



ENVIRONMENTAL ASSESSMENT

**Gnangara Sand Quarries –Tenements
E70/3279, E70/3275, M70/1306**





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Gnangara Sand Quarries –Tenements E70/3279, E70/3275, M70/1306

Prepared by:

RPS

Level 2, 27-31 Troode Street,
WEST PERTH WA 6005
PO Box 170, WEST PERTH WA 6872

T: +61 8 9211 1111

F: +61 8 9211 1122

E: environment@rpsgroup.com.au

W: rpsgroup.com.au

Prepared for:

HANSON CONSTRUCTION MATERIALS

Level 1, 35 Great Eastern Hwy
Rivervale, WA 6103

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SUMMARY

Hanson Construction Materials Pty Ltd (Hanson) is seeking approval to establish three sand quarries in the Gnangara Pine Plantation within the following tenements Smokebush E70/3279 (Two Rocks), Tamega Road E70/3275 (Pinjar) and Mulga Road M70/1306 (Gnangara) (Figure 1). The proposal would extract over 80 million cubic metres (m³) of sand over a 50 year (plus) project life.

The three tenements are located within the City of Wanneroo and, to a lesser degree, the Shire of Gingin. The majority of the tenements also fall within the Gnangara-Moore River State Forest, which is Department of Parks and Wildlife (DPaW) managed land. The three tenements are also located within the Gnangara Pine Plantation. There are 22,000 ha of pine plantations within the Gnangara-Moore River State Forest, 5,000 hectares (ha) of which has been harvested to date, as part of the Gnangara Sustainability Strategy (GSS). The “proposal area” (disturbance area) boundaries within the three tenements are focused within the pine plantation areas (Figure 2).

Table I provides a summary of the key project characteristics and the project elements for the three sand quarries in accordance with the Environmental Protection Authority’s (EPA) Environmental Assessment Guidelines – defining the key characteristics of a proposal (EAG I).

Table I: Gnangara Sand Mine Proposal Characteristics

Proposal Title: Gnangara Sand Mines			
Proponent: Hanson Construction Materials Pty Ltd (Hanson)			
Short description: The proposal is to develop and operate three sand quarries within tenements M70/1306, E70/3275 and E70/3279 which are located within the Gnangara Pine Plantation approximately 30 km to 50 km north of Perth business district. The proposal includes sand mining infrastructure including:			
<ul style="list-style-type: none"> ▪ internal roads ▪ sand screening and washing plant ▪ fuel tanks ▪ weighbridge ▪ wash down facility ▪ site office 			
	Gnangara (M70/1306) (Mulga Road)	Pinjar (E70/3275) (Tamega Road)	Two Rocks (E70/3279) (Smokebush)
Excavation			
Quarry life	10+ years	50+ years	50+ years
Total estimated material excavated	5 million metres ³	25 million metres ³	25 million metres ³
Total area of quarry footprint (proposal area)	163.11 ha (proposal area)	3553.86 ha (proposal area)	5037.39 ha (proposal area)
Estimated excavation rate	Each tenement site will produce 3000–4000 tonnes per day		
Maximum pit depth	The excavation level will have an interim depth of 3 m from the historical maximum groundwater level (i.e. the highest ever recorded groundwater level). Once the DoW has agreed with Hanson on the methodology for determining the Likely Future Maximum Winter Water Table (LFMWWT), then the Water Management Plan will be amended and finalised to extract 3 m above this level.		
Screening plant	A screening plant will be used at each site to screen oversized rock and organic material.		

Quarry Site Infrastructure	
Machinery	
Water Cart	18 kL capacity, used for dust suppression of haul road, pit floor and stockpiles.
Front end loaders	Three Volvo 150E or similar earthmoving equipment as required
Semi-trailers	Variable. From 10 m ³ to 40 m ³ capacity. Will be provided by customers. Vehicles used will be classified by Main Roads Western Australia
Grader	One Cat 140G or similar. For maintaining roads, as required
Dump Trucks	Approximately five articulated dump trucks
Service truck	Truck with 5000 L fuel capacity and tanks for separate lubricants, including a waste oil tank and evacuation pump.
Light vehicles	Two for site operators.
Fuel Tanks	Each sand quarry requires x3 17,500 L above ground self banded tanks
Diesel generators	Suitably-sized diesel generators
Mobile screening plant	A washing and screening plant will be used to sort sand material after excavation at each sand quarry site
Transport	
Truck movements and hours	Approximately 100 to 200 return truck movements per day of operation (depending on truck sizes). Only include noise from within the site. Off-site noise is not included.
Workforce	
Operation	15-25 personnel during operation
Hours of Operation	24 hours per day or from 6.00 am to 7 pm if sand extraction stage(s) occurs within 1,000 m of sensitive receptors

The “proposal area” excludes Bush Forever sites, wetlands, native vegetation defined in the draft Green Growth Plan and their associated buffers. The access road to the Mulga Road M70/1306 (Gnangara) is excluded from this proposal.

It is proposed the three tenements across the Gnangara Pine Plantation will be first cleared of pine trees by the Forest Products Commission (FPC) before Hanson commences sand excavation operations. However, Hanson may need to clear any regrowth (pines and native vegetation) that occurs after the existing pines are cleared, should the timeframe between clearing of the pine trees and commencement of sand extraction be sufficiently long so as to allow for regrowth to become established on future stages. Prior to undertaking any regrowth clearing Hanson will lodge a clearing application for approval by the Department of Mines and Petroleum (DMP) – Native Vegetation Branch.

The sand quarries within each of the three tenements will be mined in several stages. A brief description of the project activities is provided here for context. Each sand excavation stage (within the “proposal area”) will be characterised by an open quarry area of approximately 10 ha to 30 ha at any one time over the 50 plus year quarry life. The sand will be screened (and washed if required) on site and then transported off site to customers. Within the “proposal area(s)” but external to the sand excavation stages, approximately 5 ha within the tenement area will be used for site infrastructure, including, but not limited to for each Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306:

- sand screening plants and washing plants
- ‘self contained’ elevated fuel tanks
- weighbridge

- wash down facility
- site office.

Extraction of construction sand will be market driven and historically approximately 19 million tonnes of material is required annually by the Perth market for uses including: concrete, plastering, bricklaying, fill sand and specialised sands for foundries, glass, grouts and other specialised uses.

Quarrying is proposed to commence at select tenements as soon as approval is issued and as required by market conditions.

Environmental Issues

Within the three tenement areas there are the following key environmental receptors:

- Bush Forever sites
- Conservation category wetlands (CCWs)
- Resource enhancement wetlands (REWs)
- Areas of native vegetation.

A review of the following datasets and mapping identified the preliminary environmental factors have been identified relevant to this proposal:

- Site review
- Aboriginal Heritage Inquiry System
- Bush Forever mapping
- Department of Environmental Regulation (DER) Acid Sulfate Soil (ASS) mapping
- Department of Parks and Wildlife (DPaW) fauna, vegetation and flora Nature Base database
- Department of the Environment EPBC Act Protected Matters Search Tool
- Natural Regeneration of Cleared Plantations in Nowergup (PGV Environmental)
- Perth Groundwater Atlas and the Department of Water (DoW) groundwater contours in the Gnangara Mound
- Western Australian Planning Commission (WAPC) Draft Perth and Peel@3.5 million report
- WAPC State Planning Policy 2.4 Basic Raw Materials mapping
- Geological survey mapping.

The preliminary environmental factors identified for this proposal include:

1. Hydrological processes.
2. Flora and vegetation.
3. Terrestrial fauna.
4. Amenity – dust and noise.
5. Aboriginal heritage.
6. Rehabilitation and decommissioning.

Environmental Management

In considering the potential direct and indirect impacts of the proposal on hydrology, flora and vegetation, fauna, heritage, amenity (dust and noise) and rehabilitation Hanson in defining the three sand quarry areas has had particular regard to the following:

- The three “proposal area(s)” (disturbance area) boundaries within the tenements are focused within the existing pine plantation areas.
- The environmental values within each tenement which include wetlands, areas of Banksia woodland and black cockatoo foraging habitat are avoided. The majority of the tenements have been cleared and are in various states of regeneration.
- The potential impacts to the mapped wetlands, which are considered unlikely to be significantly impacted due to:
 - avoidance of wetlands
 - the proposal does not require dewatering
 - the mining activities occur above the groundwater table
 - prepare and implement a Water Management Plan and a Fuel Management Plan for each of the three tenements to the satisfaction of the Department of Water (DoW)
 - the fuel tanks will be located a minimum 500 m from all wellheads
 - if groundwater is required within the tenement, e.g. for sand washing Hanson will seek a groundwater licence from the DoW, or alternatively use scheme water. The groundwater licence assessment requires a hydrological impact assessment inclusive of groundwater quality and any surrounding wetlands.
- The potential impacts to flora and vegetation are considered unlikely to be significantly impacted due to:
 - avoiding stands of remnant vegetation and bush forever sites
 - avoiding all the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan
 - proposed rehabilitation of vegetation, consistent with the objectives of the draft Green Growth Strategy for the Gnangara Mound.
- The potential impacts to fauna, which are unlikely to be significantly impacted due to:
 - avoiding all the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan
 - avoidance of wetlands
 - the post-mining rehabilitation utilising native plant species that are known black cockatoo food sources.
- The potential impacts to Amenity in the form of dust and noise, which is unlikely to be significantly impacted due to:
 - minimum 300 m buffer to any sensitive premises from the “proposal area(s)” boundaries within the three tenements
 - the proposal is for extraction only and does not include a crushing or processing component

- the proponent's dust suppression measures to minimise dust emission from construction and operation.
- The potential impacts to Heritage (Aboriginal Heritage), which is unlikely to be significantly impacted due to:
 - avoidance of the registered Aboriginal Site - Smokebush Waterhole (Site ID 3574)
 - the results of desktop and field surveys undertaken by the proponent which indicate that the two registered sites of significance near the proposal, extend well beyond the development envelope and are unlikely to be disturbed by mining operations
 - the engagement of a heritage consultant to walk the site prior to ground disturbing activities to ensure no heritage artefacts are disturbed, as required.

It is also noted there are other statutory processes under both *Environmental Protection Act 1986* and the *Mining Act 1978* which will be utilised by Hanson to manage the potential impacts from the sand excavation. Specifically, Hanson will prepare and implement the following for each of the proposed three sand quarries:

1. Mining Proposal consistent with the Department of Mines and Petroleum (DMP) guidelines.
2. Mine Closure Plan that is consistent with the DMP and EPA Joint Guidelines for Preparing Mine Closure Plans for each of the sand quarries.
3. Water Management Plan to the satisfaction of the DoW.
4. Fuel Management Plan as specified in *Statewide Policy No. 1: Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas* (WRC 1999) to the satisfaction of the DoW.
5. Dieback management protocols.
6. Weed management procedures.

The majority of the native vegetation within the proposal areas was historically cleared of vegetation to establish the Gnangara Pine Plantation. Although no areas of remnant bushland (as identified and mapped in *Bush Forever* and the draft *Green Growth Plan*) will be cleared as part of this proposal, Hanson will need to clear any areas of regrowth within the sand quarry disturbance area that may occurred after the pines trees are harvested. Acknowledging this Hanson will seek approval to clear any regrowth vegetation through a Part V Division 2 of the *Environmental Protection Act 1986* - Clearing Permit.

Table 2 outlines the key management commitments. The below summary of environmental commitments are protocols that have been endorsed at other Hanson sand quarry operations in the Gnangara Pine Plantation (i.e. McKinley Road sand quarry).

Table 2: Summary of Environmental Commitments for all Tenement Areas

Environmental Factor	Summary	Management Commitment
Flora and Vegetation	<p>The “proposal area” boundaries in each tenement are comprised solely of pine plantation and no native vegetation will be cleared as part of the proposal. Hanson will seek approval to clear any regrowth vegetation through a Part V Division 2 of the <i>Environmental Protection Act 1986</i> - Clearing Permit</p>	<ul style="list-style-type: none"> ▪ Avoidance of remnant native vegetation in the area including the Bush Forever and wetland areas. ▪ The potential spread of weeds and dieback, if present, during operations will be managed through implementing the weed and dieback management protocols. ▪ Dust will be managed during the quarrying operations to protect surrounding native vegetation. ▪ Buffers will be maintained between “proposal areas” and adjacent native vegetation and Bush Forever sites. ▪ Vehicles will be restricted to designated roads. ▪ The post-mining land use of the area will be directed through the outcomes of the government’s draft Green Growth Plan, which is currently in draft form. The “proposal areas” / development footprint will be rehabilitated utilising low water use native vegetation comprised of species native to the Swan Coastal Plain 2 (SWA2) IBRA subregion and provides benefits to conservation of Carnaby’s cockatoo.
Dieback	<p>The sites are considered un- interpretable, due to the absence of any indicator species.</p> <p>Hygiene guidelines will be implemented on site entry and exit. This policy will apply to all mobile excavation equipment as they have a high risk of carrying soil.</p>	<ul style="list-style-type: none"> ▪ The potential spread of weeds and dieback, if present, during operations will be managed through implementing the weed and dieback management protocols. ▪ Training programs and inductions will be conducted for site personnel. ▪ Area will be quarantined ahead of excavation. ▪ All surface water will be contained on site. Run-off from the quarry pit, stockpiles, cleaning down and haul roads will be contained, and not released into areas of native vegetation. ▪ Vehicles and machinery will be restricted to access roads, tracks and the “proposal area”. ▪ No soil or vegetation will be brought on site.
Fauna	<p>A variety of threatened fauna species may occur within and adjacent to the proposed sites. The “proposal areas” are in pine plantation areas so it is unlikely that suitable habitat for significant species will be directly disturbed by the sand quarries within the three tenements.</p>	<ul style="list-style-type: none"> ▪ Avoidance of the remnant native vegetation in the area including the Bush Forever and wetland areas. ▪ Staged excavation of the “proposal area(s)” to allow for acclimatisation for any remaining fauna in the area. ▪ The control and monitoring of dust and noise ▪ Induction of machinery operators involved in the operations and stump removal process. Operators will be advised to be alert for fauna, and to take steps to avoid impacts, where practical. ▪ Speed limits will apply on site to limit fauna fatalities.
Groundwater Resources	<p>Groundwater abstraction is likely to occur from groundwater bores to be installed on each site, however pit dewatering will not be required as the maximum pit depth will remain above the water table.</p>	<ul style="list-style-type: none"> ▪ Prepare and implement a Water Management Plan (WMP) in liaison with the DoW. ▪ The WMP will define an initial mine floor level that provides 3 metres (m) buffer to the historical maximum groundwater level. This initial and conservative buffer will be necessary until on-site groundwater level data is available to determine the water table elevation accurately and the DoW based on this site specific information can advise on the methodology for determining the “likely future maximum winter water table” (LFMWWT) ▪ Monitoring bores will be installed across the site to assess water level, water quality. ▪ Fuel Management Plan will be prepare and implemented to the satisfaction of DoW. Fuel tanks will be located a minimum 500 m from any wellhead. ▪ Waste management to ensure all wastes are disposed of appropriately, minimising the risk of groundwater contamination. ▪ Surface water management will minimise the risk of contamination to groundwater via local infiltration.

Environmental Factor	Summary	Management Commitment
Acid Sulfate Soils	The “proposal area” do not include any areas of high ASS risk.	<ul style="list-style-type: none"> ▪ Avoidance of high to moderate ASS risk area at all times during operations. ▪ Excavation will not intersect the water table at any time during operations, minimising the risk of exposing potential ASS.
Noise	<p>There are no residential dwellings within close proximity of the “proposal area”.</p> <p>Hanson does not expect significant noise issues to arise for the duration of operations.</p>	<p>To protect the amenity of the receiving environments from noise impacts, the following key management measures will be implemented during the construction and operation phase:</p> <ul style="list-style-type: none"> ▪ Minimum 300 m buffer to any sensitive premises from the “proposal area(s)” boundaries within the three tenements ▪ 24 hours per day or from 6.00 am to 7 pm if sand extraction stage(s) occurs within 1,000 m of sensitive receptors ▪ Maintain noise suppression devices in good condition on all operational machinery. ▪ Shut down equipment when not in use. ▪ Operate machinery only within the designated hours of operation. ▪ Schedule activities to minimise the likelihood of noise nuisance. ▪ Use the dedicated transport route. <p>Record any complaints received regarding noise disturbance and instigate follow-up action instigated immediately to minimise the cause, to the greatest possible extent.</p>
Air Quality	There are no residential dwellings within close proximity to the “proposal area”. Local residents may be affected by the transportation of material along transport routes. Dust monitoring will only be required in the event of a legitimate complaint.	<p>To prevent or minimise dust generation during quarry operations, the following dust management measures will be implemented during the construction and operation phase:</p> <ul style="list-style-type: none"> ▪ Minimum 300 m buffer to any sensitive premises from the “proposal area(s)” boundaries within the three tenements ▪ The excavation within the “proposal area” will occur in stages. A key objective is to minimise the disturbance or open area at any one time, as far as practicable. ▪ Maintain haul road surface in a good condition and with suitable grades. ▪ Restrict vehicle movements to defined roads. ▪ All vehicles leaving the site are required to have covered loads. ▪ Use water as appropriate to wet down roads and trafficked areas. ▪ Use dust suppressants where appropriate (either mixed with water to enhance dust suppression and vegetation cover, or applied periodically to specific areas). ▪ Limit the speed of vehicles on the site. ▪ Apply surface treatments (e.g. mulch, ground cover) to stabilise any bare areas which might be prone to wind erosion. ▪ Define buffer areas within the site to avoid any unnecessary disturbance of stabilised surfaces or vehicle traffic. ▪ Limit the quantity of machinery / vehicles in operation. ▪ Inducting all contractors working within the sites. <p>Record any complaints received and instigate follow-up action instigated immediately to minimise the cause, to the greatest possible extent.</p>

Environmental Factor	Summary	Management Commitment
Hydrocarbons and Waste	<p>Hydrocarbons will be stored on site in a compliant elevated self-bundled fuel tank and transported around the site in a mobile fuel tank.</p> <p>The following wastes may be produced by the proposed sand quarries:</p> <ul style="list-style-type: none"> ▪ hydrocarbon and chemical contaminated waste ▪ general waste (e.g. kitchen waste, paper, cardboard) ▪ sewage and domestic wastewater. 	<ul style="list-style-type: none"> ▪ Procedures will be implemented for the correct handling, storage, spill management and clean up. ▪ Contaminated material will be removed and bio-remediated (if biodegradable) or disposed of at a licensed facility. ▪ Spill response equipment will be located in the vicinity of work areas, with site personnel trained in spill response management. ▪ The mobile service truck will deliver fuels, oil and lubricant and remove all waste oil. It will be appropriately designed to prevent spillages to the environment and will carry appropriate spill prevention (e.g. drip trays) and clean-up equipment. ▪ Diesel fuel will be stored within each tenement in elevated self-bundled tanks (~17,500 L per tank) in accordance with the Fuel Management Plan. ▪ There will be minimal hydrocarbons (lubricant, coolant, grease, oil, etc.) stored in the machinery shed. ▪ Any spills or leaks will be cleaned up immediately. Contaminated absorbent material will be disposed of in accordance with legal requirements and contaminated soil will be taken off site by a licensed waste contractor in accordance with relevant legislation. Contaminated absorbent material and soil will be disposed of to a licensed landfill facility. ▪ Hydrocarbons and chemical containers, such as lubricants will be regularly removed from site for disposal at a licensed landfill facility. ▪ Sewage waste will be transported off site for treatment and disposal by a licensed contractor. No effluent will be released on site. ▪ Instruction will be provided to site personnel on waste management. ▪ Mobile service vehicles will store any waste oil removed from machinery, and remove it from site daily.
Visual Amenity	<p>It is not expected that the sand quarries will have a significant effect on the visual amenity of the nearest neighbours.</p>	<ul style="list-style-type: none"> ▪ The pit design will be such that natural topography and sand bunds will be utilised to shield the view of the mine from surrounding land uses. ▪ Ensure barrier fences and gates are compatible with the semi-rural style of the surround land areas and natural landscape. ▪ Ensure orderly storage and removal of disused equipment or waste. ▪ Locate buildings in areas of low visual impact, and maintain appropriate size. ▪ Rehabilitate all disturbed and excavated areas when work is completed.
Aboriginal Heritage	<p>There are no registered Aboriginal heritage sites within the “proposal area”.</p>	<ul style="list-style-type: none"> ▪ Avoids the registered Aboriginal Site - Smokebush Waterhole (Site ID 3574) ▪ Engagement of a heritage consultant to walk the site prior to ground disturbing activities to ensure no heritage artefacts are disturbed, if required. ▪ Any significant sites identified during construction will not be removed, damaged or altered without approval under Section 18 of the <i>Aboriginal Heritage Act 1972</i>. ▪ Training will be provided to all construction workers detailing the importance of avoiding heritage sites and reporting of any suspected heritage sites. Exclusion zones will also be identified and clearly communicated to the personnel in the event of a heritage site being uncovered.

Environmental Factor	Summary	Management Commitment
Rehabilitation / Closure	All legally binding conditions and commitments relevant to rehabilitation and closure will be met	<ul style="list-style-type: none"> ▪ All buildings and infrastructure will be removed. ▪ Any hard-stand surfaces will be removed and used to backfill the pit. ▪ Overburden and oversize screened material will be used as backfill. ▪ The site will be rehabilitated with broadcast seeding and with some tubestock and seedling planting out to encourage native vegetation cover establishment if pine trees are not replanted (which is not likely). ▪ A Closure Plan that complies with the DMP Closure Guideline will be prepared and submitted.

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I.0 INTRODUCTION

I.1 Purpose of this Report

This report has been prepared as an environmental summary to accompany a Section 38(a) referral to the Environmental Protection Authority (EPA).

I.2 Background

Hanson Construction Materials Pty Ltd (Hanson) is seeking approval to establish three sand quarries within the following tenements Smokebush E70/3279 (Two Rocks), Tamega Road E70/3275 (Pinjar) and Mulga Road M70/1306 (Gnangara) (Figure 1). The proposal would extract over 80 million cubic metres (m³) of sand over a 50 year plus project life.

The “proposal area” boundaries within the three tenements are focused within the pine plantation areas.

The three mining tenements are partially located within the Banksia woodland belt of the Swan Coastal Plain (SCP). The native vegetation was cleared approximately 85 years ago to establish the Gnangara Pine Plantation. There are 22,000 ha of pine plantations within the Gnangara system, 5,000 hectares (ha) of which has been harvested to date, as part of the Gnangara Sustainability Strategy (GSS), which is a joint project between the Department of Water (DoW), Department of Agriculture and Food WA, Department of Parks and Wildlife (DPaW), Department for Planning and Infrastructure, Forest Products Commission, Water Corporation and the CSIRO (GSS 2009).

The GSS was a State Government initiative that aimed to provide a framework for a whole of government approach to address land use and water planning issues associated with the Gnangara groundwater system. The three pine plantations have been targeted for harvesting by the FPC by 2028, with no new plantations to be established. Some of this area has been identified to be restored to native woodlands.

The GSS is now largely redundant and the post mining land use of the area will be directed through the outcomes of the Government’s Green Growth Plan, which is currently in draft form. The draft Green Growth Plan indicates that the area is to remain as State forest and DPaW indicate this is unlikely to change.

The proposed sand quarries (the “proposal area(s)”) described in this proposal has not been previously mined or excavated.

These three tenements are located in the Gnangara Pine Plantation within the City of Wanneroo and Shire of Gingin. The majority of the tenements also fall within the Gnangara-Moore River State Forest, which is DPaW managed land (Figure 2).

In consultation with the Forest Products Commission (FPC) it was discussed that Hanson would manage and plan their operations to align with FPC forestry management and planning. Hanson will extract from recently harvested pine plantation areas. DPaW has confirmed that the pine trees within the mining tenement will be harvested and will not be replaced by the FPC for the majority of the tenement area.

The post-mining land use of the area will be directed through the outcomes of the Government's draft Green Growth Plan, which is currently in draft form. The draft Green Growth Plan indicates that the area is to remain as State forest the key objectives in the draft Green Growth Plan relevant to Hanson's rehabilitation include groundwater protection and conservation of black cockatoo.

After the completion of sand extraction, each sand quarry will be rehabilitated utilising low water use native vegetation comprised of species native to the Swan Coastal Plain 2 (SWA2) IBRA subregion, that facilitates ease of ongoing management by DPaW and provides benefits to conservation of black cockatoos.

1.3 Project Description

The objective of this proposal is to extract a variety of sands from within the "proposal area" boundaries within the three tenements (Figures 1 and 2). Some excavation of limestone may occur if encountered within the extraction area. If this occurs the limestone will be extracted and track crushed (or similar) to make the product suitable for market.

A working footprint within the "proposal area" of approximately 30 ha is proposed at any one time, with a further area of approximately 5 ha utilised for site infrastructure, including, but not limited to:

- internal roads
- sand screening and washing plant
- 'self contained' elevated fuel tanks
- weighbridge
- wash down facility
- site office.

The "proposal area" boundaries within the three tenements (Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306) will be mined in several stages; staging will be discussed and confirmed with DPaW and FPC and will be addressed closer to the excavation dates. Extraction of construction sand will be market driven and historically approximately 19 million tonne of material is required annually by the northern Perth market. The different sand quarries within each of the three tenements will provide different types of sand to market, including: concrete, plastering, brick laying, fill sand and specialised sands for foundries, glass, grouts and other specialised uses.

The sand will be screened (and washed if required) on site and then transported off site to customers. Quarrying is proposed to commence at the three tenements as soon as approval is issued and as required by market conditions.

1.4 Location

Figure 1 shows the regional location of the three mining tenements.

Figure 2 shows the Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306 tenements within the context of the Gnangara-Moore River State Forest, Gnangara Pine Plantation and the local government boundaries.

Figures 3a-c illustrates the “proposal area” boundaries (disturbance footprint) and the proposal excludes wetlands, bush forever sites, exclusion areas (“red” areas) defined in the draft Green Growth Plan and native vegetation (and their buffers) within the three mining tenements.

1.5 Proponent Details

Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306 are all held by Hanson.

The contact details for the proponent are listed below:

Vern Newton
Development Manager
Hanson Construction Materials Pty Ltd (Hanson)
Level 1, 35 Great Eastern Hwy, Rivervale, WA 6103

1.6 DPaW Managed Lands and Conservation Reserves

The mining tenements falls within the Gnangara-Moore River State Forest (State Forest 65) (Department of Environment and Conservation 2012b). This is DPaW Managed Land, vested in the Conservation Commission.

Conservation Reserves are Crown lands to which the *Conservation and Land Management Act 1984* applies (e.g. reserves and state forests). These lands are managed by DPaW. State forests are managed for multiple purposes, including water catchment protection, timber production on a sustainable yield basis, recreation and conservation. These areas are afforded special protection and some land uses are not permitted within them.

In practice, the Mining Proposals and Mine Closure Plans mandated under the *Mining Act 1978* for each of the three sand quarries will require consultation and approval from DPaW and the Minister for the Environment’s concurrent with the Minister for Mines and Petroleum. Hanson has been in liaison with DPaW in regards to mine closure and revegetation requirements.

1.7 Project Characteristics

A summary of the key characteristics of the Gnangara sand quarry proposal in accordance with EPA Environmental Assessment Guideline - Defining the key characteristics of a proposal (EAG 1) is provided in Table 3 and Figures 3a-3c.

1.7.1 Smokebush (E70/3279) Two Rocks

The Smokebush Hill Road site in Two Rocks is located approximately 20 kilometres (km) north of Quinns Rock and covers an area of approximately 7416 ha. The site is located partially within both the City of Wanneroo and the Shire of Gingin. The “proposal area” area is 5037.39 ha.

Within the Smokebush tenement the proposed “excavation area” boundaries (disturbance footprint) avoids the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan. Additionally, there is a 50 m buffer from the registered Aboriginal Site - Smokebush Waterhole (Site ID 3574).

1.7.2 Tamega Road (E70/3275) Pinjar

The Tamega Road site in Pinjar is located approximately 15 km north-east of Quinns Rock and covers an area of approximately 4868 ha. The site is located wholly within the City of Wanneroo. The “proposal area” is 3553.86 ha.

Within the Tamega Road tenement the proposed “proposal area” boundaries (disturbance footprint) avoids the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan.

1.7.3 Mulga Road (M70/1306) Gnangara

The Mulga Road site in Gnangara is located approximately 15 km south-west of Quinns Rock and covers an area of approximately 323 ha. The site is located wholly within the City of Wanneroo. The “proposal area” is 163.11 ha.

A summary of the sand quarry proposals is provided in Table 3.

Table 3: Gnangara Sand Mine Proposal Characteristics

Proposal Title: Gnangara Sand Mines			
Proponent: Hanson Construction Materials Pty Ltd (Hanson)			
Short description: The proposal is to develop and operate three sand quarries within tenements M70/1306, E70/3275 and E70/3279 which are located within the Gnangara Pine Plantation approximately 30 km to 50 km north of Perth business district. The proposal includes sand mining infrastructure including: <ul style="list-style-type: none"> ▪ internal roads ▪ sand screening and washing plant ▪ fuel tanks ▪ weighbridge ▪ wash down facility ▪ site office 			
	Gnangara (M70/1306) (Mulga Road)	Pinjar (E70/3275) (Tamega Road)	Two Rocks (E70/3279) (Smokebush)
Excavation			
Quarry life	10+ years	50+ years	50+ years
Total estimated material excavated	5 million metres ³	25 million metres ³	25 million metres ³
Total area of quarry footprint (proposal area)	163.11 ha (proposal area)	3553.86 ha (proposal area)	5037.39 ha (proposal area)
Estimated excavation rate	Each tenement site will produce 3000–4000 tonnes per day		
Maximum pit depth	The excavation level will have an interim depth of 3 m from the historical maximum groundwater level (i.e. the highest ever recorded groundwater level). Once the DoW has agreed with Hanson on the methodology for determining the Likely Future Maximum Winter Water Table (LFMWWT), then the Water Management Plan will be amended and finalised to extract 3 m above this level.		
Screening plant	A screening plant will be used at each site to screen oversized rock and organic material.		
Quarry Site Infrastructure			
Machinery			
Water Cart	18 kL capacity, used for dust suppression of haul road, pit floor and stockpiles.		
Front end loaders	Three Volvo 150E or similar earthmoving equipment as required		
Semi-trailers	Variable. From 10 m ³ to 40 m ³ capacity. Will be provided by customers. Vehicles used will be classified by Main Roads Western Australia		
Grader	One Cat 140G or similar. For maintaining roads, as required		
Dump Trucks	Approximately five articulated dump trucks		
Service truck	Truck with 5000 L fuel capacity and tanks for separate lubricants, including a waste oil tank and evacuation pump.		
Light vehicles	Two for site operators.		
Fuel Tanks	Each sand quarry requires x3 17,500 L above ground self banded tanks		
Diesel generators	Suitably-sized diesel generators		
Mobile screening plant	A washing and screening plant will be used to sort sand material after excavation at each sand quarry site		
Transport			
Truck movements and hours	Approximately 100 to 200 return truck movements per day of operation (depending on truck sizes). Only include noise from within the site. Off-site noise is not included.		

Workforce	
Operation	15-25 personnel during operation
Hours of Operation	24 hours per day or from 6.00 am to 7 pm if sand extraction stage(s) occurs within 1,000 m of sensitive receptors

The “proposal area(s)” excludes Bush Forever sites, wetlands, native vegetation defined in the draft Green Growth Plan and their associated 50 m buffers. The access road to the Mulga Road M70/1306 (Gngangara) is excluded from this proposal.

1.8 Site Layout

The “proposal area” boundaries within the three tenements are focused within the pine plantation areas (Figures 3a–3c).

The proposal has taken into consideration the location of the sand resource, environmental features (e.g. bush forever and wetlands), gradient, drainage lines, noise minimisation, and visibility from the road, cartage distances and the minimal necessary infrastructure. The mine pad will contain the stockpiles and loop road to minimise ground disturbance. The infrastructure (portable office, machinery shed, water tanks and portable toilet) will be located adjacent to the access road.

The infrastructure (office, machinery shed, water tanks and portable toilet) will be located adjacent to the access road. The “proposal area” accommodates the following:

- The three “proposed area” boundaries within the tenements are focused within the pine plantation areas.
- All wetlands are avoided.
- All the designated exclusion (or “red”) areas in the draft Green Growth Plan are avoided.
- All excavation will be at least 100 m from Water Corporation’s abstraction bore. The proposed sand quarry will not store hydrocarbons within 500 m of the wellhead protection zone.
- A 20 m buffer will be maintained from all DoW monitoring bores.
- All high to moderate ASS risk areas are avoided.
- A 50 m buffer will be maintained from all road reserves.
- All bush forever sites and areas of native vegetation are avoided.

- The registered Aboriginal Site - Smokebush Waterhole (Site ID 3574) is avoided (Figure 10)

1.9 Construction

The construction process will involve:

- accurately marking out the construction areas
- construction of the access roads, communication, bores, power cables, etc.
- building a machinery laydown shed, including concrete pad
- constructing an office building, toilet facility, laboratory and weighbridge facility
- set up of screening and washing plant.

1.10 Mining Operations

Approximately 3,000 to 4,000 tonnes is proposed to be extracted daily from the “proposal area” boundaries (disturbance footprint) within each of the sand quarries. The sand will be screened and washed on site (if required) and then transported off site to customer locations. The stockpiles for overburden and oversize screened material will be located in the designated stockpile area on the run of mine pad. Volumes are unknown but overburden depth is expected to be minimal due to the nature of the sand. Oversize material is expected to consist of organic matter and some rock, and is likely to be fairly low, especially if burnt. This location provides maximum screening for aesthetics and noise.

There will be stockpiles located adjacent to the screening plant, for screened and unscreened material. Allowance will be made to house the volume of seven days of screening. Note that not all material must be screened, but is generally required for concrete, building and silica sands. Limestone may also be extracted, crushed, screened, and sold to market if encountered.

Topsoil or overburden will be stockpiled for use in rehabilitation. It is not considered necessary to restore the soil profile as it is highly contaminated with pine seeds, needles and weeds; no native seed bank is anticipated in the topsoil, though if deemed suitable this resource will be utilised.

Vegetation and topsoil from weed-infested areas will be stripped and stockpiled separately from non-weed infested areas. Overburden and oversize material stockpiles will be used to backfill the excavations at mine closure and are thus temporary. Barriers will surround each excavation area, with lockable gates securing the access road entrances outside of operating hours.

The machinery proposed for the sand quarries is listed in Table 3, though alternative machinery may also be necessary.

I.11 Staging and Timing

The three sand quarries will be generally carried out in accordance to the following stages:

- removal of any remaining pine stumps once FPC have cleared the pine plantation. Any remaining stumps will be dug up, windrowed and burnt
- overburden stripping and stockpiling
- establishment of supporting infrastructure (roads, buildings, screens, etc.)
- mining of sand
- rehabilitation of each stage to commence when the resource is stripped.

I.12 Screening and Washing

Depending on purpose, some of the material will be screened prior to being transported off site. Screening may encompass dry screening only or washing and screening of required.

No further processing is required. The screening and washing plant will initially be positioned on the run of mine pad adjacent to initial sand mining activities.

I.13 Tailings Storage

There will not be any tailings produced. The only waste will be clay and fine silt washed from the sand or oversize screened material, which will consist of organic material (mostly pine tree roots) and any rocky material present. This material will be stockpiled, and returned during rehabilitation of each stage once it has dried from the washing process, or sold if a market is available.

I.14 Workforce

Personnel will commute to the site each day. During the construction phase, there will be 15 to 25 personnel on site. During operations there will be approximately two to three personnel. Operating hours will be 24 hours per day or from 6.00 am to 7 pm if sand extraction stage(s) occurs within 1,000 m of sensitive receptors.

I.15 Compliance with Legislation and other Approvals

The proposed three sand quarries do not require any clearing of native bushland complexes. However, because the tenement is within an ESA, clearing approvals will be required for any native vegetation regrowth post clearing by the FPC.

A Dangerous Goods licence will not be required, dangerous goods licencing volumes will not be stored on site.

Part V of the EP Act covers Works Approvals and Licences. These are the key statutory tools the DER use to regulate industry in WA. They are intended to prevent pollution during both the construction and operational phases. All prescribed premises (premises that are likely to cause pollution of the air, land or water), described in Schedule I of the WA Environmental Protection Regulations 1987 require a Works Approval for construction and a licence to commence and continue operations.

The proposed quarry will be classified as a Prescribed Premise under Category 12 when more than 50,000 tonnes per year is screened. A Works Approval will be applied for related to the proposed screening and washing plant and any limestone crushing plant if this is required.

Hanson will also implement the Licence(s) to Take Water from DoW as approved. The Minister for the Environment on advice from Parks and Wildlife also provides the regulatory approval and will set conditions with regard to rehabilitation and closure obligations.

Planning Approval and a Building Permit for the buildings may be required from the City of Wanneroo.

The key Commonwealth and state legislation relevant to this proposal has been summarised in Table 4.

Table 4: Key Commonwealth and State Legislation

Legislation	Relevance	Regulatory Authority
<i>Aboriginal Heritage Act 1978</i>	Heritage sites are not to be altered, excavated, damaged, concealed or any portion of the site removed in anyway, unless granted via Section 16 or 18.	Department of Aboriginal Affairs
<i>Environmental Protection Act 1986 (WA)</i>	Prevention, control and abatement of pollution, including dust, and conservation protection and enhancement of the environment. Regulates vegetation clearing and the screening licence.	DER / DPaW
<i>Wildlife Conservation Act 1950 (WA)</i>	Provides for the conservation and protection of wildlife (flora and fauna). Special provisions and schedules cover protection and management of gazetted rare flora and fauna.	DPaW
<i>Contaminated Sites Act 2003</i> Contaminated Sites Regulations 2006.	The proponent or individuals are to report known or suspected areas of contaminated sites.	Department of Environment Regulation (DER)
<i>Conservation and Land Management Act 1984</i>	Administers all reserved land vested in the Conservation Commission, collectively referred to as DPaW Managed lands.	DPaW
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)	Covers clearing of native vegetation. A clearing permit must be sought under these regulations.	DPaW
Environmental Protection (Noise) Regulations 1997 (WA)	Covers noise limits for certain premises listed.	DER
<i>Agriculture and Related Resources Protection Act 1976 (WA)</i>	Covers management of weeds with potential to impact agricultural production.	Department of Agriculture and Food

1.15.1 **Environmental Protection Act 1986 (WA)**

The proposed sand quarries will be classified as a Prescribed Premise under Category 12 when more than 50,000 tonnes per year is screened. A DER Works Approval will be applied for related to the proposed screening and washing plant and potentially for limestone crushing plant if this is required.

1.15.2 **Clearing of Native Vegetation**

As previously noted, the FPC will be responsible for the clearing of the existing pine trees. However, Hanson may need to clear any regrowth (pines and native vegetation) that occurs after the existing pines are cleared, should the timeframe between clearing of the pine trees and commencement of sand extraction be sufficiently long so as to allow for regrowth to become established on future stages.

Prior to undertaking any regrowth clearing Hanson will lodge a clearing application for approval by the Department of Mines and Petroleum (DMP) – Native Vegetation Branch.

1.15.3 Mining Rehabilitation Fund

The Mining Rehabilitation Fund (MRF) is a new pooled fund contributed to by Western Australian mining operators. There are approximately 22,000 mining tenements in WA and, as a requirement of the MRF, all holders are required to provide the DMP with accurate information of the types and areas of ground disturbance for each tenement. MRF data is used to calculate an annual levy to be paid into a fund that, in time, will be used for rehabilitation of abandoned and legacy mine sites across the state.

1.15.4 Draft Perth Peel Green Growth Plan

RPS notes under the draft Perth-Peel Green Growth Plan the majority of the three Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306 “proposal area(s)” are mapped both as within a designated “significant geological supply node” and a “future resource extraction area” (i.e. a “green” colour code) within the Gnangara Sand Node. Importantly, the “proposal areas” within the three tenements avoid the mapped designated “red” or mining exclusion areas. The three mining tenements in relation to the draft Green Growth Plan are illustrated in Figures 4a–4c.

This proposal is consistent with the outcomes defined in the Basic Raw Material Class of Action in the draft Green Growth Plan, specifically in “future resource extraction area” extraction is permitted, subject to, a streamlined assessment and compliance with required measures.

1.16 Environmental Policy

Hanson is committed to the protection of the environment and continuous improvement of production and environmental practices. In protecting the environment, Hanson will:

- Meet all statutory requirements.
- Minimise waste.
- Take demonstrable action to ensure maintenance of effective minimum levels of environmental control.
- Give consideration to the use of recycled material.
- Assess the environmental impact of the operations, handling, storage and disposal of sand products.
- Undertake regular monitoring and risk assessment, wherever there is potential for adverse impact on the environment, employees or the community.
- Provide employee training programs in implementing the Environmental Policy.

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2.0 EXISTING ENVIRONMENT

2.1 Regional Setting

The following discusses the overall region, including all tenement areas.

The Interim Biogeographic Regionalisation for Australia (IBRA) classification system divides Australia into 85 bioregions and 403 subregions. The bioregions and subregions are the reporting unit for assessing the status of native ecosystems, their protection in the national reserve system and for use in the monitoring and evaluation framework in the Australian Government's current Natural Resource Management initiatives (DSEWPC 2012a).

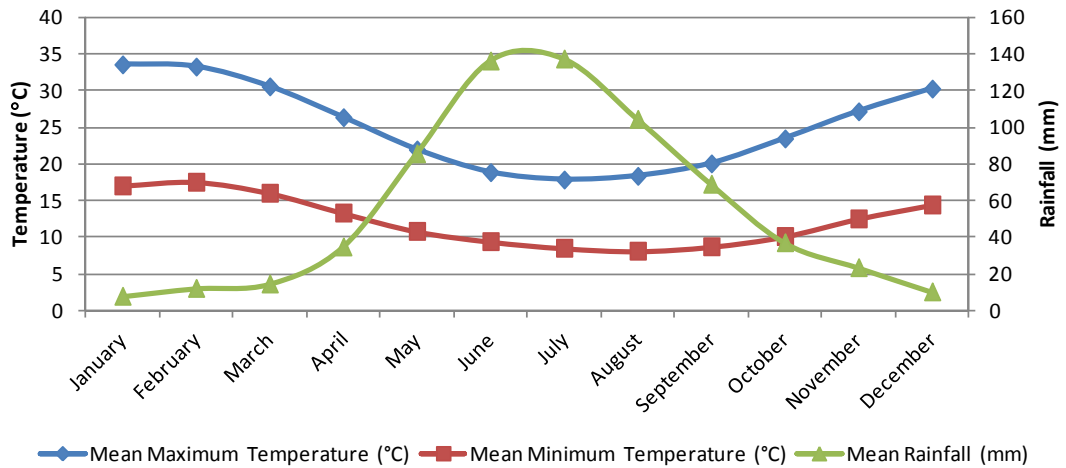
The proposed sand quarries are located within the Swan Coastal Plain 2 (SWA2) subregion, which lies within the Swan Coastal Plain Bioregion.

The Swan Coastal Plain (SCP) is a low-lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to dissected Mesozoic sediments dominated by jarrah woodland. The climate is warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-marri woodlands and *Melaleuca* shrublands, are extensive only in the south. (Mitchell et al. 2002)

The Perth subregion is composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone. Heath and/or tuart woodlands are present on the limestone, Banksia and jarrah – Banksia woodlands on Quaternary marine dunes of various ages, and marri on colluvial and alluvials. The region includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands. Rainfall ranges between 600 and 1000 mm annually. The subregional area is 1,333,901 ha. (Mitchell et al. 2002)

2.2 Climate

The proposed three quarries are located just north of the Perth metropolitan area. The climate is classified as Mediterranean. The closest open climate station is located at the Pearce Royal Australian Air Force (RAAF) base. This area experiences hot, dry summers and cool, wet winters. Graph A below displays the average annual climate data for RAAF Pearce Station No. 09053 (BOM 2012).



(BOM 2012)

Graph A: Climatic Means from RAAF Pearce Station from 1940 to 2012 Physical Environment

2.2.1 Geology and Soils

The following is an overall explanation of the geology and soils of the entire Gngangara region, including all tenements, and then will focus on each individual tenement.

The SCP consists of Pliocene to Quaternary sediments (collectively termed “superficial formations” which comprise Aeolian, alluvial, swamp, estuarine and shoreline sediments) that were deposited on a gently seaward-sloping unconformity surface on top of Mesozoic sedimentary rocks (Bettany et al. 1960). The latter rocks include the Leederville Formation (Cretaceous) and the Yarragadee Formation (Jurassic). The major dune systems, oriented in a north–south direction, transect the SCP. The Bassendean dunes are the oldest (Pleistocene), lowest and most leached of the series. To the west of the Bassendean dune system are the calcareous Quindalup dunes, the youngest unit (Bettany et al. 1960). The superficial formations (i.e. sands, sandstone and limestone) support Perth’s two major aquifers: the Gngangara mound north of the Swan River, and the Jandakot mound south of the river.

2.2.1.1 Smokebush (E70/3279) Two Rocks

Regional geology mapping indicates that the site is predominantly Tamala limestone through the central and west portion of the site and Bassendean sand in the east. The far south-western portion of the site consists of S7 sand (pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin) with very minor stands of LS1 limestone (light yellowish brown, fine to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin) and LS2 limestone (light yellowish brown, fine to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, or eolian origin, abundant karstic). There are also two swamp deposits in the west and a small portion of Alluvium in the north-east (Figure 5a).

2.2.1.2 Tamega Road (E70/3275) Pinjar

Regional geology mapping indicates that the site is predominantly S8 sand (very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin) (Figure 5b).

The northern portion of the site is Bassendean sand and the south-western portion is S7 sand (pale and olive yellow, medium to coarse-grained, sub-angular quartz with a trace of feldspar, moderately sorted, of residual origin) with a small stand of LSI limestone (light yellowish brown, fine to coarse-grained, sub-angular to well-rounded quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin). There is also a swamp deposit in the north-east corner.

2.2.1.3 Mulga Road (M70/1306) Gnangara

Regional geology mapping indicates that this site is predominantly S8 sand (very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin) and S10 sand (as S8 sand) with some small portions of peaty clay (dark grey and black with variable sand content of lacustrine origin) in the north-west and east of the tenement (Figure 5c).

2.2.2 **Acid Sulfate Soils**

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments containing iron sulfides, most commonly pyrite. A summary of the ASS risk across the three tenements are provided below.

2.2.2.1 Smokebush (E70/3279) Two Rocks

The majority of the site has no ASS risk, however there is a small portion of “high to moderate risk of ASS within 3 m of the natural soil surface (or deeper)” in the west and the eastern portion of the site is “moderate to low risk of ASS within 3 m of the natural soil surface (or deeper)” (Figure 6a).

2.2.2.2 Tamega Road (E70/3275) Pinjar

The majority of the site is considered to be “moderate to low risk of ASS within 3 m of the natural soil surface (or deeper)”, except the south-west portion, which is a no ASS risk area (Figure 6b).

2.2.2.3 Mulga Road (M70/1306) Gnangara

The site consists predominantly of “moderate to low risk of ASS within 3 m of the natural soil surface (or deeper)”, with a small portion of “high to moderate risk of ASS within 3 m of the natural soil surface (or deeper)” in the north (Figure 6c).

2.2.3 Contaminated Sites

A search of the DER Contaminated Sites database (DER 2016) returned no contaminated sites within any of the tenements.

2.2.4 Topography

2.2.4.1 Smokebush (E70/3279) Two Rocks

The Smokebush site varies in height from 15 m Australian Height Datum (m AHD) to 95 m AHD, with the lowest lying land in the south-west and the highest peak in the south-east (Figure 7a).

2.2.4.2 Tamega Road (E70/3275) Pinjar

The Tamega Road site varies in height from 50 m AHD to 100 m AHD, with the majority of the highest land in the south-east portion of the site. The northern portion of the site consists of far more gradual sloping land, in comparison to the greatly undulating land throughout the centre and south (Figure 7b).

2.2.4.3 Mulga Road (M70/1306) Gnangara

The Mulga Road site varies in height from 50 m AHD to 75 m AHD. The highest point is within the northern section of the tenement, which consists of a central point at 75 m AHD, decreasing gradually to 55 m AHD. The southern portion of the tenement is comprised of much flatter land, with two central points at 60 m AHD, decreasing gradually to 50 m AHD in the outer areas of the site (Figure 7c).

2.2.5 Hydrology

The three tenements are located within the Swan/Avon catchment, in the sub-catchment of Lower Swan. The Swan/Avon River has a total catchment area of 125,000 km², extending from Dalwallinu in the north, Southern Cross in the north-east and Lake King in the south-east, down to the river mouth at Fremantle.

Over a quarter of the SCP subregional land area from Wedge Island to Dunsborough is wetland (Mitchell et al. 2002). Most of the wetlands on the SCP occur in inter-dunal swales and are hence also orientated in the north-south direction. Although some are perched, the majority of the SCP wetlands are hydraulically connected to the underlying superficial aquifers. At low points in the landscape, the water table frequently intersects the land surface to form lakes and swamps (Salama et al. 2005).

Surface water quality of the wetlands largely reflects groundwater quality, with the Bassendean wetlands historically tending to be coloured, base-poor and slightly acidic, while wetlands on the Spearwood and Quindalup dunes tend to be richer in calcium carbonate with relatively high to very high pH.

2.2.5.1 Surface Water

Smokebush (E70/3279) Two Rocks

The Loch McNess System, a nationally important wetland, is located approximately 5 km south of the site.

There are six CCW within the site; one in the west and five in the east. These CCWs have been excluded from the “proposal area” boundary (Figure 3a).

Tamega Road (E70/3275) Pinjar

There are no nationally important, or internationally significant, wetlands within a 10 km radius of this site.

There is one CCW within the northern portion of the site. This CCW has been excluded from the “proposal area” boundary (Figure 3b).

Mulga Road (M70/1306) Gnangara

Joondalup Lake, a nationally important wetland, is located approximately 7 km west of the site.

There is a CCW located wholly within the northern section of the tenement and a large REW spanning across the central section of the tenement. There are no CCWs or REWs within the “proposal area” boundary (Figure 3c).

2.2.5.2 Groundwater

Smokebush (E70/3279) Two Rocks

Groundwater contours indicate that the groundwater flow direction is west towards the Indian Ocean. The minimum groundwater contours across the site range from 0 m AHD in the south-west to 50 m AHD in the north-east. The average annual maximum groundwater mapping does not reach this site (Figure 7a).

Perth Groundwater Atlas indicates that the site lies within the Gnangara Underground Water Pollution Control Area (Priority I Zone) (Figure 8a).

Tamega Road (E70/3275) Pinjar

Groundwater contours indicate that the groundwater flow direction is south-west towards the Indian Ocean. The minimum groundwater contours across the site range from 35 m AHD in the south-west to 50 m AHD in the north-east. The maximum groundwater contour mapping reaches only the southern portion of the site and ranges from 35 m AHD in the south-west to 55 m AHD in the south-east (Figure 7b).

Perth Groundwater Atlas indicates that the site lies within the Gnangara Underground Water Pollution Control Area (Priority I Zone) (Figure 8b).

Mulga Road (M70/1306) Gnangara

Groundwater contours indicate that the groundwater flow direction is south-west towards the Indian Ocean. The maximum groundwater contours range from 53 m AHD in the north-east to 47 m AHD in the south. The average annual maximum groundwater level in the vicinity of the site is 51 m AHD (Figure 7c).

Perth Groundwater Atlas indicates that a portion of the three tenements are within the Gnangara Underground Water Pollution Control Area (Priority I Zone) (Figure 8c). The remainder of the tenements are outside the Gnangara Water Pollution Area.

2.3 Biological Environment

2.3.1 Vegetation and Flora

2.3.1.1 General Overview

Hanson's three proposed "proposal area" boundaries (within each tenement) avoids wetlands, bush forever sites, exclusion areas defined (or "red" areas) in the draft Green Growth Plan and native vegetation. The "proposal area" boundaries are focused within areas of pine plantation after clearing is undertaken by the FPC and the "green" area defined in the draft Green Growth Plan.

Acknowledging the proposal development timeframes being 50 years plus, Hanson will need to clear any areas of regrowth within the sand quarry disturbance area that may occurred after the pines trees are harvested. Acknowledging this Hanson will seek approval to clear any regrowth vegetation through a Part V Division 2 of the EP Act - Clearing Permit.

The following sections are simply an overview of the vegetation present in the region.

The majority of the three tenements have been used for pine plantation which has been harvested within the last 20 years. Areas of native vegetation regrowth is present this regrowth consists of scattered individual plants such as *Nuytsia floribunda*, *Xanthorrhoea preissii*, *Jacksonia spp.* and low woody shrubs (e.g. *Acacia puchella*, *Daviesia divaricata*, *D. physodes*, *Hibbertia subvaginata*, *Hypocalymma robustum*). The ground layer typically consists of annual herbs (e.g. *Podotheca sp.*) and geophytes (e.g. species of *Cyperaceae*, *Restionaceae*). Annual weeds are very common.

The ecological condition varies from being "completely degraded" in recently cleared areas to "degraded" in older regrowth.

A search of the DPaW Threatened Ecological Community (TEC) database indicated 17 TECs occur within the search area which included a 20 km buffer around the three “proposal area” boundaries (disturbance footprint), however none of these TEC records occur within the “proposal area”. The DPaW search is summarised in Table 5.

Table 5: DPaW TEC Records within 20 km Buffer of Gnangara Sand Proposals

Name	ID	Conservation Status
Aquatic Root Mat Community Number 1 of Caves of the Swan Coastal Plain	CAVES SCP01	Critically Endangered
<i>Banksia attenuata</i> woodland over species rich dense shrublands	SCP20a	Endangered
<i>Banksia ilicifolia</i> woodlands	SCP22	Priority 3
Coastal shrublands on shallow sands	SCP29a	Priority 3
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	Mound Springs	Critically Endangered
<i>Eucalyptus calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain	SCP3c	Critically Endangered
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain	SCP15	Vulnerable
Herb rich saline shrublands in clay pans	SCP07	Vulnerable
Herb rich shrublands in clay pans	SCP08	Vulnerable
Low lying <i>Banksia attenuata</i> woodlands or shrublands	SCP21c	Priority 3
Melaleuca huegelii - Melaleuca acerosa (currently M. systema) shrublands on limestone ridges (Gibson et al. 1994 type 26a)	Limestone ridges SCP 26a	Endangered
Northern Spearwood shrublands and woodlands	SCP24	Priority 3
Shrublands and woodlands on Muchea Limestone	Muchea Limestone	Endangered
Shrublands on calcareous silts of the Swan Coastal Plain	SCP18	Vulnerable
Shrublands on dry clay flats	SCP10a	Endangered
Southern <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands	SCP25	Priority 3
Swan Coastal Plain <i>Banksia attenuata</i> – <i>Banksia menziesii</i> woodlands	SCP23b	Priority 3

2.3.1.2 Priority Flora

A flora search for a 20 km buffer of the Gnangara Sand Quarry proposal found 37 species of conservation significance. All significant flora species from the DPaW search are listed in Table 6, along with their conservation significance and an assessment of the likely presence within the tenements.

The 2014 flora and vegetation survey post pine tree removal assessment by PGV Environmental was undertaken in the Gnangara Pine Plantation area did not identify any conservation significant flora species within the cleared pine plantation areas (which is the focus of the “proposal area” boundaries), however they could be present within the adjacent Bush Forever Sites and wetland areas. Importantly, the mapped areas of native vegetation bushland and Bush Forever sites are excluded from the three “proposal area” boundaries.

Table 6: DPaW Significant Flora Records

Species Conservation	Status	Flowering Time	Habit	Habitat Notes	Presence in Tenements
<i>Acacia anomala</i>	Threatened	August to September	Slender, rush-like shrub, 0.2 m - 0.5 m high, yellow flowers	Lateritic soils. Slopes	A species occurring on laterite which is not present in the tenements
<i>Acacia benthamii</i>	Priority 2	August to September	shrub growing to 1 m, producing yellow flowers	Brown/grey sand on limestone breakaways	A conspicuous coastal species. Unlikely to be present in the pine plantation areas
<i>Anigozanthos humilis</i> <i>subsp. chrysanthus</i>	Priority 4	July to October	Rhizomatous, perennial, herb, 0.2-0.4(-0.8) m high. Yellow flower	Grey or yellow sand	Unlikely to be present in the cleared pine plantation areas
<i>Baeckea sp. Limestone</i>	Priority 1		A woody shrub	grey sand on limestone breakaways	Unlikely to be present in the cleared pine plantation areas
<i>Caladenia huegelii</i>	Threatened	September to October	Tuberous, perennial, herb, 0.25-0.6 m high. Flowers green & cream & red	Grey or brown sand, clay loam	Possibly present in the undisturbed banksia woodland, unlikely to be present in plantation or regrowth areas. Unlikely to be present in the pine plantation areas
<i>Calectasia sp. Pinjar</i>	Priority 1		Perennial, herb, to 0.4 m high, with multiple stems and roots.	Deep grey quartz soils. Gentle slopes, damplands.	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Chamaescilla gibsonii</i>	Priority 3	Spring ephemeral	Small lily, Blue flowers		Unlikely to be present in the cleared pine plantation areas
<i>Conostylis bracteata</i>	Priority 3	August to September	perennial, rhizomatous, tufted or grass like herb, yellow flowers	Sand over limestone on coastal dunes	Possibly present in the undisturbed banksia woodland, unlikely to be present in plantation or regrowth areas.
<i>Cyathochaeta teretifolia</i>	Priority 3	September	Clumped tuberous, herb. Blue flower	Clay to sandy clay. Winter-wet flats, shallow water-filled clay pans.	The proposed “proposal area” boundaries (within each tenement) avoids wetlands, bush forever sites
<i>Dampiera triloba</i>	Priority 3	August to December	Erect perennial, herb or shrub, to 0.5 m high, Blue flower		Unlikely to be present in the pine plantation areas
<i>Darwinia foetida</i>	Threatened	October to November	Shrub to 1m, flowers red-green	grey-black sandy rises in winter-damp to wet clay flats	The proposed “proposal area” boundaries (within each tenement) avoids wetlands, bush forever sites. Unlikely to be present in the pine plantation areas

Species Conservation	Status	Flowering Time	Habit	Habitat Notes	Presence in Tenements
<i>Dasymalla axillaris</i>	Threatened	September to October	Grey shrub to 80cm. Flowers pink/red	Grey sands, damplands	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Drosera occidentalis</i> subsp. <i>occidentalis</i>	Priority 4	November to December	Fibrous-rooted, rosette perennial, herb, to 0.01 m high. Pink/white flower	Sandy & clayey soils. Swamps & wet depressions.	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Eleocharis keigheryi</i>	Threatened	August to November	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Green flower.	Clay, sandy loam. Emergent in freshwater: creeks, claypans.	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Eryngium pinnatifidum</i> subsp. <i>Palustre</i>	Priority 3	Spring	Spring ephemeral	Damplands	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	Threatened	October	Prostrate to erect shrub, 0.1-2.5 m high. White-cream flower	Grey sand. Winter-wet heath	Possibly present in the undisturbed banksia woodland, unlikely to be present in plantation or regrowth areas.
<i>Guichenotia tuberculata</i>	Priority 3	August to October	Erect, open shrub, (0.25-) 0.6-0.9 m high. Purple-pink flower	Sand clay over laterite, sand.	Unlikely to be present in the cleared pine plantation areas
<i>Hibbertia helianthemoides</i>	Priority 4	July to October	spreading to erect, low or prostrate shrub growing to 0.3 m high. It produces yellow flowers	Clayey sand over sandstone or loam over quartzite on hills and slopes	Unlikely to be present in the cleared pine plantation areas
<i>Hydrocotyle lemnoides</i>	Priority 4	August to October	Aquatic, floating annual, herb	Wetlands	The “proposal area” boundaries (within each tenement) avoids wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Jacksonia sericea</i>	Priority 4	December to February	Low spreading shrub, to 0.6 m high. Orange flower	Calcareous & sandy soils	Unlikely to be present in the cleared pine plantation areas
<i>Pimelea calcicola</i>	Priority 3	September to November	erect to spreading shrub growing to 1m high, producing pink flowers	Sand over limestone in coastal areas	Unlikely to be present in the cleared pine plantation areas
<i>Pithocarpa corymbulosa</i>	Priority 3	January to April	erect to scrambling perennial herb growing to 1 m high, producing white flowers	Gravelly or sandy loam amongst granite outcrops near the coast	A coastal species unlikely to be present in the cleared pine plantation areas

Species Conservation	Status	Flowering Time	Habit	Habitat Notes	Presence in Tenements
<i>Poranthera moorokatta</i>	Priority 2	September to November	annual herb to 5cm, flowers pink/white	Damplands, sandy soils	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Stylidium longitubum</i>	Priority 3	October to December	Erect annual (ephemeral), herb, 0.05-0.12 m high. Pink flower	Sandy clay, clay. Seasonal wetlands	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Stylidium trudgenii</i>	Priority 3		Caespitose perennial, herb, 0.05-0.5 m high	Grey sand, dark grey to black sandy peat. Margins of winter-wet swamps, depressions	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation areas
<i>Tetraria sp Chandala</i>	Priority 2		A sedge	Grey sand, Margins of winter-wet swamps, depressions	The “proposal area” boundaries (within each tenement) avoid wetlands, bush forever sites. Unlikely to be present in the pine plantation
<i>Thelymitra variegata</i>	Priority 3	June to September	Tuberous, perennial, herb, 0.1-0.35 m high. Orange & red & purple & pink flower	Sandy clay, sand, laterite.	Possibly present in the undisturbed banksia woodland, unlikely to be present in plantation or regrowth areas.

2.3.1.3 Weeds

Annual weeds are a key feature of the cleared pine plantation areas. Key weed species observed or are known to occur with the Gnangara pine plantation area includes:

- *Arctotheca calendula*
- *Asphodelus fistulosus*
- *Brassica tournefortii*
- *Briza maxima*
- *Crassula glomerata*
- *Dimorphotheca ecklonius*
- *Diplotaxis muralis*
- *Ehrharta calycina*
- *Eragrostis curvula*
- *Gladiolus caryophyllaceus*
- *Leptospermum laevigatum*
- *Lupinus consentinii*
- *Pinus pinaster*
- *Trachyandra divaricata*
- *Trifolium hirtum*
- *Ursinia anthemoides*.

2.3.1.4 Smokebush (E70/3279) Two Rocks

A search of the EPBC Protected Matters Search Tool with a 10 km radius returned two TECs; Aquatic Root Mat Community in Caves of the SCP and Sedgeland in Holocene dune swales of the southern SCP. The search also returned seven species of threatened plants and 13 species of weeds that are likely to occur in the area (Appendix 1).

A NatureMap search with a 10 km radius revealed seven species of Bryopsid, 417 species of Dicotyledon (including one threatened, two priority one, one priority two, eight priority three and one priority four species), one species of fungus (priority two), two species of fungus (including one priority two species), three species of Gymnosperm, 11 species of Lichen (including two priority two and one priority three species), 165 species of Monocotyledon (including one threatened and one priority four species) and one species of Pteridophyte (Appendix 2).

The site wholly encompasses Bush Forever Site 127. The site also intersects Bush Forever Sites 128, 284, 381, 396 and 406 along the southern and western boundaries (Figure 9a).

The vegetation complex present within Bush Forever sites 127 128 and 396 is:

- Spearwood Dunes
 - Cottesloe Complex – North.

The vegetation complexes present within Bush Forever site 284 are:

- Spearwood Dunes
 - Cottesloe Complex – North
- Quindalup Dunes
 - Quindalup Complex.

The vegetation complex present within Bush Forever site 381 is:

- Spearwood Dunes
 - Karrakatta Complex – North
 - Karrakatta Complex – North (one of two most northern occurrences)
 - Karrakatta Complex – Central and South (most northern occurrence).

The vegetation complexes present within Bush Forever site 406 are:

- Spearwood Dunes
 - Cottesloe Complex – North
- Quindalup Dunes
 - Quindalup Complex.

(Government of Western Australia 2000)

2.3.1.5 Tamega Road (E70/3275) Pinjar

A search of the EPBC Protected Matters Search Tool with a 10 km radius returned two TECs; Aquatic Root Mat Community in Caves of the SCP and Sedgeland in Holocene dune swales of the southern SCP. The search also returned 10 species of threatened plants and 13 species of weeds that are likely to occur in the area (Appendix 1).

A NatureMap search with a 10 km radius revealed one species of alga, 291 species of Dicotyledon (including one threatened and six priority three species), one species of fungus (priority two), two species of Gymnosperm, 106 species of Monocotyledon (including one threatened and one priority four species), one species of Pteridophyte and one species of water mould (Appendix 2).

The site wholly encompasses three Bush Forever sites (94, 285 and 286). In addition, site 380 is intersected on the eastern boundary and sites 410 and 381 in the south-west (Figure 9b).

The vegetation complex present within Bush Forever sites 94, 285 and 286 is:

- Spearwood Dunes
 - Karrakatta Complex – North.

The vegetation complexes present within Bush Forever site 380 are:

- Bassendean Dunes
 - Bassendean Complex – North
 - Bassendean Complex – North Transition (restricted complex, contains significant area)
 - Bassendean Complex – Central and South Transition (restricted complex, contains significant area, most southern occurrence).
- Spearwood Dunes
 - Karrakatta Complex – North (most southern occurrence)
 - Karrakatta Complex – North Transition (restricted complex, contains significant area, most northern occurrence)
 - Karrakatta Complex – Central and South (restricted complex, contains significant area).

The vegetation complex present within Bush Forever site 381 is:

- Spearwood Dunes
 - Karrakatta Complex – North
 - Karrakatta Complex – North (one of two most northern occurrences)
 - Karrakatta Complex – Central and South (most northern occurrence).

The vegetation complex present within Bush Forever site 410 is:

- Spearwood Dunes
 - Karrakatta Complex – Central and South (most northern occurrence)
 - Cottesloe Complex – North
 - Cottesloe Complex – Central and South.

(Government of Western Australia 2000)

2.3.1.6 Mulga Road (M70/1306) Gnangara

A search of the EPBC Protected Matters Search Tool with a 10 km radius returned one TEC; assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the SCP. The search also returned 12 species of threatened plants and 13 species of weeds that are likely to occur in the area (Appendix I).

A NatureMap search with an 10 km radius revealed 14 species of Bryopsid, 447 species of Dicotyledon (including two threatened, three priority one, one priority two, two priority three and one priority four species), six species of fungus, three species of Gymnosperm, 224 species of Monocotyledon (including two threatened, one priority

one, one priority two, three priority three and one priority four species), one species of Pteridophyte, one species of slime mould and one species of water mould (Appendix 2).

The western portion of the tenement intersects Bush Forever Site 326 (Figure 9c). The vegetation complexes present within this site are:

- Bassendean Dunes
 - Bassendean Complex – North
 - Bassendean Complex – Central and South (most northern occurrence)
 - Bassendean Complex – North Transition
- Wetlands
 - Pinjar Complex.

(Government of Western Australia 2000)

2.3.2 Post Pine Plantation Clearing Vegetation Assessment

A flora and vegetation survey post pine tree removal was undertaken in the Gnangara Pine Plantation area in 2014 by PGV Environmental. This survey was undertaken to provide information on the patterns of natural regeneration of the previously cleared pine plantation within the Gnangara region.

The flora and vegetation survey identified the in the Gnangara Pine Plantation area comprises a combination of existing pine plantations (of variable age). Native vegetation that has regenerated within the previously cleared areas is mainly degraded condition with poor structural integrity as summarised below. This vegetation survey is provided in Appendix 3.

- low shrubs and herbs dominated by *Acacia pulchella*, *Xanthorrhoea preissii*, *Stirlingia latifolia*, *Jacksonia densiflora* and *Anigozanthos humilis*
- low woodland of *Corymbia calophylla* with an open understory of *Gastrolobium capitatum*, *Acacia pulchella*, *Xanthorrhoea preissii*, *Gompholobium tomentosum*, *Hibbertia hypericoides* and *Hardenbergia comptoniana*
- scattered small *Eucalyptus marginata* trees over an open heath understorey and scattered *Stirlingia latifolia*, *Gastrolobium capitatum* and *Daviesia triflora* and abundant weed species
- low open woodland of *Corymbia calophylla* over a weedy understorey dominated by lupins and veldt grass
- cleared and open areas dominated by weed species with scattered, small shrubs and trees.

The structure, complexity and condition of the vegetation identified on the site were dependent on the time since the pine plantation had been cleared. With those areas of only one year's worth of regrowth being the most degraded areas of vegetation.

Hanson will not be undertaking any clearing of existing bushland complexes as part of this proposal as the proposed sand quarrying will occur in areas of the Gnangara-Moore State Forest pine plantation after clearing of existing vegetation is undertaken by the FPC.

2.3.3 Fauna

The pine plantation vegetation and regrowth areas provide limited shelter and nesting locations and food resources (flowers, fruit, leaves) for terrestrial, arboreal and aerial species. The lack of large trees means the area does not contain habitat for large arboreal or aerial species. There is no breeding habitat for significant bird species (such as tree hollows). The low levels of the native flora combined with the sparseness of this vegetation limits the habitat values of these areas.

A search of the DPaW fauna database indicated 28 species of conservation species within the Gnangara Pine Plantation area. The area of native wetland vegetation may provide some seasonal fauna habitat. The Banksia woodland community and existing Pine Plantation may provide foraging resources for Carnaby's Cockatoo. A summary of the DPaW search is provided in Table 7.

Table 7: DPaW Significant Fauna Records

Species Name	Common Name	Status
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Threatened
<i>Calidris ferruginea</i>	Curlew Sandpiper	Threatened
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	Threatened
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	Threatened
<i>Dasyurus geoffroii</i>	Chuditch / Western Quoll	Threatened
<i>Falco peregrinus</i>	Peregrine Falcon	Schedule Priority 4
<i>Falco peregrinus subsp. macropus</i>	Australian Peregrine Falcon	Schedule Priority 4
<i>Actitis hypoleucos</i>	Common Sandpiper	Migratory
<i>Ardea modesta</i>	Eastern Great Egret	Migratory
<i>Calidris ruficollis</i>	Red-necked Stint	Migratory
<i>Glareola maldivarum</i>	Oriental Pratincole	Migratory
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Migratory
<i>Limosa lapponica</i>	Bar-tailed Godwit	Migratory
<i>Merops ornatus</i>	Rainbow Bee-eater	Migratory
<i>Plegadis falcinellus</i>	Glossy Ibis	Migratory
<i>Pluvialis squatarola</i>	Grey Plover	Migratory

Species Name	Common Name	Status
<i>Tringa glareola</i>	Wood Sandpiper	Migratory
<i>Tringa nebularia</i>	Common Greenshank	Migratory
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Migratory
<i>Xenus cinereus</i>	Terek Sandpiper	Migratory
<i>Hylaeus globuliferus</i>	Native Bee	Priority 3
<i>Tyto novaehollandiae</i> subsp. <i>novaehollandiae</i>	Masked Owl (southern subsp)	Priority 3
<i>Ardeotis australis</i>	Australian Bustard	Priority 4
<i>Macropus irma</i>	Western Brush Wallaby	Priority 4
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	Quenda, Southern Brown Bandicoot	Priority 4

A fauna species list compiled from the individual EPBC searches is shown in Table 8.

Table 8: Fauna Species List

Species	Common Name	Status
Birds		
<i>Botaurus poiciloptilus</i>	Australasian bittern	Endangered
<i>Calyptorhynchus banksii naso</i>	Forest red-tailed black cockatoo	Vulnerable
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo, short-billed black cockatoo	Endangered
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable, Migratory
<i>Rostratula australis</i>	Australian painted snipe	Vulnerable
<i>Sternula nereis nereis</i>	Fairy tern (Australian)	Vulnerable
<i>Merops ornatus</i>	Rainbow bee-eater	Migratory
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	Migratory
<i>Ardea alba</i>	Great egret, white egret	Migratory
<i>Ardea ibis</i>	Cattle egret	Migratory
<i>Rostratula benghalensis s. lat.</i>	Painted snipe	Vulnerable, Migratory
Insects		
<i>Synemon gratiosa</i>	Graceful Sun Moth	Endangered
Mammals		
<i>Dasyurus geoffroii</i>	Chuditch, western quoll	Vulnerable

2.3.3.1 Smokebush (E70/3279) Two Rocks

A search of the EPBC Protected Matters Search Tool returned 13 threatened bird species (including seven migratory species), one insect and five mammals (including one threatened and four invasive species) (Appendix I).

A NatureMap search with a 10 km radius returned five amphibians, 67 birds (including two threatened species), one invertebrate (threatened species), seven mammals (including one priority four and one priority five species) and 28 reptiles (Appendix 2).

2.3.3.2 Tamega Road (E70/3275) Pinjar

A search of the EPBC Protected Matters Search Tool returned 13 threatened bird species (including seven migratory species), one insect and five mammals (including one threatened and four invasive species) (Appendix 1).

A NatureMap search with a 10 km radius returned six amphibians, 26 birds (including one threatened species), one mammal and 16 reptiles (Appendix 2).

2.3.3.3 Mulga Road (M70/1306) Gnangara

A search of the EPBC Protected Matters Search Tool returned 19 threatened bird species (including 10 migratory and four marine species), one insect and four mammals (including one threatened and three invasive mammal species) (Appendix 1).

A NatureMap search with a 10 km radius returned 10 amphibians, 149 birds (including four threatened, one priority three, two priority four and two “other specially protected fauna” species), three invertebrates (including one threatened two priority three species), 22 mammals (including one threatened, two priority four and one priority five species) and 69 reptiles (including one priority three) (Appendix 2).

2.4 Social Environment

2.4.1 **Smokebush (E70/3279) Two Rocks**

Major access roads (Breakwater Drive and Wanneroo Road) transect the tenement through the western portion (Figure 2).

2.4.2 **Tamega Road (E70/3275) Pinjar**

Surrounding land uses include the Commonwealth defence land uses; Gingin Satellite Airfield and Muchea Armament Range. In addition, the Muchea/Pearce Air Weapons Range, located approximately 2 km north-east of the site is a Commonwealth Heritage Place (Appendix 1).

2.4.3 **Mulga Road (M70/1306) Gnangara**

Semi-rural properties and market gardens are present in close proximity to the western boundary of the tenement (Figure 3c).

2.4.4 Aboriginal Heritage

Hanson has been working with the South West Aboriginal Land and Sea Council (SWALSC) (representing the Whadjuk and Yued people) regarding the three sand quarries in the Gnangara Pine Plantation area. Hanson has been in formal discussions with SWALSC since 2008 regarding the sand quarries (Appendix 4); the formalising of these discussions is at different points for each tenement. However, the following summaries the status of the engagement with SWALSC:

- Native Title Agreement and associated State Deed (e.g. McKinley and Mulga Roads)
- Heritage survey completed (e.g. Smokebush)
- Consultation regarding the Temega and Smokebush mining tenements in the Gnangara Pine Plantations noting, the individual sand quarries will step through the assessment process as required, under the DMP's approval process for Mining Proposals.

A search of the Aboriginal Heritage Enquiry System returned one “other heritage place”; “Smokebush Waterhole”, which is located within the western portion of the site (Appendix 4a, Figure 10a). An Aboriginal Heritage survey and engagement with the Traditional Owners for the Smokebush tenement is detailed in Brad Goode and Associates report of aboriginal heritage survey (Appendix 5).

The outcome from this engagement with the Traditional Owners was that permission was granted to drill over 900 holes throughout this tenement.

No known Indigenous sites within a 10 km radius of the site were identified at either the Tamega Road (E70/3275) or Mulga Road (M70/1306) tenements (Appendix 4a).

2.4.5 Natural Heritage

The Smokebush, Tamega and Mulga Road tenements are located within a portion of the Gnangara-Moore River State Forest and a DPaW Reserve (limestone quarry) (Figure 2).

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3.0 ENVIRONMENTAL IMPACTS AND MANAGEMENT

Figures 3a–3c illustrates the “proposal area” boundaries, which considers all relevant environmental and social restrictive areas and their associated buffers for each of the three sand quarries.

All impacts associated with mining activities undertaken within the tenements relate only to the “proposal area(s)”. As noted Hanson will be mining vacant land after clearing has been undertaken by FPC. The management strategies outlined below have been agreed with DPaW and DoW in 2016 in relation to Hanson’s other mining operations in the Gnangara Pine Plantation, e.g. McKinley Road sand quarry. The McKinley Road and Mulga Road Mining Proposals are currently awaiting Minister for Mines and Petroleum approval.

3.1 General Management Strategy

The “proposal area(s)” has been drafted to avoid key environmental assets (e.g. Bush Forever sites and wetlands) and have incorporated the following buffers (Figures 3A and 3B):

- The three sand quarry “proposal area(s)” (disturbance area) boundaries within the tenements are focused within the pine plantation areas.
- The environmental values within each tenement which include wetlands, areas of Banksia woodland and black cockatoo foraging habitat are avoided. The majority of the tenements have been cleared and are in various states of regeneration.
- The potential impacts to the mapped wetlands, which are considered unlikely to be significantly impacted due to
 - avoidance of wetlands
 - the proposal does not require dewatering
 - the mining activities occur above the groundwater table
 - prepare and implement a Water Management Plan and a Fuel Management Plan for each of the three tenements to the satisfaction of the DoW
 - the fuel tanks will be located a minimum 500 m from all wellheads
 - if groundwater is required within the tenement e.g. for sand washing Hanson will seek a groundwater licence from the DoW, or alternatively use scheme water. The groundwater licence assessment requires a hydrological impact assessment inclusive of groundwater quality and any surrounding wetlands.
- The potential impacts to flora and vegetation are considered unlikely to be significantly impacted due to
 - avoiding stands of remnant vegetation and bush forever sites

- avoiding all the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan.
- proposed rehabilitation of vegetation, consistent with the objectives of the draft Green Growth Strategy for the Gnangara Mound.
- The potential impacts to fauna, which are unlikely to be significantly impacted due to
 - avoiding all the designated exclusion (or “red”) areas as mapped in the draft Green Growth Plan
 - avoidance of wetlands
 - the staged approach to clearing to allow local migration of fauna into adjacent areas
 - the post-mining rehabilitation utilising native plant species that are known black cockatoo food sources.
- The potential impacts to Amenity in the form of dust and noise, which is unlikely to be significantly impacted due to
 - minimum 300 m buffer to any sensitive premises from the “proposal area(s)” boundaries within the three tenements
 - the proposal is for extraction only and does not include a crushing or processing component
 - the proponent’s dust suppression measures to minimise dust emission from construction and operation.
- The potential impacts to Heritage (Aboriginal Heritage), which is unlikely to be significantly impacted due to
 - avoidance of the registered Aboriginal Site - Smokebush Waterhole (Site ID 3574)
 - the results of desktop and field surveys undertaken by the proponent which indicate that the two registered sites of significance near the proposal, extend well beyond the development envelope and are unlikely to be disturbed by mining operations
 - the engagement of a heritage consultant to walk the site prior to ground disturbing activities to ensure no heritage artefacts are disturbed, as required.

3.2 Site Infrastructure

Access to and from sites will occur from the tenement onto existing network roads for delivery to the local market.

3.3 Topsoil and Acid Sulfate Soils

No native seed bank is anticipated in the topsoil, though if deemed suitable this resource will be utilised for rehabilitation at the sites. The three sand quarry “proposal area(s)” will consist of areas of pine plantation. The site will be single stripped as overburden, which will be stockpiled for use in future rehabilitation activities. As direct return is not possible, the small open area of the excavation means progressive rehabilitation is not practicable. Overburden will be stripped from the clearing footprint, and will be stockpiled on the edge of the run of mine pad in appropriate windrows. Stripping of overburden will occur in calm wind conditions and dry conditions.

The majority of the “proposal area(s)” are within a moderate to low risk area of ASS, or no risk area, and due to excavation activities not intersecting the water table, ASS risks are low.

3.3.1 Management Strategies

Hanson proposes to manage ASS and overburden with the following management strategies:

- Avoid high to moderate ASS risk areas.
- Disturbance will be limited to the moderate to low ASS risk areas.
- Excavation will not intersect the water table.
- Overburden will be stockpiled and used for rehabilitation.
- The site will be single stripped. No native seed bank is anticipated in the topsoil, though if deemed suitable this resource will be utilised.

3.4 Surface Water Management

High infiltration rates are expected as a result of the large pore space and lack of water holding capacity of the Safety Bay and Bassendean Sands.

There are no surface drainage lines within close proximity of the “proposal area(s)” and all existing run-off at the site is assumed to be via shallow dispersed flow.

Surface water may cause some temporary pooling in surrounding areas, although this pooling is expected to be of short duration due to the high infiltration rates and the likely short duration of any significant rain events. This temporary and infrequent pooling is unlikely to have a negative impact on surrounding vegetation outside of the tenement.

Potential surface water impacts include:

- erosion or scour at drainage outlets, occurring when surface flows are channelised by the drainage design
- changes to natural hydrology (surface flows, erosion, inundation and surface/groundwater interaction)
- changes in surface water flows to nearby wetlands
- contamination of surface water with hydrocarbons or chemicals.

3.4.1 Management Strategies

To manage the potential impacts the “proposal area(s)” are located, constructed and operated to avoid disruption of surface water flows and ensure that potential contaminants are not released into any surrounding wetlands, lakes or Bush Forever sites.

To manage the potential impacts on water quality from the discharge of stormwater with elevated sediment levels or any other contaminants, the following practices will be implemented:

- Prepare and implement a Water Management Plan to the satisfaction of DoW
- Prepare and implement a Fuel Management Plan to the satisfaction of DoW
- Avoid all REWs.
- Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in run-off.
- Each stage will be rehabilitated at completion of excavation.
- Spill response equipment will be available at each site.
- Bunds and drains will be established along the access roads to contain run-off.
- Hydrocarbon management measures i.e. detailed in a Fuel Management Plan will ensure surface water contamination does not occur.
- Surface water management will minimise the risk of contamination to groundwater via infiltration.

- Riffle zones and contour sills will be used downslope of the run of mine pad. Crop cover will be established to encourage the spreading out of water rather than channelised flow.
- Bunds and “v” drains will be established along the access road to contain run-off, in particular to prevent uncontrolled run-off entering adjacent wetlands.

3.4.2 Water Management

The “proposal area(s)” will not intersect the water table. Given that pit dewatering is not proposed as part of the three proposed sand quarries, impact to groundwater is unlikely.

The main potential impact to groundwater is contamination via hydrocarbons and sewerage. There are minimal hydrocarbons and chemicals to be stored on site, reducing the likelihood of any major groundwater contamination.

Portion of the proposed sand quarry excavation areas are within a Priority I (PI) Public Drinking Water Source Area (PDWSA). The objective of PDWSAs, as outlined in the Western Australian Planning Commission’s State Planning Policy 2.7, *Public Drinking Water Source Policy (2003)*, is to ensure that land use and development within PDWSAs is compatible with the protection and management of the public water supply. According to the policy, Priority I is the highest level of protection and, in areas with this classification, protection of the public water supply is the most important consideration with respect to use of the land.

There are also Water Corporation bores within the mining tenements. All mining activities will be at least 100 m from any Water Corporation production bore, the proposed self banded and elevation fuel tanks will 500 m from and production wellheads. A 20 m buffer will be allocated to any monitoring bore, unless on agreement with the DoW the bore can be lowered or relocated.

3.4.2.1 Management Strategies

The three sand quarries area falls under the jurisdiction of State Planning Policy 2.2, *Gnangara Groundwater Protection (2005)*, which lists mining as a “compatible with conditions” land use in Priority I protection areas. The conditions outlined in this policy pertain to the management of fuels and chemicals, and to the depth of excavation relative to the water table.

State-wide Planning Policy No. 1, *Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas (Water and Rivers Commission (WRC) 1999)*, outlines guidelines for protection of water quality and quantity from sand extraction activities in PDWSAs. It lists the policy principles as follows:

- Operations in Public Drinking Water Source Areas will only be acceptable if it can be demonstrated that there is sufficient clearance above the water table.

- Fuel and chemical storage facilities shall meet the DoW specified standards.
- Operations shall incorporate appropriate mine-site management procedures to ensure surface water run-off, waste disposal and water abstraction do not compromise the water resource objectives.
- Operators shall demonstrate that end land uses are compatible with the water resource objectives for the area.

In addition to PDWSAs, State Planning Policy 2.7 also defines well-head protection zones in Priority I areas as having a 500 m radius, within which land uses and activities are restricted to prevent direct contamination of the water source at its point of abstraction.

A Water Management Plan (WMP) will be prepared and will be implemented to the satisfaction of the DoW for each “proposal area” prior to the commencement of mining activities for each of the three sand quarries.

The primary objective of this WMP is to define an interim mine floor level that defines a buffer to the Likely Future Maximum Winter Water Table (LFMWWT). As an interim step Hanson (as agreed with DoW) will excavate to a depth of 3 m from the historical maximum groundwater level (i.e. the highest ever recorded groundwater level). Once the DoW has agreed on the methodology for determining the LFMWWT, then the WMP will be amended and finalised to be 3 metres above this modelled level.

Specific management measures that will be implemented to minimise the potential for impact to groundwater quality and quantity include:

- contamination and spills management (with correct storage and handling there is low risk that a spill would move off site, or infiltrate groundwater beneath the three “proposal area”)
- surface water management will minimise the risk of contamination to groundwater via infiltration
- installation of monitoring bores at each “proposal area” to measure groundwater levels and groundwater quality
- waste management to ensure that all wastes are disposed of appropriately, minimising the risk of groundwater contamination.

In conjunction with the water level monitoring, it is proposed to monitor baseline groundwater quality. The future groundwater quality resulting from the excavation works can then be compared with the baseline data to assess any impacts associated with the excavation area activities.

A Fuel Management Plan is required to prevent impacts from accidental spills and leakage. A Fuel Management Plan will be prepared and implement in order to provide assurance that extraction activities will not negatively impact on the groundwater resource, the protection of which are highly important as indicated by the classification of a Priority I Public Drinking Water Source Area across a portion of the three tenements. The Fuel Management Plan will address:

- fuel spill prevention
- details of fuel transportation and refuelling
- risk assessment
- a contingency plan for dealing with fuel spillage
- a groundwater monitoring program for hydrocarbons.

Table 9 outlines a potential groundwater monitoring program, which was recently approved by DoW for Hanson’s Mackinley Road tenement located within the Gngangara Pine Plantation area. A similar monitoring program is proposed to be conducted for the three tenements.

Table 9: Proposed Baseline Groundwater Monitoring Program

Location	Proposed Analytes	Potential Source	Frequency
Three bores adjacent to the “proposal area(s)”	Total Petroleum Hydrocarbons	Hydrocarbon spill/ leak	Biannually over water level monitoring period (winter high and summer low).
Three bores adjacent to the “proposal area(s)”	pH, Total Iron, Total Aluminium	Acidic Groundwater from Regional Area	
Three bores adjacent to the “proposal area(s)”	Total N, Total P	On-site toilets	
All bores	Water levels	Regional	Monthly

The specifics of this monitoring program may be adjusted pending results over the interim period. Final details will be provided to DoW having established the appropriate excavation depth and water quality parameters for monitoring in the Water Management Plan.

A groundwater licence application will be referred to the DoW approval to allow for the washing of sand to meet market requirements, if the market determines this is required. This water allowance will also assist with dust management and rehabilitation.

3.4.3 Hydrocarbon Management

Without appropriate management controls, there is potential for incorrect storage of hydrocarbons and spillages to result in the contamination of soil, surface water and groundwater. Hanson will ensure that current management procedures based on Australian Standard AS 1940:2004, *The Storage and Handling of Flammable and*

Combustible Liquids are implemented to prevent any potential hydrocarbon contamination to the environment. Hydrocarbons will be managed during construction and operation to prevent any contamination to the surrounding environment.

The proposed mining operation will incorporate storage of hydrocarbons in up to three elevated 17,500 L self-bunded tanks in each of the three “proposal area”. This fuel storage tank is to service the on-site machinery and will comply fully with the Australian Standard AS 1940:2004, *The Storage and Handling of Flammable and Combustible Liquids*. Limited oil, lubricant, coolant and other hydrocarbons will be stored on site and a mobile service truck will be used as required. The storage and management of fuels within each of the three tenements will be addressed in a Fuel Management Plan which requires DoW approval.

3.4.3.1 Hydrocarbon Management Strategies

Hanson is committed to ensuring that its extraction activities do not adversely impact the local groundwater resources and this section outlines the specific fuel management measures.

Several guidelines have been utilised in the development of fuel management measures, including:

- Statewide Policy No. 1: Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas (WRC 1999)
- Water Quality Protection Guidelines No. 1 – Water Quality Management in Mining and Mineral Processing: an overview (WRC 2000a)
- Water Quality Protection Note 60 – Tanks for mobile fuel storage in PDWSAs (DoW 2008)
- Water Quality Protection Note 65 – Toxic and hazardous substances: storage and use (DoW 2006)
- Australian Standard AS 1940:2004, *The Storage and Handling of Flammable and Combustible Liquids*.

Hanson will operate each “proposal area(s)” to minimise potential contamination by following these procedures:

- Fuel Management Plan will be prepared and implemented to the satisfaction of DoW.
- Procedures will be implemented for the correct handling, storage, spill management and clean up. Site personnel and operators of heavy machinery will be advised of the protocol in relation to refuelling, and actions to be undertaken in the event of a spillage. A copy of an Emergency Response Plan will be available on site.

- The mobile service truck will deliver fuels, oil and lubricant and remove all waste oil. It will be appropriately designed to prevent spillages to the environment and will carry appropriate spill prevention (e.g. drip trays) and clean-up equipment.
- Fuel transfer will be undertaken by hand to ensure that fuel is managed carefully without spillage. Connector hoses/funnels will be used to prevent fuel spillage and care will be taken when coupling/uncoupling hoses between vehicles.
- The fuel tanks will be elevated i.e. an above ground, self-bunded approximately three 17,500 L tanks within each “proposal area(s)” to Australian Standards.
- No fuel storage tanks shall be installed in a wellhead protection zone.
- There will be minimal hydrocarbons (lubricants, coolant, grease, oil, etc.) stored in the machinery shed.
- Spill response equipment will be located in the vicinity of work areas, with site personnel trained in spill response management.
- As specified in WRC (1999) a buffer of at least 3 m of undisturbed soil will be maintained to the water table to minimise the risk of contamination of groundwater from hydrocarbons and allow time for remediation to take place.

The following protocol will be applied in the case of a fuel spillage:

- The area of soil impacted is to be removed immediately. This may be undertaken via hand shovel or use of mechanical equipment if necessary. A shovel is to be kept on the service vehicle at all times).
- Visual analysis to confirm all impacted soil has been removed.
- The operating team are to phone the Operations Manager immediately to report the spillage.
- The Operations Manager is to inform the DPaW of the spillage and remedial action undertaken.
- Should the spillage exceed 10 Lt, the Operations Manager will also contact the Water Corporation and the DER to advise of the spillage and remedial action proposed/undertaken. Laboratory testing of the soils from the remediated area will also be undertaken to confirm all of the contaminated soil was removed.
- Hanson’s “Incident Report” to be prepared and submitted to the Operations Manager and the Health and Safety Advisor in accordance with the Fuel Management.

- Contaminated soil will be taken off site via excavation by a licensed waste contractor in accordance with relevant legislation.
- Contaminated absorbent material and soil will be disposed of to a licensed landfill facility in accordance with legal requirements.

3.4.3.2 Proposed Water Quality Monitoring Program

It is proposed to monitor baseline groundwater quality. The monitoring will include hydrocarbon monitoring in bores that will be installed across the “proposal area(s)” and the adjacent tenement. Table 6 summarises the proposed groundwater monitoring program, which will be conducted.

3.5 **Vegetation and Flora**

Existing native vegetation bushland complexes are avoided. The sand mining works will be undertaken within the three “proposal area” boundaries which are located solely within the existing Gnangara-Moore State Forest pine plantation. The pine plantation has been cleared by the FPC. Hanson will only commence operations after clearing by the FPC has occurred. However, as noted, it will be necessary for Hanson to clear any regrowth that occurs within the “proposal area” boundaries of the Gnangara-Moore State Forest that is cleared by the FPC. As outlined in PGV Environmental 2014 report the regrowth of native vegetation post the clearing of the pine trees is mainly degraded condition with poor structural integrity. Hanson will seek approval of a clearing application to remove the regrowth of native vegetation within each of the sand quarry development areas.

Hanson’s proposal involves a 50 year plus timeframe, during which time extraction will be staged. However, the timing and extent of FPC clearing is not fully known. It is not possible for Hanson to commit to its excavation proceeding at the same rate as the FPC clearing, or Hanson’s excavation occurring, within a particular time frame after clearing by the FPC. This may potentially result in large areas of land being cleared of vegetation without the commencement of excavation being imminent (i.e. within six months). Furthermore, it is not known how the FPC will deal with cleared land that is not required for excavation within the next six months (i.e. it is not known whether cleared land will be revegetated or otherwise stabilised or what weed management actions will be undertaken by the FPC). Currently, the mining tenement area is being left fallow after the removal of the pine trees by the FPC, with limited regrowth of pines and weed species with some native species stabilising the land. This current post pine removal land practice will be the plan into the future by DPaW and FPC. Similar land management practices which are occurring at Hanson’s Gaskell Avenue operations where DPaW / FPC manage the land pre sand excavation and Hanson only manages the land excavated or utilised for infrastructure (within the tenement) during the extraction period and subsequent rehabilitation until it is released under the *Mining Act 1978*.

3.5.1 Management Strategies

Despite some current logistical uncertainties, the management strategies during operations and the following management procedures are fixed and will be implemented as follows:

- All disturbances will occur in previously cleared pine plantation areas.
- Avoidance of remnant bushland vegetation and bush forever sites and nearby wetlands.
- Vehicles will be restricted to designated access roads.
- Areas will be cleared of tree stumps as well as pine and native regrowth in stages, as they help stabilise the soil.

3.5.1.1 Banksia Seed Farm

Hanson proposes to construct Western Australia's first production seed farm for *Banksia* species required for the company's restoration work on the Perth Swan Coastal Plain. Hanson's intention to develop seed farms will secure *Banksia* seed for long-term future use in the Gnangara Pine Plantation for restoration after mining works and will be the first of its type in Australia to address native seed supply using innovative native seed farming. Importantly, the farm will underpin seed security for restoration of *Banksia* species important to sustaining natural foraging habitat for the Carnaby's Black-Cockatoo. Further details are provided in Appendix 6.

3.5.2 Dieback Management

The arrival and spread of dieback disease, otherwise known as *Phytophthora* dieback, in Western Australia has been catastrophic for the biota of a number of south-west Australian ecosystems. It has also been a major problem for road construction, timber harvesting, mining and other industries since land managers realised that the movement of soil is the most important method of spread of the soil-borne pathogen (which is actually a water mould, not a fungus as previously believed). There are several species of *Phytophthora* present in native vegetation in the south-west of Western Australia, but by far the most widespread and destructive is *Phytophthora cinnamomi* thought to have been introduced soon after European settlement. (Dieback Working Group 2005).

The Dieback Management Protocol will document the dieback management measures and site-specific management activities aimed at reducing the dieback risk.

The aim of dieback management during operations is to minimise the risk of entry of dieback to the three "proposal area(s)". This is achieved by preventing the import of any soil or plant material on mobile equipment and vehicles. The risk of this transportation is low due to the vehicles and machinery travelling on sealed roads prior to entering the three "proposal area(s)".

3.5.2.1 Dieback Management Strategies

Management strategies for dieback control are very similar to that of weed control and the two practices should be considered together. Several of the practices outlined below are recommended for un-interpretable sites in the *Management of Phytophthora Dieback in Extractive Industries* document (Dieback Working Group 2005):

- Unauthorised and/or unhygienic entry must not be permitted into the site. This may be achieved via restrictive fencing, and provision of parking areas off site. Similarly a boundary barrier around the site will minimise the risks associated with boundary breaches.
- All vehicles or equipment entering the compound are to be “clean on entry”, and therefore are required to be washed down prior to entering the site. Once clean, vehicles and equipment can move around within the site without hygiene restrictions. All footwear should also be clean upon entry to the site.
- Training programs and inductions shall be conducted for all site personnel.
- Areas will be “quarantined” ahead of excavation.
- All surface water and wash-down water will be contained. Run-off from the quarry pit, stockpiles and haul roads will be contained, and not released into areas of native vegetation.
- Light vehicles and machinery will be restricted to access roads, tracks and fire breaks, if present. Off-road driving will be prohibited and excavation equipment will be restricted to the three “proposal area(s)” only.
- Vehicles that travel off the limestone tracks must be cleaned down at the designated “clean down bay”. Clean down will consist of
 - in dry soil conditions
 - use a brush and/or blow with air to remove clods of soil and a metal bar or spade to remove compacted soil, where necessary
 - dust adhering to the sides of vehicles does not need to be removed
 - material removed shall be collected on the limestone pad in the clean down bay and periodically covered with fresh limestone
 - alternately (in wet soil conditions)
 - wash down using a suitable hose to remove all clods of soil
 - clean wash-down water will be provided in an on-site mobile tank filled via water truck from a clean source

- waste water will be collected in a limestone lined controlled area within the clean down bay and allowed to drain through the limestone base.
- No soil or vegetation will be brought on site, except that for use in rehabilitation. Only certified *Phytophthora* dieback free materials (e.g. soil, mulch and compost) will be brought to the site. Plants will be purchased from accredited nurseries and direct seeding would be considered, rather than planting seedlings.

3.5.3 Weed Management

Earthworks, topsoil and overburden transportation, vehicle movement and several other factors have the potential to introduce additional weeds and spread existing populations of introduced flora within the three “proposal area” boundaries. A weed is a non-native plant in any particular area or region and is considered a nuisance due to excessive growth and/or disturbance to the local ecosystem. The management strategies for weed management are similar to those of plant disease and generally, if dieback management procedures are followed, weeds will be controlled as a result.

The majority of the three sand quarries areas are within former pine plantation or cleared areas of land. A Weed Management Procedure will be implemented at each of the sand quarry sites. The Weed Management Procedure documents the weed management measures to be implemented within each tenement. The three “proposal area” boundaries will be monitored at the conclusion of operations for any signs of weeds and if they are found, they will be removed, buried or sprayed with herbicide.

3.5.3.1 Weed Management Strategies

The following strategies will be implemented to assist in minimising the risk of introducing weeds:

- All vehicles or equipment entering the compound are to be “clean on entry”, and therefore are required to be washed down prior to entering the three “proposal area” boundaries. Once clean, vehicles and equipment can move around within the three “proposal area” boundaries without hygiene restrictions. All footwear should also be clean upon entry to the “proposal area” boundaries.
- Any illegally dumped rubbish located during operations will be removed and disposed of as soon as practicable, as rubbish is a major source of weed species.
- Vegetation and topsoil from weed-infested areas will be stripped and stockpiled separately from non-weed infested areas.
- Site personnel will be educated and inducted on weed risk reduction methods and the identification of problem species.

3.6 Fauna

The “proposal area” boundaries for each sand quarry will be located within areas of cleared pine plantation and as a result, it is unlikely that significant fauna habitat species will be impacted by the proposal. Some localised loss of fauna is possible due to the additional traffic around the “proposal area” boundaries, and between the excavation stages and customer locations. However, this impact is considered so minimal it is unlikely to be of any significance to the conservation status of any fauna that may be found within the region.

Loss of fauna may arise however from re-colonisation if vegetation regrowth (generating suitable habitat) occurs between vegetation being cleared by the FPC and Hanson commencing excavation within that area. As noted, Hanson’s proposal involves a 50 year plus timeframe, during which time extraction will be staged. However, the timing and extent of FPC clearing is not presently known. It is not possible for Hanson to commit to its excavation proceeding at the same rate as the FPC clearing or Hanson’s excavation occurring within a particular time frame after clearing by the FPC. Consequently, regrowth may occur, which may be suitable foraging or breeding habitat, prior to Hanson’s excavation commencing in that area. If this occurs it will be necessary for Hanson to clear that regrowth habitat prior to the commencement of excavation.

Desktop assessments undertaken identified the potential presence of black cockatoos within the three sand quarries footprint areas. In addition to the black cockatoo species, the desktop assessments identified habitat suitable for the rainbow bee eater within the areas adjacent to the sand quarries. This species is known to breed in sandy soils and around wetlands. The proposal includes a 50 m buffer around all wetland areas and as such it is unlikely that suitable habitat for the rainbow bee eater will be impacted by the proposal. As the proposal will not clear suitable habitat the proponent has not undertaken a detailed habitat assessment for this species.

3.6.1 Fauna Management Strategies

Management strategies that will be employed during operations include:

- Disturbances will occur in previously cleared pine plantation in most areas.
- Avoidance of the Bush Forever sites and wetlands.
- Rehabilitation of disturbed areas will occur once each stage is complete.
- Speed limits will apply on site to limit accidental road kill.
- All site personnel will be informed of avoidance measures and the importance of avoiding causing harm to significant species. In addition, positive sighting of any significant species will be reported to the DPaW as soon as practical.
- No non-native fauna will be permitted in the “proposal area” boundaries.

- No excavation will occur below the water table, meaning impacts to any stygofauna and troglofauna that may be present is avoided.

3.7 Noise

The proposed operation is likely to generate some noise pollution as a result of the operation of earthmoving equipment, traffic along transport routes and noise generated by the screening machinery. However, the three proposed sand quarries are relatively isolated and is not located near or adjacent to any sensitive premises.

Noise associated with quarrying falls under the *Mines Safety and Inspection Act 1994* and *Regulations 1995*. Management generally includes necessary hearing protection and conducting inductions and education for all site personnel.

Given the geology of the local area, no blasting or breaking of a dense duricrust will be required. The noise levels emitted from quarrying sand is expected to be much less in comparison to other forms of mining. Disturbance from vibrations is also expected to be minimal as no blasting is proposed.

Significant noise impacts are not expected from the operations across the three sand quarries and Hanson will ensure that all emissions comply with the requirements of the *Environmental Protection (Noise) Regulations 1997* and the *Mining Act 1978* at all times.

3.7.1 Separation Distances

The three mining tenement are located within the Gnangara pine plantation. There is significant distance (300 m) between existing dwellings and the proposed sand quarry, which will have screening bunds in place. Hanson will use specific management measures to ensure sufficient buffer distances are maintained, and the quarry operations do not adversely impact residents.

The separation distances between the proposed quarry operations and are illustrated in Figures 11a-11c. The minimum separation distance to sensitive dwellings is 300 m, which is at the Mulga Road M70/1306 sand quarry. There is a 460 m buffer to sensitive dwellings at the Smokebush E70/3279 sand quarry. There are no sensitive premises within 500 m from the Tamega Road E70/3275 sand quarry.

3.7.2 Noise Management Strategies

The Environmental Assessment Guideline for Consideration of environmental impacts from noise (EAG 13) provides guidance on how noise impacts are considered, and the EPA expects that best practice design and noise management would be used to minimise noise impacts. For this proposal the proponent will locate stockpiles and construct bunds to provide substantial noise suppression between the nearest dwellings.

In general, sound travels along a line-of-sight, so as a result the majority of noise management strategies involve locating equipment and plant in a topographical depression or behind stockpile bunds to reflect/absorb the noise. The three sand are well removed from sensitive land uses, however if during operations noise is identified as an issue to sensitive land uses then the following strategies will be implemented:

- A minimum 300 m buffer will be maintained between mining activities and the residential houses within rural properties on the “proposal area” boundaries.
- The screening plant and excavation area will be located behind stockpiles to reduce noise impacts.
- All mobile equipment will be maintained with efficient mufflers and noise shielding devices.
- Mobile equipment without audible reversing alarms will be utilised where possible (i.e. low frequency reversing alarms will be used).
- All personnel will be provided with appropriate noise protection equipment and will be inducted on safe work practices.
- Access roads and tracks will be maintained to a suitable standard to reduce traffic noise as a result of empty trucks entering the “proposal area” boundaries.
- Should a justifiable noise complaint be received during operations, Hanson commit to contracting an acoustic consultant to identify the noise source and provide possible solutions. Any complaints received regarding noise will be investigated immediately.

3.8 Dust

Excessive dust may impact the health of site personnel and surrounding vegetation. The proposed three sand quarries are located in the Gnangara Pine Plantation in isolated areas not adjacent to any sensitive premises. Dust generated from the proposed operations is likely to be minimal and localised and may be caused by:

- earthworks during construction and operation phase
- clearing and stripping
- excavation
- screening
- loading and transport
- vehicle movement
- wind erosion of exposed surfaces.

The EPA Guidance Statement 18: *Prevention of Air Quality Impacts from Land Development Sites* (EPA 2000) outlines control of dust and smoke from land development sites. Assessments of potential dust impacts were undertaken using the Draft Guideline for the Development and Implementation of a Dust Management Program (DEC 2008).

The following factors were taken into account when calculating the dust risk of the “proposal area”:

- nuisance potential of sand when disturbed
- topography
- exposed area on excavation area
- nature of works
- proximity to sensitive receptors
- effect of prevailing winds.

The “proposal area” boundaries was assessed and resulted in an overall “low” site dust-risk potential, predominantly due to the coarse material properties. Minimal control and contingency measures are required for this level of risk (DEC 2008).

3.8.1 Dust Management Strategies

Allowances will be made for water cart operation and Hanson will ensure the disturbed area exposed is kept to a minimum at all times. Adhering to the requirements of the *Mines Safety and Inspection Act 1994* and Regulations 1995, with respect to occupational health risks resulting from dust exposure, Hanson will ensure all personnel working on the “proposal area” boundaries will have access to adequate and efficient dust masks at all times.

Standard dust suppression measures will be implemented during construction and operations to minimise the impacts on surrounding vegetation. Management strategies that will be undertaken include:

- A minimum 300 m buffer will be maintained between mining activities and the residential houses within rural properties on the “proposal area” boundaries.
- Dust suppression measures, such as water sprays, are implemented as necessary, in the event that high levels of dust are observed.
- Visual monitoring of dust will be undertaken daily.
- Tree stumps will be cleared in stages to assist with soil stabilisation.
- Access roads will be constructed of crushed limestone and well maintained.
- Activities with high dust generating potential will not be undertaken during adverse weather conditions.

- Vehicles will be confined to designated roads and tracks, with speed limits enforced.
- Material drop heights between loaders and trucks, and trucks to stockpiles, will be kept to the minimum practical height.
- Any complaints will be investigated immediately.

Pine plantation areas will be cleared by the FPC to meet their requirements and markets. Once cleared, Hanson will extract from the area with approximately 30 ha open area at any given time.

3.9 Waste

It is important to manage waste properly to reduce the impacts to visual amenity, groundwater, soil and surface water contamination and human health issues. The following wastes will potentially be produced by the proposal:

- hydrocarbon and chemical contaminated wastes (such as oil, empty drums and containers, spill absorbent materials, etc.)
- general domestic waste (such as kitchen waste, paper, cardboard, etc.)
- sewage and domestic wastewater.

3.9.1 Waste Management Strategies

The following waste management strategies will be implemented during operations:

- Hydrocarbons and chemical containers will be removed from the “proposal area” boundaries and disposed of at a licensed landfill facility at regular intervals.
- Sewage waste will be transported off the “proposal area” boundaries for treatment and disposal by a licensed contractor.
- Site personnel will be informed of on-site waste management procedures.
- Mobile service vehicles will store all waste oil and remove it from the “proposal area” boundaries daily.

3.10 Dangerous Goods and Hazardous Substances

Hazardous substances and materials include:

- chemicals that are potentially harmful to humans and the environment
- hydrocarbons, which can pollute soil, waterways and harm flora and fauna
- sewage
- landfill and domestic waste.

There will be no dangerous goods or hazardous materials stored or used on site. Diesel will be transported in as required and small volumes of oil, grease, coolant and so on brought on site by mobile service truck.

3.10.1 Management Strategies

As explained above, there will be minimal hazardous substances (sewage and domestic waste) and no dangerous goods stored on site. Hazardous substances should be managed during both construction and operation to prevent contamination and health exposures. Management strategies to minimise impacts include:

- development and implementation of a Spill Response Plan including appropriate equipment availability, staff training and waste disposal

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4.0 SOCIAL IMPACTS AND MANAGEMENT

The impacts of the proposal on the socio-economic environment would be largely positive given the maintenance of employment, the local production of construction products with reduced delivery costs (and therefore potentially reduced costs in general), and the flow-on effects to subsidiary and associated industries and businesses of the proposal. Additionally, considering the proposal includes the rehabilitation of the ex-pine plantation areas (post-sand excavation) this increases net native vegetation and habitat for black cockatoos.

Each sand quarry would ensure the employment of at least five full-time personnel with a range of other contractors also be engaged from time to time.

4.1 Visual Amenity

Visual impact can occur when the operation is visible from neighbouring properties or roads, caused by being too high in the landscape, too close to neighbours, or having insufficient visual screening. Zoning surrounding the three tenements is either general “Rural” or state forest.

The three sand quarry area proposed is within cleared areas of the Gnangara Pine Plantation therefore it is unlikely the sand quarries will result in visual amenity impacts for any local resident’s houses with a minimum 300 m separation distance.

4.1.1 Management Strategies

Potential management strategies include:

- rehabilitation of all disturbed and excavated areas when works are completed.
- ensure barriers, fences and gates are compatible with the semi-rural style of the surround land areas and natural landscape.
- locate the screening plant so the stockpile area and fringing vegetation screen it from well-used roads.
- locate buildings and other site infrastructure in areas of low visual impact.
- locate stockpiles to create screening bunds.
- adopt good housekeeping practices, such as orderly storage and removal of disused equipment or waste.

4.2 Aboriginal Heritage

Hanson notes that the areas of the proposed sand quarry areas to be mined have mostly been disturbed by clearing, pine plantation and clearing of the pine plantation again, including removal of stumps and roots.

The EPA's objective for this factor is to ensure that historical and cultural associations, and natural heritage, are not adversely affected. Guidance Statement 41 outlines the EPA's expectation that proponents undertake a competent analysis of, and report on, the likelihood of the presence of matters of heritage significance to Aboriginal people. Consistent with this, a search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (DAA 2015) was undertaken.

There is an "other heritage site" within the western portion of Smokebush tenement E70/3279, however, the sand quarry area will not occur in close proximity to this site. There is a proposed 50 m buffer from the registered Aboriginal Site - Smokebush Waterhole (Site ID 3574) (Figure 10). Hanson has actively engaged with the SWALSC in regards to the three tenements since 2008. Hanson has undertaken the following in consultation with the SWALSC across its Gnangara Pine plantation tenements:

- Native Title Agreement and associated State Deed (e.g. McKinley and Mulga Roads)
- Heritage survey completed (e.g. Smokebush)
- Consultation regarding the Temega and Smokebush mining tenements in the Gnangara Pine Plantations noting, the individual sand quarries will step through the assessment process as required, under the DMP's approval process for Mining Proposals.

The SWALSC acknowledges Hanson's engagement across its tenements in Appendix 4b.

While it is possible that there are other sites present that have not been registered, it is very unlikely given the duration of the current land use (pine plantation). Extraction and the associated operations have the potential to damage Aboriginal artefacts if they exist in the proposed mining footprint.

Should any evidence of early aboriginal occupation be uncovered during works, all activities will be stopped in compliance with the *Aboriginal Heritage Act 1972–1980* pending an assessment by a recognised consultant. If it is unavoidable that the operations will disturb a site, a Section 18 application will be made to the Department of Indigenous Affairs under the *Aboriginal Heritage Act 1972*.

The traditional owners have been engaged and it was agreed through a consultation period that access to the Smokebush E70/3279 (Two Rocks) tenement land for mining purposes would be agreed (Appendix 5).

4.2.1 Management Strategies

Hanson will engage a heritage consultant to walk the site prior to ground disturbing activities to ensure no heritage artefacts are disturbed, if required. Should any evidence of early Aboriginal occupation be uncovered during works, all activities will be stopped in compliance with the *Aboriginal Heritage Act 1972* pending an assessment by a recognised consultant. If it is unavoidable that the operations will disturb a site, a Section 18 application will be made to the Department of Indigenous Affairs under the *Aboriginal Heritage Act 1972*.

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5.0 CONSULTATION

5.1 Consultation Register

Hanson has also undertaken extensive consultation across the past four years, in particular with regulatory agencies and the traditional owners.

In consultation with the FPC (Russell Warnes and Michael Lobb, pers. comm. late 2011) it was discussed that Hanson would manage and plan their operations to align with FPC forestry management and planning; Hanson will extract from recently harvested pine plantation areas. When extraction activities are completed, DPaW has confirmed that the pine trees within the mining tenement will be harvested and will not be replaced by the FPC for the majority of the tenement area. The site will likely be rehabilitated as directed by the draft Green Growth Plan.

The details of stakeholder consultation undertaken to date is outlined in Table 10.

Table 10: Consultation Register

Stakeholder/ Organisation	Contact	Comment/Outcome
DPaW	Kieran McNamara Director General	Various letter correspondence (2010–2012) regarding approvals for access to site for drilling program
	Daniel Coffey Owen Donovan Grant Lamb Michael Roberts Jacqui McGuire Nicholas Woolfrey	Written correspondence (2010–2015) regarding gaining approval from Minister for Environment (exploratory drilling program) and future sand extraction operations and subsequent rehabilitation works in the Gnangara pine plantations as part of the mine closure.
		Correspondence outlining the commitment and support of the development and progression of the mining application to the EPA / Minister for Environment (2010–2015).
DER	Sarah McEnvoy Sarah Chapman	Hanson coordinated a site visit with DER and Appeals Convenors office as part of the EPA's assessment of the environmental factors and as part of the Perth Peel Strategic Review (September 2014).
DMP	Mike Freeman Warren Ormsby Colin Strickland Ivor Roberts Demelza Dravniers Neil Spencer Eugene Bowhuis Tyler Sujdovic	Numerous meetings (2010 – 2015) to discuss the mining extraction proposal and closure approach and requirement for the sand resource in to meet the looming shortage (e.g. building sand) as a result of market demand.
Minister for Mines	Ben Allen Collin Edwardes	Hanson provided an overview of Gnangara Sand Quarry project and assessment process and status to the Minister for Mines and Petroleum
DSD	Brian Wood (General Manager of Strategic Projects) Peter Baldwin (Director of Strategic Approvals)	Meeting and then a site visit 15 September 2014.

Stakeholder/ Organisation	Contact	Comment/Outcome
DoP	Geoff Findlay	Discussions regarding proposal and the site's importance to the long-term sand supply of Perth in late 2010 and again in 2014.
DoW	James Mackintosh Carlie Slodecki	Discussions and correspondence (2010–2015) regarding exploration works, and future mining groundwater / separation levels for future mining operations in the Gnangara pine plantations. Met with DoW to finalise the Water Management Plan requirements (October 2015).
EPA	Dr. Paul Vogel Anthony Sutton Darren Foster Kaylene Carter Mark Jefferies	Assessment of the proposal, referral approach and likely outcomes discussed at meetings from 2011 to 2016.
Commonwealth Department of the Environment	Con Voutas	Phone meeting Hanson and the Commonwealth Department of the Environment to outline/provide background to the project and the state assessment process.
FPC	Michael Lobb Russell Wornes John Tredinnick	Various meeting from 2011 to 2015. Excavation activities will be planned and managed to coincide with forestry management and planning.
Yued & Whadjuk People (SWLASC)	Carolyn Fennelle	Discussions on the Gnangara Pine Plantation project (2008-2010). Discussion and agreement on the Negotiation Protocol for Native Title Agreement 2012–2013 and in 2014 a signed NTA for some of the tenements.

5.2 Future Consultation

Hanson commits to future liaison with DPaW on an annual basis and making the annual audit reports available to DPaW.

6.0 MINE CLOSURE

6.1 Post-Mining Land Use

The post-mining land use of the area will be directed through the outcomes of the Government's draft Green Growth Plan, which is currently in draft form. The draft Green Growth Plan indicates that the area is to remain as State forest and Parks and Wildlife indicate this is unlikely to change. Current key objectives in the draft Green Growth Plan relevant to Hanson's rehabilitation include groundwater protection and conservation of black cockatoo.

After the completion of sand extraction, the land will be rehabilitated utilising low water use native vegetation comprised of species native to the Swan Coastal Plain 2 (SWA2) IBRA subregion, that facilitates ease of ongoing management by Parks and Wildlife and provides benefits to conservation of black cockatoo.

6.2 Banksia Woodland Restoration Overview

Hanson has focused on restoration standards considered to be the highest in Australia (consistently achieving greater than 80% restoration of comparable habitat and species). This has been achieved by strategic long-term investment in research and development into species and ecosystem restoration by utilizing leading science from Kings Park and the University of Western Australia, and innovating engineering solutions in the field. The restoration standards developed by Hanson are benchmarks acknowledged internationally with benefits of ecosystem restoration directly improving habitat opportunities for black cockatoos.

The tangible benefits (present and future) from Hanson's research investment and partnership with Kings Park include:

- Approximately 300 ha of Banksia Woodland successfully restored (post-sand extraction operations) across the Swan Coastal Plain.
- Hanson has been involved with the development of a Banksia Woodland restoration guideline that details the techniques and requirements for successful Banksia Woodland regeneration. This is currently being published by the University of Western Australia after five years of work.
- Banksia Woodland restoration success rates have been benchmarked every hectare of topsoil that is preserved and utilised correctly will result in additional Banksia Woodland habitat for black cockatoos.
- Restoration completion criteria (success targets) can be set with scientific certainty and confidence allowing proper auditing and monitoring.

- Results are measurable, resulting in certain and real outcomes for the black cockatoo habitat.
- Ongoing research will facilitate improved outcomes for restoration works.

6.3 Closure Plan

Hanson commits to decommissioning all infrastructure and rehabilitating as outlined above. A closure plan for this operation will also be prepared in accordance with the DMP Mine Closure Guideline (Department of Mines and Petroleum 2015), and will be updated throughout the life of the mining operation in agreement with Parks and Wildlife and the DMP.

The proposed guiding closure principles for each of the Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306 sand quarries. These closure principles are based on the agreed outcomes with DPaW on other sand quarry projects within the Gnangara Pine Plantation area (e.g. McKinley Road and Mulga Road). These principles are summarised as follows:

- The site will be rehabilitated consistent with the purposes of State Forest and meet draft Green Growth Plan objectives.
- There should be no significant, physical off site impacts.
- Landforms remaining after mining should be stable and in keeping with others in the region.
- The established vegetation cover will be sustainable, self-sufficient and minimise erosion.
- The post-mining landform will be geotechnically stable and respond to erosion agents in a similar manner to naturally occurring landforms.
- There should be no unsafe areas where members of the general public could be exposed to health and safety risks resulting from inadequate quarry closure.

A Mine Closure Plan for the Gnangara Sand Quarries is provided in Appendix 7. The Mine Closure Plan will be submitted to the DMP for approval.

A summary of the mine closure plan and associated sand extraction buffers is provided in Figure A.

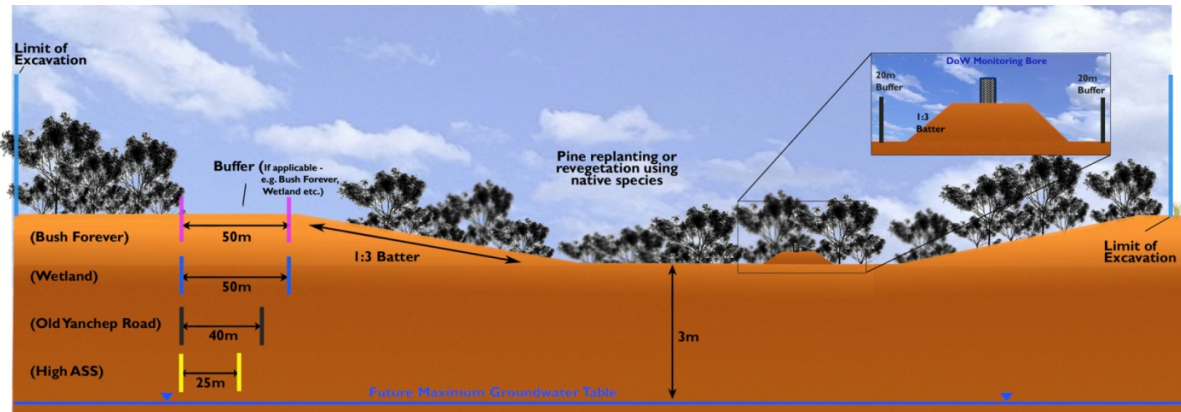


Figure A: Mine Closure Plan

6.3.1 Landform Reconstruction

Once the three quarries are complete, the “proposal area” boundaries will be backfilled with oversize screened material and reshaped. Overburden, if suitable will be spread evenly over backfilled material and other areas where waste has been picked up. Surfaces will be ripped or ploughed along the contour to minimise erosion from water run-off and relieve compaction.

As part of the final landform reconstruction, surface drainage lines will be established to control surface run-off and minimise potential erosion.

6.3.2 Topsoil Replacement

Topsoil or overburden will be stockpiled for use in rehabilitation. It is not considered necessary to restore the soil profile as it is highly contaminated with pine seeds, needles and weeds; no native seed bank is anticipated in the topsoil, though if deemed suitable this resource will be utilised.

Vegetation and topsoil from weed-infested areas will be stripped and stockpiled separately from non-weed infested areas.

Hanson will integrate the outcomes of research and development discussed below into its topsoil management practices. Noting that, Hanson has previous experience in the establishment of native vegetation cover within overburden, without the provision of a separate topsoil layer, considers this to be the most effective approach for the post-sand extraction, given the objective is to establish native vegetation cover in order to limit erosion and weeds.

If the end land use is to change at some time in the future the change would need to be agreed by all stakeholders e.g. Hanson, DPaW and FPC.

6.3.3 Revegetation

Revegetation of pine plantations is currently being subject to research program by Hanson and Kings Park. This research is in its infancy, however, significant steps in rehabilitation have been made over the past six years. The closure object is to return native vegetation to post extraction sites utilising the available seed resources and rehabilitation techniques developed to date.

If pines are not replanted Hanson proposes the following measures based on the pine plantation research currently known and outcomes of the research program.

Broadcast seeding will likely be required with some tubestock and seedling planting out to encourage native vegetation cover establishment if pine trees are not replanted. If available, native seed(s) will be collected from within the mining tenement and used as part of the revegetation program. However, it is not anticipated the seed supply will be a significant revegetation source. To supplement this, seed will be sourced from seed farm(s) or other external sources.

The broadcast native species list will be determined by Hanson and Kings Park from their Gnangara mound restoration knowledge. To achieve this Hanson will:

1. Leverage from Banksia woodland restoration experience and research.
2. Continue to measure and monitor rehabilitation works that have been undertaken in the Gnangara pine plantation (including Gaskell Avenue) since 2009.
3. Utilise the pine plantation rehabilitation research to develop best practice at the time of rehabilitation (depending on the rehabilitation resources (e.g. seed bank) available).
4. Continue the research partnership with Kings Park (or a suitable alternative) and utilise these leanings for rehabilitation for future pine plantation rehabilitation programs.

Alternatively, to leave the “proposal area” boundaries in a state suitable for development if proposed under the draft Green Growth Plan.

6.3.4 Decommissioning

At the completion of each excavation stage, Hanson will undertake the following actions to decommission the site:

- All buildings and infrastructure will be removed.
- Any hard stand surfaces will be removed and used to backfill the pit.
- Overburden and scalps (oversize screened material) will be used as backfill.

- The area will have the slopes and soils contoured to allow for regeneration of native vegetation that can be returned via seed and tubestock at rates commercially acceptable to Hanson and Kings Park to complete the works, or alternatively pine plantation or an alternative use if agreed by all stakeholders in the future.
- Broadcast seeding and tubestock planting will likely be used, or native vegetation topsoil if available.
- Alternatively the “proposal area” boundaries will be left in a state suitable for development if proposed under the draft Green Growth Plan.

The proposed sand extraction cycle for the Smokebush E70/3279, Tamega Road E70/3275 and Mulga Road M70/1306 sand quarries is illustrated in Figure 12.

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7.0 MONITORING AND REPORTING

All quarry activities and potential environmental impacts require ongoing monitoring to ensure legislation, policies, standards and guidelines are being met.

7.1 Inspections and Audits

Monthly environmental, health and safety (EHS) inspections will be undertaken by a suitably appointed EHS representative, using a pre-determined checklist. All corrective actions will be logged and must be completed.

7.2 Annual Reporting

Under the *Mining Act 1978*, mining lease holders are required to submit an Annual Environmental Report (AER) to the DMP each year. An AER will also be submitted to the DER for the Works Approval Licence.

An AER will include:

- excavation progress, including volume of sand removed
- volume of material screened
- contingency actions and outcomes
- environmental incidents, if any
- community complaints and responses, if any.

7.3 Incidents and Complaints

Hanson commit to reporting any environmental incidents that may occur within the “proposal area” boundaries during operations. An environmental incident is any event that could or does result in an impact to the environment, including, but not limited to, the following:

- water (surface or ground) contamination
- soil contamination
- incorrect waste disposal
- illegal clearing of native vegetation
- wildlife fatalities
- hazardous material spills
- unauthorised land disturbance, including clearing or disturbance of heritage sites
- community complaints
- other environmental harm.

Hanson will systematically investigate any incidents that occur, identify the cause and implement management measures to eradicate the possibility of the incident reoccurring.

8.0 ENVIRONMENTAL SUMMARY

Table 11: Environmental Summary

Environmental Factor	Environmental Objective	Potential Impacts	Management Measures	Predicted Outcome
Flora and Vegetation	<ul style="list-style-type: none"> To maintain abundance, diversity, geographic distribution interconnectedness and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. 	<ul style="list-style-type: none"> Disturbance to nearby conservation significant flora Changes to wetland hydrology Introduction and spread of weeds Introduction and spread of dieback Dust emission and deposition 	<ul style="list-style-type: none"> Avoidance of the remnant native vegetation in the area including the Bush Forever and wetland areas. The potential spread of weeds and dieback, if present, during operations will be prevented. Dust will be managed during the quarrying operations to protect surrounding native vegetation. The extent of vegetation clearing will not extend past that of the FPC and stumps will be cleared in stages. Avoidance of the adjacent Bush Forever sites. Vehicles will be restricted to designated roads. At the completion of operations, adequate rehabilitation will occur across the sites. A rehabilitation plan will be devised and implemented to the satisfaction of the DEC and DMP. 	<ul style="list-style-type: none"> This proposal does not involve any native vegetation clearing and will therefore have minimal impact on this environmental factor. Detailed vegetation rehabilitation management for four rehabilitated sites
Fauna	<ul style="list-style-type: none"> To maintain abundance, diversity, geographic distribution, interconnectedness and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. 	<ul style="list-style-type: none"> Habitat fragmentation and disturbance and impacts due to loss and degradation of habitat through clearing. Physical Injury or Fatality Indirect Effects on Adjacent Habitats 	<ul style="list-style-type: none"> Excavation will only occur in previously cleared pine plantations. Avoidance of remnant native vegetation in the area including the Bush Forever and wetland areas. Rehabilitation of potential fauna habitat species after the completion of operations, dependent on FPC requirements. Management measures will be implemented to reduce indirect disturbance of surrounding fauna habitat. Staged removal of pine stumps as well as pine and native regrowth to allow for acclimatisation for any remaining fauna in the area. The control and monitoring of dust, noise and smoke. Induction of machinery operators involved in the operations and stump removal process. Operators will be advised to be alert for fauna, and to take steps to avoid impacts, where practical. Vehicles will be restricted to designated access roads and the excavation area. Speed limits will apply at the excavation areas to limit fauna fatalities. Non-native fauna will be prohibited from excavation areas 	<ul style="list-style-type: none"> No fauna species will cease to exist or have their conservation status adversely affected as a result of the implementation of this proposal. The proposal area (cleared pine plantation) does not contain any critical habitats for protected species or populations. The proposal will result in the reduction in the general availability of habitat (including fragmentation) for those fauna species that are present in the area.

Environmental Factor	Environmental Objective	Potential Impacts	Management Measures	Predicted Outcome
Surface Water and Groundwater Resources	<ul style="list-style-type: none"> ▪ To maintain the integrity, ecological functions and environmental values of GDEs to ensure that any impacts are appropriately managed 	<ul style="list-style-type: none"> ▪ Impacting on GDEs in the area ▪ Oxidation of Potential Acid Sulfate Soils (no to low risk) ▪ Impact to Subterranean Fauna (from changes in GW level and direct impact) 	<ul style="list-style-type: none"> ▪ Avoidance of all REWs. ▪ Stockpiles of erodible material will be located away from roads and pavements to minimise sediment transport in run-off. ▪ Each stage will be rehabilitated at completion of excavation. ▪ Spill response equipment will be available at each site. ▪ Prepare and implement a Water Management Plan to the satisfaction of the DoW. ▪ Fuel Management Plan will be prepare and implemented to the satisfaction of DoW. Fuel tanks will be located a minimum 500 m from any wellhead. ▪ Initially quarry operations will not excavate to within 3 m of the historical maximum groundwater level (finished floor level), once DoW has agreed on the method of determining LFMWWT Hanson will extract 3 m above this level. A Water Management Plan will be implemented when the quarry is operational. ▪ Surface water management will minimise the risk of contamination to groundwater via infiltration. ▪ Riffle zones and contour sills will be used downslope of the run of mine pad. Crop cover will be established to encourage the spreading out of water rather than channelised flow. ▪ Bunds and “v” drains will be established along the access road to contain run-off, in particular to prevent uncontrolled run-off entering adjacent wetlands. 	<ul style="list-style-type: none"> ▪ There will be minimal, if any, impact to groundwater levels or water quality resulting from quarry operations.
Acid Sulfate Soils	<ul style="list-style-type: none"> ▪ To maintain the integrity, ecological functions and environmental values of the soil and landform. 	<ul style="list-style-type: none"> ▪ Increase in heavy metal concentrations ▪ Loss of visual amenity 	<ul style="list-style-type: none"> ▪ Avoidance of the high to moderate ASS risk areas. ▪ Disturbance will be limited to the moderate to low ASS risk areas. ▪ Excavation will not intersect the water table. ▪ Overburden and topsoil will be stockpiled and used for rehabilitation. 	<ul style="list-style-type: none"> ▪ The management measures will ensure that the risk of potential impacts occurring as a result of the quarrying operations is minimal.

Environmental Factor	Environmental Objective	Potential Impacts	Management Measures	Predicted Outcome
Noise	<ul style="list-style-type: none"> ▪ To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards. 	<ul style="list-style-type: none"> ▪ Construction noise impacts upon local residents and workers. ▪ Ongoing operational noise impacts upon local residents and workers. 	<p>To protect the amenity of the receiving environments from noise impacts, the following key management measures will be implemented during the construction and operation phase:</p> <ul style="list-style-type: none"> ▪ A minimum 300 m buffer will be maintained between mining activities and the residential houses within rural properties on the three “proposal area” boundaries. ▪ The screening plant and the “proposal area” will be located behind stockpiles to reduce noise impacts, where applicable. ▪ All mobile equipment will be maintained with efficient mufflers and noise shielding devices. ▪ Mobile equipment without audible reversing alarms will be utilised where possible (i.e. low frequency reversing alarms will be used). ▪ All personnel will be provided with appropriate noise protection equipment and will be inducted on safe work practices. ▪ Access roads and tracks will be maintained to a suitable standard to reduce traffic noise as a result of empty trucks entering the three “proposal area” boundaries. ▪ Should a justifiable noise complaint be received during operations, Hanson commit to contracting an acoustic consultant to identify the noise source and provide possible solutions. Any complaints received regarding noise will be investigated immediately. 	<ul style="list-style-type: none"> ▪ The sand quarry site are relatively isolated from surrounding land uses. ▪ The predicted outcome of the proposed operations is that that the amenity of residents is unlikely to be affected by construction or operation noises.

Environmental Factor	Environmental Objective	Potential Impacts	Management Measures	Predicted Outcome
Air Quality	<ul style="list-style-type: none"> To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards 	<ul style="list-style-type: none"> Dust emissions may occur as a result of the excavation. Minor levels of exhaust emissions are anticipated from mine equipment. Vehicle movements associated with the quarry operations will result in exhaust emissions and potential dust emissions from unsealed roads. 	<p>To prevent or minimise dust generation during quarry operations, the following dust management measures will be implemented during the construction and operation phase:</p> <ul style="list-style-type: none"> A minimum 300 m buffer will be maintained between mining activities and the residential houses within rural properties on the “proposal area” boundaries. Dust suppression measures, such as water sprays, are implemented as necessary, in the event that high levels of dust are observed. Visual monitoring of dust will be undertaken daily. Tree stumps will be cleared in stages to assist with soil stabilisation. Access roads will be constructed of crushed limestone and well maintained. Activities with high dust generating potential will not be undertaken during adverse weather conditions. Vehicles will be confined to designated roads and tracks, with speed limits enforced. Material drop heights between loaders and trucks, and trucks to stockpiles, will be kept to the minimum practical height. Any complaints will be investigated immediately. Pine plantation areas will be cleared by the FPC to meet their requirements and markets. Once cleared, Hanson will extract from the area with approximately 30 ha open area at any given time. 	<ul style="list-style-type: none"> The predicted outcome is that emissions are unlikely to adversely affect the area’s environmental values or the health, welfare and amenity of neighbouring residences. The objective of ensuring that emissions from construction works do not adversely affect environmental values or the health, welfare and amenity of people and land uses will be met through managing potentially adverse construction and operation impacts as per the air quality management measures.
Hydrocarbons and Waste	<ul style="list-style-type: none"> Ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards 	<ul style="list-style-type: none"> Contamination of local soil, groundwater or surface waters as a result of waste materials generated by construction and operation and the possible inadequate handling, storage or disposal of hydrocarbons and chemicals Sewerage and waste discharge adding nutrients and pollutants to the soil and groundwater. 	<ul style="list-style-type: none"> Fuel Management Plan will be prepared and implemented to the satisfaction of DoW. Fuel tanks will be located a minimum 500 m from any wellhead. Procedures will be implemented for the correct handling, storage, spill management and clean up. Contaminated material will be removed and bio-remediated (if biodegradable) or disposed of at a licensed facility. Spill response equipment will be located in the vicinity of work areas, with site personnel trained in spill response management. The proposed fuel storage tanks to service the machinery will be required to comply fully with the Australian Standard 1940:2004 The Storage and Handling of Flammable and Combustible Liquids. This standard specifies requirements for security, bunding, signage, fire protection and handling. 	<ul style="list-style-type: none"> The objective of ensuring that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land will be met through managing adverse construction impacts in accordance with Australian Standard 1940-2004, Guideline No. 1: Controlling Waste Generators (DoE, 2004a). The management of general and hazardous waste is expected to result in negligible environmental impacts.

Environmental Factor	Environmental Objective	Potential Impacts	Management Measures	Predicted Outcome
Visual Amenity	<ul style="list-style-type: none"> ▪ To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable. 	<ul style="list-style-type: none"> ▪ Views of “natural” vegetation will be altered by the addition of a “man-made” excavation pit 	<ul style="list-style-type: none"> ▪ Minimum 300 m buffer to sensitive dwellings will be established and maintained. ▪ The pit design will be such that natural topography and sand bunds will be utilised to shield the view of the mine from surrounding land uses. ▪ Ensure barrier fences and gates are compatible with the semi-rural style of the surround land areas and natural landscape. ▪ Ensure orderly storage and removal of disused equipment or waste. 	<ul style="list-style-type: none"> ▪ The predicted outcome of the quarry operations will be a minor change in the nature of the natural vegetation in each area with an increased element of “man-made” structures impacting on the view-scape. ▪ Considering the limited surround land uses, the impact on visual amenity is expected to be minimal.
Aboriginal Heritage	<ul style="list-style-type: none"> ▪ To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation. 	<ul style="list-style-type: none"> ▪ Damage or loss to Aboriginal heritage sites 	<ul style="list-style-type: none"> ▪ Survey and avoidance of the Smokebush Waterhole registered site. ▪ Engagement of a heritage consultant to walk the site prior to ground disturbing activities to ensure no heritage artefacts are disturbed, if required. ▪ Any significant sites identified during construction will not be removed, damaged or altered without approval under Section 18 of the <i>Aboriginal Heritage Act 1972</i>. ▪ Training will be provided to all construction workers detailing the importance of avoiding heritage sites and reporting of any suspected heritage sites. Exclusion zones will also be identified and clearly communicated to the personnel in the event of a heritage site being uncovered. 	<ul style="list-style-type: none"> ▪ Significant sites identified from the Aboriginal Sites register and during construction will not be removed, damaged or altered without approval under Section 18 of the <i>Aboriginal Heritage Act 1972</i>. ▪ Only one registered “other heritage site” occurs within one of the tenements, so impact is expected to be minimal.

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