Produced Water Injection Piping Upgrade BD Summary
QE-91-RI-20015.02

Bridging Document to the Varanus Island Hub Operations Environment Plan

PROJECT / FACILITY	Varanus Island Hub	
REVIEW INTERVAL (MONTHS)	n/a	
SAFETY CRITICAL DOCUMENT	~~YES~~	NO

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REVISION HISTORY

Revision	Revision Date	Author / Editor	Amendment
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1	12/10/18	L Muir	Re-issued to incorporate comments from DMIRS on 04/10/18 and DBCA on 11/10/18

CONTENTS

1. INTRODUCTION

The produced water (PW) system on Varanus Island (VI) runs through one remaining carbon steel 8" line from the PW pumps through to Alkimos-01 and Tanami-01 disposal wells. The secondary 10" produced water line was taken out of service in May 2016. Both lines suffered from significant internal corrosion due to microbiological activity.

The 8" line was installed/commissioned in 1997 and recent inspection of the line indicated that the design life would expire in approximately August 2018. Following the discovery of the internal corrosion, the existing 8" spool and PW system have been pressure restricted and subject to regular inspection. Therefore, a phased plan was initiated to replace the 8" carbon steel line with a new 8" duplex stainless steel line to increase the design life of the pipeline and reduce the effects of microbiological activity and potential leaks. All pipework and associated valves from along this line are also planned to be replaced. The new 8" line is to be installed predominantly in the route of the now redundant 10" line.

This bridging document (BD) describes the activity proposed to install the culvert for the PW piping from point 6 to point 7 (Alkimos PW Well) during Phase 3 of the works.

2. WORK TO DATE

The replacement work was phased to ensure activities occur outside of the key fauna sensitivity window defined in the VI Hub Operations EP on Varanus Island (1st October – 30th April) to avoid potential impacts to wedge-tailed shearwater (WTS) rookeries or turtle nesting areas. Phase 1 (**Figure 2-1**) has been completed with Phase 2 and 3 to be commenced in mid October 2018. Due to delays in equipment, phase 3 works adjacent to the WTS rookery are required during the WTS nesting period (at the location marked as point 6 in **Figure 2-1**).

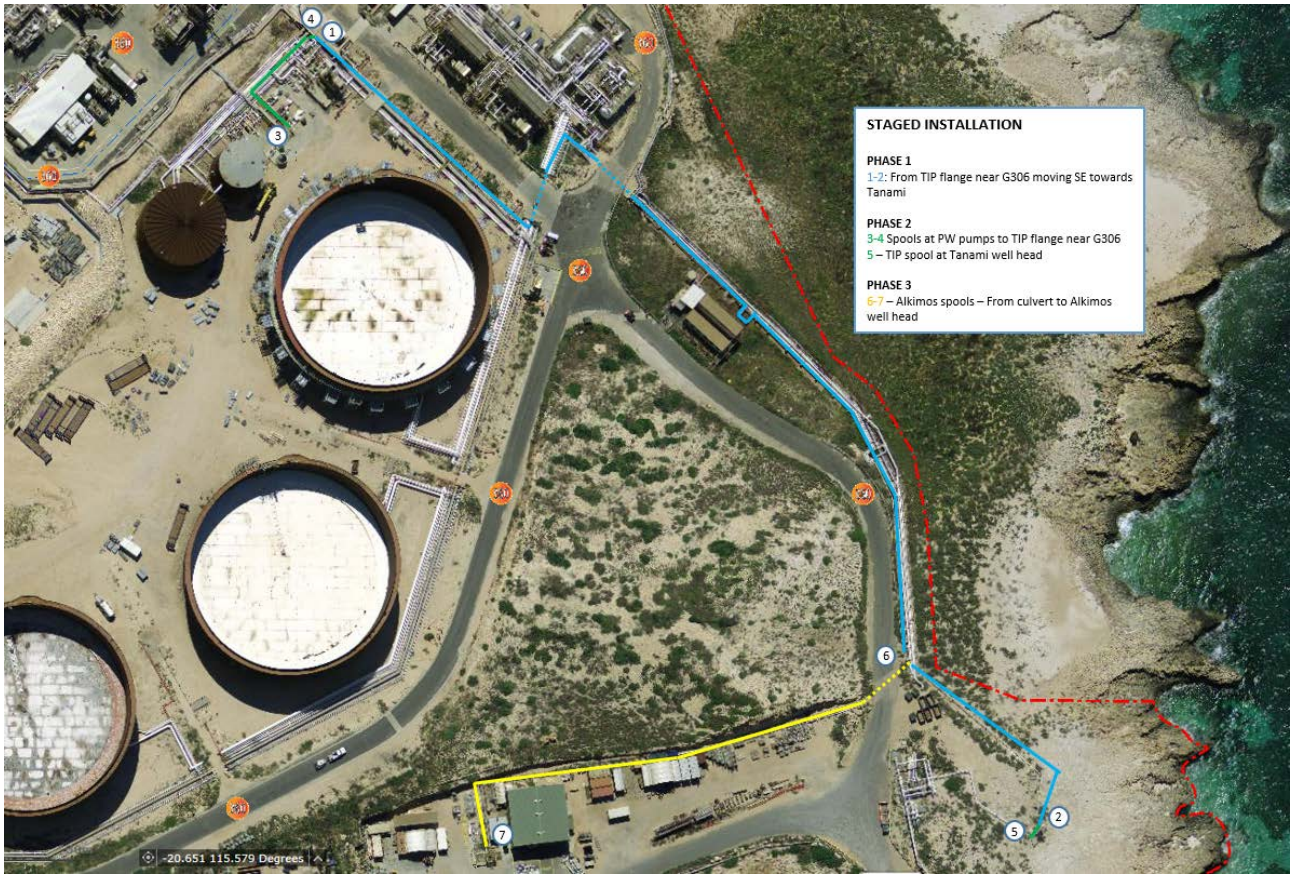

Figure 2-1: Staged Installation of 8" PFW line

3. ACTIVITY DESCRIPTION

3.1 Work scope

3.1.1 Excavation works

Earthworks are required to expose and remove the old 8" and 10" PW piping and allow installation of a new prefabricated culvert. This requires ground disturbing activities with machinery to be undertaken in close proximity to a known WTS rookery within the nesting period detailed in the VI Hub Ops EP. The bitumen and ground will be excavated using a small 4 tonne excavator (**Section 3.1.6**). The depth of the trench will be up to 1.7m deep and 5.8 m wide at the widest point; the profile of the excavation cannot be confirmed until the job has commenced and ground stability assessed.

The area around the culvert installation location has previously been disturbed, and therefore the rock breaking required is expected to be minimal. The nature of the ground beneath the old PW piping is unknown and therefore a worst case assumption that excavation and rock breaking is required for this section has been assumed.

At the completion of each day's activities, the trench will be covered or have planks left in overnight to allow fauna egress in the event they enter the trench as per the permit to work (excavation permit). The trench will also be checked for fauna prior to works each day. If fauna are found in the trench, they will be removed by a licensed fauna handler on VI in accordance with the Regulation 15 licence to take fauna (Licence number: 02-000357-3).

3.1.2 Excavated material

During excavation, the excavated material will be taken to the quarry area and screened. The excavated material will not be stored in the vicinity of the rookery. The material is not required for the remainder of the culvert works.

3.1.3 Compaction

Once the trench is at depth, the bottom of the trench will be levelled and compacted using a small diesel powered compactor (**Figure 3-2**). This compacting will take < 0.5 days.

3.1.4 Culvert Installation

Once the trench is completed and lined, the new pre-fabricated culvert will be installed with inspection pits at the road crossing. The inspection pits at either end are also pre-fabricated concrete which remain exposed following completion of the activity but are fully enclosed, with aluminium covers to enclose the piping and cable trays.

A cement slurry will be used to backfill the culvert (instead of compaction). The top of the culvert will be covered with pre-cast concrete covers with lifting points for future maintenance works, and concrete blocks installed adjacent to the culvert edge to protect the culvert from potential damage from vehicles. As the inspection pits are fully enclosed, no fauna access is feasible.

The culvert has been designed to maintain the slope of the road, therefore no change to the drainage is expected due to these works.

3.1.5 Tie In and Installation

Following completion of culvert installation, the piping will be tied into the Alkimos line with a bolt up flange connection on either side.

3.1.6 Equipment

A 4 tonne excavator will be used to undertake the excavation and rock-breaking works required. The excavator will be fitted with a rock breaker attachment (**Figure 3-1**) to break up the road and/or rocks beneath the existing pipework if required.

Figure 3-1: Excavator (KX121-3) and rock breaker attachment

A small diesel powered compactor (**Figure 3-2**) will be utilised to undertake levelling of the trench once at depth prior to culvert installation.

Figure 3-2: Compacter

3.2 Deferred works

As part of the piping upgrade works, replacement guardrails are proposed to be installed adjacent to the WTS rookery. Given the non-essential nature of these works, this will be delayed to occur outside of WTS nesting season as some minor trench works and excavation would be required for the footings. This activity will be completed under the VI Hub Operations EP at a later date.

3.3 Location

The activity is located on Varanus Island in permit area PL/12. The culvert will be installed at the approximate coordinates provided in **Table 3-1**.

Table 3-1: Approximate location of culvert installation

Latitude	Longitude
20° 39' 11.390" S	115° 34' 50.254" E
20° 39' 11.190" S	115° 34' 50.846" E
20° 39' 11.336" S	115° 34' 50.897" E
20° 39' 11.499" S	115° 34' 50.292" E

3.4 VI Hub Operations EP Requirements

Section 6.6.4 of the EP requires approval for ground disturbing activities within 50 m of the WTS rookery/nesting area. The specific wording is:

Ground disturbing activities with machinery (e.g. trenching, drilling) resulting in additional noise or vibration will preferentially be undertaken outside the turtle nesting and Wedge-tailed Shearwater courting and nesting season (between 1 October 15 April)[1] on VI if required within 50m of the shearwater rookery / turtle nesting areas. If required to be carried out during this period within this buffer zone, approval for the activities will be sought from DMP and DPaW.

The activity is within 50 m of the boundary of the rookery area, and therefore approval is required from DBCA and DMIRS. This BD is provided to both regulators for assessment and approval.

4. SCHEDULE

4.1 Proposed timing

The earliest commencement date for this activity is 16th October 2018, after the Tanami well has been tied in to the PW pumps and PW can be diverted to the Tanami PW well. The timing of the Tanami well tie-in is determined by the arrival of pressure safety valves (PSV's) that are critical for the safe operation of the new Produced Water Line. It is expected to take up to 5 days to excavate and remove the old pipe work then another 5 days to dig the culvert to depth.

Rock breaking activities (i.e. excavation only is likely to be required) are not expected for the initial 5 days and limited rock breaking may be encountered to achieve the culvert depth. Following ground disturbing activities (i.e. excavation), the culvert will be installed and the trench backfilled with cement. The target completion date is 15th November 2018; with all ground disturbing activities scheduled to be completed at the beginning of the works programme.

Activities will be completed during daylight hours only. The date of commencement is subject to regulatory approvals being in place, preparatory works will commence prior to acceptance of this BD (including removal of road railings and rock spoil with hand tools, marking out the area), so that ground disturbing activities can commence as soon as possible. The schedule indicates that ground disturbing activities will be completed by 1st November 2018 subject to regulatory approvals.

4.2 Delay in timing

The excavation and installation of the Alkimos road crossing culvert had to be delayed due to the delivery of PSVs for the new PW piping installation. The original delivery of the PSVs was expected early September allowing time to execute new PW line tie-ins and commence excavations before 1st October. The tie-ins are required to take place before PW can be diverted from the Alkimos PW well to the Tanami PW well and allow digging around the old Alkimos underground line. The new delivery date of 4th October has pushed back the tie-in schedule and therefore the excavation of the old Alkimos line.

[1] It is noted that recent studies undertaken on VI indicate the peak fledgling period extends to 30th April.

4.3 Alternative timing considerations

To undertake the excavation and culvert installation works, the access road must be cordoned off and closed, and the PW line must be taken out of service. It is not good practice for excavation works to be undertaken over and around live infrastructure. To minimise downtime, the excavation works should not commence until the other equipment (PSVs) have arrived on site. Given the delay to PSV arrival, the excavation works will not be commenced until mid-October.

Phase 3 of the replacement activity cannot be delayed to 2019 as work scopes planned for Q4 2018 and 2019 are reliant on this PW piping upgrade to restore full system pressure to both water injection wells and therefore these works are considered essential for completion as soon as possible.

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Existing Environment

5.1.1 Background

VI is part of the Lowendal group of islands. The Lowendal Islands Group consists of over 40 islands, islets and rocky stacks comprised of eroded Pleistocene limestone. VI is the largest island in the group.

5.1.2 Reptiles and other fauna

VI, named after the goanna (*Varanus acanthurus*) that inhabits the island, is 2.5km long, 600m wide at its widest point and reaches a height of 30m above sea level. There are no native mammals found on VI. Twelve terrestrial reptiles are found but there are no national or state threatened terrestrial reptiles listed under either EPBC Act or the *Wildlife Conservation Act 1950* that are found on VI. None of the reptile species are endemic to the island. Invertebrate species such as spiders, beetles, moths and other insects have been noted on Varanus Island.

5.1.3 Avifauna

The Lowendal Group has a diverse avifauna comprising of 89 recorded species, compared with 70 species of the Montebello Islands and 112 species at Barrow Island (Dinara, 1991; Burbidge et al., 2000). At least 64 species of birds feed and nest on the surrounding waters and islands within Barrow/Montebello/Lowendal Islands region. Of these, 26 are Australian and 15 are migratory species that breed in the arctic or sub-arctic areas of the Northern Hemisphere and spend their non-breeding season in Australia (during the Australian summer) (Apache, 2001). The two key groups of birds found on the islands are the raptors and seabirds.

Forty one avifauna species listed as migratory under the EPBC Act have been recorded in the vicinity of VI. One species recorded on VI, the great knot (*Calidris tenuirostris*), is listed on Schedule 1 (Fauna that is rare or is likely to become extinct) of the Wildlife Conservation Act 1950. No species recorded from VI are listed as threatened under the EPBC Act. It must be noted that many of these species are migratory, and may only temporarily pass through the VI area. Eleven of the listed species are known to breed on VI. Of importance to this activity are WTS.

5.1.4 Wedge tailed Shearwaters

The wedge-tailed shearwater is a burrowing species, arriving and departing the burrow under the cover of darkness. Shearwaters nest in burrows that are excavated or renovated by the breeding pairs at the start of each nesting season. On islands of the NWS, wedge-tailed shearwaters usually return to their colony areas to resume courtship and re-excavate burrows in August each year. The wedge-tailed shearwater burrows are approximately 1.5 m in depth and provide protection for eggs and chicks from the elements and predators. Prior to egg laying there is an exodus of 2–3 weeks where the birds go out to sea to feed and build up body weight and condition. On returning, only one egg is laid per pair of birds. Eggs are laid ten days after breeding, and their single egg is laid in early November which is incubated until the chick hatches 53 days later in early January. Chicks grow slowly taking approximately 97 days to fledge, and are fed only

at night by their parents. The chicks remain in their burrows until they are ready to fledge in mid-April (Nicholson, 2002).

5.2 Existing noise

Operational noise is currently generated by the existing facilities on VI. Studies suggest that long-term noise effects may have a negligible impact on the breeding success of many seabird species as they can become accustomed to background noise over time (Halfmoon, 2012). Wedge-tailed Shearwater burrows located closest to the existing gas plant facility have recorded the same breeding participation and breeding success as those burrows which do not have a noise source nearby (Nicholson, 2002).

5.3 Burrow Collapse and re-excavation

Halfmoon, (2012) states that burrow collapses/loss outside breeding season (i.e. prior to November) has little effect on breeding birds as they are able to re-excavate burrows.

Burrows within 50 m of the proposed activity may be occupied by adult WTS during the duration of the works. It is considered possible (but unlikely) that burrows could collapse during the activity due to the noise or vibration experienced during excavation, however the burrows are adjacent to the road where frequent traffic is present. The likelihood of burrow collapse during the activities is considered unlikely (refer **Section 5.6**). Adult WTS are known to re-excavate their burrows in the event of partial or full collapse, which can happen due to heavy rainfall events and other natural disturbances.

In the event that more than 2 of the 15 burrows collapse during the activity, the frequency of burrow checks will be increased to allow the seabird specialist to rehabilitate burrows quickly following collapse. This considers the likelihood of collapse or erosion that could occur in the area from natural events, and from the activities as advised by the seabird specialist. Ground disturbing activities will not occur whilst the burrow is rehabilitated and all other burrows checked for signs of collapse.

5.4 Rehabilitation

Burrows collapsing (due to noise or vibration from excavation or natural causes) on adult WTS is not considered to result in significant impacts as the collapse would likely be gradual rather than an instant collapse (such as if stepped on) and the birds will re-excavate. However, inspection of the burrows during the activity, if burrow collapse is observed, rehabilitation of the burrow will be undertaken (removal of soil from the collapsed area), and a temporary roof can be placed (if required) to ensure the burrow remains dark and covered. The materials required for burrow rehabilitation are readily available on VI. During rehabilitation, birds will be isolated (e.g. in a bag) by the seabird specialist and the burrow re-excavated and roof added (as required). The seabird specialist will assess any birds present in the burrows for injury prior to replacing in the rehabilitated burrow. Ground disturbing works will not occur during burrow rehabilitation activities.

Relocation of the birds is not recommended due to their strong site fidelity. Any injured or deceased seabirds will be reported in accordance with Quadrant Energy's Regulation 15 Licence to take fauna.

5.5 WTS Sensitivity

On VI, the commencement of egg laying in 2018 is expected at the start of November (pers. comms, Halfmoon Biosciences, 2018) based on current WTS activities in WA. Therefore the potential for impact on nestlings or chicks does not exist given the >50 day incubation period. The potential for impact on eggs is considered extremely unlikely given the proposed timing of the activity, however burrows will be checked for eggs and birds in the event of burrow collapse during the activity.

Vocalisations are an important part of Wedge-tailed Shearwater behaviour during the hours of darkness, when they use calls to interact with their mates and young (Halfmoon, 2012). By restricting the proposed

earthworks activities to daylight hours only, the impact of noise on the Wedge-tailed Shearwaters is not likely to be significant on the local population.

A recent inspection of the area by the seabird specialist within 50m of the proposed activity indicates that there are 15 burrows within the area which have all been recently used (this season), at the time of inspection three were occupied, although this will vary on a day to day basis throughout the season.

The most recent WTS monitoring report (*Quadrant Environmental Monitoring Program – Varanus and Airlie Islands Shearwater Monitoring – Annual Report 2017/18*, Doc ref: EA-60-RI-10216) estimated that the density of shearwater burrows on VI is approximately 3,646 (standard deviation of 1,626). Therefore the 15 burrows present in the 50m radius of the works represent <1% of the total burrows on VI and any impacts to shearwaters within these burrows would not impact on the species at a population level.

5.6 Risk Workshop

An activity specific risk workshop was undertaken on 17th October 2018 to discuss the proposed works, develop the proposed controls and agree on a risk ranking. The workshop was attended by relevant engineers working on the project and environmental specialists. Following the workshop and discussions with the seabird specialist, the risk ranking was further confirmed (**Table 5-1**).

The overall risk ranking is considered minor (**Table 5-1**) in accordance with *Quadrant Energy Risk Matrix* (QE-91-IF-00039) when considering the proposed controls to be implemented during the activity, the potential impact to individual WTS compared to the number of burrows on VI, the low likelihood of burrow collapse and considering previous works undertaken in close proximity to rookeries.

Previous ground disturbing activities undertaken on VI were considered during the workshop to assess the likelihood of occurrence of burrow collapse. When undertaking construction upgrades on the Kitchen Mess Cyclone Refuge (KMCR), much larger machinery was used and for ~ 18 months and no instances of burrow collapse were experienced during this activity. The activity is therefore deemed acceptable.

Table 5-1: Risk Ranking outcome

Likelihood	Consequence	Ranking
Unlikely	*Minor*	Low Risk (Acceptable)
The likelihood of the activity impacting on WTS nesting (including egg laying) in the vicinity of the excavation is considered to be unlikely due to the low level noise and vibration expected during the activity.	Due to the proposed controls, the impact to nesting (including egg laying) WTS is considered to be minor as there will be no impacts at population level or above given the small number of burrows within 50m of the activity compared to available habitat and estimated burrow density on VI, and recovery will be within days to weeks.	

5.7 ALARP Consideration

Alternatives to the proposed method and timing were considered and assessed as described below.

Alternative control	Cost of Control	Benefit of Control	Adopt/Reject Justification
Utilise smaller excavation and rock breaking equipment for the activity such as hand tools. The smallest non-hand held tools available have already	The use of smaller hand tools would extend the duration of the activity to excavate the trench for the culvert to several months. This would result in the activity	Reduces the potential for noise and vibration impacts to nearby shearwater burrows.	**Reject** – the risk of burrow collapse using the selected tools is considered unlikely. The cost of undertaking the activity over a longer period with smaller tools is

been selected for the activity.	continuing later into the WTS nesting season and a higher likelihood of egg and fledging presence which may be more susceptible to injury from burrow collapse. The use of hand tools also exposes personnel to safety issues due to hole collapse. The delay in schedule would also delay the upgrade required for essential works on the water injection wells and result in a significant increase in costs for personnel and equipment use due to the extended duration (to several months).		considered grossly disproportionate given the increased risk to safety, increased costs and significant delays to essential works compared to the reduction in noise and vibration to WTS. In addition, the ground disturbance activities would take longer and therefore overlap with WTS egg laying and fledgling seasons, potentially increasing the risk to WTS.
Remove or reduce the requirement for compacting	An alternative to compacting the backfilled trench is to use a cement slurry instead. This reduces the need for compacting from 4 days to <0.5 days. Minimal cost of cement.	Reduces the potential for noise and vibration impacts to nearby shearwater burrows.	**Adopt** – The reduction in compacting is considered of greater environmental benefit and allows ground disturbing activities to be completed prior to potential egg laying season and therefore reduces the risk to WTS. This control is therefore adopted, and a cement slurry is planned for use instead of backfilling and compacting the trench.
Undertake the activity outside of the WTS sensitivity window (i.e. after 30th April 2019)	Phase 3 of the replacement activity cannot be delayed to 2019 as work scopes planned for Q4 2018 and Q1 2019 are reliant on this PW piping upgrade to restore full system pressure to both water injection wells	Reduces potential for impact to WTS present in burrows at time of activity	**Reject** –These works are considered essential for completion as soon as possible given the reliance of the water injection system on the piping upgrade.
Block all burrows within a 50m radius of the activity and relocate nesting WTS	Additional time on site for seabird specialist to block burrows and relocate any birds occupying burrows already. WTS have strong site fidelity, relocation of birds would result in additional stress for the birds and it is highly likely the birds would return to the same site within hours to days.	Reduces potential for impact to WTS present in burrows at time of activity	**Reject** – Given the low likelihood of burrow collapse occurring during the proposed activity, the disturbance to nesting birds within burrows through handling and relocation is considered grossly disproportionate to the risk of injury or death from the activity occurring in the first place and would result in undue stress to WTS that are relocated. There is also no guarantee that WTS would not return to the same site and excavate a new burrow (as advised by Dr. Chris Surman).

6. ENVIRONMENTAL PERFORMANCE

The proposed activities will be completed in accordance with the VI Hub Ops EP (EA-60-RI-186) Revision 6. To ensure no significant impacts to WTS during the activity, additional controls are proposed as defined in **Table 6-1**. The bird specialist present during the excavation activity will be Dr. Chris Surman of Halfmoon Biosciences who has undertaken monitoring of WTS on VI in previous years and is a seabird specialist with 30 years' experience.

Table 6-1: Additional Environmental Performance Standards

Hazard	Disturbance of terrestrial fauna		
Performance Objective	No fauna death or injury from operational activities on VI.		
Control Measure	**Performance Standard**	**Measurement Criteria**	**Responsible person**
Earthworks activities must not be undertaken outside of daylight hours (between sunset and sunrise)	Earthworks and culvert installation activities will only take place during the hours of sunrise and sunset.	Permit to work states daylight hour operations only	HSE Advisor
Bird behaviour and burrow stability monitoring will be undertaken during earthworks within 50m of the excavation works	Prior to commencement of works, WTS burrows present within 50 m of the excavation works will be demarcated by a seabird specialist. During excavation activities, WTS burrows present within 50 m of the excavation works will be checked in the morning for activity by the seabird specialist to inform if the burrow is being used allowing these burrows to be prioritised for checking at the end of each day. During excavation activities, WTS burrows present within 50 m of the excavation works will be checked at the end of activity each day by the seabird specialist for any collapsed burrows.	All WTS burrows within 50m of excavation activity to be monitored for burrow condition twice daily during ~~excavation~~ ground disturbing works and reported in a completed checklist	HSE Advisor and seabird specialist
Burrow collapse	If a burrow is found to have collapsed during the activity, the seabird specialist will rehabilitate the burrow and checks others for signs of collapse. Ground disturbing activities will not occur during burrow rehabilitation activities If more than 2 burrows are found to have collapsed during the ground disturbing activities, the frequency of burrow checking will be increased to 4 times daily or as advised by the seabird specialist.	All WTS burrows within 50m of excavation activity to be monitored for burrow condition, during ground disturbing works, rehabilitated (if required) and reported in a completed checklist	HSE Advisor and seabird specialist
Fauna escape means in open trenches	Fauna escape means or exclusion methods are provided for excavations left open overnight in accordance with the permit to work.	All excavations left open overnight must have fauna escape or exclusion methods. Permit to work for excavation	HSE Advisor
Fauna Handling	Trench checked for fauna prior to commencement of works each day. If fauna are found in the trench, they will be removed by a licensed fauna handler on VI in accordance with	Evidence of verbal/written reports provided to regulators in accordance with	HSE Advisor

Hazard	Disturbance of terrestrial fauna		
Performance Objective	No fauna death or injury from operational activities on VI.		
Control Measure	**Performance Standard**	**Measurement Criteria**	**Responsible person**
	the Regulation 15 licence to take fauna (Licence number: 02-000357-3).	licence requirements	
Fauna reporting	Fauna interactions (including relocation of fauna and injured or deceased fauna) are reported to the DBCA and DMIRS in accordance with the Regulation 15 Licence and the VI Hub Operations EP.	Evidence of verbal/written reports provided to regulators	HSE Advisor
	At the end of the activity, any collapsed burrows or rehabilitation efforts required on burrows within the 50m radius of works will be reported to DBCA and DMIRS.	End of activity summary provided within 3 months of activity completion	HSE Advisor

7. ENVIRONMENTAL MANAGEMENT

Ground breaking and culvert installation activities will be managed under Quadrant's safety management system and the VI Hub Ops EP (EA-60-RI-186) Revision 6.

A full description of the existing environment onshore, including the known WTS rookeries is provided in the VI Hub Ops EP (EA-60-RI-186) Revision 6. A summary is provided in Section 5.1 of this BD Summary.

The proposed activities are not considered a significant modification to the operational details described within the VI Hub Ops EP as they pose no significant new risks or significant increase in existing risks with the proposed control measures in place.

7.1 Other approvals

As part of the planning process for these particular activities, Quadrant Energy risk reviewed the proposed activities and location and identified that no additional environmental approvals to the *Petroleum (Submerged Lands) (Environment) Regulations 2012* under either State or Commonwealth approvals processes are required. There will be no significant impacts to matters of national environmental significance from the activity with the proposed control measures in place.

8. STAKEHOLDER CONSULTATION

As required by the VI Hub Ops EP (EA-60-RI-186) Revision 6, consultation has been undertaken with the Department of Biodiversity, Conservation and Attractions (DBCA) and this BD has been provided to the department for comment. Comments received from the DMIRS on 04/10/18 and DBCA on 11/10/18 have been incorporated into this BD Summary (Revision 1). No additional consultation is required given the onshore location of the activity within the lease area.

9. REPORTING AND RECORDING

If incidents do occur during the proposed activities they will be reported to DMIRS and DBCA under established recording and reporting requirements as documented in the VI Hub Ops EP. Following completion of the activity, any incidences of burrow collapse and rehabilitation will be reported to DMIRS and DBCA.

10. REFERENCES

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11. CONTACT

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