
- On the eastern slopes the soils were influenced by Quaternary material and, as such, the soils are much coarser with coarse clayey sands, sandy loams and sandy clays dominating. In the lower lying areas, duplex soils are present
- The south-eastern slopes are strongly influenced by aeolian processes
- In the north-east, stranded relic dunes are present, underlain by calcareous, cemented, coarse sandy hard pans, and surrounded by a mixture of coarse and fine soils influenced by past marine inundation.

Acid sulphate soils (ASS) have been identified in the mudflats associated with mangroves, for example, around Bandicoot Bay. Any sites with the potential for ASS will be investigated and managed in accordance with the Department of Environment Regulation (DER) ASS Guidelines (Ref.5 and Ref.6).

Contamination will not be considered as an issue, as it is assumed that sites proposed for rehabilitation will have been assessed and, where required, remediated in accordance with the Contaminated Sites Act 2003, prior to rehabilitation commencing. The exception to this scenario is where rehabilitation activities are performed as part of an agreed remediation strategy (refer to Section 4.11.1).

3 Objectives for Barrow Island Rehabilitation

The objectives of this document are to provide a framework for rehabilitation activities aimed at meeting Completion Criteria approved by the Western Australian Department of Mines, Industry Regulation and Safety (DMIRS) and Department of Biodiversity, Conservation and Attractions (DBCA), and to meet other regulatory and corporate requirements. The following rehabilitation objectives have been identified for disturbed land on BWI:

- Leave the site in a condition where the risk of adverse effects to people, fauna, and the environment in general, has been reduced to a level acceptable to stakeholders
- Develop final landforms that are as close as practicable to their surrounding landform, contour and soil characteristics compatible with the surrounding landscape
- Disturbed areas are rehabilitated to a stable condition that is compatible with the natural ecosystem composition and processes of analogous areas with equivalent landform and soil characteristics
- Achieve a condition where the processes affecting landform stability are occurring at rates that meet agreed completion criteria.

4 Rehabilitation Principles

Environmental aspects that are particular to BWI have informed the rehabilitation principles in this section. In addition to the below, other key aspects that may impact rehabilitation success include extreme rainfall variability, seed dormancy, absence of fire and species recalcitrance and these should be considered in site specific rehabilitation planning and execution.

4.1 Weed Hygiene

Rehabilitation sites will be checked against the GeoHOUSE Weed Hygiene Zone (WHZ) and Primary Weed Management Area (PWMA) database to determine the status of sites and identify where additional weed hygiene controls may be required. WHZs and PWMAs are managed in accordance with the *ABU141200104 WA Oil Barrow Island–Environment–Weed Hygiene Zone Guideline* (Ref.7). Rehabilitation areas will also undergo a pre-disturbance survey to confirm their current weed status.

Where rehabilitation occurs within a WHZ, controls relevant to the rehabilitation activities will be implemented, as outlined in the *ABU141200104 WA Oil Barrow Island–Environment–Weed Hygiene Zone Guideline* (Ref.7). Weed management controls may include, but are not limited to:

- A Weed Hygiene Assessment Form is completed for works being undertaken within a WHZ
- Machinery and equipment to be inspected and, if necessary, washed / brushed down prior to entering / exiting the WHZ
- Personnel to inspect footwear and clothing when exiting the WHZ to ensure that it is clean of soil and plant material
- Rehabilitation materials such as topsoil or fill to be sourced from areas outside known WHZ.

Disturbed areas are conducive to weed proliferation, therefore rehabilitation areas in a WHZ will undergo weed surveillance at appropriate intervals after significant rainfall events to capture opportunistic weed establishment, as detailed in the *ABU121200314 Integrated Weed Management Program–Barrow Island Integrated Weed Management Plan* (IWMP) (Ref.8). If weeds are recorded, they will be either manually controlled, or sprayed with a knock-down herbicide such as Glyphosate.

The IWMP details weed management across BWI and has significantly reduced weed occurrence since the program's inception. As a result, there is now the potential to push for the eradication of several weed species, most notably the serious environmental weed *Cenchrus ciliaris* (Buffel Grass). If seeded records of Buffel Grass are detected that have the potential for proliferation, or may have an associated seedbank, a five-metre squared area surrounding the record may be treated with a pre-emergent herbicide such as Flupropanate to prevent any dropped seed from germinating. This eradication program will be conducted in consultation with DBCA and other stakeholders. To minimise potential collateral damage to native vegetation, a process has been established and must be followed if pre-emergent herbicides are used (see **Figure 4-1**).

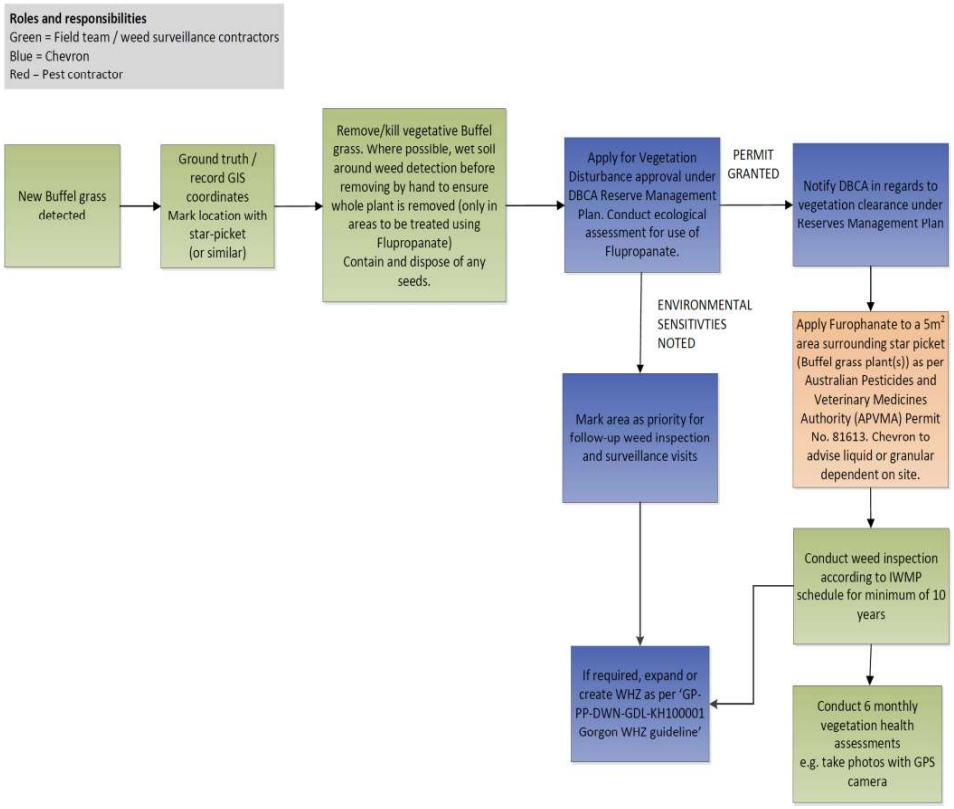

Figure 4-1: Process for the approval to use pre-emergent herbicide against seeded, or emergent Buffel Grass records

4.2 Vegetation Clearing

Areas requiring rehabilitation have various levels of native vegetation cover. Operational areas, such as well sites and tracks, and other historically-disturbed areas, such as gravel pits, are often re-colonised opportunistically by native vegetation. This vegetation may be cleared as required to allow necessary earthworks. Cleared vegetation will be managed in accordance with Chevron's Clearing Permit (CPS123/7) and disposed of as outlined in Section 4.5 and Section 4.6. Further information regarding vegetation clearing is contained within the *ABU Ground and Vegetation Disturbance Procedure* (Ref.9). In circumstances where the area of native vegetation or vegetation regrowth is small, for example a pipeline crossing, the vegetation may not be removed and instead fill may be directly deposited onto the vegetation. The ABU – WA Oil Environmental Specialist provides authorisation for clearing under CPS123/7.

In some circumstances, vegetation immediately adjacent to the area to be rehabilitated may need to be cleared. These circumstances could include where earthworks are required to achieve consistent topography between the area and its surrounds. Adjacent vegetation may also be cleared in order to access topsoil, if there is otherwise limited availability of suitable topsoil for rehabilitation. This would facilitate the introduction of seed bank and microbial resources from surrounding areas. In such cases, cleared vegetation will be managed as described in Section 4.5 and Section 4.6.

4.3 Soil Windrows

Windrows are formed through the construction, or maintenance of roads or tracks via grading. Windrows are not consistent with rehabilitation objectives (Section 3) and stakeholder correspondence (Section 10) has strongly recommended their removal wherever possible.

Primarily, windrows on BWI are a fire risk. *Triodia* spp. hummocks will opportunistically colonise these incidental structures and due to the increased depth of soil, can grow to a larger stature than hummocks in surrounding areas. In some areas, the windrow hummocks are encroaching on roads, increasing fire risk and reducing visibility for vehicle traffic. Windrows can also divert and disrupt hydrological flows, increasing the risk of erosion and potentially creating habitat for invasive species to exploit. The combined impacts of increased vegetation (providing shade) and changes to hydrological flows can attract fauna to roadsides, increasing the risk of vehicle strikes. Windrow removal is therefore an important consideration for future operations and the eventual rehabilitation of BWI.

Despite these negative attributes, windrows may also represent an important biological resource for rehabilitation, both as a carbon source via harvesting of vegetation (see Section 4.5) and as source of topsoil. Windrows should be removed in a staged process, to minimise impacts to surrounding vegetation and to maximise the return of topsoil for rehabilitation activities. Vegetation growing on windrows should be removed prior to topsoil harvesting. This vegetation should be carefully removed to avoid entrained soil and rocks, and should be transported to the vegetation storage locations on BWI for volume minimisation processes such as shredding, or pyrolysis (see Section 4.5). The underlying topsoil should be collected for direct reuse or used to refresh BWIJV topsoil stockpiles.

Removal of windrows may necessitate the minor clearing of some previously undisturbed vegetation, due to the width of a loader bucket. This will be conducted in accordance with Clearing Permit CPS 123/7 (Clearing for Active Rehabilitation) and will be assessed on a case by case basis by the ABU–WA Oil Environmental Specialist.

4.4 Landscaping and Earthworks

Due to the topography of BWI, cut and fill processes have been required to establish foundations suitable for oil and gas operations. Therefore, most disturbed sites have had significant alteration of the sub-surface profile. For some sites (i.e. gravel pits, roads, and some well pads), the operational area was prepared through excavation, with the excess soil material used elsewhere. In reconstructing the profile of these disturbed sites, soil will be imported from other disturbed sites that have excess fill material, such as other well pads. Remediated soil from the BWI Bioremediation Facility (see Section 4.5), or inert fill may also be used to facilitate integration of the landform into the surrounding topography.

The relative availability of soil materials at each site is a key factor to be considered in planning the suite of sites to be included in a rehabilitation program. For efficiencies in execution, sites with excess material would ideally be in close proximity to sites requiring fill material, to minimise material transport.

Some operational disturbances such as vehicle trafficking or seismic lines have had negligible or minor impact on the soil profile. In these situations, rehabilitation earthworks are unlikely to be required or will be very superficial.

For disturbed sites located in Limestone Upland landscapes, rehabilitation work will aim to remove excess added soil, to leave a soil profile that reflects the pre-disturbance conditions of limestone cap-rock with shallow or interspersed soil. In some cases, this may extend to not placing topsoil on exposed limestone. Rehabilitation earthworks for sites within Drainage Lines and Flats will aim to create a profile reflecting the original deeper soil. It is not intended to replicate the original soil profile. This is not practicable considering all of the original excavated material will not be available.

Where erosion is a risk, controls will be implemented, as appropriate. Measures may include placement of competent rip-rap material, geofabrics, or water-control banks, together with treatments to create an erosion-resistant soil surface.

Some previously rehabilitated gravel pits may be comprised of monocultural stands of landscape inappropriate species, such as Scentgrass (*Cymbopogon ambiguus*), which may suppress the growth of keystone species such as *Triodia* ([redacted]). If the landform is found to be contributing to this problem, it may be reworked with fresh fill to provide sufficient soil depth in order to encourage *Triodia* regrowth.

4.5 Vegetation Re-use

Cleared vegetation is generated through several necessary BWIJV operational activities, including clearing for infrastructure, fire protection around key infrastructure and lease maintenance. Active rehabilitation may also generate cleared vegetation, particularly through the removal of windrows.

Cleared vegetation on BWI is predominantly comprised of *Triodia* spp. These hummock grasses may impact rehabilitation performance when the cleared vegetation is incorporated into rehabilitated soil substrates and landforms. *Triodia* spp. are known to contain natural fibres of comparably high tensile strength (Ref.11), that resist decomposition and *T. epactia* contains resins that can seize up machinery and may be phytotoxic to the seedbank, due to the presence of alkaloids or diterpenoid compounds. Anecdotally, rehabilitation performance on BWI has been observed to be impacted when the proportion of cleared *Triodia* spp. in topsoil volume exceeds 10%.

Whilst cleared vegetation may not be complimentary to rehabilitation on BWI, it does represent a significant potential biological resource if these inherent detrimental properties can be overcome. The BWIJV has conducted a trial of pyrolysis on predominantly *Triodia* spp. vegetation waste. Pyrolysis is the thermal decomposition of biomass at elevated temperatures in an inert atmosphere (Ref.13). This has resulted in a significant reduction in the volume of cleared vegetation in storage, with biochar produced as a potentially useful by-product.

To improve the suitability of some topsoil blends, biochar may be incorporated at approximately 10% of respread topsoil volume. Biochar Carbon is not directly available to plants or microbes; however, biochar incorporation can increase the bioavailability of key nutrients by altering the microbial composition of soils (Ref.15). Biochar application may also alleviate some of the disruption of soil

physical properties that can result from mechanical harvesting and use of unweathered soil or waste rock materials (Ref.13).

4.6 Disposal of Weed Hygiene Material

The management of weed hygiene material will be carried out in accordance with the *ABU141200104 WA Oil Barrow Island–Environment–Weed Hygiene Zone Guideline* (Ref.7). Weed hygiene material from existing operational areas can be buried within suitable borrow pits. The ABU–WA Oil Environmental Specialist and ABU–HES Specialist Rehabilitation will conduct a risk assessment prior to the burial of weed hygiene material to determine if the approach is appropriate and the depth of capping required to render the seedbank unviable. The depth of capping required will be assessed on a case by case basis, however a recent capping operation at Airport Oval South used 500 mm as a minimum (Ref.10).

Only borrow pits that have sufficient depth to allow for burial of the weed hygiene material, plus the required capping layer, will be suited (see Section 4.5). As far as practicable, burial and capping of vegetation from weed hygiene zones will be completed promptly, to minimise the risk of scouring and exposure of the buried material by run-off after heavy rain. Alternatively, pyrolysis (see Section 4.5) could be considered as a sterilisation measure for vegetation or soil containing weed hygiene material. Weed hygiene vegetation that is unable to be used in rehabilitation activities is disposed as waste at an off-island location.

4.7 Landform Restoration via Burial of Inert Material

Inert material has been and will continue to be disposed of on BWI. This provides a synergy to dispose of inert material while facilitating the integration of the rehabilitated topography into the surrounding landscape.

Areas of BWI (particularly within the oilfield footprint) have been mined for gravel and soil historically to build well leases, roads and other infrastructure since the 1960s. This practice typically targeted incised valleys and depressions, often resulting in a skeletal soil structure that is susceptible to erosion and may not be suitable for vegetation establishment. In many instances these areas have been rehabilitated. However, the skeletal, inorganic soil structure may have contributed to an inappropriate species assemblage, predominately comprised of the allelopathic *Cymbopogon* spp, at the expense of the keystone *Triodia* spp. Note that the controlled extraction of gravel is now conducted at the Gravel Resource Pit as per EP approvals.

The burial of inert material provides an opportunity to re-establish pre-existing landforms and drainage lines, providing enough soil depth in order to facilitate the appropriate species assemblage. Downstream erosion issues can also be mitigated, whilst also meeting the objectives of BWI rehabilitation (Section 3). Without the use of inert material to re-establish landforms, gravel and fill would be obtained from other areas of BWI, increasing the extent of land clearing and soil disturbance. The most likely materials considered for deep burial to facilitate landform restoration will be oversized rocks, non-leaching bioremediated soils (refer to Section 4.8) that have not met reuse criteria, or concrete (refer to Section 4.7.1).

4.7.1 Concrete

Progressive decommissioning of redundant facilities is expected to generate large quantities of concrete rubble. Concrete is a challenge to manage in

decommissioning programs, due to its mass, potential metals content in leachate (e.g. Chromium VI) and bulky form.

To minimise risk to sensitive groundwater receptors such as stygofauna, concrete will only be considered for landform restoration on BWI if testing proves the material is inert, or contaminants in leachate can be attenuated by adsorbents or endemic materials. If this is not the case, contaminated concrete will be disposed to mainland landfill or remediation facilities. Use of concrete for landform restoration is a priority, as the disposal of large quantities of inert concrete on the mainland may overwhelm municipal facilities and provide a net environmental cost.

Potential sites for the use of concrete in landform restoration have been identified in **Figure 4-2**. These sites have been selected according to the following criteria:

- Large void that requires backfill to re-establish landform
- Maintain, or recreate appropriate hydrological flows
- Absence of contamination or future competing land use
- Spatial distribution to minimise haulage across BWI.

For planned decommissioning activities, concrete rubble on BWI is anticipated to be of varying composition, depending on its source, age and condition. A site-specific risk assessment will be conducted by SMEs prior to the burial of concrete on BWI. Ongoing studies are focused on potential contaminants of concern, leachability and attenuation in BWI soils.

The following principles apply to the burial of concrete rubble to minimise leaching and groundwater contamination:

- Final surfaces should be sloped, and traffic compacted to minimise ponding
- Site selection should prioritise gully-type sites for concrete rubble placement, so that the side slopes are contained by low permeability hard rock and the flow of water can be slowed
- Some infiltration should be encouraged through the selection of capping fill to facilitate vegetation re-establishment
- Design levels should be obtained by onsite survey and hydrological modelling where appropriate.

Concrete will be buried in a manner consistent with requirements of relevant guidelines (Ref.9). Sites with buried concrete will be rehabilitated according to the prescription described in this document for their landscape position.

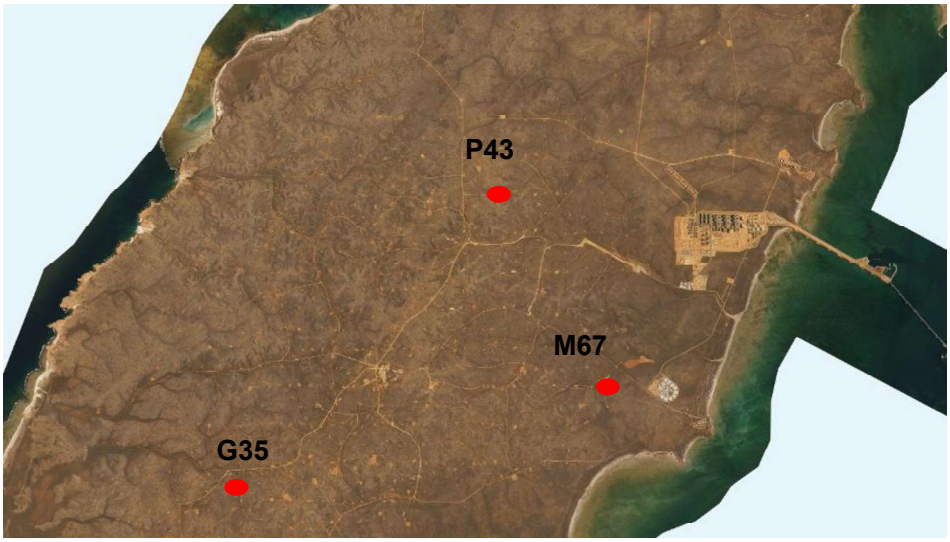

Figure 4-2: Landform restoration areas where concrete may be used to re-establish pre-disturbance landforms

4.8 Soil Profile Restoration

Rehabilitation of elevated sites such as well leases and separator stations may be problematic, particularly if the previously imported fill must be removed during remediation, or if the site was cut into the original landform (see Section 6.3.1). In these instances, it may be necessary to import fill to create sufficient rootzone for vegetation establishment.

The J78 Gravel Resource Pit is predominantly reserved for the use of road and lease maintenance to minimise the amount of vegetation disturbance in the nature reserve. To reduce pressure on this finite resource, the BWIJV has established a Bioremediation Facility on BWI to treat hydrocarbon impacted soil. This will enable the beneficial reuse of this soil, including as subsoil for the rehabilitation of decommissioned facilities.

Bioremediation of impacted soil is conducted at the Bioremediation Facility in accordance with the BWI Bioremediation Facility Site Management Plan (SMP) (Ref.11) and the BWIJV EP and *Environmental Protection Act 1986* Licence L4467. The SMP details reuse criteria that are considered likely to be protective of ecological receptors under the proposed reuse scenario. This includes as rehabilitation subsoil to provide a viable root zone medium for the keystone *Triodia* genus.

4.9 Subsoil Management

Ripping, scarification, or subsoiling may be used to break up compacted, or naturally impermeable subsoils in areas undergoing rehabilitation on BWI. Ripping refers to the use of tines on a grader to break up compacted soil layers. Tines are set 300 mm apart and used to rip to a maximum depth of 300 mm. If ripping is being conducted to produce contours for erosion resistance, use of winged tines may be considered. Scarifying aims to reduce surface compaction with the use of a toothed bucket on an excavator. The soil surface (<100 mm) is “scratched” to alleviate residual surface compaction. For both ripping and scarifying, lifting and exposure of in situ rock should be avoided.

Scarifying is less intrusive than ripping and is suited to areas where erosion is expected to be a concern or where topsoil is shallow. Ripping and scarifying will be along the contour where practicable, not running down the slope which can lead to enhanced erosion. Following ripping, the unearthed soil is left loosened and aerated.

Some rehabilitated surfaces will require compaction of surface layers to ensure they are stable and suitable for plant establishment. In this instance, use of a pad foot roller will compact surface layers sufficiently, while providing numerous small depressions for seed material and moisture to accumulate in. The pad foot roller should only be used where there is sufficient depth of topsoil over sub-base materials to avoid over compaction.

4.10 Topsoil

Topsoil will be sourced from BWI, from analogous soil-landscape types, where practicable. For example, rehabilitation projects occurring within the Limestone Uplands will use topsoil from that landscape type, and similarly, soils from Drainage Lines and Flats will be used for rehabilitation within those landscape types. In each case, topsoil will be placed at a depth which is consistent with surrounding areas. This principle will extend to areas of Limestone Uplands that have a substantial proportion of exposed limestone, where consideration will be given to not applying any topsoil. Using topsoil from the corresponding landscape type will enhance the establishment of vegetation that is comparable with surrounding native vegetation.

If insufficient good-quality topsoil is available, then additional areas adjacent to the site that have suitable topsoil depth may be cleared to access the topsoil for use, for example the practice of windrow harvesting (Section 4.3). Where possible, alternating strips of vegetation within these additional areas will be cleared in order to access the topsoil, rather than fully clearing each area. Where topsoil cannot be sourced from adjacent areas due to environmental sensitivities, the use of manufactured topsoil blends may be considered. This process may involve the use of inert sub-base material, supplemented with biochar (see Section 4.5), collected endemic seed mixes, mycorrhizal pre-biotic preparations and / or topsoil obtained from the Gorgon Project. Where there is an urgent requirement to re-establish vegetation for remediation purposes (see Section 4.11.1), some small-scale irrigation of respread topsoil will be considered.

4.11 Revegetation Methods

Establishment of vegetation will rely on:

- Topsoil as a source of biological propagules (seeds, microbes, etc.) and nutrients, and as a medium to support vegetation establishment and growth
- Distributing seed-bearing vegetative material from bradysporous species such as *Melaleuca cardiophylla,* if it is appropriate for those species to occur in the area
- Distributing seed bearing vegetative material from *Triodia* spp. after a mast seeding event (Section 4.11.2)
- Natural recruitment from adjacent vegetation. This is more effective in smaller areas with a large boundary to area ratio, i.e. tracks.

4.11.1 Rehabilitation for Remediation

Some sites on BWI may have intractable contamination, or other legacy issues that cannot be further resolved through active remediation. In these instances, it may be optimal to rehabilitate the site, by capping the existing surface to prevent the spread of the contamination in question and proceed with rehabilitation to provide long-term stability via revegetation. This approach has been used successfully at WAPET Landing South to remediate asbestos contamination and may be considered at other sites in consultation with regulatory agencies.

4.11.2 Direct Seeding

Materials arriving at BWI have been subject to quarantine restrictions since the establishment of the oilfield in the 1960s. This has prohibited the importation of seed for rehabilitation purposes, which would otherwise be a cost-effective method of returning some species to rehabilitation areas.

Inconsistent seed production has precluded the collection of endemic seed on BWI, particularly the keystone genus *Triodia*. For example, monitoring of topsoil stockpiles on the Gorgon Project has provided useful data on rainfall triggers for the onset of seeding in *Triodia* on BWI, following a mast seeding event in 2017. Mast seeding is described as the intermittent production of large, synchronised, seed crops (Ref.9). These mast events naturally replenish the seedbank in endemic soils and topsoil stockpiles and are a key component of BWI ecology. From 2011 to 2018, the ideal conditions for seed production have only occurred in the 2017 growing season. Due to this inconsistent seed production, direct seeding can never be a core rehabilitation methodology on BWI, but if conditions do support seed production, environmental contractors may collect seed for rehabilitation purposes. Collected seed will be stored under temperature-controlled conditions and will eventually be incorporated into topsoil sites, where the rapid establishment of vegetation is desirable (see Section 4.10).

4.12 Adaptive Management

Rehabilitation of disturbed areas has been conducted for many years on BWI and future work will extend over several years. There will be substantial opportunities for ongoing refinements of this rehabilitation prescription as a result of the diversity of sites rehabilitated and learnings from monitoring. An important element of this will be to maintain accurate records of the rehabilitation work completed at each site. This will be achieved by developing Rehabilitation Plans for each area and retaining these as outlined in Section 5.

Outcomes from past practices have been considered in developing this Prescription, and innovative approaches to achieving improved rehabilitation outcomes will continue to be actively encouraged, including targeted field comparisons of treatments and statistical analysis as appropriate. Where the need for change in the rehabilitation prescription is identified, this will be done in consultation with DMIRS, DBCA and subject matter experts as appropriate.

5 Site Rehabilitation Plans

Rehabilitation Plans will be developed for sites on BWI that are to be rehabilitated. In some cases where several small areas with similar characteristics are in close proximity, these individual areas may be grouped under a single Rehabilitation Plan. Plans will include:

- Site description
- Any potential limitations or constraints for rehabilitation activities (e.g. equipment size and maneuverability restrictions, presence of pipelines or other infrastructure, hours of operations, etc.)
- Pre-disturbance landform, soil and vegetation
- Site drainage
- Aerial and ground photos
- Maps, cross-sections of landscape where required
- Source of soil and fill materials required for earthworks, or destination of excess materials that need to be removed
- Permit to Work (PTW) requirements
- Rehabilitation design and works required
- Schedule.

5.1 Rehabilitation Verification

Upon completion of all rehabilitation tasks at a site, the HES Specialist - Decommissioning will inspect the site and confirm rehabilitation works have been completed satisfactorily. The site and associated rehabilitation tasks completed will then be added to the completed rehabilitation sites checklist and updated on the DMS.

The ABU – WA Oil BWI Environmental Specialist will also inspect the site and will spatially capture the rehabilitation area on a tablet or other digital device. The resulting polygon will be uploaded to GeoHOUSE and the rehabilitation database by the Perth-based GIS team. A selection of rehabilitation sites will also be included in the annual rehabilitation monitoring program as time and resources permit.

5.2 MSW 2.0 Permit to Work Requirements

All necessary permits and associated certificates are to be obtained before the Rehabilitation Plan is executed in accordance with the Managing Safe Work (MSW) 2.0 Permit to Work system.

6 Rehabilitation Methods

The rehabilitation methodologies described below are specific to the disturbance types, which include:

- Rolled vegetation
- Tracks
- Roads
- Facilities & Well Pads
- Borrow Pits.

The approaches to rehabilitation for each disturbance type do not include fencing of the rehabilitated area. The effect of fencing has previously been evaluated on BWI (Ref.13) with the main observations that grazing in unfenced plots has delayed *Triodia* foliar cover and plant development by approximately two years, but with no effect on species richness.

6.1 Assumptions

The following assumptions are applied to rehabilitation works carried out according to this rehabilitation prescription document:

- All areas planned for rehabilitation are no longer required for operations and have been approved for rehabilitation by the relevant stakeholders
- All infrastructure that is not required for the rehabilitation of the site has been removed prior to rehabilitation earth works. However, structures for equipment access (i.e. culverts) should remain in place until they are removed as part of the rehabilitation site works
- Sites will have been assessed, and where required, remediated, in accordance with the *Contaminated Sites Act 2003*
- Works will stop immediately, and the onsite HES Specialist - Decommissioning notified, in the event that residual debris is uncovered during rehabilitation earthworks. Works may recommence when the site has been assessed and, where required, remediated in accordance with the *Contaminated Sites Act 2003*.

6.2 Roads and Tracks

6.2.1 Approach

Some roads or tracks on BWI may need to be retained for reserve management purposes by DBCA. Defining this requirement for long-term access, before rehabilitating roads or tracks, is included as a completion criterion in appendix a:. Roads or tracks not required for long-term reserve management purposes will be rehabilitated.

Typically, roads and tracks follow the natural topography and require relatively minor earthworks for rehabilitation. In general, roads may be distinguished from

tracks by evidence of topsoil removal and sometimes, areas of cut and fill. Revegetation will be promoted by retaining existing vegetation, respreading topsoil if present, and ripping or scarification of bare areas to encourage plant establishment. However, steep slopes will not be ripped as this can encourage gully formation and promote erosion. Ripping will be restricted to the tyre tracks where vegetation is present within the centre of a track.

6.2.2 Rehabilitation of Tracks

The following activities are involved in the rehabilitation of tracks:

- Retain vegetation growing in the centre of the track where possible
- Vegetation cleared as part of rehabilitation works to be loaded and removed from the rehabilitation area
- Progressively remove infrastructure associated with the track (including signs etc.) during rehabilitation earthworks
- Alleviate compaction, if required, by shallow ripping (<300 mm) using a single tine in each vehicle track. This depth must be reduced if required to avoid lifting of in situ rock
- Encourage seed germination and remove surface compaction by using a toothed excavator bucket to scarify the soil surface
- Return cleared vegetation to recently rehabilitated areas to assist in the stabilisation of the soil surface
- Spread returned vegetation evenly with total cover not exceeding 10% of the total rehabilitation area
- Restrict access to the track with signs on completion of rehabilitation works.

6.2.3 Rehabilitation of Roads

The following activities are involved in the rehabilitation of roads:

- Remove vegetation growing on soil windrows (Section 4.3) and road margins. Extent of clearing to be restricted to the width of the windrow, or to one metre where no windrow is present
- Remove vegetation growing on windrows using a loader or excavator with a stick rake or grated bucket and transport to vegetation stockpile at F31A
- Remove windrow soil material and blend with older topsoil material prior to respread on available rehabilitation sites
- Remove topsoil from cleared road margins. Topsoil obtained to be set aside for mixing with imported topsoil prior to spreading
- Reinstate areas with cut or fill zones by importing or exporting fill to achieve integration with the surrounding topography. Excess material to be transported to nearby rehabilitation areas that require fill

- Shallow ripping of the road area may be conducted prior to topsoil application to alleviate compaction. No ripping to be done in areas of outcropping limestone, and this will be stipulated in the Rehabilitation Plan

- For areas to be ripped, rip with a grader with tines set to a maximum depth of 300 mm. Reduce ripping depth as required to avoid lifting and exposure of in situ rock

- Import topsoil, mix with locally sourced topsoil if available, and spread with a grader or front-end loader to a maximum depth of approximately 50 mm. For roads being rehabilitated in areas of Limestone Uplands, where topsoil in surrounding areas is minimal, reduce topsoil depth to approximately 25 mm

- All cleared vegetation to be transported to F31A

- Restrict access to the site with signs on completion of rehabilitation works.

6.3 Facilities and Well Pads

Generally, cut to fill techniques have been employed to create pads suitable for facilities and well infrastructure, with additional fill material commonly being imported. Rehabilitation methodologies for these pads may marginally differ according to their location on Limestone Uplands, or Drainage Lines and Flats. The differences in the depth of soil, and vegetation type will influence the rehabilitation works within these respective landscape positions.

6.3.1 Rehabilitation of Facilities and Well Pads

The following activities are involved in the rehabilitation of facilities and well pads:

- Ensure that any Plugged and Abandoned (P&A) signage remains in position

- Clear vegetation growing within area to be rehabilitated and from adjacent margins as required to allow earthworks to blend edges with the surrounding landscape. If insufficient good-quality topsoil is available, then additional areas adjacent to the site that have suitable topsoil depth may be cleared. Additional areas to be clearly marked before clearing and not to exceed 20% of the original area to be rehabilitated

- Cleared vegetation to be transported to F31A

- Remove topsoil from any additional areas cleared. Topsoil obtained to be set aside for mixing with imported topsoil prior to spreading

- In areas where there have been substantial cuts into the natural landform, ground disturbance beyond the original disturbed footprint may be required to ensure that the area is able to be blended appropriately with the surrounding landscape. In some cases, rock faces may be mechanically treated to reduce visual impact, potentially creating an area of loose rock at the base of the cut. Physical characteristics of the adjacent landscape will be used to guide specific strategies for treating cut features

- Rock piles may be created as fauna habitat, if appropriate rocks are available and if consistent with the features in the surrounding landscape

- Areas will have cut or fill zones reinstated by importing or exporting fill as required, to achieve integration with the surrounding topography. Excess material to be transported to nearby rehabilitation areas that require fill, as identified in the Rehabilitation Plan

- Alleviate compaction, if required, by shallow ripping with grader tines to a depth of no greater than 300 mm. This depth must be reduced as required to avoid the lifting and exposure of in situ rocks. If well pad or facility is on a steep slope (assessed on site), or surrounded by outcropping limestone, no ripping to be undertaken, and this will be stipulated in the Rehabilitation Plan

- If surface compaction needs to be alleviated, scarify surface with a toothed excavator bucket

- If topsoil is to be applied, import topsoil and mix with locally-sourced topsoil if available, and spread to a depth of approximately 25 mm (Limestone Uplands) or 50 mm (Drainage Lines and Flats) using a grader or front end loader

- Topsoil will have a slightly undulating finish to assist in protection against wind and water erosion

- Spinifex biochar may be blended with topsoil to improve soil physical, biological or chemical properties (see Section 4.5). This should be reserved for scenarios where older topsoil stockpiles, or sub-base (non-weathered) soils are being used

- Vegetation returned to the rehabilitation area to be spread out evenly and total cover not to exceed 10% of the total rehabilitation area

- Restrict access to the site with signs on completion of rehabilitation works.

6.4 Borrow Pits

Numerous borrow pits have been excavated throughout the life of the operations on BWI. Rehabilitation in these areas will focus on rehabilitating a profile that integrates with the surrounding topography, withstands episodic water flows, and supports vegetation. This may be achieved through the use of concrete rubble (Section 4.7) or other inert material.

6.4.1 Rehabilitation of Borrow Pits

The following activities are involved in the rehabilitation of borrow pits:

- Define the boundary of the disturbed area to be rehabilitated

- HES Specialist - Decommissioning to consider the need for hydrological modelling of surface flows, and initiate as required

- Survey borrow pit to determine fill requirements, informed by outcomes from hydrological modelling if conducted

- Identify access requirements during and after rehabilitation works, i.e. temporary access tracks

- Clear vegetation growing within area to be rehabilitated, and from adjacent margins to a maximum width of two metres and transport cleared vegetation to F31A. If insufficient good-quality topsoil is available, then additional areas adjacent to the site that have suitable topsoil depth may be cleared. Additional areas to be clearly marked before clearing and not to exceed 20% of the original area to be rehabilitated

- Remove topsoil from any additional areas cleared. Topsoil obtained to be set aside for mixing with imported topsoil prior to spreading

- Burial of imported material including weed hygiene material and concrete requires approval

- Ensure continuity of rehabilitation area with surrounding topography by importing fill material if required

- Temporary access tracks established as part of rehabilitation works to be included within the rehabilitation area and rehabilitated in accordance with the above methodology for Tracks

- Import topsoil (preference for Drainage Lines and Flats landscape type), mix with locally-sourced topsoil if available, and spread to a depth of 50 mm using a grader or front-end loader

- Restrict access to the site with signs on completion of rehabilitation works.

6.5 Rolled Vegetation

Rolled vegetation is generally confined to a local area and examples include where vegetation has been rolled over by vehicles creating a track, through to where it has been rolled by traffic of multiple vehicles or machinery.

A thick coverage of rolled spinifex can restrict vegetation from re-establishing and takes a considerable time to break down. The need for rehabilitation of areas of rolled spinifex will be assessed, by way of a Net Environmental Benefits Analysis (NEBA [appendix b:]). If rehabilitation is required, and the area of rolled vegetation is large enough to warrant removal / clearing of vegetation, then this will be the preferred approach (topsoil to remain). Smaller areas that have been tracked by vehicles should only be cleared if it is practical to clear without increasing the disturbance area beyond that of the original disturbance. Previously rolled vegetation should be transported to F31A for storage.

7 Monitoring and Rectification Works

The completion criteria framework (appendix a:) contains objective targets or values that can be measured to demonstrate the progress and ultimate success of the rehabilitation process. The criteria framework is used to define and evaluate rehabilitation outcomes, supporting the development of sustainable ecosystems. Approved completion criteria and associated standards provide an appropriate benchmark or guide, against which to assess and track the development of sustainable rehabilitation.

7.1 Inspection and Monitoring

Assessments will typically include visual assessment of indicators such as erosion and the presence of weeds, with quantitative monitoring of plant establishment and cover as required to respond to completion criteria. Specific timing for assessments of vegetation development will necessarily be season dependent. Vegetation monitoring will be restricted to that required to demonstrate required standards have been achieved.

A selection of sites will also be included in annual monitoring via Ecosystem Function Analysis (EFA), until Completion Criteria are met (see appendix a:). Vegetation cover in rehabilitated areas is typically very low in the first three years. Remote sensing programs such as Normalized Difference Vegetation Index (NDVI) or Modified Soil-adjusted Vegetation Index (MSAVI) may be used to monitor basic parameters such as vegetation and litter cover in these recently rehabilitated sites. Remote sensing programs such as Object Based Image Analysis (OBIA) may then be utilised as *Triodia* spp. starts to dominate from the early colonization species. This approach may also be utilised for sites that are difficult to access.

Rehabilitation sites identified to require further works will be included in subsequent rehabilitation programs for corrective works. Where weeds are found, the site will be added to the Weed Surveillance Register and monitored /controlled as per the *ABU121200314 Integrated Weed Management Program–Barrow Island Integrated Weed Management Plan* (Ref.8).

7.1.1 Verification of Reuse Criteria for Treated Soils

Treated soil from the bioremediation facility is considered suitable for reuse as rehabilitation subsoil when the interim reuse criteria are achieved as defined in the SMP (Ref.12). The interim reuse criteria are considered likely to be protective of relevant ecological receptors (Ref.15). In any case where bioremediated soil is used as subsoil at a rehabilitation site on BWI, the rehabilitation results will be monitored under the annual monitoring program in accordance with this rehabilitation prescription. This monitoring will:

- Facilitate assessment of the applicability of the reuse of bioremediated soils for this purpose
- Will provide valuable information on the suitability of the interim criteria to support rehabilitation endpoints
- Will provide a mechanism to assess whether the interim criteria are sufficiently protective.

The interim criteria will be confirmed to pose no unacceptable risk to receptors, once it can be demonstrated that Phase 3 rehabilitation end-points can be achieved in accordance with this rehabilitation prescription (refer to 29appendix a:).

Where treated soil has been utilised and assessment indicates a rehabilitation site is not progressing or has not achieved the Completion Criteria, the requirement for any rectification works will be considered in accordance with Section 7.2. Modification of the reuse criteria would be considered as required for future use of treated soil at rehabilitation sites.

7.2 Rectification Works

No ongoing routine maintenance is anticipated for rehabilitation areas. Where monitoring indicates a rehabilitation area is not progressing appropriately, a NEBA will be undertaken to determine if additional actions would be beneficial. A framework for a NEBA for rehabilitation is set out in appendix b:. In this analysis, the net benefit of rectification is considered in relation to the potential impacts that may be caused by re-entering the site. When undertaking a NEBA, the following will be considered:

- Size of the area identified as performing below expectation
- Ease of access to the area
- Nature of rectification works required and extent of additional disturbance that would occur
- Adequacy of *Triodia* spp. cover as assessed by OBIA (see Section 7.1)
- Erosion and drainage status
- Amenity
- Potential for ongoing natural recruitment.

Where NEBA indicates that rehabilitated areas would benefit from rectification works, then a rectification plan will be developed. Rectification works will respond to key issues identified, but may include:

- Ongoing monitoring, rather than intervention, to allow a longer time frame for processes such as plant growth and natural recruitment from adjacent areas
- Applying additional topsoil (by machine or by hand)
- Addressing drainage / water flow issues
- Repairing erosion
- Weed control.

Achievement of completion criteria will be re-assessed after sites have been disturbed for rectification works.

8 Document Review

This rehabilitation prescription is intended to be updated and reviewed at least every three years or earlier if required, to capture advances in rehabilitation methods resulting from learnings, monitoring programs and research.

9 Roles and Responsibilities

Table 9-1 outlines the roles and responsibilities associated with rehabilitation on BWI and this prescription.

Table 9-1: Rehabilitation Roles and Responsibilities

Role	Responsibilities
ABU Legacy Team Supervisor	• Oversee Rehabilitation Program in context of Chevron obligations and stakeholder requirements • Manage budget and resources • Manage communications with stakeholders.
ABU Environmental Specialist–Rehabilitation	• Manage Rehabilitation scope and associated research projects • Update this Prescription when required • Prepare site-specific Rehabilitation Plans • Coordinate monitoring programs • Maintain records and collate data for reporting • Manage budget and resources • Manage weed surveillance and inspection.
ABU HES Specialist - Decommissioning	• Implement Rehabilitation Plans in accordance with this Prescription • Onsite Supervision and HES support.
Work Crew	• Implement Rehabilitation Plan in accordance with this Prescription under the supervision of the HES Specialist – Decommissioning.
Chevron Responsible Person	• Person delegated by ABU Legacy Team Lead to take responsibility for rehabilitation tasks as appropriate.

10 Stakeholder Consultation

Extensive consultation was conducted by the BWIJV with the following stakeholders during the development of Revision 1.0:

- DBCA
- Department of Health
- DWER
- Gorgon Project.

Comments received from DBCA (Senior Reserves Officers) and DMIRS informed the development of Revision 2.0. Revision 3.0 is predominately informed by lessons learned through annual monitoring of rehabilitation areas and discussion with rehabilitation personnel onsite. In December 2017, Chevron hosted a topsoil and rehabilitation workshop with DBCA Senior Reserves Officers. Aspects that pertain to the revision of this document are listed in **Table 10-1**.

Table 10-1: Stakeholder Consultation

Aspect	Actions / Outcomes
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

11 Acronyms and Abbreviations

Table 11-1 defines the acronyms and abbreviations used in this document.

Table 11-1: Acronyms and Abbreviations

Acronym/Abbreviation	Definition
ASS	Acid Sulphate Soils
Borrow Pit	A pit created by removal of soil material
BINR	Barrow Island Nature Reserve
BRF	Bioremediation Facility
BWI	Barrow Island
BWI JV	Barrow Island Joint Venture
Chevron Australia Pty Ltd	Chevron
Compatible	Capable of coexisting with surrounding environment without negative impact
Completion Criteria	Completion criteria are defined elements, which can be measured to demonstrate achievement of rehabilitation objectives
DBCA	Department of Biodiversity, Conservation and Attractions
DER	Department of Environment Regulation (now DWER)
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Department of Mines and Petroleum (now DMIRS)
DMS	Document Management System
DSI	Detailed Site Investigation
DWER	Department of Water and Environmental Regulation
GIS	Geographic Information Systems
GeoHOUSE	Chevron internal GIS-based web mapping platform
Landform	Topography of the earth's surface
Landscape	All the visible features of an area of land
OBIA	Object Based Image Analysis
P&A	Plugged and Abandoned
Primary Weed Management Area (PWMA)	An area delineated around active weed species, which is inspected regularly and maintained for the period that a detected weed species is considered likely to be present but inactive
PTW	Permit to Work
Rectification Works	Works conducted as required on a rehabilitated area, to repair or enhance rehabilitation outcomes
Rehabilitation	The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed (Ref. 20)
Ripping	Process of using a tine pulled behind machinery, to rip the surface soil profile in order to alleviate soil compaction
Roads	Includes both major and minor, gravel and sealed roads, which are cleared of all vegetation

Acronym/Abbreviation	Definition
Scarification	A method to reduce surface compaction in surface soil. Generally with the use of an excavator with a toothed bucket
Spinifex	Common name for grasses in the genus *Triodia*
SOP	Standard Operating Procedure
SMP	Site Management Plan
Topography	The arrangement of the surface physical features of an area
Topsoil	The surface layer of soil, usually containing the highest concentration of organic matter, nutrients and biological propagules (seeds, microbes etc.)
Tracks	Are less significant than minor gravel roads and are generally restricted to one vehicle width. Tracks usually have vegetation growing between vehicle tracks and are not maintained (graded)
Vegetation Waste	Vegetation material from clearing
Weed Hygiene Material	Soil or vegetation material that has originated from within a Weed Hygiene Zone or Primary Weed Management Area (PWMA)
Weed Hygiene Zone (WHZ)	A Weed Hygiene Zone is an area within which non-indigenous plant species, assessed to be high risk species, have established populations and/or where a seed bank of a high risk species is present
Weeds	Non-indigenous plant species
Weed Surveillance Register	A prioritised register of locations where high risk disturbance activities have occurred, movement of soil/vegetation from WHZ's has been carried out and/or where weed hygiene breaches have occurred and weed surveillance is recommended
Windrow	A narrow row of material, typically soil, rock and vegetation, created during site preparation by grading material to the edge of the area, ie. along road sides

12 References

The following documentation is either directly referenced in this document or is a recommended source of background information.

Ref. No.	Description	Document ID
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7.	Chevron Australia Pty Ltd. 2015. WA Oil Barrow Island – Environment – Weed Hygiene Zone Guideline. Perth, Western Australia.	ABU141200104
8.	Chevron Australia Pty Ltd. Integrated Weed Management Program – Barrow Island Integrated Weed Management Plan. Perth, Western Australia.	ABU121200314
9.	Chevron Australia Pty Ltd. 2018. Gorgon Project: Topsoil Stockpile Monitoring Program in 2017. Perth Western Australia.	ABU171200724
10.	Chevron Australia Pty Ltd. 2019. Ground and Vegetation Disturbance Procedure. Perth Western Australia.	ABU181001450
11.	Chevron Australia Pty Ltd. 2019. Rehabilitation Plan – Airport Oval South and Osprey Tower. Perth Western Australia	ABU190300321
12.	Chevron Australia Pty Ltd. 2019. Barrow Island Bioremediation Facility Site Management Plan. Perth Western Australia	ABU180300906
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15.	Enpoint. 2019. Basis for Interim Acceptance and Reuse Criteria: Proposed Bioremediation Facility Barrow Island. Perth Western Australia	ABU170800784

Ref. No.	Description	Document ID
16.	Golder Associates 2010. Barrow Island WAPET Landing South Remedial Action Plan. Perth Western Australia	ABU170100117
17.	International Union of Pure and Applied Chemistry. Compendium of Chemical Terminology. 2009 pp. 1824. Retrieved October 2018.	
18.	MWH 2015. Impact of herbivore grazing on vegetation establishment in rehabilitated areas – established in July 2010: December 2014 assessment. Unpublished report prepared for Chevron Australia Pty Ltd, April 2015.	
19.	Singh, B., Macdonald, L.M. 2014. Opportunities and constraints for biochar technology in Australian agriculture: looking beyond carbon sequestration. Soil Research, 2014, 52, 739–750.	
20.	Society for Ecological Restoration. 2004. SER International Primer on Ecological Restoration. SER Science and Policy Working Group, Version 2, October 2004.	
21.	Stantec. 2017. Gorgon Project: Topsoil Monitoring Program in 2017. Unpublished report for Chevron Australia. November 2017	ABU171200724
22.	Williams, DJ, Stolberg, DJ, and Currey, NA. 2006. Long term Performance of Kidston's "store/release" cover system over potentially acid forming waste rock dumps. Proceedings of seventh International Conference on Acid Rock Drainage, St Louis. Missouri, USA, 26-30 March 2006, pp. 2385-2396.	

appendix a: completion criteria

appendix b: framework for Net Environmental Benefit Analysis

Purpose of NEBA:	Assess and compare the benefits and risks to the environment associated with rectification options for rehabilitated areas.
Objectives of NEBA process:	• Confirm that planned rehabilitation strategies will achieve an improved rehabilitation outcome • Determine whether the planned rehabilitation strategies may have negative environmental consequences that outweigh the potential benefits • Inform the selection and prioritization of rehabilitation options • Focus rehabilitation activities to areas where net environmental benefits are highest
Key steps in NEBA and rehabilitation prioritization process:	
1. Before an area is identified as performing below expectation: Compile information and data to support NEBA decision-making.	✓ **Evaluate data:** Assemble and collate data on ecosystem development in rehabilitated areas, in the context of both the Barrow Island environment and agreed completion criteria for rehabilitation. ✓ **Predict outcomes:** Review and compare previous rectification projects and other available data to understand likely outcomes for different rehabilitation options. ✓ **Balance trade-offs:** Identify likely environmental impacts to inform optimal rectification activities. ✓ **Select options:** Develop generic plans for preferred options.
2. When a rehabilitated area has been identified as performing below expectation: Apply NEBA to site specifics.	✓ **Evaluate data:** Assess specific attributes of poor rehabilitation performance, in the context of prior climatic conditions, local site conditions, and ease of site access, to determine most appropriate rehabilitation options, which include allowing more time for vegetation development rather than intervention. ✓ **Predict outcomes:** Confirm effectiveness and feasibility of rehabilitation options, to achieve optimal outcomes. ✓ **Balance trade-offs:** Re-evaluate likely environmental impacts to inform the most appropriate rehabilitation options. ✓ **Select options:** Determine if intervention is appropriate and if so, develop and implement a targeted rectification plan based on data evaluation.
3. After rectification work is complete and outcomes have been evaluated: Review lessons from rectification works and update information in rectification plans.	✓ **Evaluate data:** Gather lessons learned and best practices to understand environmental impacts resulting from intervention. ✓ **Predict outcomes:** Review accuracy of predicted outcomes and refine decision-making tools as appropriate. ✓ **Balance trade-offs:** Re-evaluate environmental impacts to inform future decisions about trade-offs. ✓ **Select options:** Inform decision-making and future implementation of rectification activities by updating plans and decision-making tools.